

# FRCS revision

## Surgical Specialities

Oman - September 2, 2014

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-  $< 0.2 \text{ mm} \rightarrow$  Isolated tumor cells

-  $0.2 - 2 \text{ mm} \rightarrow$  Micrometastases

37. skip worms



# Breast

## Management of the axilla-breast cancer

### Lymph node stage

Accurate staging of the axilla is an essential component of breast cancer management. Involvement of the axillary nodes has an adverse effect on prognosis, with 10 year survival reduced from 75% to 25%[1]. Involvement of level 3 nodes carries the worst prognosis[2]. Most axillary lymph node metastasis occurs primarily to level 1 nodes, skip metastasis to level 2 and 3 nodal tiers may occur primarily in up to 3% of patients.

Historically, management of the axilla ranged from limited level 1 axillary node excision through to full level 3 axillary nodal clearances. Attempts to minimise the morbidity of axillary node clearance led to targeted operations including axillary nodal sampling and sentinel lymph node biopsy. The focus on sentinel lymph node biopsy has led to more detailed pathological analysis of excised lymph nodes (e.g. using immunohistochemistry). This has led to increasing focus on the develop of axillary nodal micrometastasis. The presence of micrometastasis and its impact on survival is debated. In some studies it seems to confer an increased risk of locoregional recurrence [3] and a reduction of disease free survival [4], whilst in others it shows no overall impact[5]. It is important to distinguish between micrometastasis and isolated tumour cells, as the latter do not have an adverse impact on prognosis[6]. The need for definitive treatment of the axilla in women with positive sentinel nodes was addressed by the ASCOG Z0011 trial. In this trial women were randomised to either undergo axillary node clearance or observation, groups were adjusted for other prognostic factors and treatments. The investigators found no survival benefit in routinely undertaking axillary node clearance where axillary nodal disease was limited in its extent.

Regardless of the options in women with a low risk axilla, those individuals who have overt evidence of axillary nodal involvement either through positive SLNB or preoperative USS and FNA, should still receive axillary clearance as a standard of care.

Nodal micrometastasis=0.2-2mm of tumour foci

Isolated tumour cells= 0.2mm or less of tumour foci in single node

Tamoxifen

Aromatase inhibitors

progestagens

GnRH agonists

"Ovarian ablation"



# Endocrine therapy in breast cancer

A number of breast cancers are highly sensitive to endocrine therapy and all breast cancers should be specifically tested to determine their sensitivity to endocrine agents. In determining which agents to administer it is also important to consider the patients age and menopausal status for the reasons outlined below.

## Tamoxifen

Tamoxifen is a non steroidal antioestrogen which acts as a selective oestrogen receptor modulator. Its clinical application was first described over 40 years ago (1). It does display partial agonist activity in tissues such as bone and endometrium. However, it is its antagonistic activity in breast cancer tissues (which are ER positive) that has led to its widespread clinical use. Its clinical effects are mediated via competitive inhibition of oestrogen binding to receptors, which results in inhibition of genes regulated through the oestrogen receptor. The consequence of this is blockade of the cell cycle at G1, with decreased growth of tumour.

The commonest adverse effect are climacteric symptoms, which may be distressing for some patients. More rarely, but more serious, is the doubled risk of endometrial cancer (2). Tamoxifen is also a recognised cause of thromboembolism, which is seen in between 1 and 2% of those taking the drug. Tamoxifen has been shown to have a dramatic effect on the development of recurrence and even two years of treatment was shown to reduce the incidence of recurrent disease by 30% (NATO Trial) (3). There is compelling data to support the use of tamoxifen for at least 5 years, continuation of endocrine therapy for a further 5 years has been the topic of the aTTom study, which at present does not suggest robust data to support longer term tamoxifen therapy. In premenopausal women tamoxifen remains the undisputed agent of choice for endocrine therapy in those who have oestrogen receptor positive tumours. Women who become menopausal during tamoxifen therapy should probably switch agents and then receive aromatase inhibitors.

$\frac{x2}{2} = 1$

## Aromatase inhibitors

These agents reduce oestrogen production in post menopausal women through inhibition of aromatase, a cytochrome P450 enzyme located in many peripheral tissues and breast tumours. They are ineffective in premenopausal women because they result in an increase in gonadotrophin secretion, resulting in decreased negative feedback of oestrogen on the pituitary. There are two main types of drug, type 1 inhibitors such as exemestane bind irreversibly to aromatase, type 2 agents such as anastrozole and letrozole bind reversibly. One of the main advantages of anastrozole over tamoxifen is its reduction in the risk of contralateral breast

# Bisphosphonate in hypercalcemic

Crisis

↓ osteoclasts  
↓ bone resorption

nephrotoxic

## Pamidronate

60-90 mg IV.  
over 4 hours

Zoledronic acid

4 mg I.V. over  
15 min

① fluids → Sodium 2-4 L IV  
Daily

② Lasix 20mg IV after rehydration

③ Bisphosphonate

④ Calcitonin 4-8 U/kg IM-SC  
1/4h

⑤ Hydrocortisone 200mg IV/ day

⑥ Ga Nitrat / plicamycin  
methacim



cancer and its more favourable safety profile with fewer thromboembolic events and less uterine cancer. The drug letrozole was evaluated in the BIG 1-98 trial and found to compare favourably against tamoxifen with respect to disease free survival and overall survival

### Progestagens

These are derivatives of progesterone which has an anti-oestrogenic action. Medroxyprogesterone acetate is one of the more commonly used agents. They have a definite risk of thromboembolic events and are largely used as agents for the treatment of disease that has progressed on standard therapy.

### GnRH Agonists

GnRH is released from the hypothalamus and binds to receptors on the pituitary gland resulting in the release of LH and FSH, these in turn lead to the ovarian production of oestrogens (up to 90% premenopausal oestrogen). GnRH agonists over stimulate and thus down regulate GnRH receptors. This will eventually result in lower oestrogen release from the ovary. Surgical ovarian ablation remains an alternative. Trials have shown benefit of ovarian ablation / suppression. However, the data comparing such treatments as add on therapy are less compelling. There have been small benefits noted in females under 40 years in whom chemotherapy failed to achieve amenorrhoea.

*Triptorelin goserelin "Zoladex" BRCA*

A 78 year old lady is reviewed in the breast clinic. She has been diagnosed with a 5cm carcinoma of the left breast which is fixed to the underlying muscle. A core biopsy confirms an invasive ductal carcinoma of no special type (grade 2) which is strongly oestrogen receptor positive. Her medical history includes mild aortic stenosis.

**Letrozole ??**

A 65 year old lady is recovering following a mastectomy and sentinel node biopsy for invasive ductal carcinoma. Her subsequent histology confirms the tumour to be strongly oestrogen receptor positive.

**Anastrozole ??**

### IN THE ABSENCE OF SYMPTOMS, PATIENTS WITH GOOD PROGNOSIS BREAST CANCER DO NOT REQUIRE STAGING INVESTIGATIONS APART FROM AXILLARY NODAL STAGING.

Breast cancer is not subjected to the staging investigations that are utilised with other cancer types. NICE guidance is that patients with recurrent breast cancer, inflammatory breast cancer or advanced breast cancer be considered for whole body staging CT scanning.

*Locally Advanced Br. Ca. "6 LN +ve"*

*- Bone Scan*

*- CT Chest, Abdomen, pelvis / PET/CT*

DCIS

## Spectrum

- Ductal hyperplasia
- Atypical ductal hyperplasia
- Ductal Carcinoma in situ
- DCIS with microinvasion

Options Surgery / radiotherapy / hormonal therapy

Radiotherapy  
↓ Local Recurrence  
Not evidence of increased Survival

## hormonal therapy in ER+ve



## Complications of mastectomy

infection      hematoma      Seroma

chronic incisional pain      lymphedema

Unique but Rare comp.  $\rightarrow$  pneumothorax from wire placement  
 $\rightarrow$  Mondor's disease

## Micro Calcification in Mammography

Suggestive  
of

Malignant

Bomgar

linear

Team Corp

Spiculated

## Layer out

Branching



## Lobular CIS

THE DIRECT MALIGNANT POTENTIAL OF **LCIS** IS UNCLEAR AND AT THE PRESENT TIME ADVICE IS GENERALLY THAT THESE AREAS BE **EXCISED IN A NON ONCOLOGICAL MANNER**. THESE PATIENTS **REQUIRE CLOSE POST OPERATIVE SURVEILLANCE** AS THEY HAVE A **SEVEN FOLD INCREASED RISK OF THE DEVELOPMENT OF BREAST CANCER**.

### Ductal carcinoma in situ

DCIS is a heterogeneous lesion morphologically. Four types of lesion are recognised; **papillary, cribriform, solid and comedo**. DCIS consists of cellular atypia contained with surrounding normal myoepithelial basement membrane. Both solid and comedo types of DCIS are recognised as **high grade lesions** with a greater risk of malignant transformation over a shortened timeframe. **Most cases of DCIS present as mammographic abnormalities (80%)** rather than as a palpable mass. These figures are similar to the presenting demographics of the condition in both the NSABP-B-17 and EORTC- 10853 trials.

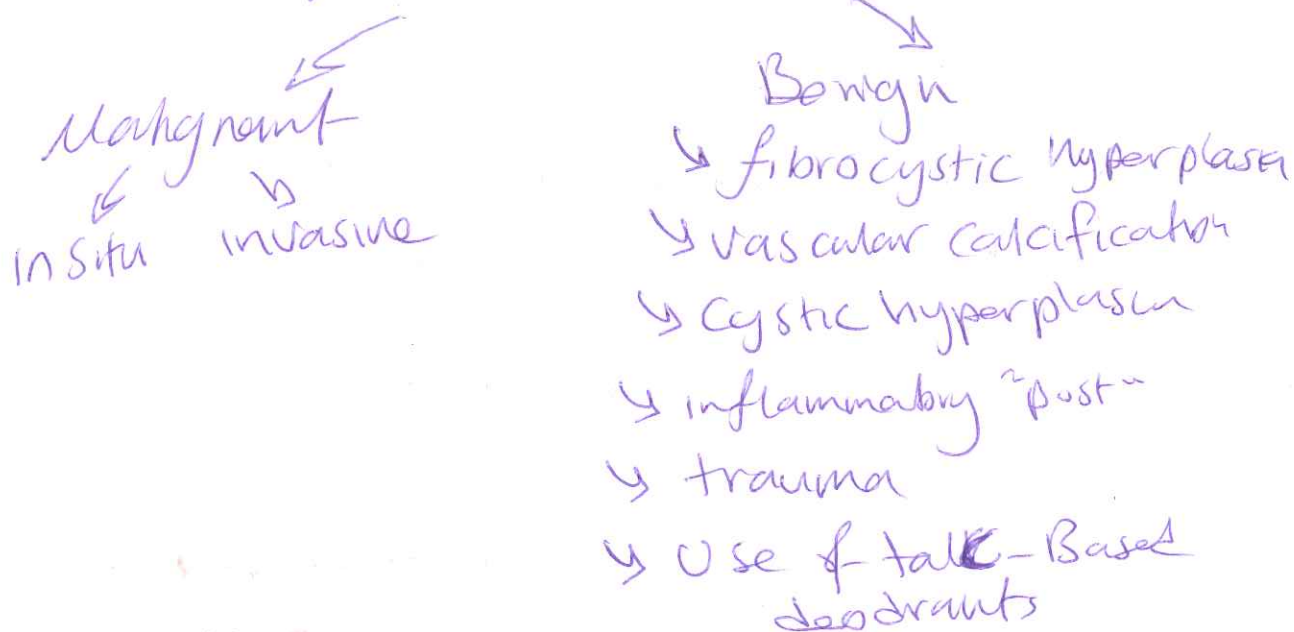
The diagnosis is confirmed in most cases with core biopsy histology.

### Treatment

Until recently, the customary treatment of DCIS was mastectomy. The rationale for mastectomy included a **30% incidence of multicentric disease**, a **40% prevalence of residual tumor at mastectomy** following wide excision alone, and a **25% to 50% incidence of breast recurrence** following limited surgery for palpable tumor, **with 50% of those recurrences being invasive carcinoma**. **The combined local and distant recurrence rate following mastectomy is 1% to 2%**. More recently there has been enthusiasm for considering **breast conservation surgery**. This can usually be considered if there is a **single focus of disease**, predicted ability to get clear margins with conserving surgery, a good cosmetic result and a motivated patient. There is good evidence that **adding radiotherapy to segmental excision reduces the local recurrence rates (1)**. **Adding tamoxifen may reduce local recurrence rates but does not impact on survival (2)**.

**If a mastectomy is the planned treatment and the lesion of high grade then most surgeons would consider a sentinel lymph node biopsy** at the same time as this is not technically possible if a mastectomy is performed and a foci of invasive disease is identified on subsequent histological evaluation.

# Microcalcification cont.



Usually Mammogram Done By  
Experienced team  
& Using magnification

## Surgical Resection Indications for Suspicious lesions

- failed Biopsy
- Benign lesion found  
discordant with the target images
- high risk lesion found in Biopsy

DCIS - ADH -

LCIS - ALH -

LCIS Raloxifene can be used  
prophylactically in

Selected post menopausal women  
for longer periods  
if indicated for control of Osteoporosis

→ In premenopausal women tamoxifen / Avoid pregnancy



## Prognosis

The **Van Nuys prognostic index** is commonly used (3). It is mainly used to determine the likelihood of local recurrence with breast conserving surgery.

<b>VNPI Scoring system</b>	<b>1</b>	<b>2</b>	<b>3</b>
Tumour size (in mm)	15 or less	16-40	41 or greater
Margin width (in mm)	10 or more	1-9	Less than 1
Pathology	Non high grade, nuclear grade 1/2, no necrosis	Non high grade, nuclear grade 1 and 2, necrosis present	High nuclear grade with/without necrosis
<b>Overall VNPI score</b>	<b>3 or 4</b>	<b>5 - 7</b>	<b>8 or 9</b>
8 year local recurrence-free survival rate (statistics from the original study, not a prediction)	97%	77%	20%
8 year breast-cancer specific survival rate (statistics from the original study, not a prediction)	100%	97%	100%

Mastectomy + SLN

# Nottingham Prognostic Index

$$NPI = [0.2 \times S] + N + G$$

S = index lesion size  
in cm

G I = 1  
II = 2  
III = 3

N = Number of LN

0 = 1  
1-3 = 2  
> 3 = 3

2 → 2.4 excellent 93% 5y survival  
3.41 → 4.4 moderate 70%  
5.41 → 6.4 poor 50%

→ Size Histology

→ Multicentric

• prior history of Radiation to chest wall

• Connective tissue disease

→ Lupus  
→ Scleroderma

• Active pregnancy

So contraindicated  
in

## BCS ⇒ Radiotherapy

Safety margin

1 cm in BCS "for cancer"

> 1 mm DCIS But Surgically it will be 1 cm grossly to be tried

non oncological LCIS

margins do NOT  
need to be free



There have been randomised trials of adjuvant radiotherapy after breast conservation for DCIS. In the EORTC study, clear margins ( $>1$  mm) were associated with a local recurrence rate of 15% at 5 years compared to 36% in patients with close or involved margins ( $<1$  mm or frankly involved), regardless of the use of radiotherapy. Likewise, low grade DCIS is associated with a low risk of recurrence.

Areas of DCIS  $> 40$ mm should generally be considered for mastectomy, local recurrence of these lesions is not uncommon and when it occurs generally represents invasive malignancy. Whilst there is good evidence that DXT following breast conserving surgery decreases local recurrence rates, there is no evidence that this is the case following mastectomy. It must also be remembered that there are likely to be considerably cosmetic implications in attempting BCS in the face of large lesions.

Neo

**TUMOURS TREATED WITH ADJUVANT CHEMOTHERAPY HAVE A HIGHER RATE OF LOCAL RECURRENCE WHEN TREATED WITH BREAST CONSERVING SURGERY. GIVEN THAT THIS TRANSLATES TO AN INCREASED RISK OF DEATH, THE SAFEST OPTION IS A MASTECTOMY.**

## Surgical options in breast cancer

The decision as to the best surgical option in the treatment of breast cancer is governed by a combination of patient wishes and expectations and clinical judgment. The broad options lie between wide local excision (which may or may not be image guided) and mastectomy. Patients in the former group have unacceptably high rates of local recurrence unless adjuvant radiotherapy is offered and this should be considered routine in all patients with breast cancer in whom breast conserving surgery is contemplated. Radiotherapy is sometimes required following mastectomy (e.g. large tumours, high grade and vascular invasion) but is not routinely given in all cases.

- Large  
- high grade  
- Vascular  
  Invasion

The factors to be considered include breast size, tumour site, genetic status (if applicable) and whether the tumour is multifocal or unifocal. Most surgeons would tend to consider offering a mastectomy to a woman whose tumour was larger than three centimetres, although the size of the patient's breasts can be critical in finalising this option. Smaller tumours in small breasts may still be better served by mastectomy. The upper inner quadrant is a cosmetically

# BLS in Invasive lobular Cancer

## MRI 1st

Inflammatory Breast Cancer T4d / Stage III B

Diffuse brawny induration of skin of breast  
with erysipeloid edges

mammography → Skin thickening  
→ Increase Breast density  
→ discrete mass in 80% of cases

PET/CT

ultrasound → ↑ Vascularity  
→ Architectural distortion  
→ Mass lesion

inflammatory appearance due to tumor emboli in dermal lymphatics

neo Adjuvant  
chemotherapy → MRM → Radiotherapy

↓  
as BCT by survival 40% now  
~~ferriol~~ ferriol > contraindicated



challenging area and whilst tumours in this site can be removed with wide local excision the eventual cosmetic result following radiotherapy is often poor. Where the tumour does not invade the overlying skin, it can be possible to approach the lesion from an incision centered on the margin of the nipple areolar complex and this can further enhance cosmesis. However, re-excision of margins following such an approach can be challenging. Multifocal tumours should be considered for mastectomy and the results of conservation surgery are often poor. In this regard particular care has to be taken in patients with invasive lobular cancers as the size of these tumours can be difficult to appreciate with standard imaging modalities and MRI scanning of the breasts should be considered where breast conservation surgery is planned. Breast conserving surgery is associated with a higher risk of local recurrence if it is undertaken following neoadjuvant chemotherapy and this should be considered. The Oxford overview which shows that the avoidance of local recurrence in the conserved breast prevents about one breast cancer death for every four such recurrences avoided.

### Decision making

Favors mastectomy	Favors wide local excision
<ul style="list-style-type: none"> <li>Large tumour in small breast</li> <li>Central tumours</li> <li>Large tumours in upper inner quadrant</li> <li>Patient choice</li> <li>Multifocal disease –</li> <li>BRCA 1 and 2 mutation carriers</li> <li>Bulky nodal disease</li> </ul>	<ul style="list-style-type: none"> <li>Small or impalpable lesions (c.f. image guided surgery)</li> <li>Tumours in the upper outer quadrant</li> <li>Minimal axillary nodal disease</li> <li>Patient choice</li> <li>Unifocal disease</li> </ul>

+ contraindications  
of RTX

As a general rule ,the incomplete excision rates following breast conserving surgery should be less than 25%. Complete clear margins are the goal of breast cancer surgery. The exact size of the margins can vary from unit to unit, as a guide the minimum margin is considered to be 1-2mm.

**HER 2 POSITIVITY RESULTS IN INCREASED BIOLOGICAL AGGRESSIVENESS OF TUMOURS, THEY HAVE LESS APOPTOSIS, HIGHER PROLIFERATION RATES AND SHORTER DISEASE FREE SURVIVAL THAN OTHER TUMOURS.**



## Human epidermal growth factor receptor- breast cancer

The epidermal growth factor receptor is a member of the tyrosine kinase class of cellular receptor. These play a role in cellular growth and differentiation. Up to 25% of breast cancers demonstrate HER-2 over expression (while 60 are ER positive receptors). HER2 over expression is associated with an aggressive clinical phenotype that includes high-grade tumors, increased growth rates, early systemic metastasis, and decreased rates of disease-free and overall survival.

It is now routine practice to assess the expression of HER2 in all breast cancers. The adverse prognostic effect of HER 2 positivity means that it is sensible to use biological therapies targeted against this receptor (trastuzumab) which is associated with an improvement in disease free survival. When used alongside anthracycline regimes this comes at the price of increased cardiotoxicity (1). More recent trials focusing on use of this agent with non anthracycline regimes have shown similar benefits with reduced cardiotoxicity.

In most cases herceptin should be considered in breast cancers of all stages where there is likely to be clinical benefit, it is generally given at the conclusion of standard therapies (surgery, chemotherapy and radiotherapy as needed). It is generally given at intervals of three weeks for up to one year or until disease recurrence (whichever is shorter).

Adverse reactions to trastuzumab itself are minor and the treatment is generally well tolerated.

### RISK OF BREAST CANCER

1 FIRST DEGREE RELATIVE AFFECTED AGED <40= 1 IN 6

2 FIRST DEGREE RELATIVES UNDER 40 = 1 IN 3

3 FIRST DEGREE RELATIVES UNDER 60= 1 IN 4

BRCA1 → 50-65 Br. Ca.  
→ 35-45 Ov. Ca.

BRCA2 → 55 Br. Ca.  
→ 20 Ov. Ca.

30% Risk =

<50 2 → 1 1st Degree

<60 3 → 1 1st Degree

<40 2 1st Degree

BRCA1,2 Advised to consider  
Bilateral prophylactic oophorectomy and Mastectomy  
after completion of child bearing

OR

Breast MRI  
& Abdominal US

annual <sup>in</sup> USA

Consider tamoxifen  
chemoprevention



## BRCA 1 and 2

BRCA 1 is a human caretaker gene that produces a protein (breast cancer type 1 susceptibility protein). It combines with other proteins to form a complex; BRCA1 genome surveillance complex. Its function is to repair double stranded DNA breaks, or where this is not possible promoting cellular apoptosis.

Mutations of the BRCA 1 and 2 genes can result in the development of hereditary breast and ovarian cancer syndromes. The mutations in these genes are typically inherited in an autosomal dominant fashion.

Women with deleterious mutations of the BRCA 1 gene have a 50-65% risk of developing breast cancer by the age of 70. Between 35- 45% will develop ovarian cancer during the same time frame. The risks associated with BRCA 2 mutations are lower with up to 55% developing breast cancer by the age of 70 and an ovarian cancer risk of 20%.

The increased risk conferred by genetic mutations means that up to 20% of breast cancers occurring in women under 30 are due to BRCA 1 and 2 mutations.

One of the complexities in testing women at increased risk is that the mutations in the genes can vary from one individual to another. However, once the specific abnormality has been identified in a high risk family then wider testing of relatives then becomes possible.

For the purposes of risk counseling women are considered to be at high risk if their lifetime risk of breast cancer is 30% or greater. This approximates to having two relatives (one first degree) with breast cancer diagnosed under 50 years of age, or three relatives developing breast cancer under the age of 60 years of age (where these are first degree relatives).

The options for these individuals include regular screening with mammography and or MRI and consideration of risk reducing mastectomy. The NICE (UK) guidelines suggest that MRI be used annually in women aged 30 - 49 who are BRCA 1 and 2 carriers. Chemoprevention using tamoxifen may be considered as it has been shown to reduce the incidence of oestrogen receptor positive tumours, however, at least 8 years of treatment is needed (Powles et al.)



# Anthracycline

5FU

Epi rubicin

Adriamycin

Cyclo phosphamide

- Haemorrhagic cystitis

## Cape cita bine

Indications

Individualized Approach

Oncotype DX

- post menopausal
- ER +ve
- Border line tumor character

Assess the Benefit of chemotherapy postop

→ triple negative is for <sup>Adjuvant</sup> Chemotherapy

Neo Adjuvant Chemotherapy

- large tumor pt needs Br. Conservation
- non operable tumor

# Chemotherapy for breast cancer

Chemotherapy generally has greater and more beneficial effects in younger women. The disease biology in this patient group are different. Not only are their tumours more likely to be hormone receptor negative but they are also more likely to be human epidermal growth factor 2 positive. In general terms, women with high grade tumours, nodal positivity or vascular invasion are usually considered for chemotherapy especially if this is associated with lack of hormonal receptor expression.

- Most regimes include an anthracycline (e.g. 5FU, epirubicin and cyclophosphamide) **FEC**
- **Docetaxel** may be considered in high risk patients after three cycles of FEC or as rescue therapy for disease relapse
- Therapy with **trastuzumab** may be considered for selected **HER 2** positive patients after completion of chemotherapy
- The oral drug **capecitabine** may be used in patients with metastatic disease

Rescue  
after 1 year  
mets

A 43 year old lady presents with a malignant pleural effusion 6 months after receiving treatment for an invasive ductal carcinoma. At that stage she received chemotherapy with a combination of cyclophosphamide, 5FU and doxorubicin together with docetaxel.

## Capecitabine

The oral prodrug of 5FU is well tolerated by patients and may be used in those with metastatic disease who have relapsed with recent taxane therapy.

## Trastuzumab

- Trastuzumab is a monoclonal antibody targeted at the HER/neu receptor
- Its main use is in HER positive breast cancer and is usually administered with chemotherapy
- It is typically given by infusion over a one year period
- Its most serious adverse effect is one of myocardial toxicity and it increases the risk of serious cardiac malfunction by 2.1%, this risk is increased when administered with anthracycline chemotherapy which is also well known to have cardiac effects.

Cardiac

# Genetic Counseling in USA

indicated in

- Ashkenazi Jewish
  - Personal and Family history of  $\rightarrow$  ovarian Cancer  
 $\rightarrow$  Bilateral Breast Cancer
  - 1<sup>st</sup> Degree Breast Cancer  $< 50y$
  - 1<sup>st</sup> or 2<sup>nd</sup> Degree 2 or more with Breast Cancer
  - Male Breast Cancer "male Pelehu"
- 

## Gail Model

Statistical tool for risk assessment  
in 5 year period & Life time

high risk      5y risk  $> 1.7\%$   
Lifetime risk  $> 20\% - 25\%$



## Screening for breast cancer

Screening of patients for breast cancer can be subdivided into those who fall into the remit of the UK NHS breast screening programme (NHSBSP) and those who are being screened by virtue of increased risk of hereditary breast cancer.

### NHSBSP

In the UK women aged between 50 to 69 are screened by mammography every 3 years. The age ranges are gradually being expanded and by 2016 the age ranges will be 47 to 73. Older women can continue to be screened if they request to be.

The ABS Audit showed that; 2,221,938 women were screened by the UK NHSBSP in England, Wales, Northern Ireland and Scotland between 1 April 2010 and 31 March 2011. 17,838 cancers were detected in women of all ages; 80% were invasive, 19% non-invasive and 1% micro-invasive. The invasive status of 7 cancers was unknown. In the UK as a whole the 2010/2011 cancer detection rates for all cancers and small invasive cancers were 8 per 1000 and 3.3 per 1000 respectively. Treatment options in this patient group was usually in the form of breast conserving surgery (75%) with the remained having a mastectomy, just under a quarter of this group chose to have immediate reconstruction performed (1).

A Cochrane review of 7 trials involving 600,000 participants was published in 2013. The authors concluded; If we assume that screening reduces breast cancer mortality by 15% after 13 years of follow-up and that overdiagnosis and overtreatment is at 30%, it means that for every 2000 women invited for screening throughout 10 years, one will avoid dying of breast cancer and 10 healthy women, who would not have been diagnosed if there had not been screening, will be treated unnecessarily. Furthermore, more than 200 women will experience important psychological distress including anxiety and uncertainty for years because of false positive findings(2).

2000 → 1 avoid dying  
→ 10 TTT unnecessarily  
→ 200 anxiety

BRCA  
P53  
Germline

<30%  
+ High Risk

~~BRCA~~  
P53

Mammary

Common

30%  
No Gen. test

+ Moderate Risk

all (40-49)

BRCA / 30-49

No Gen. test  
730% Risk

Known

MR T

P53 / 20-49

No Gen. test  
730% Risk

Known



## Screening of at risk individuals

### Classifying risk

	Breast cancer risk category		
	Near population risk	Moderate risk	High risk
Lifetime risk from age 20	Less than 17%	Greater than 17% less than 30%	30% or greater
Risk between 40 and 50	Less than 3%	3-8%	Greater than 8%

### Surveillance for women with no personal history of breast cancer

Offer annual mammographic surveillance to women:

- aged 40- 49 years at moderate risk of breast cancer
- aged 40-59 years at high risk of breast cancer but with a 30% or lower probability of being a BRCA or TP53 Carrier
- aged 40- 59 years who have not had genetic testing but have a greater than 30% probability of being a BRCA carrier

### Offer annual MRI surveillance to women

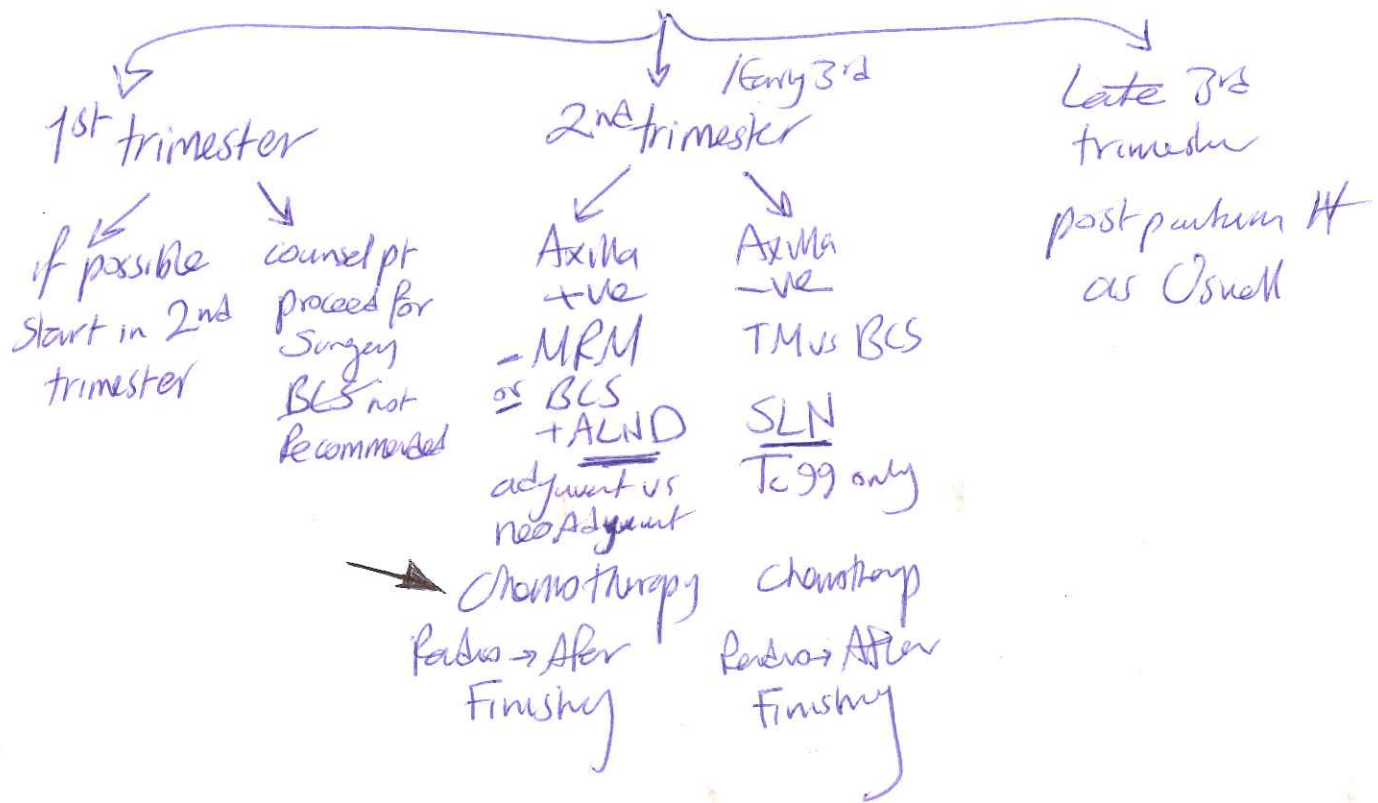
- aged 30- 49 years who have not had genetic testing but have a greater than 30% probability of being a BRCA carrier
- aged 30- 49 years with a known BRCA1 or BRCA2 mutation
- aged 20- 49 years who have not had genetic testing but have a greater than 30% probability of being a TP53 carrier
- aged 20- 49 years with a known TP53 mutation.

Routine Se.

all 50-69 13 year  
47-73 in 2016

# Breast Cancer During Pregnancy

- MRI not safe in pregnancy
- Termination does not improve outcome & should not be recommended



- \* Radiation contraindicated
- \* Methylene Blue for SLN is contraindicated
- \* Metastatic workup by - Ultrasound / CT, Bone scan  
- Chest X-ray / others after finishing pregnancy



## Radiotherapy following mastectomy

Radiotherapy is not routinely used following mastectomy. It is considered beneficial in the following high risk groups:

- >4LN +ve
- T3 and T4 tumours
- Vascular invasion
- Extranodal disease
- Inflammatory breast cancer

The recent SUPREMO trial has been designed to determine the benefit of radiotherapy in the intermediate patient groups and has yet to complete its follow up period.

## Mammary duct fistula

A mammary duct fistula may occur following an incision and drainage of a previous episode of lactational mastitis. It presents as a persistent defect in a region adjacent to the nipple areolar complex. It is usually treated by probing the duct under general anaesthesia and then excising it. Laying open the duct results in equivalent healing rates but at the cost of a very poor cosmetic outcome.

## Lobular cancers

Lobular cancers are poorly visualized on conventional imaging. Where a mastectomy is the planned treatment this is of no practical significance. However, the size of the lesion and associated other lesions will not be appreciated unless an MRI scan is performed. This will determine the safety with which breast conserving surgery could be offered. In view of the tumour location the outcome in terms of cosmesis is likely to be poor. Neoadjuvent therapy is unlikely to alter the eventual outcome here.

*A 56 year old women presents with a mass in her right breast. On examination there is a mass lesion in the upper inner quadrant which clinically measures 2cm. Imaging with mammography and ultrasound shows a lesion which measures approximately 1.9cm. An image guided core biopsy diagnoses an invasive lobular carcinoma. The patient requests a wide local excision as her primary treatment. What is the best option?*

**MRI**



# Breast Reconstruction

Before - Obesity -> Nicotine Use

- Stop Aspirin, NSAID, Clopidogrel 7-10 days
- Stop Garlic, ginseng vit. c 1-2 weeks
- BRCA & LCIS counseled for -> Bilateral Mastectomy
- previous operations
  - > paramedial/subcostal "TRAM"
  - > Axillary "LD flap" -> CT Angio Behr
- Latissimus dorsi examination
- Abdominal wall examination

## Breast prostheses / tissue expanders

### indications

- pt wants more expedient post operative recovery
- Not a candidate for autologous reconstruction

### Contraindications

- inadequate skin & pectoralis
- Radiation therapy

Silicone contraindicated < 22 y  
MRI after 3y & every 2 years

## Autologous Tissue Reconstruction

- TRAM -> deep epigastric vessels pedicled / Bilateral pedicled / Microvascular
- Free TRAM - Superior Deep Epigastric -> many Reley procedure - after ligation of Inf. epigastric -> Inf. deep epigastric
- DIEP -> deep inferior epigastric perforator "dissected from the muscle" -> "muscle sparing" -> longer pedicle length -> less abdominal wall morbidity
- Latissimus Dorsi Myocutaneous flap -> myocutaneous -> muscle only -> typically with permanent implant -> with/without implant

Superior Gluteal artery flap

Inferior Gluteal artery flap

SIEA Superficial inferior epigastric artery flap



**A SMALL SOLITARY FIBROADENOMA IN A YOUNG FEMALE DOES NOT REQUIRE A FORMAL TISSUE DIAGNOSIS IF CLINICAL AND RADIOLOGICAL FEATURES ARE CONCORDANT.**

## Breast cancer metastatic bone disease

In the United Kingdom around 9,000 women with breast cancer will develop bony metastatic disease per year. Up to 20% of these will survive for 5 years or more. Bone metastasis are significantly more likely in women with oestrogen receptor positive tumours that are well differentiated. Women with suspected metastatic bone disease should have their serum calcium measured and skeletal scintigraphy performed. CT scanning is less useful in assessing bone metastasis and where there is diagnostic doubt an MRI scan is the most useful second line investigation.

### Risk of fracture

#### Mirel Scoring system

Score points	Site	Radiographic appearance	Width of bone involved
1	Upper extremity	Blastic	Less than 1/3
2	Lower extremity	Mixed	1/3 to 2/3
3	Peritrochanteric	Lytic	More than 2/3

Depending upon the score the treatment should be as follows:

Score	Risk of fracture	Treatment
9 or greater	Impending (33%)	Prophylactic fixation
8	Borderline	Consider fixation
7 or less	Not impending (4%)	Non operative management

# palpable Breast mass

Diagnostic Mammogram  
& Ultrasound

Normal findings

low clinical suspicion  
2-3 month  
FU/clinical  
& Imaging

intermediate  
clinical  
suspicion  
- FNA/CNB  
- MRI  
- 2-3 month  
FU/clinical  
& Imaging

Solid mass

US Guided CNB

imaging

Repeat  
CNB  
or Excisional  
Biopsy

Excisional Biopsy  
FNA  
Complex

Cyst

Simple

Symptomatic

Aspiration

Follow up  
CBE/mammogram

Asymptomatic

Also Adjuvant chemo → pt Resine BCT But Size Big  
SLN biopsy if preop Axillary US -ve

## SLN

- peritumoral
- intradermal over the lesion
- Sub areolar

all works

But

If there is Scar → intradermal on Axillary Side of the previous incision

if Recurrent → peritumoral & imaging

if failed → Axillary Lymphadenectomy

level I & II only  
if clinically involved

Usually 2-3 LN

take

- Nodes Stained Blue
- Evidence of Radio activity
- Firm enlarged LN → Clinically
- Radio Activity counts > 10% of highest Count detected



### Other treatments

- Since many patients with bony lesions have oestrogen receptor positive tumours the **ER status** should be confirmed and therapy started (or switched)
- **Intravenous pamidronate** should be given to women with **hypercalcaemia** that fails to respond to **intravenous fluids**
- Painful metastasis may be considered for **palliative radiotherapy** (which is **effective** but provides no **structural stability**).

## Benign breast lesions and risk of malignancy

No increased risk of breast cancer	Increased risk
Intraductal papilloma Sclerosing adenosis Hamartoma Fibroadenoma Fat necrosis	Atypical ductal hyperplasia Radial scar

### Atypical ductal hyperplasia

ADH is a rare condition and is found in 4% of benign breast biopsies taken from symptomatic women. The histological distinction of ADH from DCIS is difficult and size is one criteria that is widely used; **lesions should usually be small (2-3mm), larger lesions are usually classified as DCIS.** For this reason **ADH is usually accorded a B3 classification on biopsy.** The finding of atypical ductal hyperplasia confers an increase in **breast cancer risk of (17%)** over a ten year period. **Chemoprevention has been shown to decrease this risk to 7% (1).** The finding of atypical ductal hyperplasia on a core biopsy is usually a trigger for an **excisional biopsy of the lesion**, upstaging to more sinister pathology is seen in approximately **18%** of cases (2).

### Radial scars

Radial scar (RS) is a benign, well recognised, radiological and pathological entity. Histologically, it is characterised by a **fibroelastic core with entrapped ducts and surrounding radiating ducts and lobules.** The radiological criteria for the diagnosis of radial scar include:

- **Central radiolucency**
- **Radiating long thin spicules**
- **Varying appearance in different projections**
- **Radiolucent linear structures parallel to the spicules**
- **Absence of palpable mass**

# Suspicious Mamographic Abnormalities

## ① Sclerosing Adenosis

- Mimic Carcinoma clinically  
Histology - Myo-epithelial cells  
↳ Benign

② Lobular hyperplasia "Atypical"

③ Ductal hyperplasia "Atypical"

④ Fibrocystic disease

↳ Cysts  
↳ Fibrous  
↳ epithelial

⑤ columnar cell change in TDLU terminal ductal lobular unit  
if associated with Atypia → Ca causative

⑥ LCIS → 70% invasive Duct  
↳ 1/3 Invasive lobular

⑦ DCIS

Investigate Mammogram → Usually Screen

US → Diagnostic Focused

MRI → Screening women at high risk

Biopsy for non palpable Breast lesions

- Stereotactic Biopsy

- US Guided Biopsy

- MRI Guided Biopsy

- Surgical Excision with image Localization



It is generally accepted that the term radial scar refers to lesions less than 1 cm, whereas complex sclerosing lesion is used to describe lesions 1 cm or larger. In a longterm study (with a median follow up of 12 years) arising from the Nurses Health Study, in which almost 1400 cases of open biopsies for benign breast disease were examined, Jacobs *et al* found that the presence of RS conferred double the risk of developing subsequent malignancy, regardless of the type of primary breast disease.

Transe-anal TEM

Endoscopic

Microsurgery

---

Total TME

Meso-colic

Excision

---

Circumferential  
Resection CRM  
Margin

# Colorectal

## Colorectal cancer

Colorectal cancer is a common disease, in 2010 there were 40,695 new cases in the UK, of which 22,851 occurred in males. Overall, 66% occur above the level of the peritoneal reflection. The highest incidence is seen in relation to male disease which is most prevalent in Scotland and Northern Ireland. 26% of cases are seen in those aged 60-69. In 2010, lifetime risk of developing bowel cancer in the UK was 1 in 14 for men and 1 in 19 for women.

### Presenting features

The commonest symptoms include:

- Rectal bleeding
- Abdominal pain
- Weight loss

### Investigation

Both CT colonoscopy or conventional endoscopic evaluation of the large bowel are currently the gold standard diagnostic tests. Double contrast barium enema is less sensitive and specific and now less commonly used.

### Staging

The staging of rectal and colonic cancer is different. Distant disease is screened for in both cases with CT scans of the chest, abdomen and pelvis. Rectal cancer is slightly different because additional treatment is often used in rectal cancer, because it is amenable to radiotherapy, in the hope of increasing the R0 resection rate. For this reason most rectal cancers are also assessed with MRI scanning, this was demonstrated to be beneficial as a result of the MERCURY trial. PET-CT scanning is not routinely used in evaluating patients with colorectal cancer, nor is pre-resection laparoscopy. Trans rectal USS is performed in those patients with low T1/T2 tumours considered for transanal endoscopic microsurgery. It is not routinely performed in those patients who are scheduled for conventional resectional surgery.

### Treatment

Segmental resection of tumours is the primary treatment of colorectal cancer, total mesocolic excision of the lymphatic segments is standard and this is based on the arterial supply of the area in question. In the rectum the nodes are contained within the mesorectal envelope and total mesorectal excision which was popularised by Heald over 25 years ago has improved the local



Colon 5cm Distal  
Rectum 10mm Margin

---

Abdomino-APER  
perineal

Excision of

Rectum

---

Extra

ELAPE

Levator

Abdomino-  
perineal

Excision

recurrence rates of rectal cancer considerably. In the colon it is usual practice to aim for a distal margin of 5cm. In the rectum 10mm is the minimum distal resection margin. The use of stapling devices can allow for very low resections in patients with distally sited rectal cancers. However, those with poor preoperative function may be better served with a low Hartmans style operation or a conventional APER. Tumours less than 5cm from the anal verge and/ or involving the sphincters will require APER and the modern approach is to use a more radical ELAPE approach. The local recurrence rates of low rectal cancer following APER have been disappointing (15%) and it is for this reason that ELAPE is being used increasingly frequently. Properly performed it can leave a substantial tissue deficit and this requires formal plastic surgical coverage.

In patients with colonic cancer the primary treatment is surgery and chemotherapy is used relatively rarely in the neoadjuvent setting. The standard treatment packages for rectal cancer are outlined below.

### Rectal cancer treatment

Stage	Treatment
T1/2, N0, M0	Straight to surgery or TEM's
T3, N0, M0	Short course radiotherapy followed by surgery or straight to surgery
T4/N1 (with any T stage)	Long course chemoradiotherapy
M1 (liver)	Downstaging treatment and usually <u>liver first approach</u>

MDT

### Consent for operation "Rectal" AR

- Stoma
- Sexual Dysfunction
- Bladder Dysfunction
- Low anterior Resection Syndrome (LAR)

- ↳ Frequency
- ↳ Urgency
- ↳ Clustering

plateau after 12-24 months



# Anal Carcinoma

## Suspicion Raised in

any anal complaint in high-Risk patient

- age  $\geq 50$
- HIV positive
- colorectal adenoma
- HPV history "Gynae or anal"
- relevant family history

or average Risk on

6 weeks diet/medical therapy &  
no improvement

↓  
- Endoscopic evaluation

- Biopsy

• Examine  
Inguinal LN  
• FNAC ↑

##

non-Surgical

Chemo-Radiotherapy

For 5 weeks

Examine

For

Residual

progress

→ +ve

Wait for 12 weeks

Surgery

+ve

Trans  
and  
Resection of  
Tumor

TART

## Rectal cancer

Rectal cancer remains a common surgical problem. Tumours that occur within 15 cm of the dentate line on rigid sigmoidoscopy are classified as rectal. Intramural spread of malignancy is usually 1cm or less distally, a figure that is important in decision making with low tumours.

### Diagnosis

All rectal cancers should have a biopsy proven diagnosis prior to definitive oncological or surgical treatment. Given their anatomical location there are almost no legitimate exceptions to this rule.

### Staging

- CT scanning for distant disease
- MRI for T and N staging within the mesorectum
- Endo anal USS for T1 tumours where TEM is considered

### Radiotherapy

- Unnecessary for T1 tumours
- Usually required for T3 or N1 tumours and usually long course
- Mandatory for T4 tumours (long course)

### Surgical options

Option	Indication
TEM	Tis or small T1 tumours that are node negative
Low anterior resection	Rectal tumours where a 2-5cm distal clearance margin can be gained.
Abdomino-perineal excision of the rectum	Poorly differentiated tumours less than 5cm from the anal verge (and often the well differentiated ones too) Tumours with sphincter involvement Patients with poor sphincter function (although they may undergo an ultralow Hartmans)

- The choice of therapy is dictated by the height and T stage of tumour. Only small tumours with low probability of lymph node involvement can be realistic candidates for TEM. The old operation of TART (trans anal resection of tumour) is not appropriate for cancer excision.



- A low anterior resection and TME is considered the gold standard for rectal cancer surgery. In the UK and Europe an iliac nodal dissection is not considered routine but may be considered selectively on a case by case basis. Whilst there is no oncological advantage in high ligation of the IMA it is required for mobilisation purposes. Some surgeons will consider a colopouch after anterior resection. In those whom a pouch is not constructed the function will usually improve after the first year or so. However, there is considerable evidence that those with colonic J pouches do have much better function for the first 18 months (1)
- Patients with poor rectal function should be counseled that an AP resection or low Hartmans may be a better functional option for them.
- The newer operation of extra levator abdomino-perineal excision of the rectum is gaining popularity and avoids the waisting that was encountered in the distal aspect of the resection with the older style Lloyd Davies AP's. Even where the decision is made not to proceed with an ELAPE style approach there are considerable technical advantages in performing the perineal dissection in the prone position. A true ELAPE procedure is not required where patients are having an AP because an anterior resection would be unsuitable for functional reasons.

### **Sutured or stapled anastomosis?**

There is no evidence to choose between them when anastomotic leak is considered (2). The stricture rate is reported to be higher with a stapled anastomosis. The author's experience is that this is seldom a problem if a CDH 29 or CDH 33 (Ethicon Ltd) stapler is used. In addition there is little doubt that a stapler is much easier to use from a technical perspective if the procedure is being performed laparoscopically.

### **How many lymph nodes?**

As a rule 12 lymph nodes are required. The number reported reflects the skill of both the pathologist and the surgeon. Understaging may occur when fewer nodes are reported.

12

**RECTAL CANCER IS STAGED WITH MRI  
ENDOANAL USS IS CONSIDERED FOR CASES WHERE A TEM IS  
PLANNED  
THERE IS NO ROLE FOR ENDOSCOPIC ULTRASOUND IN THE STAGING  
OF RECTAL CANCER**

Competent  
ileocecal valve

vs incompetent  
ileocecal valve

↳ True Surgical Emergency

Rt lower Quadrant pain  
is for operation

Colonoscopy is formally  
contra indicated

if no pain

↳ Colonic stenting

↳ No  
Subtotal colectomy

indications ↓  
→ proximal Bowel Damage  
→ Synchronous tumors

workup

CT

Chest X-ray or CT

CEA

Colonoscopy "Synchronous"  
lesions

+ Stoma  
Nurse  
input

↓ Left hemicolectomy

12 Lymph nodes

1 stage Resection anastomosis

2 stages Resection Stoma  
in high Risk pt

3 stages Stoma → Resection → Anas  
in Very high Risk

Why the Best

Because high permanent Stoma rate

40%

Adjuvant chemotherapy Stage III  
IV

↓ II if

high Risk character

→ Lymphovascular invasion

→ perineural invasion

→ Lack of microsatellite stability

FOLFOX

± Avastin

beva cizu mab

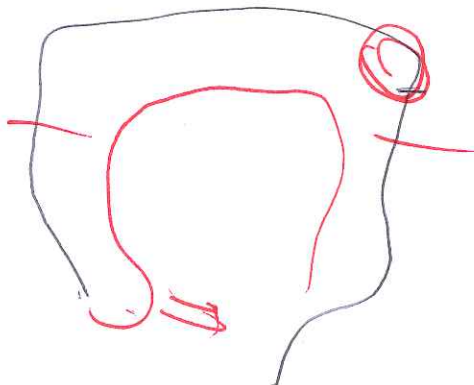


## Management of colonic splenic flexure cancer

Carcinomas affecting the splenic flexure present a challenging option for surgeons. They typically present in younger patients than other types of colorectal cancer, at the same time lymph node involvement is more likely and unfortunately the lymph node yield is likely to be lower.

Standard oncological practice is to advocate the high proximal ligation of the tumour vessel in colonic cancer cases. The dilemma surrounding the splenic flexure is whether this necessitates the high ligation of the middle colic artery, the inferior mesenteric artery, both or neither.

From an anatomical perspective the blood supply to the splenic flexure is via the left colic branch of the IMA in 89% of cases (1). Therefore left hemicolectomy would seem a logical option. Unfortunately, splenic flexure cancers will sometimes present with features of **large bowel obstruction**. Options then lie between emergency surgery (which should probably consist of an **extended right hemicolectomy** or **colonic stenting**). Stenting will clearly allow a more planned approach at a later stage. In general terms the **treatment of splenic flexure cancer should probably be with left hemicolectomy in the elective setting** as survival between those patients and individuals undergoing extended right hemicolectomy is no different (2). The addition of splenectomy has not been shown to be of benefit. The laparoscopic approach to splenic flexure cancers can be challenging and some surgeons will tend to consider these for **open rather than laparoscopic** resections.





## Genetics of colorectal cancer

The lifetime risk of colorectal cancer in the UK population is 5%. Up to 5% of newly diagnosed bowel cancers will be in those individuals who have a high genetically acquired risk of bowel cancer. Cancers arising in the low-moderate genetic risk group comprise approximately 30% of newly diagnosed bowel cancer.

### Genetics of inherited colorectal cancer syndromes

Syndrome	Features	Genes implicated
FAP	More than 100 adenomatous polyps affecting the colon and rectum. Duodenal and fundic glandular polyps	APC (over 90%)
Gardner syndrome	As FAP but with desmoid tumours and mandibular osteomas	APC
Turcots syndrome	Polyposis and colonic tumours and CNS tumours	APC + MLH1 and PMS2
HNPCC Lynch	Colorectal cancer without extensive polyposis. Endometrial cancer, renal and CNS	MSH2, MLH1, PMS2 and GTBP
Peutz-Jeghers syndrome	Hamartomatous polyps in GI tract and increased risk of GI malignancy	LKB1 and STK11 (in up to 70%)
Cowden disease	Multiple hamartomas (see below)	PTEN (85%)
MYH associated polyposis	Autosomal recessive, multiple adenomatous polyps in GI tract, those in colon having somatic KRAS mutations	MYH



Somatic  
Some of them

Germ line  
(parents)

\* proto oncogene  $\rightarrow$  oncogene  
Dominant

\* Tumor Suppressor genes  
Recessive

- 3 indiv 1 1st Relative to other 2
  - 2 successive generations
  - 1 under 50
- } Amsterdam Criteria

At Sites  
mucinous  $\leftarrow$  + Exclude FAP  
dense lymphocytic infiltration + pathology

## FAP

Autosomal dominant condition, affects 1 in 12,000. Accounts for 0.5% of all CRCs. Lifetime incidence of colorectal cancer in untreated FAP = 100%. Up to 25% cases are caused by de-novo germ line mutations and show no prior family history. The APC tumour suppressor gene is affected in most cases.

## APC in non inherited colorectal cancer

Up to 80% of sporadic colorectal cancers will have somatic mutations that inactivate APC[1]. Both alleles are usually affected. Although the APC protein more than likely has multiple critical cellular functions, the best-established role for APC in the cancer process is as a major binding partner and regulator of the  $\beta$ -catenin protein in the so-called canonical or  $\beta$ -catenin dependent Wnt signaling pathway.

## HNPCC

HNPCC cancers differ from conventional tumours in a number of respects. In the colon the tumours are more likely to be right sided, histologically they are more likely to be mucinous and have dense lymphocytic infiltrates. To be diagnosed as having HNPCC individuals must show typically HNPCC tumours in at least three individuals, (one of whom must be a first degree relative to the other two). In at least two successive generations. At least one cancer must be diagnosed under the age of 50. FAP must be excluded and tumours should be verified by pathological identification (Amsterdam criteria). The genetic changes in HNPCC stem primarily from microsatellite instability affecting DNA mismatch repair genes. In HNPCC the mismatch repair genes most commonly implicated include; MSH2 and MLH1 and these occur in up to 70% of people with HNPCC. The finding of microsatellite instability is unusual in sporadic colorectal cancers. Approximately 60% of individuals who fulfill the Amsterdam criteria will not be found to have evidence of mismatch repair gene defects on genetic testing. The risk of developing colorectal cancer in those who have not demonstrated mutation of the mismatch repair genes is increased if they fulfill the Amsterdam criteria, but not the extent that it is increased in those who fulfill the criteria AND have evidence of mismatch repair gene defects.

## KRAS Mutations

The RAS family of small G proteins act as molecular switches downstream of growth factor receptors. KRAS and the other two members of the family; HRAS and NRAS, are the site of mutation in approximately 40% of colorectal cancers. When adenomas are examined the proportion of adenomas less than 1cm showing KRAS mutations was only 10% which contrasts with 50% in those lesions greater than 1cm.

1cm

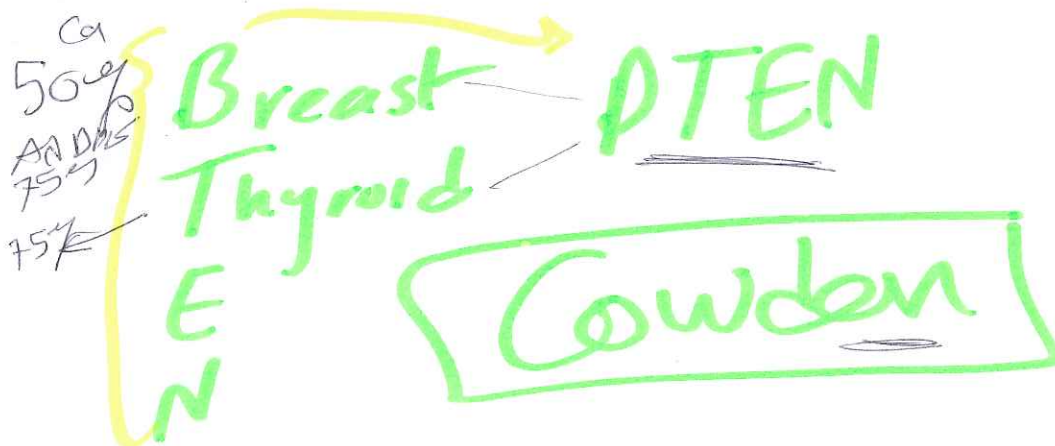


### p53 mutations

The p53 protein functions as a key transcriptional regulator of genes that encode proteins with functions in cell-cycle checkpoints at the G1/S and G2/M boundaries, in promoting apoptosis, and in restricting angiogenesis. As such, selection for p53 defects at the adenoma-carcinoma transition may reflect the fact that stresses on tumor cells activate cell-cycle arrest, apoptotic, and antiangiogenic pathways in cells with wild-type p53 function. Many colonic tumours will demonstrate changes in the p53 gene that may facilitate tumour progression through from adenoma to carcinoma.

### Cowden syndrome

Also known as multiple hamartoma syndrome. Rare autosomal dominant condition with incidence of 1 in 200,000. It is characterised by multiple mucocutaneous lesions, trichilemmomas, oral papillomas and acral keratosis. Most often diagnosed in third decade of life. Breast carcinoma may occur in up to 50% of patients and conditions such as fibrocystic disease of the breast may occur in 75% of women. Thyroid disease occurs in 75% and may include malignancy. Endoscopic screening will identify disease in up to 85% although the small bowel is rarely involved. There is a 15-20% risk of developing colorectal cancer and regular colonoscopic screening from age 45 is recommended.

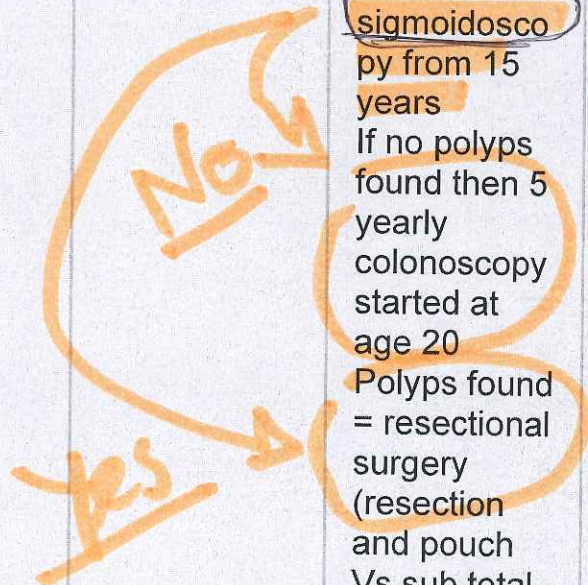




# Polyposis syndromes

Syndrome	Genetic defect	Features	Screening and management	Associated disorders
Familial adenomatous polyposis	Mutation of APC gene (80%) cases, dominant	Typically over 100 colonic adenomas Cancer risk of 100% 20% are new mutations	<p>If known to be at risk then predictive genetic testing as teenager</p> <p>Annual flexible sigmoidoscopy from 15 years</p> <p>If no polyps found then 5 yearly colonoscopy started at age 20</p> <p>Polyps found = resectional surgery (resection and pouch Vs sub total colectomy and IRA)</p>	<p>Gastric fundal polyps (50%).</p> <p>Duodenal polyps 90%.</p> <p>If severe duodenal polyposis cancer risk of 30% at 10 years.</p> <p>Abdominal desmoid tumours.</p>

*fundal Glandular polyps*



*Gastric*

*Attenuated FAP*



MYH associated polyposis	Biallelic mutation of mut Y human homologue (MYH) on chromosome 1p, <b>recessive</b>	Multiple colonic polyps Later onset right sided cancers more common than in FAP 100% cancer risk by age 60	Once identified <b>resection and ileoanal pouch reconstruction</b> is recommended <b>Attenuated phenotype - regular colonoscopy</b>	Duodenal polyposis in 30% Associated with increased risk of <b>breast cancer</b> (self examination)
Peutz - Jeghers syndrome	STK11 (LKB1) mutation on chromosome 19 in some (but not all) cases, <b>dominant</b>	Multiple benign intestinal <b>hamartomas</b> Episodic obstruction and intussusception Increased risk of GI cancers ( <b>colorectal cancer 20%</b> , <b>gastric 5%</b> ) Increased risk of <div style="display: flex; align-items: center;"> <div style="margin-right: 5px;"> — breast, — ovarian, — cervical — pancreatic — and — testicular — </div> <div style="font-size: 2em; margin-left: 5px;">}</div> </div> cancers	<b>Annual examination</b> <b>Pan intestinal endoscopy every 2-3 years</b>	Malignancies at other sites Classical pigmentation pattern



Cowden disease	Mutation of PTEN gene on chromosome 10q22, dominant	Macrocephaly Multiple intestinal hamartomas Multiple trichilemmomas 89% risk of cancer at any site 16% risk of colorectal cancer	Targeted individualised screening	Breast cancer (81% risk) Thyroid cancer and non toxic goitre Uterine cancer
HNPCC (Lynch syndrome)	Germline mutations of DNA mismatch repair genes	Colorectal cancer 30-70% Endometrial cancer 30-70% Gastric cancer 5-10% Scanty colonic polyps may be present Colonic tumours likely to be right sided and mucinous	Colonoscopy every 1-2 years from age 25 Consideration of prophylactic surgery Extra colonic surveillance recommended	Extra colonic cancers



1-2 < 1cm / 5y

---

3-4 < 1cm / 3y  
1 > 1cm

---

> 5 small / 1y

3 one > 1cm

---

# Colonic polyp follow up

## Follow up of colonic polyps

Group	Features	Action
Low risk	1 or 2 adenomas less than 1cm	No follow up or re-colonoscopy at 5 years
Moderate risk	3 or 4 small adenomas or 1 adenoma greater than 1cm	Re-scope at 3 years
High risk	More than 5 small adenomas or more than 3 with 1 of them greater than 1cm	Re scope at 1 year

From Atkins and Saunders Gut 2002 51 (suppl V:V6-V9). It is important to stratify patients appropriately and ensure that a complete colonoscopy with good views was performed.

Segmental resection or complete colectomy should be considered when:

1. Incomplete excision of malignant polyp
2. Malignant sessile polyp
3. Malignant pedunculated polyp with submucosal invasion
4. Polyps with poorly differentiated carcinoma
5. Familial polyposis coli

-Screening from teenager up to 40 years by 2 yearly sigmoidoscopy/ colonoscopy

-Panproctocolectomy and Ileostomy or Restorative Panproctocolectomy.

Rectal polypoidal lesions may be amenable to trans anal endoscopic microsurgery.



## Spigelman System

Number

Size

histological type

Degree of Dysplasia

"Duodenal Polyps"

stage IV

Score 9-12

Surgical Resection

## Familial adenomatous polyposis coli

- Hundreds of colonic polyps
- Risk of malignancy nearly 100%
- Duodenal adenomatous polyps
- Occurs as a result of mutation of APC gene on chromosome 5q
- Autosomal dominant inheritance
- Up to 20% may occur as a new mutation and not be part of an FAP family

### Surveillance

If family mutation is known then at risk members are offered predictive genetic testing in early adolescence. Annual flexible sigmoidoscopy is usually commenced at age 13-15 years. If no polyps are identified then annual colonoscopy is commenced at around 20 years of age.

### Treatment options

- Panproctocolectomy and ileoanal pouch
- Colectomy and ileorectal anastomosis
- Panproctocolectomy and end ileostomy

There is a risk of cancer in the retained rectal stump following ileorectal anastomosis and the cumulative risk is 30% at 60 years. During this time up to 30% of patients will undergo proctectomy.

### Upper GI polyps

- Fundic gastric polyps are seen in up to 50% of patients, these have a low malignant potential.
- Duodenal adenomas occur in nearly all patients. They are severe in 10% and malignant transformation occurs in 5%.
- Duodenal polyposis is staged using the Spigelman system. This is scored according to the number of polyps, their size, histological type and degree of dysplasia. A score of 0-12 is the result. Patients with stage IV disease (scores 9-12) may be considered for surgical resection.

### Other tumours

Desmoid tumours, clonal proliferation of myofibroblasts are seen in some patients. These have a tendency towards local recurrence if not completely excised.

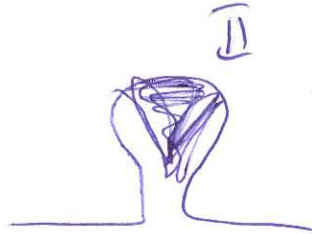


HAGGIT  
Level  
I

→ Pedunculated  
 Polyp



limited to head  
 of polyp



extending into neck



III

extending into  
 any part of  
 the stalk



IV

beyond stalk  
 but above  
 muscularis propria

THE **HAGGITT LEVEL** DETERMINES THE LEVEL OF INVASION **WITHIN THE POLYP.**

THE **KIKUCHI LEVEL** DETERMINES THE DEGREE OF **SUB MUCOSAL INVASION IN THE COLONIC WALL.**

THE OVERALL **MORPHOLOGY OF POLYPS** IS DEFINED BY THE **PARIS CLASSIFICATION.**

## Colonic polyp management

With the introduction of the NHS bowel cancer screening programme there has been a rise in the number of colonic polyps discovered. The decisions surrounding some polyp types has become increasingly complex. The ACPGBI has introduced a position statement in August 2013 with the objective of standardising the approach to polyps.

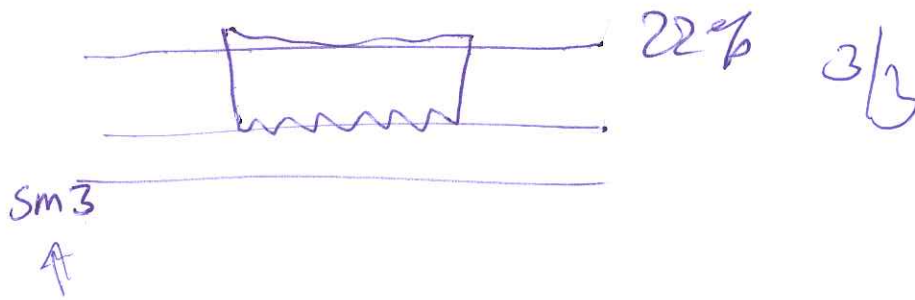
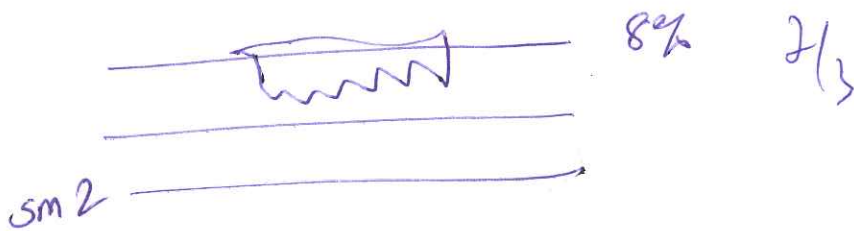
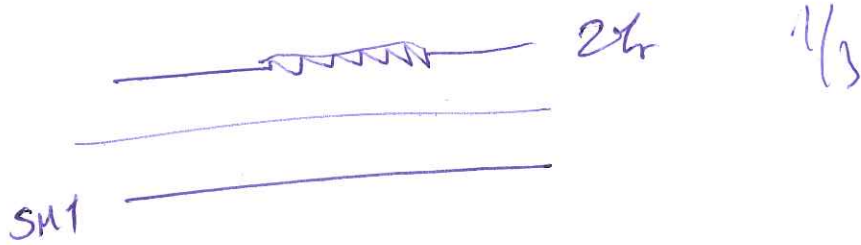
### Defining morphology

The overall morphology of polyps is defined by the Paris classification.

Endoscopic appearance	Paris type	Description
Protruded	1p	Pedunculated polyp
Protruded	1ps	Subpedunculated polyp
Protruded	1s	Sessile
Flat elevated	0-IIa	Flat elevation of the mucosa
Flat elevated	o-IIa-IIc	Flat elevation with central depression
Flat lesion	0-IIb	Flat mucosal change
Flat lesion	0-IIc	Mucosal depression
Flat lesion	0-IIc/IIa	Mucosal depression with raised edges



# Kikuchi levels



Submicron

- Chromo endoscopy
- narrow band imaging

### **Pit pattern**

The pattern of pits within a colonic polyp assessed using either chromoendoscopy or narrow band imaging may also provide a clue as to the underlying nature of the polyp. These are described as **Kudo groups**, these range from 1 to 5 where type 1 has normal rounded pits and type 5 has irregular, amorphous non structural pits suggestive of cancer.

### **Polyp size**

The size of the polyp has a strong bearing on the likelihood of underlying invasive malignancy. Polyps > 2cm in diameter has a risk of the order of 30%. Assessment of size can be challenging, an open biopsy forceps generally has a length of 8mm.

### **Management of polyp**

Essentially this consists of determining the timing and mode of resection. Immediate endoscopic resection is the method of choice for smaller polyps that fall within the endoscopists technical ability. Inability to perform endoscopic mucosal resection, poor preparation (or even lack of time), co-existing malignancy and coagulopathy are all sound reasons for deferring resection.

### **Polypectomy Vs segmental resection**

This is specifically addressed in the ACPGBI position statement. Essentially high risk polyps will have some or all of the following:

- **Poorly differentiated** (20% risk LN metastasis)
- **Lymphovascular invasion** (30% LN metastasis)
- **Size >2.5cm**
- **Kikuchi levels 2 and 3** (deep sub mucosal involvement)
- **Haggitt level IV**

These are not contraindications to endoscopic resection but should form the basis of informed decision making with patients.



## Colonic investigations

Colonic investigation	Sensitivity/ specificity	Specific indications
Colonoscopy	95% for large polyps and cancer, 80% for adenomas less than 5mm	Gold standard investigation for colon; invasive
Faecal occult blood testing	60% sensitivity, specificity 10%	Screening populations
CT colonoscopy	93% and 97%	Screening those who cannot undergo colonoscopy, or in those whom colonoscopy incomplete
Barium enema double contrast	48% for large polyps 80% for cancer, 70% specificity	Colonoscopy and CT colon unavailable

**SYNCRHONOUS LESIONS ARE FOUND IN 5% OF CASES AND IT IS FOR THIS REASON THAT THE WHOLE COLON BE IMAGED PRE-OPERATIVELY. IF THE PATIENT ALREADY HAS A TISSUE DIAGNOSIS THEN THIS CAN READILY BE ACHIEVED WITH CT COLONOGRAPHY WHICH HAS THE ADVANTAGE OF SIMULTANEOUS STAGING.**

**PATHOLOGY DISCOVERED DURING THE COURSE OF FLEXIBLE SIGMOIDOSCOPY IS DIFFICULT. IF THE LESION LOOKS OVERTLY MALIGNANT THEN A BIOPSY OF THE LESION IS APPROPRIATE AS IT WILL SPEED THE DIAGNOSTIC PROCESS AND THE REMAINING BOWEL CAN BE ASSESSED BY CT COLONOSCOPY DURING STAGING. HOWEVER, LESIONS WHICH MAY BE MORE SUITED TO ENDOSCOPIC RESECTION ARE BEST BROUGHT BACK ON A SEPARATE OCCASION. THIS IS BECAUSE FORMAL BOWEL PREPARATION WILL MAKE THE PROCEDURE SAFER, MORE TIME CAN BE ALLOCATED TO THE CASE AND THE REMAINING BOWEL ASSESSED.**

---

Circumferential  
Resection CRM  
Margin



## Effects of positive faecal occult blood tests

Screening for colorectal cancer in the UK currently relies on the faecal occult blood test.

A large trial in the UK with recruitment of nearly half a million participants demonstrated that individuals aged between 50 and 69 had a 1.9% chance of having a positive FOB test. Of these 35% were subsequently found to have colonic adenomas and 10% were found to have invasive cancer. It is interesting to note that over 25% of people in that study had either Dukes C or D stage disease.

For this reason those people in the UK bowel cancer screening programme who have two positive FOB tests will be offered a screening colonoscopy.

## Radiotherapy for rectal cancer

- Rectal cancer = tumours with distal margin 15cm or less from the anal verge as measured with rigid sigmoidoscopy.
- All patients with rectal cancer should have rectal MRI scanning to assess nodal disease, T and N stages.
- Patients with T1 tumours who are being considered for TEM should have endo rectal USS performed.
- The addition of chemoradiotherapy is of proven benefit in downstaging and reducing local recurrence rates in patients with a threatened CRM (*Circumferential resection margin*) of suspicion of nodal disease in the mesorectum.
- Pre-operative chemoradiotherapy is probably of little benefit in T1 N0 tumours.
- Controversy surrounds the T2/ T3 tumours with no evidence of nodal disease. There is reasonable evidence that long course radiotherapy results in improved local recurrence rates and that these (but not survival) are further improved by the addition of chemotherapy (1).
- The use of short course radiotherapy is in decline, but may be indicated in selected patients. It is advocated in the ACPGBI guidance (but this published document is now quite dated).

NOT



## Adjuvant therapy in colonic cancer

The survival of patients with nodal disease and poor prognostic features following colo-rectal resections has dramatically improved. This is due in part to an improvement in surgical technique, such as widely adopting TME, sub specialisation and improved staging.

In the context of colonic cancer adjuvant therapy tends to mean chemotherapy, radiotherapy to the abdomen is poorly tolerated by the small bowel and is associated with a high incidence of radiation enteritis.

### Chemotherapy for colonic cancer

- **5FU** and **folinic acid** (Leucovorin). The 5FU is an antimetabolite and its action is **potentiated with leucovorin**.
- **5FU and oxaliplatin**. When combined with 5FU and folinic acid it is known as the **FOLFOX regime**.
- **Capcetabine** is an oral prodrug of 5FU and is used in patients with **metastatic disease** or in patients with **Dukes C disease**.
- **Irinotecan** may be used in combination with 5FU and folinic acid, the **FOLFIRI regime**.
- The monoclonal antibody **cetuximab** may be useful for patients with wild type K RAS. It is either given **alone or together with irinotecan**.

### Adverse effects

- **Neuropathy** is the main side effect of **oxaliplatin**. It is also **ototoxic** though less than the other platinum chemotherapy drugs.
- Side effects of **5FU** include; **myelosuppression**, **mucositis**, **dermatitis** and **diarrhea**.
- Side effects of **irinotecan** are severe **diarrhea** and **extreme suppression of the immune system**.

**INVOLVEMENT OF THE MESENTERY IS NOT UNCOMMON WITH SMALL BOWEL CARCINOID AND THIS COUPLED WITH VASCULAR AND LUMENAL COMPROMISE WOULD ATTRACT A RECOMMENDATION FOR PRIMARY RESECTION. THE ONLY CONTRA-INDICATION TO THIS APPROACH WOULD BE A LACK OF SKILL IN PERFORMING THIS TYPE OF SURGERY IN WHICH CASE THE PATIENT SHOULD BE CLOSED AND REFERRED TO A COLLEAGUE OR TERTIARY CENTRE.**



# Appendiceal Carcinoid tumor

- all non carcinoid malignancies in appendix  $\rightarrow$  Rt colectomy
- tumor  $> 2\text{ cm}$   $\rightarrow$  Rt colectomy
- tumor  $< 1\text{ cm}$  <sup>①</sup> at Body <sup>②</sup> or tip + <sup>③</sup> favorable histology  $\rightarrow$  just appendectomy
- Between 1-2 cm Balance

} usually after 3 months

## Carcinoid tumours

NET's

Carcinoids are rare neuroendocrine tumours with an incidence of 1.2-2.0 per 100,000 per year. Approximately 70% are located in the GI tract. They are usually classified according to their location. Foregut carcinoids affect the lungs, thymus, stomach, duodenum and pancreas. Midgut carcinoids affect the small bowel and proximal colon. Hindgut carcinoids affect the distal colon and rectum. Of these, the midgut carcinoids display the classical appearances; originating from enterochromaffin cells with a positive silver histological staining response due to their serotonin production. The non classical carcinoids are technically regarded as being neuroendocrine tumours.

Carcinoids are termed as being well or poorly differentiated based on their histological appearances, mitotic index and proliferation index. The latter is assessed through the use of the immunohistochemical stain to Ki67. Poorly differentiated tumours have, as expected, a high rate of mitotic activity and proliferation index.

The focus here will primarily be on midgut and rectal carcinoids.

Small intestinal carcinoids have increased in frequency and account for 30% of all carcinoid tumours. They have a predilection for occurrence in the terminal ileum. And in their early stages may appear as being little more than a flat, fibrotic submucosal lesion. Enterochromaffin cells are located deep in the small bowel crypts thereby accounting for this appearance. Lymph node metastasis may occur and it is not unusual for the lymph nodes to be significantly larger than the lesion from which they originated. These tumours can display a marked desmoplastic reaction with puckering and shortening of affected mesentery being commonplace. The result of this is that vascular compromise of significant distal regions of small bowel can occur and represent a considerable resectional challenge.

Liver metastasis may occur and liver involvement is typically diffuse. The classical carcinoid syndrome tends not to occur without liver involvement and comprises;

- Diarrhoea
- Cutaneous flushing
- Heart valve fibrosis
- Bronchoconstriction

### Diagnosis

When lesions are resected this is typically histological. A biochemical assessment through the measurement of 5-HIAA in 24 hour urine measurements is an important part of follow up and elevated values are

5 HIAA → Urine  
Chromogranin A → Blood



NET

somatostatin subtypography

typically seen in advanced disease. An alternative method is the measurement of **plasma chromogranin A**. **CT scanning** is useful in staging distant disease, identification of the primary lesion through the use of this modality of imaging is unusual. **Somatostatin receptor scintigraphic scanning** is a more sensitive test.

SRS scan



Rectal carcinoids are an important sub group of lesions. They are often identified as incidental lesions. Local evaluation is usually achieved through a combination of pelvic MRI scanning and endoscopic USS.

## Treatment

**Surgical resection of carcinoid tumours is the mainstay of treatment and the only realistic prospect of cure.** Smaller lesions of the appendix (**1-2cm or less**) of the appendix are sufficiently treated by simple appendicectomy alone. Small **rectal lesions (1-2cm or less)** can usually be managed through the use of local excision alone and a TEMS approach may achieve this. **Larger rectal lesions may require formal resection and TME.** **Palliation and even cure can be effectively achieved by resection mesenteric disease.** However, the procedures are challenging and vascular control can be difficult.

Medical therapy with **somatostatin analogues** is an important adjunct to treatment in those with advanced disease. Not least, because chemotherapy confers very limited benefit. They are relatively radioresistant tumours.

Ocintides

## Ileostomy

Ileostomies are generally fashioned in the right iliac fossa in a triangle between the anterior superior iliac spine, symphysis pubis and umbilicus. They should lie **one-third of the distance between the anterior superior iliac spine and umbilicus**. A 2cm skin incision is made and dissection continued through the rectus muscle. A cruciate incision should be made, and generally dilated to admit two fingers. The ileum is brought through the incisions and should generally be spouted to a final length of 2.5cm. Ileostomies that are too short may cause problems with appliance fixation and those which are too long may cause problems with tension and subsequent ulceration or prolapse.

Complications following ileostomy construction include **dermatitis** (most common), **bowel obstruction** (usually adhesional) and **prolapse**.

Ileostomy **output is roughly in the range of 5-10ml/Kg/ 24 hours**. Output in excess of **20ml/Kg/24 hours usually requires supplementary intravenous fluids**. Excessive fluid losses are generally managed by administration of oral **loperamide (up to 4mg QDS)** to try and slow the output. **Foods containing gelatine** may also thicken output. Early high output is not uncommon and most patients (50%) will respond to conservative management.



# Anastomotic leak after colectomy

early < 6 days

- Dramatic presentation

- Severe pain • tachycardia • high fever
- rigid abdomen • hemodynamic Unstable

CT scan or other contrast • water soluble  
Can be done usually before → OT

Late > 6 days

- insidiously

- low grade fever - ileus - failure to progress

Earliest Signs → mental change, tachypnea, "non specific"  
DD PE • pneumonia • atelectasis  
• Adverse Drug reaction

So Obtain chest X-Ray - CT chest for PE

CT abdomen & pelvis & rectal contrast

## management

early

fluids, antibiotics, Urinary Cath, CVP, Arterial Line  
Mark Stoma site → OT  
CT usually time sensitive Contrast

Late patient antibiotics, percutaneous Drainage  
intervention 7-10 Dangerous  
minor leaks ~~leaks~~ heals with time

operation  
Rt side

phone a friend

anastomosis can be Resected & redone

if not possible → Stoma

↳ or Resection-Anastomosis + proximal loop ileostomy

Lft Side

Repair - omentoplasty + Loop ileostomy

if not possible → Hartmann's

↳ fecal Diversion + Drainage

pre sacral Drainage  
omental mobilization

post op

ICU

inotropes ventilation  
Goal Directed Anti Biotic → ↓ temp  
Nutrition  
Imaging  
Drainage of Res. dual  
↓ WBC



## Drains and diverting stomas in rectal surgery

Rectal surgery in the form of **low anterior resection** is compromised by a **relatively high incidence of anastomotic leaks**. Whilst not all of these may be clinically significant there is little doubt that they can pose considerable challenge for surgeons. The incidence varies but is generally accepted to be between **8 and 20%**. Here we consider the role of two factors that may modulate this process; the use of drains and diverting stomas.

### Drains

The reason underpinning drain usage is that evacuation of fluid from the tissues surrounding a rectal anastomosis prevents secondary infection which may subsequently compromise the join. Opponents of this suggest that such a strategy may, in fact, have the opposite effect and increase the risk of leak. A Cochrane review into this practice was undertaken (1), and the conclusion was that **insertion of drains had no robust evidence base**. The trials they considered did not show that drain insertion conferred any benefit in the prophylaxis against leakage.

### Stomas

In view of the high risk of leak, the vast majority of surgeons performing rectal cancer surgery will consider defunctioning the rectum in order to reduce the clinical sequelae of anastomotic leakage. In practice two main options are available, that of **loop ileostomy** or **loop colostomy**. A Cochrane review (2) of this topic identified the outcomes below:

Outcome measure	Finding
Mortality Wound dehiscence Anastomotic leak Re-operation	No difference between stoma types
Stoma prolapse	More common with loop colostomy
Stoma closure	Lower wound sepsis rate with ileostomy

So, { Ileostomy }  
↓ prolapse  
↓ wound  
↓ infection

A significant technical factor which is not addressed in this review is the increased danger that is posed by the technical factors which govern loop colostomy closure. In practical terms the loop will usually be a transverse loop colostomy. If this is constructed distal to the middle colic vessels then the risks posed to the distal colon in stoma take down are considerable, and



Stoma Usually closed operatively  
after 3 months

Before closure

you may do contrast studies/CT  
Colonoscopy

could lead to necrosis of the distal colonic conduit. An additional factor, which is also not discussed in the review is the better healing of a small bowel anastomosis over a colonic one. Whilst they did formally address this in the review in terms of anastomotic leak rates. Clearly some patients undergoing rectal cancer surgery will have undergone either short or long course chemoradiation. With modern techniques the radiation dose to the small bowel residing in the pelvis is small. If the bowel from which a stoma is to be constructed, shows radiation changes, it should not be used.

Therefore the choice of defunctioning stoma remains one of surgeons preference. In the UK most surgeons would tend to prefer loop ileostomy.

↓ SSI  
↓ Proapse

## Toxic megacolon

Toxic megacolon is mainly associated with severe ulcerative colitis and colonic Crohn's disease.

**Amoebic dysentery** may progress to:

- amoeboma
- fulminant colitis (made worse by loperamide)
- toxic megacolon, and
- colonic ulcers.

It may also lead to perforation.

Other complications of amoebiasis include stricture formation, haemorrhage, and amoebic liver abscess.

Toxic megacolon can also result from Clostridium difficile infection.

Pseudomembranous colitis is caused by *Clostridium difficile* and associated with antibiotic use. Symptoms vary from mild diarrhoea to fulminating toxic megacolon. Salmonella is also a recognised cause, particularly in children. *Salmonella* enterocolitis produces colitis, acute appendicitis in the young and mesenteric thrombosis in the elderly.

**Pneumatosis cystoides intestinalis** is associated with chronic bronchitis (multiple gas filled cysts in sub-mucosa of colon). It is mainly asymptomatic, but can cause abdominal pain, diarrhoea and rupture to produce pneumoperitoneum.



# Crohn's Disease

Behaviour, • inflammatory • stricturing • fistulizing

• MRI enterography → gaining popularity

• Endoscopy → upper GI  
→ lower GI

Terminal ileum should be intubated

Findings

- aphthous ulcers
- patchy erythema
- Linear serpiginous ulcers
- Deep "bear claw" ulcerations
- strictures

Colonoscopy avoided in acute setting

- Medical therapy is the most appropriate initial approach

- aminosalicylates / antibiotics / steroids / thiopurines  
cyclosporines / TNF antibody

- Obstruction → Bowel rest / IV steroids

Surgery indicated in persistence of symptoms  
Delayed when inflammation resolves

The Goal → Staged Resection to avoid Bleeding  
associated with acute inflammation  
And to preserve bowel length

→ Failed medical therapy / medical related complications  
→ Acute severe complication → perforation  
→ Neoplasia  
→ Abscess not amenable to percut. drainage  
→ Bleeding  
→ Obstruction  
→ Symptomatic fistula

Mesentery of CD, thickened & fat deposit  
and lymphadenopathy

## Microscopic changes in colitis

The microscopic changes present in the various types of colitis are a common theme in the FRCS exam.

Type of colitis	Microscopic appearances
Cytomegalovirus <i>CMV inclusion</i>	Large intra nuclear inclusion body and smaller cytoplasmic inclusions
Ulcerative colitis	<ul style="list-style-type: none"> <li>Alteration of crypt architecture. Branching crypts with marked deviation of the crypt axis from the perpendicular; variation in crypt size and/or shape; shortened crypts, with bases of crypts elevated off the muscularis mucosae</li> <li>Dense neutrophilic infiltrates and neutrophils in crypts (crypt abscesses) <i>- neutrophilic</i></li> <li>Ulceration may be identified, although fissuring is often absent</li> </ul>
Crohns disease	<ul style="list-style-type: none"> <li>Areas of chronic inflammation, comprising increased lamina propria plasma cells and lymphocytes, in association with chronic architectural distortion with patchy, mild to severe, neutrophilic inflammation, including neutrophilic cryptitis, crypt abscesses, or erosions/ulcers</li> <li>Skip lesions</li> <li>Granulomas</li> <li>Sub mucosal fibrosis</li> <li>Fissuring</li> </ul> <i>- plasma cells - lymphocytes + neutrophils</i>
Radiation enteritis	<ul style="list-style-type: none"> <li>Disordered crypts</li> <li>Endarteritis obliterans</li> <li>Fibrosis of the lamina propria</li> <li>Ulceration and fistulation</li> </ul>



# Colitis

Infective

IBD → Ulcerative  
→ Crohn's  
→ Collagenous

Radiation enteritis

CMV

Lymphocytic

Solitary Rectal Ulcer

Chronic Diarrhea

IBS

IBD → UC  
→ CD

Colorectal Cancer

Celiac Disease

others

- Thyrotoxicosis
- Laxative abuse
- Appendicular abscess
- pelvic abscess
- Radiation enteritis

Rome III criteria

↓  
Fecal Calprotectin

IBS ← other  
Important

Infective colitis	<ul style="list-style-type: none"> <li>• Increased cellularity in the lamina propria</li> <li>• Neutrophilic infiltrates</li> <li>• Loss of crypts</li> </ul>
Lymphocytic colitis	Normal crypts with lymphocytic infiltrates
Collagenous colitis	Normal crypts with lymphocytic infiltrates and collagen deposition in the lamina propria
Solitary rectal ulcer	<ul style="list-style-type: none"> <li>• Fibromuscular obliteration</li> <li>• Surface ulceration</li> <li>• Little inflammatory activity</li> </ul>

### **ACUTE DIARRHOEA WITH NORMAL CRYPT ARCHITECTURE= INFECTIOUS COLITIS**

**DIFFUSE ABDOMINAL PAIN EARLY IN THE CAUSE OF THE PROCESS SHOULD RAISE SUSPICION FOR AN INFECTIVE CAUSE. IN THE CONTEXT OF IBD ABDOMINAL PAIN IS UNUSUAL IN THOSE WHO HAVE UC (MORE COMMON IN CROHNS). IN EITHER CASE IT WOULD .BE MOST UNUSUAL SO EARLY IN THE DISEASE PROCESS**



{ Bloody Diarrhea  
+ Sudden Abdominal pain  
Ischemic colitis

CT,  
Colonoscopy  
Stool Culture

angiography  
if Acute Ischemia Suspected

→ Erythematous  
edema mucosa  
petechiae

or Gray or Black

↳ abort procedure

→ Go laparotomy

→ Gangrenous → perforation, Sepsis

→ NonGangrenous → transient → mucosa & submucosa  
→ Chrome Resolve in 1-2 weeks  
↳ all layers of colon  
↳ Fibrosis

DD

• Infective colitis

• IBD

• radiation enteritis

• diverticulitis

• malignancy

## Diarrhoea

### World Health Organisation definitions

Diarrhoea: > 3 loose or watery stool per day

Acute diarrhoea < 14 days

Chronic diarrhoea > 14 days

### Acute Diarrhoea

Gastroenteritis	May be accompanied by abdominal pain or nausea/vomiting
Diverticulitis	Classically causes left lower quadrant pain, diarrhoea and fever
Antibiotic therapy	More common with broad spectrum antibiotics <i>Clostridium difficile</i> is also seen with antibiotic use
Constipation causing overflow	A history of alternating diarrhoea and constipation may be given May lead to faecal incontinence in the elderly



# Fulminant *C. difficile* Colitis

DD of Acute onset of profuse Diarrhea

infections → Viral: Noro virus, Rota virus, Adeno virus

→ Bacterial: Vibrio, E. coli, Salmonella,

Campylobacter, Shigella

Recent Antibiotic Use *C. difficile*

Parasitic: Giardia, Cryptosporidium, Entamoeba

Non-infectious → no pathogen found

→ Diarrhea persists > 10-14 days

Causes → antibiotic-associated

→ Carcinoid Syndrome

→ Congenital Colitis

→ pancreatic insufficiency

*Clostridium difficile* → Gram +ve  
→ spore forming  
→ anaerobic

Toxin A & B → Glycosylation of ptn that normally maintain cell membrane integrity

Tests → Stool toxin enzyme immunoassay  
→ cell culture cytotoxic assay & *C. difficile* culture  
→ PCR

Endoscopy → only in case of Doubt "Risk of perforation"

## metronidazole → vancomycin oral → Surgery  
oral + IV metronidazole

Indication of Surgery

- Severe Systemic toxicity fail to improve after 24-48 hours of maximal therapy
- organ failure
- vasopressor requirement
- worsening CT scan findings
- peritonitis

Total Abdominal Colectomy

if found only part involved  
also do

Do not remove Rectum  
pt is too sick for pelvic dissection  
because pt will not tolerate other operation

## Chronic Diarrhoea

<b>Irritable bowel syndrome</b>	<p><b>Extremely common.</b> The most consistent features are abdominal pain, bloating and change in bowel habit. Patients may be divided into those with diarrhoea predominant IBS and those with constipation predominant IBS.</p> <p>Features such as lethargy, nausea, backache and bladder symptoms may also be present</p>
<b>Ulcerative colitis</b>	<p>Bloody diarrhoea may be seen. Crampy abdominal pain and weight loss are also common. Faecal urgency and tenesmus may occur</p>
<b>Crohn's disease</b>	<p>Crampy abdominal pains and diarrhoea. Bloody diarrhoea less common than in ulcerative colitis. Other features include malabsorption, mouth ulcers perianal disease and intestinal obstruction</p>
<b>Colorectal cancer</b>	<p>Symptoms depend on the site of the lesion but include diarrhoea, rectal bleeding, anaemia and constitutional symptoms e.g. Weight loss and anorexia</p>
<b>Coeliac disease</b>	<ul style="list-style-type: none"><li>• In children may present with failure to thrive, diarrhoea and abdominal distension</li><li>• In adults lethargy, anaemia, diarrhoea and weight loss are seen. Other autoimmune conditions may coexist</li></ul>

Other conditions associated with diarrhoea include:

- Thyrotoxicosis
- Laxative abuse
- Appendicitis with pelvic abscess or pelvic appendix
- Radiation enteritis



# Col pro tectin

Rome III for IBS

- abd pain & discomfort 6m
- change in bowel habit

3d within 3m

2 of

• pain

defecation →

relief

• pain

at same time & change of frequency of stools

• pain

at same time & change in appearance of stools

## Diagnosis

Stool culture

Abdominal and digital rectal examination

Consider colonoscopy (radiological studies unhelpful)

Thyroid function tests, serum calcium, anti endomysial antibodies, glucose

**FAECAL ELASTASE IS USED TO SCREEN FOR PANCREATIC INSUFFICIENCY.**

## Faecal calprotectin

Calprotectin is a zinc/ calcium binding protein located in the cytosol of inflammatory cells. It is normally excreted in relatively low levels in the stools. In conditions such as IBD, cancer or severe infections excretion will be increased. This makes the test a useful screening test for those patients fulfilling the ROME criteria for functional bowel disorders in whom more complex investigations may not be needed.

The Rome III criteria system was developed to classify the functional gastrointestinal disorders based on clinical symptoms. Each disorder has its own set of criteria. For example, the Rome III criteria for irritable bowel syndrome (IBS) is as follows:

Symptoms of recurrent abdominal pain or discomfort and a marked change in bowel habit for at least six months, with symptoms experienced on at least three days of at least three months. Two or more of the following must apply:

- Pain is relieved by a bowel movement
- Onset of pain is related to a change in frequency of stool
- Onset of pain is related to a change in the appearance of stool.



## Surgery role in UC

- patient unable to work
- Toxic effect of medical tht

### Toxic megacolon

- Distension
- tenderness
- Fever
- leucocytosis
- ↓ Bowel movement
- Bleeding
- Require transfusion
- hypoalbuminemia
- colon wall thickening for pathology & dilatation

Prednisone / <sup>mesalamine</sup> pentasa / azathioprine / infliximab

2/3 stages operation Better & Safe Because

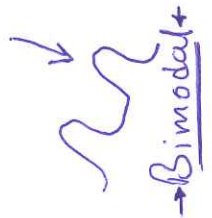
- High Dose medication
- Severe presentation
- Comorbidities
- Technical issues

Rectal Stump leak is concerning

- So Hartmann's pouch Sutured to Abdominal wall
- So leak can be drained via wound
- Rectal tube inserted

# Ulcerative colitis

Ulcerative colitis is a form of inflammatory bowel disease. Inflammation always starts at rectum, **does not spread beyond ileocaecal valve** (although backwash ileitis may occur) and is **continuous**. The peak incidence of ulcerative colitis is in people aged **15-25 years** and in those aged **55-65 years**. It is **less common in smokers**.

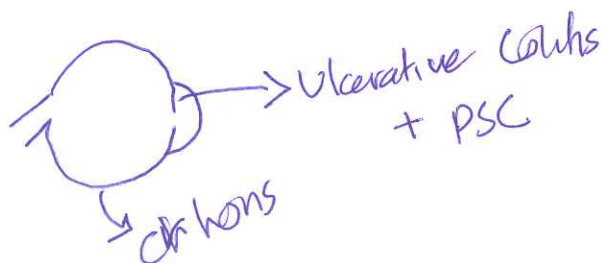


The initial presentation is usually following **insidious** and **intermittent** symptoms. Features include:

- **bloody diarrhoea**
- **urgency**
- **tenesmus**
- **abdominal pain**, particularly in the **left lower quadrant**
- extra-intestinal features (see below)

Questions regarding the 'extra-intestinal' features of inflammatory bowel disease are common. Extra-intestinal features include **sclerosing cholangitis**, **iritis** and **ankylosing spondylitis**.

	Common to both Crohn's disease (CD) and Ulcerative colitis (UC)	Notes
Related to disease activity	<p><b>Arthritis: pauciarticular, asymmetric</b></p> <p><b>Erythema nodosum</b></p> <p><b>Episcleritis</b></p> <p><b>Osteoporosis</b></p>	<p>Arthritis is the most common extra-intestinal feature in both CD and UC</p> <p>Episcleritis is more common in <b>Crohn's disease</b></p>
Unrelated to disease activity	<p><b>Arthritis: polyarticular, symmetric</b></p> <p><b>Uveitis</b></p> <p><b>Pyoderma gangrenosum</b></p> <p><b>Clubbing</b></p> <p><b>Primary sclerosing cholangitis</b></p>	<p><b>Primary sclerosing cholangitis is much more common in UC</b></p> <p><b>Uveitis is more common in UC</b></p>





## Pathology

- red, raw mucosa, bleeds easily
- no inflammation beyond submucosa (unless fulminant disease)
- widespread superficial ulceration with preservation of adjacent mucosa which has the appearance of polyps ('pseudopolyps')
- inflammatory cell infiltrate in lamina propria
- neutrophils migrate through the walls of glands to form crypt abscesses
- depletion of goblet cells and mucin from gland epithelium
- granulomas are infrequent

## Barium enema

- Loss of haustrations
- Superficial ulceration, 'pseudopolyps'
- Long standing disease: colon is narrow and short - 'drainpipe colon'

## Endoscopy

- Superficial inflammation of the colonic and rectal mucosa
- Continuous disease from rectum proximally
- Superficial ulceration, mucosal islands, loss of vascular definition and continuous ulceration pattern.

## Management

- Patients with long term disease are at increased risk of development of malignancy
- Acute exacerbations are generally managed with steroids, in chronic patients agents such as azathioprine and infliximab may be used
- Individuals with medically unresponsive disease usually require surgery- in the acute phase a sub total colectomy and end ileostomy. In the longer term a proctectomy will be required. An ileoanal pouch is an option for selected patients

## CREATION OF AN ILEO ANAL POUCH IS AN ELECTIVE OPERATION

THIS IS A REGULAR THEME ON THE FRCS CIRCUIT. THE BEST OPTION FOR UC WHICH IS NOT RESPONDING TO MAXIMAL MEDICAL THERAPY IS SUB TOTAL COLECTOMY. IN UC THERE IS ALMOST NO PLACE FOR SEGMENTAL RESECTION AND PRIMARY ANASTOMOSIS IS UNWISE. RESECTION OF THE RECTUM IN THE PRIMARY SETTING IS ASSOCIATED WITH CONSIDERABLE MORBIDITY AND NOT RECOMMENDED.

FAILURE OF MEDICAL MANAGEMENT (ALTHOUGH NOT ALWAYS ASSOCIATED WITH COMPLICATIONS) ACCOUNTS FOR MOST COLECTOMIES.

VSL#3

High potency  
probiotic  
Medical food



**Toxic megacolon** occurs typically in *ulcerative colitis*.

Known causes of toxic megacolon include:

*Crohn's disease*

*Pseudomembranous colitis*

*Amoebiasis*

*Salmonella enteritis*

*Campylobacter enteritis infection* (particularly when antimotility agents are used), and

*Ischaemic colitis*.

## Pouchitis

- Pouchitis affects up to 50% of patients undergoing restorative proctocolectomy for ulcerative colitis
- Pouchitis is the most common, long term cause of pouch dysfunction, chronic pouchitis accounts for 10% of pouch failures
- Acute pouchitis should be diagnosed by flexible endoscopic assessment of the pouch together with symptoms (asymptomatic inflammation of the pouch is common).
- First line treatment is usually with a two week course of oral metronidazole or ciprofloxacin
- Patients who relapse quickly or who have greater than 3 episodes of pouchitis per year should be considered for maintenance treatment with ciprofloxacin or VSL 3 (6g qds)

## Typhlitis

Also known as neutropaenic enterocolitis, typhlitis is an acute, life threatening, transmural inflammation of the caecum and terminal ileum.

Patients are often severely myelosuppressed (usually as the result of treatment of leukaemia), the condition has a high mortality.

The usual presentation is in a patient who is markedly myelosuppressed who develops mucositis, right iliac fossa pain and watery diarrhoea. The clinical findings depend upon the severity of the condition.

Where there are no immediate indications for laparotomy, the condition is best assessed by CT scanning. Conservative management consists of intravenous antibiotics and gut rest. TPN may be required. Where perforation has occurred, surgery with resection of the affected segment will be required, a double barreled stoma will usually be fashioned.

## Lower GI Bleeding

- 10-15% from upper GI
- Diverticular naze
- IBD
- neoplasm
- Angiodysplasia
- Meckel's diverticulum
- polyps
- Ischemic colitis

workup

- fluids - ICU
- NGT
- Anoscopy/Sigmoidoscopy
- Colonoscopy - epinephrine  
- coagulation  
- clip
- mesenteric angiography

→ Surgery

Total abdominal colectomy

± on-table colonoscopy

passed orally for Small Intestine  
Exploration



## Diverticular disease

Diverticular disease is a common surgical problem. It consists of herniation of colonic mucosa through the muscular wall of the colon. The usual site is **between the taenia coli** where vessels pierce the muscle to supply the mucosa. **Luminal pressures are highest in the sigmoid colon** (the commonest site) and the rectum is covered in its entirety by muscle and diverticulae are very rare at this site.

### Symptoms

- Altered bowel habit
- Bleeding
- Abdominal pain

### Complications

- Diverticulitis
- Haemorrhage
- Development of fistula
- Perforation and faecal peritonitis
- Perforation and development of abscess
- Development of diverticular phlegmon

**COLOVESICAL FISTULA SHOULD BE MANAGED WITH SINGLE STAGE RESECTION AND ANASTOMOSIS UNLESS THERE ARE COMPELLING REASONS NOT TO. LOOP STOMAS IN PARTICULAR OFFER ALMOST NO CONTROL OF SYMPTOMS IN THIS SETTING.**

### Diagnosis

Patients presenting in clinic will typically undergo either a **colonoscopy** or **barium enema** as part of their diagnostic work up. Both tests will identify diverticular disease. It can be far **more difficult to confidently exclude cancer**, particularly in diverticular strictures.

**Acutely unwell surgical patients** should be investigated in a systematic way. **Plain abdominal films** and an **erect chest x-ray** will identify perforation. An **abdominal CT scan with oral and intravenous contrast** will help to identify whether acute inflammation is present but also the presence of local complications such as abscess formation.

Operation Historically Hartmann's  
Start in virgin area

Resect perforation only & end  
Do not Do Sigmoidectomy Colostomy  
in Emergency

Because ~~it~~ → Time for Spleenic Flexure Dissection  
→ for anastomosis or even colostomy

if Severe inflammation + unstable pt  
proximal diversion X resection + Drainage

### Indications

for Sigmoid Colectomy

- Recurrent Episodes 2-3 & on complicated Diverticulitis
- Single Episode of Complicated Diverticulitis
  - micro perforator + abscess
  - stricture
  - fistula



## Severity Classification- Hinchey

I	Para-colonic abscess
II	Pelvic abscess
III	Purulent peritonitis
IV	Faecal peritonitis

## Treatment

- Increase dietary fibre intake.
- Mild attacks of diverticulitis may be managed conservatively with antibiotics.
- Peri colonic abscesses should be drained either surgically or radiologically.
- Recurrent episodes of acute diverticulitis requiring hospitalisation are a relative indication for a segmental resection.
- Hinchey IV perforations (generalised faecal peritonitis) will require a resection and usually a stoma. This group have a very high risk of post operative complications and usually require HDU admission. Less severe perforations may be managed by laparoscopic washout and drain insertion.

**ABSCESSSES LESS THAN 5CM CAN USUALLY BE MANAGED WITH ANTIBIOTICS ALONE.**

# Thrombosed Haemorrhoids

Covered By - Dry  
- Keratinized SKIN  
- normal appearing

- DD
- 1 - prolapsed oedematous internal haemorrhoid
  - 2 - Acute haemorrhoidal inflammation
  - 3 - perianal Abscess
  - 4 - prolapsed strangulated internal haemorrhoid
  - 5 - inflamed Skin tag & IBD
  - 6 - Infarcted haemorrhoids without prolaps
  - 7 - prolapsed anal polyp
  - 8 - acute anal fissure & oedema has Sentinel tag

## Conservative

Surgical Evacuation if

< 48h + Large

it is not kind of complicated haemorrhoids



# Haemorrhoids

Patients typically present with bright red rectal bleeding that occurs onto the toilet paper and into the toilet pan.

The underlying pathophysiology of haemorrhoidal disease is the tendency for the haemorrhoidal cushions to lose their structural support in the ano rectum. This results in prolapse and sphincter spasm may secondarily impede venous return. Further haemorrhoidal engorgement may occur and the disease may then propagate.

Many patients with haemorrhoidal disease are also constipated. However, this is not universally the case and some may have underlying organic pathology such as neoplasia, inflammatory bowel disease or an underlying pelvic floor disorder such as high grade internal prolapse.

treatment options

<b>High fibre diet/ laxatives</b>	Suitable for minor haemorrhoidal symptoms and disease Low risk
<b>Rubber band ligation</b>	Bands are applied to the base of the haemorrhoidal cushion above the dentate line Mucosal necrosis and subsequent fibrosis will tend to result in elevation of the haemorrhoids to their normal location Only likely to succeed if the underlying cause is addressed
<b>Injection sclerotherapy</b>	Injection of 5% phenol in almond oil at the base of the haemorrhoid Deep or ineffective injection may result in pelvic sepsis or prostatitis
<b>Milligan - Morgan haemorrhoidectomy</b>	Involves excision of the haemorrhoidal tissue Good for large volume prolapsed haemorrhoids Excessive tissue excision may result in anal stenosis Pain may be reduced by post operative oral metronidazole



<b>Stapled haemorrhoidopexy</b>	<p>Use of circular stapler to excise the haemorrhoidal base and surrounding mucosa</p> <p>Will elevate the cushions into the anorectum and reduce symptoms</p> <p>Urgency occurs in up to 20% (though usually resolves in the first 6 months)</p> <p>Large skin tags may be less effectively addressed with this technique</p>
<b>Doppler guided haemorrhoidal artery ligation</b>	<p>Uses doppler device to identify the haemorrhoidal vessel that is then underrun</p> <p>Additional sutures placed to hitch up the haemorrhoidal complex</p> <p>Low morbidity technique. However, equipment is expensive</p>

### Pitfalls

- Excessive skin removal with open technique may result in anal stenosis. If severe, an anoplasty may be needed
- It is important not to confuse high grade internal prolapse or even early rectal prolapse with haemorrhoids. Whilst it may be tempting to attempt to staple this using a haemorrhoidectomy stapling device this is not technically a stapled haemorrhoidectomy so much as a STARR procedure. Whilst this may be appropriate the equipment and technique are different and patients should have a comprehensive diagnostic pelvic floor work up undertaken first



## Anal fissure

Anal fissures are a common cause of painful, bright red, rectal bleeding. Most fissures are idiopathic and present as a painful mucocutaneous defect in the posterior midline (90% cases). Fissures are more likely to be anteriorly located in females, particularly if they are multiparous. Multiple fissures and those which are located at other sites are more likely to be due to an underlying cause.

Diseases associated with fissure in ano include:

- Crohns disease
- Tuberculosis
- Internal rectal prolapse

### Diagnosis

In most cases the defect can be visualised as a posterior midline epithelial defect. Where symptoms are highly suggestive of the condition and examination findings are unclear an examination under anaesthesia may be helpful. Atypical disease presentation should be investigated with colonoscopy and EUA (Examination under Anaesthesia) with biopsies of the area.

### Treatment

Stool softeners are important as the hard stools may tear the epithelium and result in recurrent symptoms. The most effective first line agents are topically applied GTN (0.2%) or Diltiazem (2%) paste. Side effects of diltiazem are better tolerated (1).

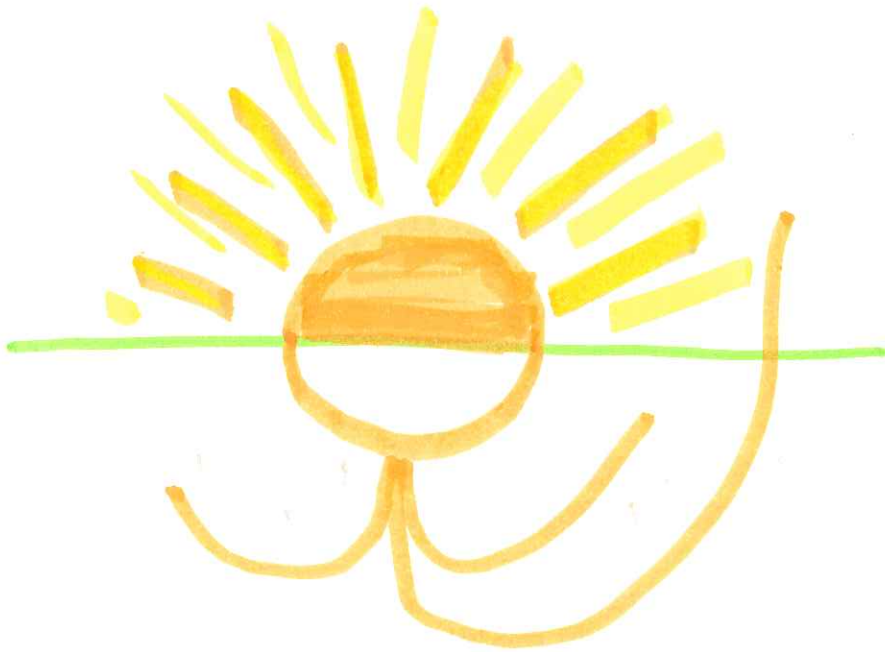
Resistant cases may benefit from injection of botulinum toxin or lateral internal sphincterotomy (beware in females). Advancement flaps may be used to treat resistant cases.

Sphincterotomy produces the best healing rates (2). It is associated with incontinence to flatus in up to 30% of patients in the long term.

The ACPGBI position statement is that first line therapy is medical with stool softeners and agents to relax the sphincter. Surgery is used following failure of botulinum toxin and may be undertaken without ano rectal manometry studies in males who have not had previous anal surgery. All others should have manometry performed. Surgery for high pressure fissures should include tailored sphincterotomy. For low pressure fissures an advancement flap should be considered.

**WHILST MANY OF THE ABOVE THERAPIES ARE ACCEPTED THERAPEUTIC INTERVENTIONS FOR FISSURE, NONE HAVE BEEN SHOWN IN META ANALYSES TO RESULT IN HEALING RATES THAT ARE SUPERIOR TO SURGERY.**

ماہنامہ  
خلیفہ  
عقودہ  
براقم





## Fistula in ano

Fistula in ano is a common condition with an incidence of 5.6/ 100,000 females and 12.3 / 100,000 males. Its incidence peaks at between 30 and 40 years of age. Most cases are of cryptoglandular origin.

### Classification

Parks classified fistula in the following manner:

Intersphincteric (70%)

Transsphincteric (25%)

Suprasphincteric (4%)

Extrasphincteric (1%)

### Aetiology

Fistulas usually arise at the result of anorectal sepsis and up to 40% are preceded by previous abscess

### Goodsalls rule

Fistulas with an external opening lying anterior to an imaginary transverse line lying in the mid part of the anus will have a direct opening to the dentate line. Fistulas with an opening posterior to this line almost always curve posterior to the anal midline. Openings more than 3cm from the anus usually do not obey this rule and may occur as the result of secondary tract formation.

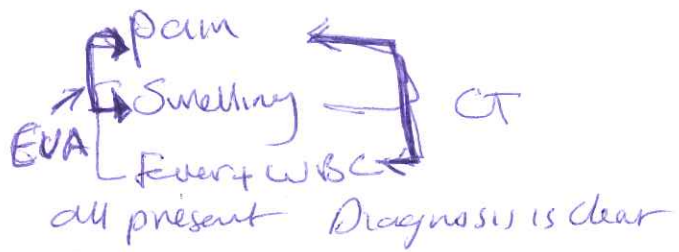
### Investigation

Physical examination still constitutes the baseline investigation. In many cases the tract may be palpable and the internal opening easily identified. Where the opening is low and the anatomy uncomplicated further detailed imaging may be unnecessary.

Where the anatomy appears more complex, Crohns disease is present or the fistula recurrent then further detailed imaging may be required. Endoanal USS is reported to be 50% better than clinical examination in identifying the anatomy. MRI scanning is widely appreciated to be the most sensitive diagnostic test with up to 90% concordance with operative findings.

In those patients at risk of occult sphincter compromise such as multiparous females or previous sphincterotomy then consideration should be given to anorectal manometry studies and endo anal USS to classify the functionality of the sphincter.

Anal Sepsis  
perianal Abscess



CT indicated if  
Unexplained anal pain + Signs of infection  
Fever - ↑WBC

IF Swelling + Pain  
& No signs of inflammation → EUA

cutting setons → 12% long term  
incontinence rate



## Anal fistula

Fistula in ano is a common complication of peri anal sepsis. Fistulae will have both an internal opening and external opening, these will be connected by tract(s). Complexity arises because of the potential for multiple entry and exit sites, together with multiple tracts. Fistulae are classified into four main groups according to anatomical location and the degree of sphincter involvement. Simple uncomplicated fistulae are low and do not involve more than 30% of the external sphincter. Complex fistulae involve the sphincter, have multiple branches or are non cryptoglandular in origin[1]

### Assessment

Examination of the perineum for signs of trauma, external openings or the stigmata of IBD is important. Digital rectal examination may reveal the cord linking the internal and external openings. At the same time the integrity of the sphincter mechanism can be assessed. Low, uncomplicated fistulas may not require any further assessment, other groups will usually require more detailed investigation. For the fistula, the use of endo-anal USS with instillation of hydrogen peroxide into the fistula tract may be helpful. Ano-rectal MRI scanning is also a useful tool, it is sensitive and specific for the identification of fistula anatomy, branching tracts and identifying occult sphincter involvement[2].

### Therapies

#### Seton suture

A seton is a piece of material that is passed through the fistula between the internal and external openings that allows the drainage of sepsis. This is important as undrained septic foci may drain along the path of least resistance, which may result in the development of accessory tracts and openings. Their main use is in treating complex fistula. Two types of seton are recognised, simple and cutting. Simple setons lie within the fistula tract and encourage both drainage and fibrosis. A cutting seton is inserted and the skin incised. The suture is tightened and re-tightened at regular intervals. This may convert a high fistula to a low fistula. Since the tissue will scar surrounding the fistula it is hoped that this technique will minimise incontinence[3]. Unfortunately, a large retrospective review of the literature related to the use of cutting setons has found that they are associated with a 12% long term incontinence rate [4]

#### Fistulotomy

Low fistulas, that are simple should be treated by fistulotomy once the acute sepsis has been controlled. Fistulotomy (where safe) provides the highest healing rates [5]. Because fistulotomy is regarded as having a high cure rate, there are some who prefer to use this technique with more extensive sphincter involvement. In these patients the fistulotomy is performed as for a

FLAT trial

⇒ role of <sup>pumps</sup> ~~flap~~ to fistula ~~the~~



low fistula. However, the muscle that is encountered is then divided and reconstructed with an overlapping sphincter repair. A price is paid in terms of incontinence with this technique and up to 12.5% of patients who were continent pre-operatively will have issues relating to continence post procedure[6]. The same group also randomised between fistulotomy and sphincter reconstruction and ano-rectal advancement flaps for the treatment of complex cryptoglandular fistulas and reported similar outcomes in terms of recurrence (>90%) and disturbances to continence (20%)[7].

Other authors have found adverse outcomes following fistulotomy in patients who have undergone previous surgery, are of female gender or who have high internal openings [8], in these patients careful assessment of pre-operative sphincter function should be considered mandatory prior to fistulotomy.

### **Anal fistula plugs and fibrin glue**

The desire to avoid injury to the sphincter complex has led to surgeons using both fibrin glue and plugs to try and improve fistula healing. Meticulous preparation of the tract and prior use of a draining seton is likely to improve chances of success.

The use of anal fistula plugs in high transphincteric fistula of cryptoglandular origin is to be discouraged because of the high incidence of non response in patients treated with such devices [9]. In most patients, septic complications are the reasons for failure [10]. The current FIAT trial is re-evaluating the role of plugs in the treatment of fistula disease.

Fibrin glue is a popular option for the treatment of fistula. There is variability of reported healing rates In some cases initial success rates of up to 50% healing at six months are reported (in patients with complex cryptogenic fistula). Of these successes 25% suffer a long term recurrence of fistula [11]. There are, however, no obvious cases of damage to the sphincter complex and the use of the devices does not appear to adversely impact on subsequent surgical options.

### **Ano-rectal advancement flaps**

This procedure is primarily directed at high fistulae, and is considered attractive as a sphincter saving operation. The procedure is performed either with the patient in the prone jack knife position or in lithotomy (depending upon the site of the fistula). The dissection is commenced in the sub mucosal plane (which may be infiltrated with dilute adrenaline solution to ease dissection). The dissection is continued into healthy proximal tissue. This is brought down and sutured over the defect.

Follow up of patients with cryptoglandular fistulas treated with advancement flaps shows a success in up to 80% patients[12-14]. With most recurrences occurring in the first 6 months following surgery[12]. Continence was affected in some patients, with up to 10% describing major continence issues post operatively.



## Ligation of the intersphincteric tract procedure

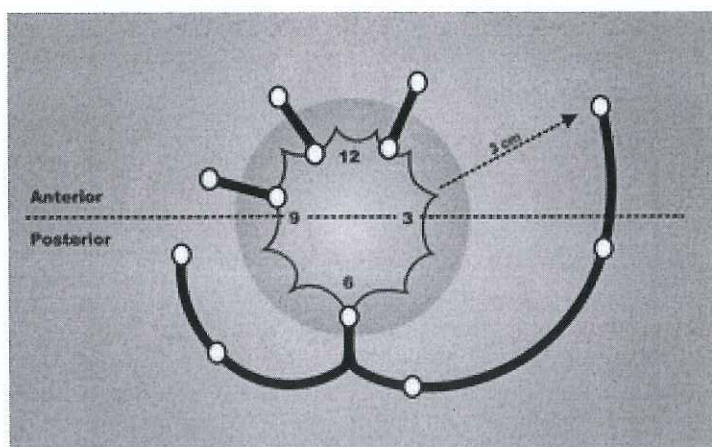
LIFT

In this procedure an incision is made in the intersphincteric groove and the fistula tract dissected out in this plane and divided. A greater than 90% cure rate within 4 weeks was initially reported[15]. Others have subsequently performed similar studies on larger numbers of patients with similar success rates.

## Fistulotomy at the time of abscess drainage?

A Cochrane review conducted in 2010 suggests that primary fistulotomy for low, uncomplicated fistula in ano may be safe and associated with better outcomes in relation to long term chronic sepsis[16]. However, there is a danger that such surgery performed by non specialists may result in a higher complication rate and therefore the traditional teaching is that primary treatment of acute sepsis is incision and drainage only. All agree that high/complex fistulae should never be subject to primary fistulotomy in the acute setting.

Therapy	Outcomes
Biological agents (anti TNF $\alpha$ drugs) <i>infleximab</i>	50-60% success rates with Crohn's fistulas
Fistulotomy	19% healed at one month and 60% at three months
Fistula plug	30% at three months
Mucosal advancement flap	80% success at 12 months and 40% at 72 months





# Rectal prolapse

Rectal prolapse is a common condition and surgical intervention is not uncommon. Both internal and external rectal prolapse are recognised. In the former condition the rectum intussuscepts inside itself. These patients may present with a confusing array of pelvic floor symptoms, specifically these will include, repeated call to stool, obstructed defecation with passage of small pelleted motions. Other features include pelvic pain and bloating although many other conditions are recognised contributors to this. In external prolapse the internal rectum comes to lie below the dentate line. The exposed mucosa may ulcerate and bleed, occasionally vascular compromise and ischaemia may occur.

## Diagnostic work up

- Colonoscopy/ CT colon/ DCBE (double contrast barium enema) to exclude organic disease
- Anorectal physiology studies
- Defecating proctogram
- EUA with circular anal dilating device (CAD) ←

Not all cases will require the full investigative process. However, in some cases the underlying anatomical defect may be elusive and it is these patients that will often need an EUA to refine the diagnosis.

## Anatomical defects

Intra rectal intussusception

Enteroceles

Rectoceles

Full thickness external prolapse

## Treatment

Treatment of these disorders is complex, particularly when internal rectal prolapse is considered. The results of surgery for rectal prolapse disorders are highly variable. The table below attempts to provide an overview of the options.

Stapled  
Trans -  
Anal

STARR

[ODS]

Resection of

Rectum

procedure for  
prolapsing  
Haemorrhoids

PPH



Procedure	Principles of procedure	Indications	Contra-indications	Outcomes
Delorme's rectopexy <i>mucosectomy + plication</i>	Perineal procedure with excision of prolapse mucosa and plication of underlying rectum	Full thickness external rectal prolapse	Unsuitable for internal prolapse	Recurrence rates of up to 50% at 5 years are not unusual
Altmeiers procedure	Perineal recto-sigmoidectomy	Full thickness prolapse	Patients with poor underlying sphincter function do very badly	Generally low recurrence rates, variable functional outcomes
Theirsch tape	Encircling tape partly occluding the anus	Used mainly for treatment of rectal prolapse in children	Internal prolapse	Poor in adults, reasonable in paediatric practice
STARR	Stapled transanal resection of prolapse	High grade internal rectal prolapse with obstructed defecation symptoms	Enteroceles	Urgency is common in up to 30%, long term outcome data not yet available

Laparoscopic ventral mesh rectopexy	Anterior dissection of rectum to sphincters, reduction of prolapse and repair using mesh sutured to rectum and anchored to sacral promontary	High grade internal rectal prolapse, symptomatic rectoceles, external prolapse	Unfit for GA	Generally good, safe procedure, even in elderly, up to 20% may require a posterior STARR subsequently. Concerns regarding mesh erosion
Resectional rectopexy	Resection of sigmoid colon and upper rectum	High grade internal prolapse	Unfit for GA	High risk surgery for functional disease and in many cases persistent hindgut inertia may result in recurrent symptoms.

Surgical preferences vary, in general terms the majority of UK surgeons would consider a younger patient with prolapse symptoms for a laparoscopic rectopexy. Whilst an older medically unfit patient with an external prolapse is generally offered a Delorme's. In North America the resectional procedures are still extremely popular.



absent

0 →

daily  
4

Cleveland  
Wexner  
score

gas

liquid

solids

pads

lifestyle

> 9 severe impairment of QoL

# Faecal incontinence

Wexner

In all sexes the physiological function of the anal sphincter deteriorates with ageing. In the vast majority of cases this amounts to little more than episodic loss of flatus control with little lifestyle disruption. In others, faecal incontinence may be a life changing event culminating in care home admission.

## Pathophysiology

Normal continence relies on a balance between intraluminal pressure and a steady state constant function of the internal anal sphincter. Recruitment of the external anal sphincter may be required when a decision is made to consciously delay or defer defecation. Innervation of the anal sphincter is via the sacral nerve roots S2,3 and 4 relayed via the pudendal nerve. Autonomic fibres from within the colon and externally will innervate the internal sphincter. The rectum itself is a capacitance organ and can usually receptively relax up to volumes of approximately 200ml, after which the call to stool will progressively increase.

Neuronal factors	Pudendal neuropathy Pudendal nerve entrapment Cauda equina
Rectal factors	Decreased compliance due to internal rectal prolapse, tumours or polyps Hypersensitive rectum Constipation with overflow Diarrhoea
Sphincter related factors	Obstetric related sphincter injury Failed sphincter repair Iatrogenic trauma (e.g. Lords Procedure) Previous surgery for anorectal malformation (e.g. posterior sagittal anorectoplasty)

## Assessment

The Cleveland Clinic (Wexner) faecal incontinence score takes into account five parameters that are scored on a scale from zero (absent) to four (daily) frequency of incontinence to <sup>1</sup>gas, <sup>2</sup>liquid, <sup>3</sup>solid, of need to wear pad, and of lifestyle changes. As a general rule a score of 9 or more equates to severe impairment of quality of life. Scoring patients symptoms at presentation is important as it is very difficult to assess therapeutic responses without this objective criteria.



- Anorectal physiological studies
- ENJ
- if Poo  $\rightarrow$  defecation  
proctogram

---

## Ano-Rectal physiology

## ARP

- anterior over levator sphincter  
repair
- graciloplasty

## Diagnostic evaluation

To accurately categorise patients the usual diagnostic process will necessitate a luminal study to exclude organic disease. Patients with minimal symptoms being considered for simple drug treatments such as loperamide do not probably warrant further investigation at presentation. In those who do not respond to simple measures a formal series of diagnostic tests is important. These will typically include; ano rectal physiology studies (ARP), endo anal ultrasound (EUS) and (if there are symptoms of pelvic outlet obstruction) a defecating proctogram.

The EUS and ARP are the most helpful tests and will delineate sphincter injuries and assess the sensitivity of the rectum as well as resting sphincter pressures.

## Treatment options

First line treatment is with drugs such as loperamide or laxative to try and control the bowel. In most cases this is all that will be required. More intensive treatments may be introduced based on the results of investigations (see above).

<b>Biofeedback</b>	Changes in toileting habits, simple to implement but time consuming and costly.
<b>Rectal irrigation</b>	Small number of patients find this helpful as the empty rectum gives them independence, in most cases retrograde irrigation is used a small number of patients may benefit from an ACE procedure.
<b>Sphincter repair</b>	Anterior overlapping sphincter repair gives the best results. However, with time function in most patients deteriorates. Post anal repairs for incontinence give poor outcomes and are best avoided.
<b>Sacral neuromodulation</b>	Popular technique with promising outcome data. Traditionally consists of two phases (test phase and permanent implant phase). Permanent implants are generally only implanted into responders.



<b>Artificial sphincter</b>	Due to success of SNS these are less frequently used. Gracilloplasty is one such technique, full diagnostic work up and patient counseling required.
<b>Stoma</b>	These remain a definitive option for selected patients, they may be most useful in patients with conditions such as multiple sclerosis where they actually facilitate care. Stomas for incontinence must be end stomas.

### Sacral neuromodulation

SNS is a popular option for the treatment of faecal incontinence. As stated above the treatment is introduced in two phases. The first phase involved the placement of a temporary electrode into the S3 or (less often) S4 foramina. The temporary electrode is connected to an energy source (clip on battery box - size of pager). Two types of temporary wire are used, the PNE wire is small and very flexible. It is prone to migration and can easily dislodge and fall out. If this happens early in the trial period then the test is uninformative. Remove of the PNE wire is an outpatient procedure and well tolerated by patients. It is very unusual for the PNE wire to remain in situ for more than 2 weeks. Longer trial periods can be achieved by inserting a different type of trial wire, the tined lead. The tined lead is a barbed device, these deploy once the wire is in situ. The barbs prevent the device being dislodged. However, the insertion of this device requires x-ray guidance, the wire itself is more expensive and a general anaesthetic is required for its removal. During the test phase of treatment the patients are asked to keep a diary. This allows an objective assessment of their response to treatment. Responders will have a permanent SNS device inserted. The permanent device is relatively small and usually sits in a pocket over the gluteal muscle. If a tined lead was not inserted during the test phase then it will be at the time of permanent implant insertion. The procedure is generally performed as a daycase. Post operatively, the device can be programmed in many different ways to try and obtain the best functional outcome.

## Colonic pseudo-obstruction

Colonic pseudo-obstruction is characterised by the progressive and painless dilation of the colon. The abdomen may become grossly distended and tympanic. Unless a complication such as impending bowel necrosis or perforation occurs, there is usually little pain.

Diagnosis involves excluding a mechanical bowel obstruction with a plain film and contrast enema. The underlying cause is usually electrolyte imbalance and the condition will resolve with correction of this and supportive care.

Patients who do not respond to supportive measures should be treated with attempted colonoscopic decompression and/ or the drug neostigmine. In rare cases surgery may be required.



# Management

{ Duplex → if immediately available  
Echocardiogram → if rapidly available  
ABI

labs for Routine & Cardiac ECG, Chest X-Ray

Medical Hydration → Monitor Urine output 1 ml/kg/h  
Oral Aspirin ??  
heparin 80U/Kg <sup>Bolus</sup> → 18U/Kg/h  
aPTT 2-5x Baseline

!!! acute medical problem  
Life Before Limb

Viable Limb  $\xrightarrow{\text{No}}$  Amputation  
 $\downarrow$  yes

Embolism  $\xrightarrow{\text{No}}$  Arteriogram/Endoluminal therapy  
 $\downarrow$  yes

Surgical Embolectomy → Successful  $\xrightarrow{\text{No}}$  Surgical Bypass  
Amputation

for injury  
4-5 for large Artery  
2-3 distal

$\downarrow$  yes  
? etiology / anticoagulation

- open transversely if  
not significantly diseased

if etiology is not clear → Angiogram Suite  
- over-the-wire embolectomy catheter  
- Suction embolectomy catheter

Take Care of Thrombolytic Agent → Release thrombus from  
atria & ventricles → Stroke

± 4-compartment  
fasciotomy if > 6 hours

So Echo should be obtained  
if it will be used

# Vascular

## Acute limb ischaemia

- Thrombosis of a pre-existing site of atherosclerosis is the commonest cause of acute limb ischaemia
- Acute thrombosis of popliteal aneurysms poses the greatest threat to the limb
- Sudden occlusion of a large proximal vessel results in the typical appearances of acute limb ischaemia

### Clinical appearances

- Less than 6 hours - white leg
- At 6-12 hours - mottled limb with blanching on pressure
- More than 12-24 hours - fixed mottling

### Management of acutely ischaemic leg

Clinical picture	Treatment
White leg with sensorimotor deficit	Surgery and embolectomy
Dusky leg, mild anaesthesia	Angiography
Fixed mottling	Primary amputation

### Role of thrombolysis

- Intra arterial thrombolysis is better than peripheral thrombolysis
- Mainly indicated in acute on chronic thrombosis
- Avoid if within 2 months of CVA or 2 weeks of surgery
- Aspiration of clot may improve success rate if the thrombosis is large

### Surgery

- Both groins should be prepared
- Transverse arteriotomy is easier to close
- Poor inflow should be managed with iliac trawl- if this fails to improve then consider a femoro-femoral cross over or axillo-femoral cross over.
- A check angiogram should be performed on table and prior to closure
- Systemic heparinisation should follow surgery
- Fasciotomy should be considered if the time between onset and surgery exceeds 6 hours



# "Claudications"

## Painful Limb

Arterial ↗

Neuro ↘

Venous

CLI → rest pain / tissue loss

Venous → following Ambulation

- Bursting Sensation

- relieved with rest & leg elevation

Diabetic Neuropathy → forefoot & digits

- Burning pain

- hyperesthesia "pins & needles"

- Constant

- not relieved By dependency

Spinal Stenosis → compression Spinal cord & N. roots

- Not consistently associated with Acute injury

- Not Rapidly relieved By rest

Claudications - Burning - cramping - aching

- Claudication Distance

- Relieved By rest

Investigations - ABTI

Toe pressures are helpful in Diabetic pts as Digital Arteries May not be Calcified

Duplex Tc PO<sub>2</sub> transcutaneous partial pressure of oxygen

## "Management of Claudications"

Risk factor Modification

- Smoking Cessation

- Tight Glucose control

- Anti plt Therapy

- Strict BP control

- Statins - LDL

Cholesterol < 100 mg/dl

pharmacologic intervention

- pentoxifylline

- Cilostazol

Naftidrofuryl

NICE

Flaxilene

Non pharmacologic

Exercise Therapy

IA

Recommendation

Revascularization

- Endovascular

- open

post op

- Clopidogrel

- Cilostazol ?? OK

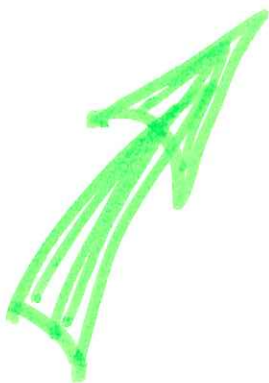
- Anticoag if

Compromised procedure

- Statin

## Peripheral arterial disease

- 20% of those aged over 60 have peripheral vascular disease. Of these 20% will progress to disabling symptoms and acute limb ischaemia
- Risk factors include smoking, dyslipidaemia and diabetes. All should be addressed early in the process
- ABPI's should be recorded in all cases and the nature of the pulse signal noted
- Initial screening for lesions should be with duplex scanning. Magnetic resonance angiography is then undertaken. CT angiography is reserved for those cases where MRA is contra indicated. Formal direct puncture angiography should be used in exceptional cases for diagnostic purposes
- First line management of intermittent claudication should include risk factor modification and supervised exercise programmes
- Patients with worsening symptoms, tissue loss or rest pain require intervention. Where possible angioplasty should be considered as first line management.
- Disease (rather than occlusion) of the aorto-iliac and femoral systems should be treated with angioplasty alone as a first line therapy
- Stent insertion may be indicated where true occlusions are present. Stents should be of the bare metal type
- Individuals who do not wish to be considered for surgery/ angioplasty and who have worsening symptoms may benefit from naftidrofuryl oxalate (vasodilator)
- Chemical sympathectomy may be of benefit (ideally conducted within context of RCT's)





## Thrombolysis for acute limb ischaemia

Thrombolytic therapy is now a part of the management of acute limb ischaemia. Mechanical methods such as clot aspiration may be used in combination. The components of the procedure include vessel puncture and penetration of the clot with an infusion catheter. Heparin is run down the sheath. In most cases the agent of choice is alteplase and this is infused into the clot directly. Continuous infusion and boluses are both used. Heparin is given concurrently. Alteplase gives the best responses in terms of clot resolution and its mode of action is as a tissue plasminogen activator. It has a half life of 5 minutes.

### Adverse events

Minor haemorrhage from catheter site in 40%

CVA in 1-2%

Distal trashing in 4%

Re-perfusion injury in 2%

### Contraindications

Total limb anaesthesia

Mottling

Paralysis

Swollen or tense muscle

X 2 months  
X 2 weeks  
CVA  
Surgery

**CLI**

rest pain / tissue loss  
within 1 year

- 25% Die
- 30% Major Amputation
- 45% alive & 2 Limbs

• Toe-Brachial index  $< 0.3$  or Toe pressure  $< 30$  mmHg

- Aorto iliac Angioplasty & stenting is increasingly becoming preliminary procedure performed to attain sufficient inflow prior to construction.

preoperative

- $\beta$  Blocker • Statin therapy
- Aspirin or Clopidogrel

Debridement of all necrotic tissue after revascularization



## Management of lower limb arterial disease

Patients with arterial disease of the lower limb will often present with symptoms of intermittent claudication. The pain is intermittent and will typically be relieved by rest and be worse when walking up hills which helps to distinguish it from other causes of lower limb pain. Risk factors for arterial disease are well known and should be addressed early.

Individuals with minimal symptoms and a reasonable exercise tolerance should usually be managed conservatively. In individuals whose condition progresses or those who develop symptoms of critical ischaemia will typically require further treatment.

Critical limb ischaemia typically occurs in patients with advanced atherosclerotic disease of the lower limb. Tissue loss and rest pain are both well recognised features and such symptoms require prompt investigation. As a minimum ABPI measurements and arterial duplex scanning should be performed. Treatment of underlying risk factors is essential and all patients should be receiving antiplatelet agents, statins and have stopped smoking. Based on duplex appearances it needs to be determined whether reconstructible or non reconstructible disease is present. As a general rule isolated, short segment, proximal arterial lesions are far more readily reconstructible than distal multiple lesions with poor run off in a patient who is diabetic and in such circumstances serious consideration should be given to primary amputation.

## Trials evaluating treatment of limb ischaemia

Trial	Population	Therapeutic interventions	Outcome
Veterans	Males in North America (n=263) with stenotic lesion greater than 80% and symptoms	Surgical bypass (n=126), PTA (n=129)	No difference between two treatments
STILE	237 men and women from North America and Canada, Claudicants (n=80), Rest pain (n=83), Tissue loss (n=74)	Surgery Vs Thrombolysis with urokinase or rt-PA	Favors surgery <i>Surgery still better</i>
Lundgren study	Swedish claudicants without tissue loss, male and female (n=50)	Surgery (endarterectomy, bypass using vein or prosthetic material Vs exercise)	Favors surgery where exercise fails
Holm Study	Swedish patients (men and women n=102), critical limb ischaemia or rest pain and with an occlusion or significant stenosis (>75% narrowing of lumen) 6cm or shorter in the common iliac, external iliac, femoral or popliteal artery.	Either surgery or PTA	Similar outcomes though noted that PTA patients had fewer short term complications

More recently the management of patients with severe limb ischaemia was addressed in the **BASIL trial**. In this trial patients were randomised to either surgery or angioplasty. The trial was first conceived in 1996 and preliminary data published in 2005. At this stage there was no overall difference noted between the two treatment arms (5). A larger review of all trials in a subsequent **Cochrane review** found a trend towards higher patency rates at 1 year in those who had undergone surgical bypass (6). As with many of these



① - surgery with val

② - P.T.A

③ - surgery with prosthetic valve  
(Mille's cuff)

trials there have been comments in relation to the fact that modern angioplasty techniques differ considerably from those used over 10 years ago. The BASIL participants were followed up beyond the initial reporting period and their data analysed according to treatment received which allowed for cross overs, this tended to favour surgical bypass with vein as a primary treatment. Where this was not possible the next best results were seen with percutaneous angioplasty Bypass with prosthetic material generally gave the worst results (7). A separate review has identified a strong body of evidence favouring vein over PTFE for bypass surgery (8). For below knee bypass surgery the use of a Miller Cuff with PTFE is recognised as improving patency rates, but does not improve overall limb salvage rates(9). The benefits of improved outcomes that are noted with surgery do come with an increase in length of stay and complications related to wound infections in the early post procedure period compared to primary angioplasty (10).

### Surveillance of grafts

Historically there was a tendency to subject all individuals who had undergone infra inguinal bypass surgery to long term duplex surveillance. The usefulness of routine duplex ultrasound graft assessment in above knee infra inguinal bypass surgery is debatable and confers little in the way of additional benefit, whilst it certainly incurs additional costs.

### Stent or no stent in SFA Disease?

Where lesions in the SFA have been deemed suitable for treatment with angioplasty the debate then centres on whether a stent should be used. The use of stents in TASC type A and B lesions confers no benefit and increases costs. In more complex lesions TASC C and D it improves patency rates, these findings are similar to those identified in a review of the trials by the Cochrane group .

no Stent	A	B
<del>no</del> Stent	C	D



A

3cm stenosis  $\left\{ \begin{array}{l} \text{SFA} \\ \text{pop.} \end{array} \right.$

B

3cm - 10cm stenosis

3cm ~~stenosis~~ heavy Ca

< 3cm multiple  $\left\{ \begin{array}{l} \text{stenosis} \\ \text{occlusion} \end{array} \right.$

C

5

single stenosis  
occlusion

3-5

multiple

D

Complete

## Classification Systems

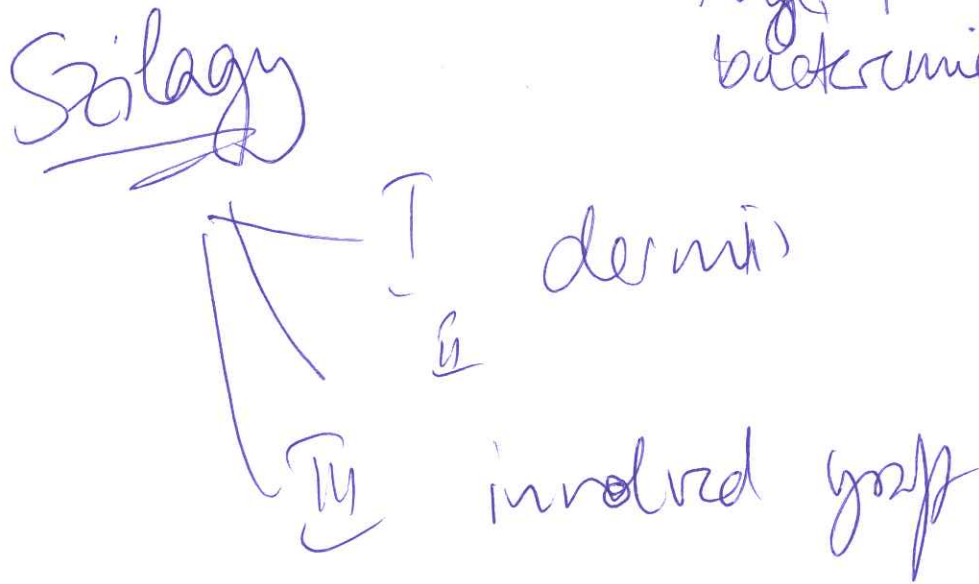
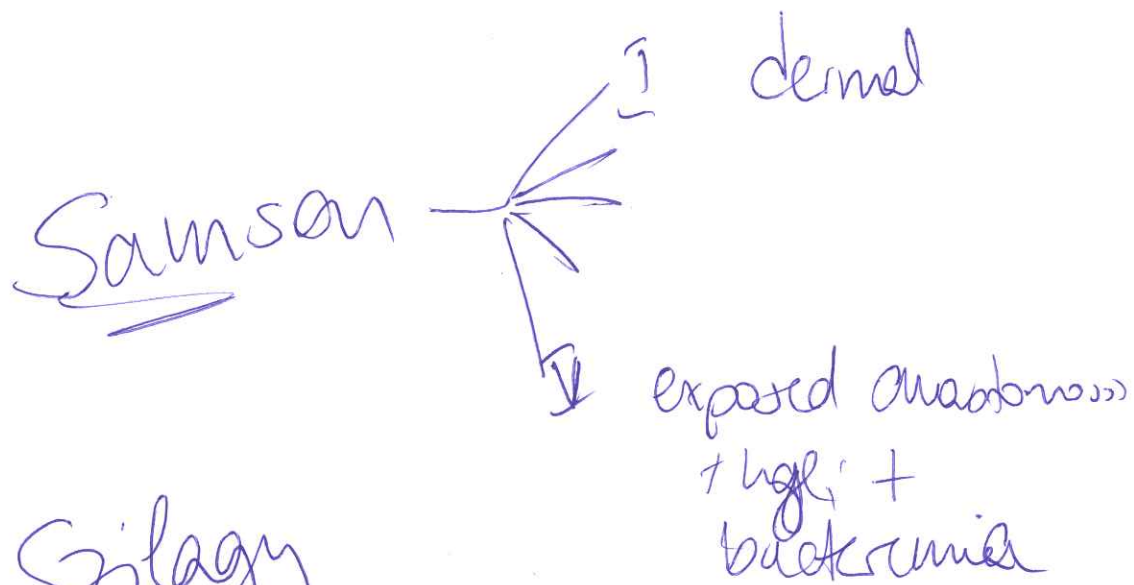
### TransAtlantic Inter-Society Consensus (TASC): morphological stratification of femoropopliteal lesions

<b>TASC type A femoropopliteal lesions</b>	Single stenosis <3 cm of the superficial femoral artery or popliteal artery.
<b>TASC type B femoropopliteal lesions</b>	Single stenosis 3 to 10 cm in length, not involving the distal popliteal artery Heavily calcified stenoses 3 cm in length Multiple lesions, each <3 cm (stenoses or occlusions) Single or multiple lesions in the absence of continuous tibial run-off to improve inflow for distal surgical bypass.
<b>TASC type C femoropopliteal lesions</b>	Single stenosis or occlusion longer than 5 cm Multiple stenoses or occlusions, each 3 to 5 cm in length, with or without heavy calcification.
<b>TASC type D femoropopliteal lesions</b>	Complete common femoral artery or superficial femoral artery occlusions or complete popliteal and proximal trifurcation occlusion

**5 YEAR PATENCY RATES WITH VEIN = 66%**

**5 YEAR PATENCY RATES WITH PTFE = 47% (ABOVE KNEE)**





# Vascular graft infection

Graft infections are not an uncommon occurrence and typically affect between 1 and 6% of vascular procedures. The toxic combination of frail patients, poorly vascularised or necrotic tissues and prior colonisation with organisms such as MRSA create an ideal environment for infection.

## Classification

Two systems are in mainstream use, those of Samson(1) and Szilagyi(2). The Samson system recognises 5 categories; ranging from stage 1 infection (dermal) through to stage 5 (exposed anastomosis, bacteraemia and haemorrhage). The Szilagyi system has three grades grade 1 (dermis) through to grade 3 (involves graft). Both are in routine use.

## Cause

There are many causes of graft infection, the incidence of MRSA infection in aortic and extremity grafts has increased during the past decade and is one of the leading causes of graft infection (3, 4).

## Prevention

Many methods have been implemented to try and reduce the incidence of graft infection. In a 2006 Cochrane review Stewart *et al* concluded by stating that the only intervention with a robust evidence base was that of prophylactic antibiotic administration (5).

## Management

This is controversial, some argue in favour of graft excision, others for lesser procedures citing medical co-morbidity as a reason for conservatism (6). In the extremity the options of graft excision, revision or even amputation are all viable, there is some evidence that VAC therapy may be safe even on exposed prosthetic graft material(7, 8) and carries less morbidity.



## Arterial occlusions/ insufficiency

Arterial occlusions may occur as a result of a number of processes. The typical clinical scenarios are outlined below.

Cause of occlusion	Typical picture
Embolus	Sudden onset Depending upon level of occlusion; limb may show typical features of pain, loss of pulses and pallor. Sensory perceptive changes may also be present
Thrombosis	Usually known disease and prodromal symptoms e.g. claudication Disruption to flow may be incomplete If background disease process present then collaterals may be present and picture <b>less dramatic</b>
Vasospasm	May be due to Raynauds and affect extremities Symptoms are often temperature related Discolouration of the hands may occur (pale, dark, red) Symptoms improve during pregnancy (hyperdynamic circulation)
Steal syndromes	Occur secondary to arteriovenous fistula, or partial arterial occlusions (e.g. cervical rib) Pain and diminished pulses distal to fistula are seen

## Vasculitis

### Vessel diameter and vasculitis classification

Aorta and branches	<ul style="list-style-type: none"> <li>• <b>Takayasu's arteritis</b></li> <li>• Buerger's disease</li> <li>• Giant cell arteritis</li> </ul>
Large and medium sized arteries	<ul style="list-style-type: none"> <li>• <b>Buerger's disease</b></li> <li>• <b>Giant cell arteritis</b></li> <li>• <b>Polyarteritis nodosa</b></li> </ul>
Medium sized muscular arteries	<ul style="list-style-type: none"> <li>• <b>Polyarteritis nodosa</b></li> <li>• <b>Wegener's granulomatosis</b></li> </ul>
Small muscular arteries	<ul style="list-style-type: none"> <li>• <b>Wegener's granulomatosis</b></li> <li>• Rheumatoid vasculitis</li> </ul>

Aorta & branches

→ Takayasu's Obliteration

Segmental

→ Buerger's Thrombosis

Systemic

{ Giant Granulomatous  
Poly Arteritis Nodosa Necrotising  
Wegeners



## Specific conditions

<b>Takayasu's arteritis</b>	<ul style="list-style-type: none"> <li>• Inflammatory, <b>obliterative arteritis</b> affecting aorta and branches</li> <li>• Females &gt; Males</li> <li>• Symptoms may include <b>upper limb claudication</b></li> <li>• Clinical findings include <b>diminished or absent pulses</b></li> <li>• <b>ESR often</b> affected during the acute phase</li> </ul>
<b>Buerger's disease</b>	<ul style="list-style-type: none"> <li>• <b>Segmental thrombotic occlusions</b> of the small and medium sized lower limb vessels</li> <li>• Commonest in young male smokers</li> <li>• Proximal pulses usually present, but pedal pulses are lost</li> <li>• An acuter hypercellular occlusive thrombus is often present</li> <li>• Tortuous corkscrew shaped collateral vessels may be seen on angiography</li> </ul>
<b>Giant cell arteritis</b>	<ul style="list-style-type: none"> <li>• <b>Systemic granulomatous arteritis</b> that usually affects <b>large and medium sized vessels</b></li> <li>• Females &gt; Males</li> <li>• <b>Temporal arteritis is commonest type</b></li> <li>• Granulomatous lesions may be seen on biopsy (although up to 50% are normal)</li> </ul>
<b>Polyarteritis nodosa</b>	<ul style="list-style-type: none"> <li>• <b>Systemic necrotising vasculitis</b> affecting small and medium sized muscular arteries</li> <li>• Most common in populations with high prevalence of <b>hepatitis B</b></li> <li>• <b>Renal disease</b> is seen in 70% cases</li> <li>• Angiography may show <b>saccular or fusiform aneurysms</b> and <b>arterial stenoses</b></li> </ul>
<b>Wegener's granulomatosis</b>	<ul style="list-style-type: none"> <li>• Predominantly affects small and medium sized arteries</li> <li>• <b>Systemic necrotising granulomatous</b> vasculitis</li> <li>• Cutaneous vascular lesions may be seen (<b>ulceration, nodules</b> and <b>purpura</b>)</li> <li>• Sinus imaging may show mucosal thickening and air fluid levels</li> </ul>

upper Respir.  
 ↳ Runny nose  
 ↳ nose bleeds  
 ↳ cough  
 ↳ chest pain  
 ↳ joint pain  
 ↳ haematuria

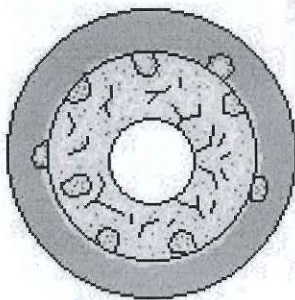
Conditions such as Buerger's disease are markedly helped by smoking cessation. **Immunosuppression is the main treatment for vasculitides.**

Some American Ladies  
Find Air Pyramids So  
Magnificent



# Temporal Arteritis

Easy to diagnose and treat -- if you think of it.



Granulomatous thickening of the inner portions of the branches of the external carotid arteries.



Tender temporal arteries  
Jaw gets tired chewing.

Physical exam and labs are otherwise nonrevealing.

Easily mistaken for "tension headaches" -- until one or both eyes suddenly go blind.

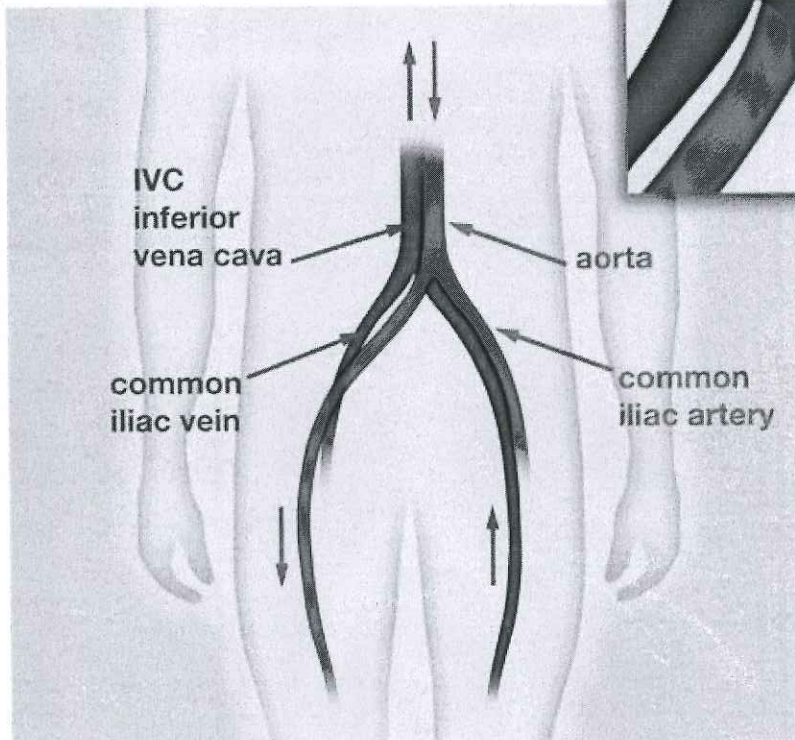
Most patients also have polymyalgia rheumatica, muscle aches easily mistaken for "rheumatism."

Tip: These patients have high sed rates!

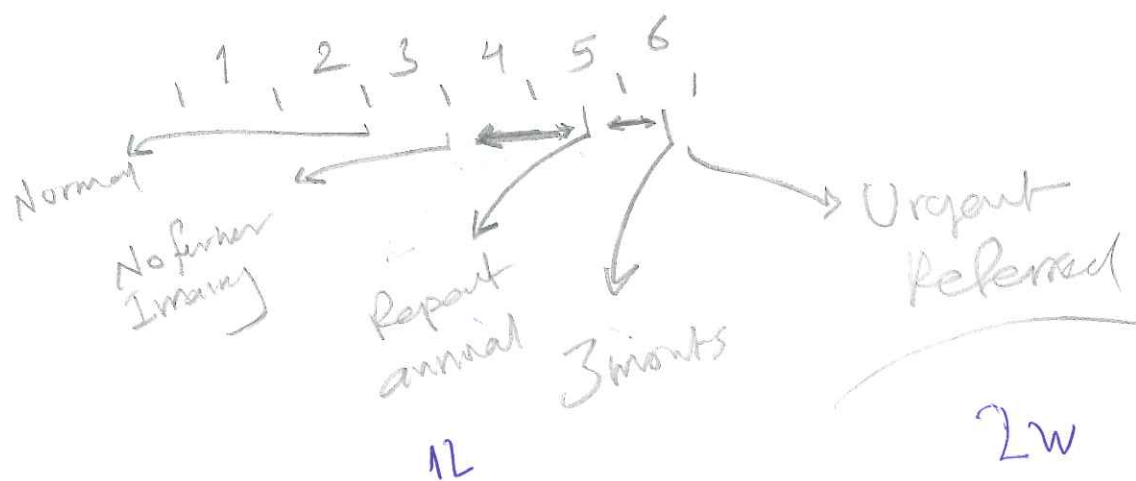
ESR

## May-Thurner syndrome

Narrowed left iliac vein  
(by pressure from right iliac artery)



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# Aneurysmal disease of the abdominal aorta- screening and definitions

## Definition

Abdominal aortic aneurysms are dilatations of the abdominal aorta of greater than 30mm diameter in the AP or transverse plane. This represents >2 standard deviations away from the norm for both males and females.

## Risk groups

The UK Chichester and MASS trials and US Veterans studies have all identified Caucasian smokers, aged between 50 and 79 as having the highest prevalence of disease. In the UK 4.9% of people in this group were found to have aneurysms.

The high prevalence and asymptomatic nature of the condition led to the planned introduction of screening for the disease. In the MASS trial the internal diameter of the aorta was measured and those greater than 3cm deemed aneurysmal.

## UK screening programme

- Single USS of the aorta of males aged 65 years
- High risk patients (e.g. positive family history) may be screened outside of the screening programme.
- Screening females has no cost benefit
  - Centres receiving screening patients must have operative mortality of less than 5% for open surgery and less than 2% for EVAR

Aortic size	Screening category	Outcome
2.9mm or less	Normal	No further imaging
30-44mm	Small aneurysm	Repeat annual USS
45-54mm	Medium aneurysm	USS at three monthly intervals
55mm or greater	Large aneurysm	Urgent vascular surgical referral (within 2 weeks) for CT angiography

Risk factors • Smoking • hypertension • COPD  
• atherosclerosis • Advanced Age

Risk factors for rupture • COPD • female  
• Rapid Expansion  $>1\text{cm}/\text{y}$   
• hypertension

EVAR Diameter of graft

Should Be 10-20% larger than  
diameter of proximal landing zone

if Both iliacs are aneurysmal

- external-to-internal iliac artery bypass  
to Be done to decrease - pelvic pain  
- mesenteric Ischemia



## Aneurysm size and rupture risk

Size in mm	12 month rupture risk
30-39	0%
40-49	1%
50-59	11%
60-69	11-22%
70mm or greater	33%

### Driving

- Notify DVLA at 6cm
- 6.5cm license to drive suspended
- Lorry drivers cannot drive once aneurysm exceeds 5.5cm

*Driver & Vehicle Licensing agency*

### Females

AAA is much less common in females and none of the trials were adequately powered to demonstrate the impact of interventions in this group. Aortic sizes are smaller in women and so usually a cut of size of 5.2cm should be considered for surgical repair.

♂ 5.5

♀ 5.2 (5)

## Ruptured AAA

- Retroperitoneum 85%
- peritoneum 7%
- IVC 6% → LL swelling, Congestive HF, Left varicose
- enterically 2%

Triad → hypotension 45%  
 → Abdominal pain 72%  
 → pulsatile Abd. mass 83% } all combined < 50%

Natural history |  $\frac{1}{3} - \frac{1}{2}$  die before arriving hospital  
40% in hospital mortality

Risks

- female 3-4 f/ds
- Current smoking
- Aortic morphology
- expansion Rate  $> 1 \text{ cm/y}$

→ eccentric / Saccular  
→ less tortuosity  
→ large Diameter  
→ increase compliance  
→ Initial Diameter on Diagnosis

Unstable  $\rightarrow$  US if available

Stable  $\rightarrow$  ALL have to do CTA

Stable  $\rightarrow$  All have to do CTA  
if no facility for operation  $\rightarrow$  Immediate transference

pre op - permissive hypotension EVAR Batter  
 - Blood product  
 - Padded & Draped from chest to toes  
 - Ready for Incision Before Anaesthesia

Op - Rapid Supraceliac control  
- Infra Renal Clamping  
- Retroperitoneal hematoma not Decompressed  
- If concern (ACS) Abdomen left open

if EVAR Aortic control Done By  
endovascularly placed Aortic Occlusion balloon Catheter

Clamping → Paravertebral - Spinal Ischemies



## Abdominal aortic aneurysm

- Abdominal aortic aneurysms are a common problem in vascular surgery.
- They may occur as either true or false aneurysm. With the former all 3 layers of the arterial wall are involved, in the latter only a single layer of fibrous tissue forms the aneurysm wall.
- True abdominal aortic aneurysms have an approximate incidence of 0.06 per 1000 people. They are commonest in elderly men and for this reason the UK is now introducing the aneurysm screening program with the aim of performing an abdominal aortic ultrasound measurement in all men aged 65 years.

### Causes

- Several different groups of patients suffer from aneurysmal disease.
- The commonest group is those who suffer from standard arterial disease, i.e. Those who are **hypertensive**, have **diabetes** and have been or are **smokers**.
- Other patients such as those suffering from **connective tissue diseases** such as Marfan's may also develop aneurysms. In patients with abdominal aortic aneurysms the extracellular matrix becomes disrupted with a change in the balance of collagen and elastic fibres.

### Management

- Most abdominal aortic aneurysms are an incidental finding.
- Symptoms most often relate to rupture or impending rupture.
- 20% rupture anteriorly into the peritoneal cavity. Very poor prognosis.
- 80% rupture posteriorly into the retroperitoneal space
- The risk of rupture is related to aneurysm size, only 2% of aneurysms measuring less than 4cm in diameter will rupture over a 5 year period. This contrasts with 75% of aneurysms measuring over 7cm in diameter.
- This is well explained by La Places' law which relates size to transmural pressure.
- For this reason most vascular surgeons will subject patients with an aneurysm size of 5cm or greater to CT scanning of the chest, abdomen and pelvis with the aim of delineating anatomy and planning treatment. Depending upon co-morbidities, surgery is generally offered once the aneurysm is between 5.5cm and 6cm.

### Indications for surgery

- **Symptomatic aneurysms** (80% annual mortality if untreated)
- Increasing size above **5.5cm** if **asymptomatic**
- **Rupture** (100% mortality without surgery)

- Brisk diuresis needed  
By mannitol & furosemide
- heparin
- Clamping
- IMA reimplanted selectively  
if Bad Back Bleeding
- placing clamps on Iliacs Before Aorta  
↓ risk of embolism  
& if happens embolectomy

postop complications especially after Ruptured AAA

- |                       |                        |
|-----------------------|------------------------|
| - Respiratory failure | - 61%                  |
| - tracheostomy        |                        |
| - renal failure       | Less commonly - Stroke |
| - MI                  | - Ischemic colitis     |
| - Congestive HF       | - LL ischemia          |
| - Bleeding            | - paraplegia           |

### Sigmoid Colon Ischemia

presentation: • hypotension • Thrombocytopenia  
• Bloody Diarrhea • Metabolic Acidosis

Sigmoidoscopy → Mild → Antibiotic / Supportive care  
→ Severe → Resection

[ACS] higher following EVAR than open repair



## **Surgical procedures**

### **Abdominal aortic aneurysm repair**

Procedure:

GA

Invasive monitoring (A-line, CVP, catheter)

Incision: Midline or transverse

Bowel and distal duodenum mobilised to access aorta.

Aneurysm neck and base dissected out and prepared for cross clamp

Systemic heparinisation

Cross clamp (distal first)

Longitudinal aortotomy

Atherectomy

Deal with back bleeding from lumbar vessels and inferior mesenteric artery

Insert graft either tube or bifurcated depending upon anatomy

Suture using Prolene (3/0 for proximal, distal anastomosis suture varies according to site)

Clamps off: End tidal CO<sub>2</sub> will rise owing to effects of reperfusion, at this point major risk of myocardial events.

Haemostasis

Closure of aneurysm sac to minimise risk of aorto-enteric fistula

Closure: Loop 1 PDS or Prolene to abdominal wall

Skin- surgeons preference

Post operatively:

ITU (Almost all)

Greatest risk of complications following emergency repair

Complications: Embolic- gut and foot infarcts

Cardiac - owing to premonitory states, reperfusion injury and effects of cross clamp

Wound problems

Later risks related to graft- infection and aorto-enteric fistula

### **Special groups**

#### **Supra renal AAA**

These patients will require a supra renal clamp and this carries a far higher risk of complications and risk of renal failure.

#### **Ruptured AAA**

Preoperatively the management depends upon haemodynamic instability. In patients with symptoms of rupture (typical pain, haemodynamic compromise and risk factors) then ideally prompt laparotomy. In those with vague

symptoms and haemodynamic stability the ideal test is CT scan to determine whether rupture has occurred or not. Most common rupture site is retroperitoneal 80%. These patients will tend to develop retroperitoneal haematoma. This can be disrupted if Bp is allowed to rise too high so aim for Bp 100mmHg.

Operative details are similar to elective repair although surgery should be swift, blind rushing often makes the situation worse. Plunging vascular clamps blindly into a pool of blood at the aneurysm neck carries the risk of injury the vena cava that these patients do not withstand. Occasionally a supraceliac clamp is needed to effect temporary control, although leaving this applied for more than 20 minutes tends to carry a dismal outcome.

## EVAR

Increasingly patients are now being offered endovascular aortic aneurysm repair. This is undertaken by surgeons and radiologists working jointly. The morphology of the aneurysm is important and not all are suitable. Here is a typical list of those features favoring a suitable aneurysm:

- Long neck
- Straight iliac vessels
- Healthy groin vessels

The technological advances in EVAR device manufacture have been considerable, fenestrated devices can now be deployed as well as branching devices which has greatly expanded the range of therapeutic options.

### Procedure:

GA

Radiology or theatre

Bilateral groin incisions

Common femoral artery dissected out

Heparinisation

Arteriotomy and insertion of guide wire

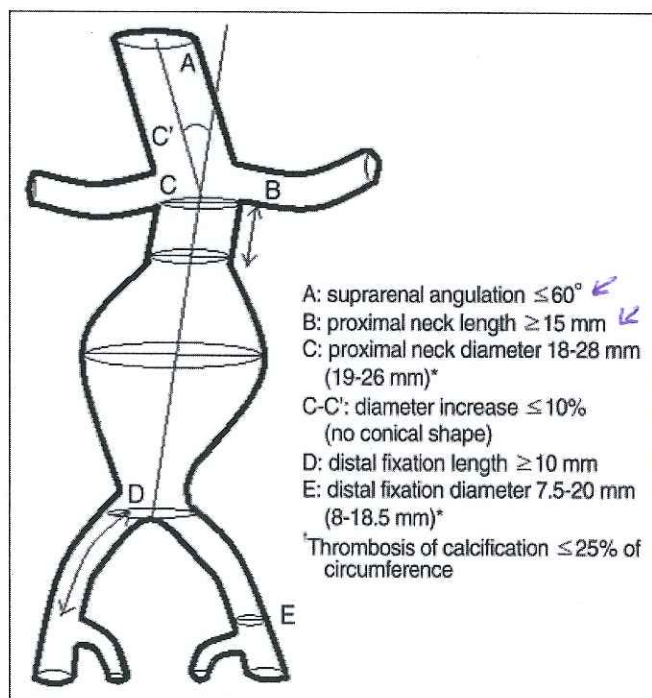
Dilation of arteriotomy

Insertion of EVAR Device

Once in satisfactory position it is released

Arteriotomy closed once check angiogram shows good position and no endoleak

### Complications:





type I & III

Identified on completion angiogram  
Ht → Immediate repair

Type IV

Resolve without intervention

Type V

- cause porosity of graft

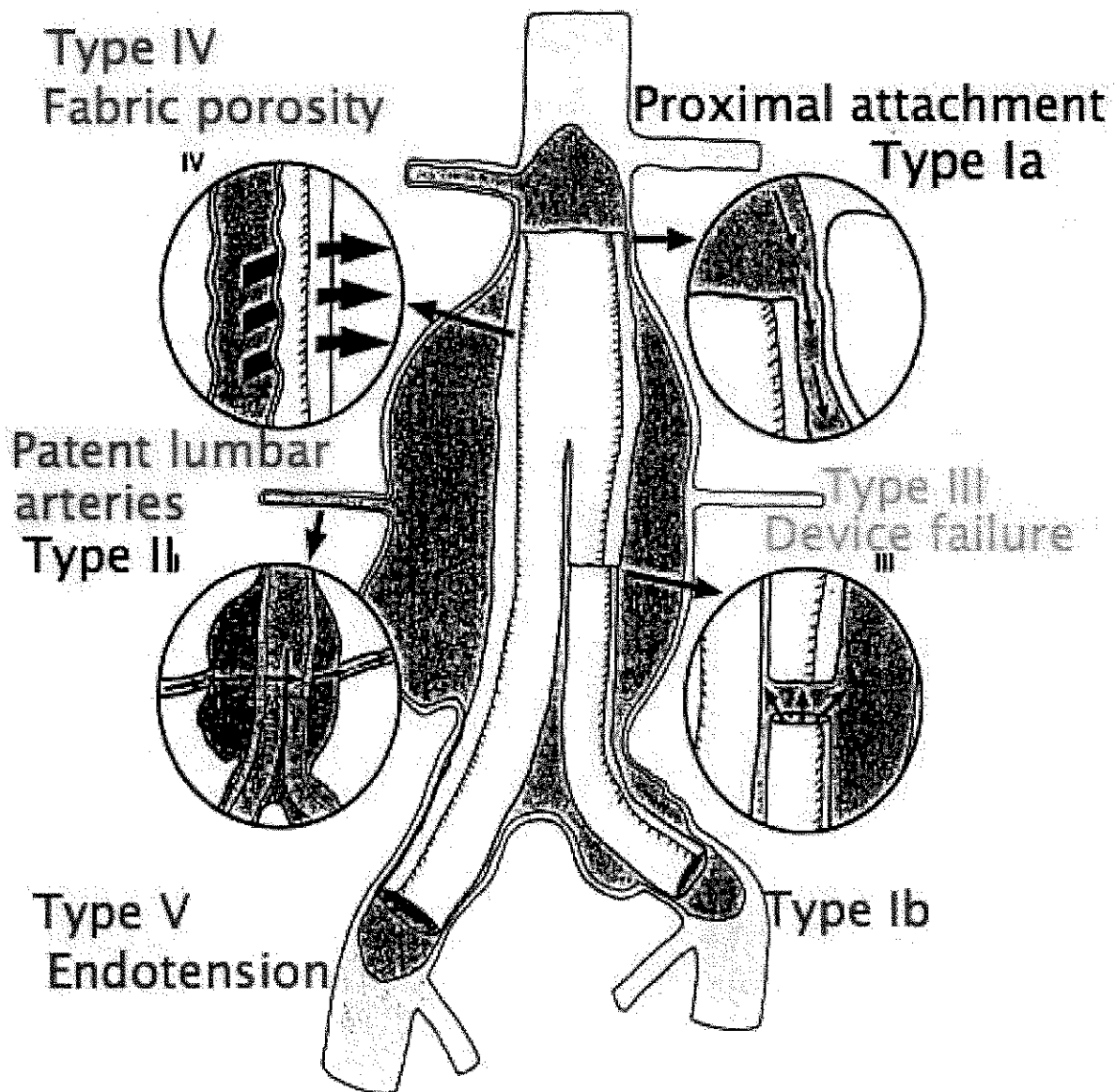
Type II

- not seen on completion angiogram

- Ht → ends vascular approach

↳ if no change in size → follow up

## Endoleaks





<b>Type 1</b>	<ul style="list-style-type: none"> <li>• Incomplete seal at graft ends allowing blood flow into the aneurysm sac</li> <li>• <u>High pressure</u> leaks</li> <li>• Type 1 A = proximal</li> <li>• Type 1 B = distal</li> </ul>
<b>Type 2</b> 60%	<ul style="list-style-type: none"> <li>• Blood flow into the aneurysm sac from collaterals (i.e. lumbar and IMA).</li> <li>• Account for 60% of all endoleaks</li> <li>• Usually <u>low pressure</u> and are difficult to see on duplex sonography</li> <li>• May close spontaneously</li> </ul>
<b>Type III endoleaks</b>	<ul style="list-style-type: none"> <li>• Leakage from graft material itself</li> <li>• Usually through the body or components of a stent graft</li> <li>• They are usually a <u>high pressure leak</u></li> </ul>
<b>Type IV endoleak</b>	<ul style="list-style-type: none"> <li>• These are typically identified intraoperatively</li> <li>• They are, by definition, <u>low pressure</u> and manifest as contrast appearing on the sac without an obvious source</li> <li>• They are seldom a long term problem and do not require specific therapy</li> </ul>
<b>Type V endoleaks</b>	<ul style="list-style-type: none"> <li>• Continued evidence of increase in aneurysm size without direct evidence of leak</li> <li>• Low risk lesions in the short term, however surgical repair is required in the long term because of the risk of rupture</li> </ul>

A low flow endoleak (type II) usually occurs as a result of back bleeding from collaterals. They are relatively low risk lesions and are common. Conservative management is the rule. They are unlikely to resolve in the short time to discharge and the large contrast dose for a check CT angiogram prior to discharge is not justified. Whilst high pressure endoleaks are an indication for urgent treatment this is not the case with low flow lesions.

## Iliac artery aneurysm

Isolated common iliac aneurysms are unusual in the absence of a proximal aortic aneurysm, and comparatively little information is available with respect to their natural history. Approximately one third to one half of common iliac aneurysms are bilateral, and 50% to 85% are asymptomatic at the time of their discovery. Up to 70% of them are located in the common iliac, 20% in the internal iliac and the remainder in the external iliac systems.

Spontaneous rupture is rare in common iliac aneurysms measuring less than 3cm and most common in those measuring greater than 5cm in maximum diameter. Those measuring less than 3cm can probably be managed with CT angiography or MRI. The pelvic location of these aneurysms does not lend itself to accurate measurement with duplex.

Surgical management is usually with endovascular stent graft placement, the ipsilateral internal iliac will invariably need to be occluded to avoid and endoleak.

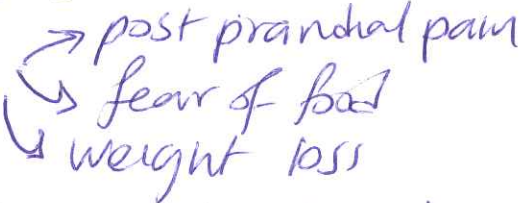


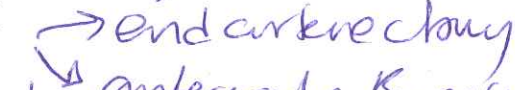
# Chronic Mesenteric Ischemia

- tend to be orificial  
& may result from "Spill-over"

Duplex -

Angiography "lateral view"

Triad of 

Open # 



Bifurcates  
used for 2 arteries  
Bypass

antegrade Bypass

retrograde Bypass

autogenous or prosthetic  
Single or multiple  
Inferior or iliac Artery

Endovascular "questionable durability"

access site Brachial easier than femoral

Due to Angulation

But Brachial Artery size is a limitation

# Mesenteric vessel disease

Mesenteric ischaemia accounts for 1 in 1000 acute surgical admissions. It is primarily caused by arterial embolism resulting in infarction of the colon. It is more likely to occur in areas such as the splenic flexure that are located at the borders of the territory supplied by the superior and inferior mesenteric arteries.

## Types

<p><b>Acute mesenteric embolus</b> (commonest 50%)</p> <p><i>Site: SMA Distal to take off of middle Colic Artery</i></p>	<ul style="list-style-type: none"> <li>• Sudden onset abdominal pain followed by profuse diarrhoea.</li> <li>• May be associated with vomiting.</li> <li>• Rapid clinical deterioration.</li> <li>• Serological tests: WCC, lactate, amylase may all be abnormal particularly in established disease. These can be normal in the early phases.</li> </ul>
<p><b>Acute on chronic mesenteric ischaemia</b> <i>"thrombosis" 20%</i></p> <p><i>Site: origin of vessel</i></p>	<ul style="list-style-type: none"> <li>• Usually longer prodromal history.</li> <li>• Post prandial abdominal discomfort and weight loss are dominant features. Patients will usually present with an acute on chronic event, but otherwise will tend not to present until mesenteric flow is reduced by greater than 80%.</li> <li>• When acute thrombosis occurs presentation may be as above. In the chronic setting the symptoms will often be those of ischaemic colitis (mucosa is the most sensitive area to this insult).</li> </ul>
<p><b>Mesenteric vein thrombosis</b></p>	<ul style="list-style-type: none"> <li>• Usually a history over weeks. <i>Subtle onset</i></li> <li>• Overt abdominal signs and symptoms will not occur until venous thrombosis has reached a stage to compromise arterial inflow.</li> <li>• Thrombophilia accounts for 60% of cases. ←</li> </ul>
<p><b>Low flow mesenteric infarction</b></p>	<ul style="list-style-type: none"> <li>• This occurs in patients with multiple co morbidities in whom mesenteric perfusion is significantly compromised by overuse of inotropes or background cardiovascular compromise.</li> <li>• The end result is that the bowel is not adequately perfused and infarcts occur from the mucosa outwards.</li> </ul> <p><i>Usually on Background of atherosclerosis</i></p>

*CTA shows flattened IVC  
→ multiple narrowing  
↳ But all patent*



HA

1. fluid resuscitation
  2. correct electrolyte abnormalities
  3. IV anti Biotics
  4. anti coagulation
  5. immediate revascularization → do not enter → 

↑

MET  
Mesenteric Vessels  
Thrombosis
  6. Resection of irreversibly necrotic Bowel → 

↓

NO MI  
Non occlusive  
Mesenteric Ischem
- intra Arterial infusion of arterial vasodilators in NO MI

- Endovascular approach can be used  
But Do not permit assessment of Bowel viability  
So Used Selectively
- Many Surgeons consider "Second look" is Mandatory  
within 24-36 hours  
others Use Selectively

## Diagnosis

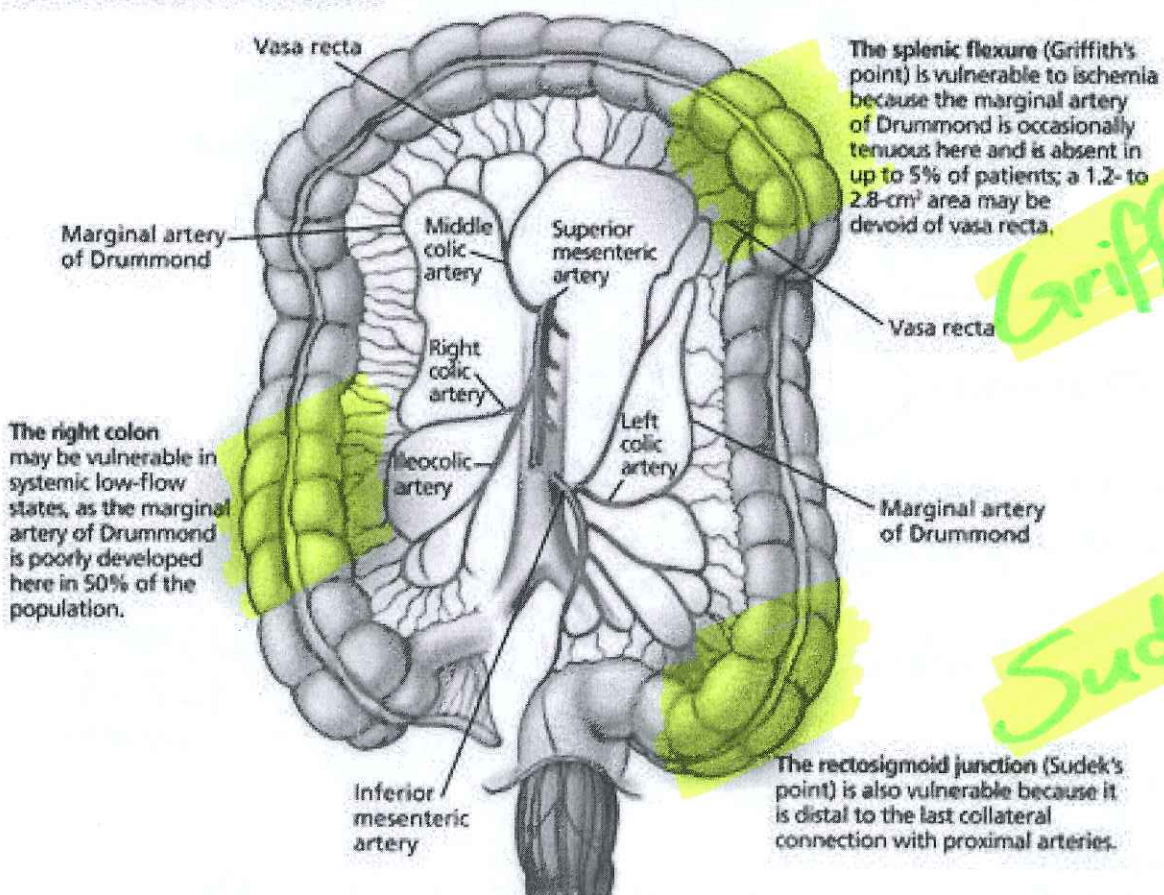
- Serological tests: WCC, lactate, CRP, amylase (can be normal in early disease).
- Cornerstone for diagnosis of arterial AND venous mesenteric disease is CT angiography scanning in the arterial phase with thin slices (<5mm). Venous phase contrast is not helpful.
- SMA duplex USS is useful in the evaluation of proximal SMA disease in patients with chronic mesenteric ischaemia.
- MRI is of limited use due to gut peristalsis and movement artefact.

## Management

- Overt signs of peritonism: Laparotomy
- Mesenteric vein thrombosis: If no peritonism: Medical management with IV heparin
- At operation limited resection of frankly necrotic bowel with view to relook laparotomy at 24-48 hours. In the interim urgent bowel revascularisation via endovascular (preferred) or surgery.

### ■ Why some areas of the colon are prone to ischemia

The colon is protected from ischemia by a collateral blood supply via the marginal artery of Drummond, a system of arcades connecting the major arteries. The anatomy is highly variable, however, and certain areas are more vulnerable in some people.





# Need for haemodialysis Access

- Non cuffed Catheter → Used Urgently not > week
- Cuffed tunneled cath. → Bridge to AVF  
weeks to months

- AVF → obligatory maturation period

Vascular Lab | arterial & venous circulation  
Diameters Determined

Criteria for Autogenous Access

(Vein)  $\geq 3\text{mm}$  • no Stenosis  
• Suitable Segment → wrist to cubital or cubital to Axilla  
• Absence of Central venous Stenosis

(Artery)  $\geq 2\text{mm}$  • absence of haemodynamically  
Significant inflow Stenosis  
•  $\geq 15\text{ mmHg}$  of brachial Brachy  
or Between foraminifera & Brachial

Options in order)

Autogenous → Radial → Cephalic  
→ Basilic  
Forearm prosthetic → Brachial → Cephalic  
→ Basilic  
Upper Arm prosthetic

Maturation

Rule of 6 → 6mm Diameter  
→ 6mm Depth  
→ 600 mL/minute  
Usually 1-2-3 months

If [Steal Syndrome]

## → ligation  
→ Distal Revascularization & Interval Ligation DRIL  
→ Banding

A COMBINATION OF HIGH INSERTION OF D4 AND EXTRINSIC COMPRESSION OF THE DUODENUM ARE SUGGESTIVE OF SMA COMPRESSION. NUTCRACKER SYNDROME IS CHARACTERISED BY THE ABNORMAL COMPRESSION OF THE LEFT RENAL VEIN BY THE ABDOMINAL AORTA AND SMA AND DOES NOT PRESENT IN THIS WAY.

## Cirroid aneurysm

These rare aneurysms occur at sites where superficially located vessels become complexed with arteriovenous malformations. They occur most commonly on the scalp and may cause cardiac problems secondary to high flow rates. They are also cosmetically disfiguring. Standard investigation is with doppler studies complemented with both MRA and CT angiography. Treatments range from cosmetic camouflage through to surgical excision.

## Raynaud phenomena

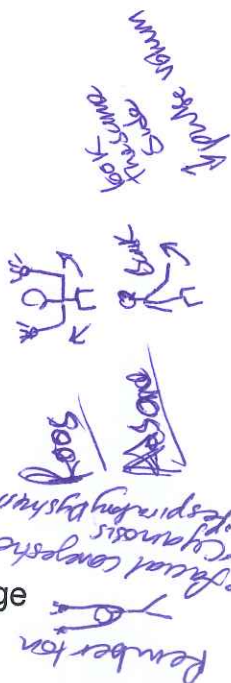
This manifests as recurrent vasospasm of the fingers and toes on exposure to the cold. Both the Raynaud phenomena and the disease are recognised. In the latter cases the aetiology is idiopathic, in the former an underlying cause is present. Its commonest association is with mixed systemic sclerosis.

Patients will usually present with discoloration of the hand; pallor --> cyanosis ---> hyperaemia.

In many cases the underlying cause will consist of a medical condition, these include connective disorders, malignancies and endocrine disorders such as acromegaly. In surgical practice there are some conditions that may be confused with Raynaulds disease. These include; carpal tunnel, reflex sympathetic dystrophy, thoracic outlet syndrome and atherosclerosis.

In order to exclude some of the surgical mimics outlined above it can be useful to perform some additional clinical investigations; carpal tunnel syndrome can be tested for using Tinel's test and thoracic outlet syndrome may be suspected if a Roos test is positive.

Most cases are treated with simple measures such as wearing gloves, vasodilators including nifedipine may be beneficial. Secondary Raynauds treatments are directed at the underlying cause.





Sympathetic energy



## Hyperhidrosis

- Excessive sweating affecting the palms and soles
- May be **primary** (young presentation, sometimes inherited) or secondary (e.g. secondary to **alcoholism, malignancy, hyperthyroidism**)
- Areas of sweat may be identified using the **iodine - starch test**
- Idiopathic disease is usually bilateral and occurs at younger ages
- Screening for secondary causes includes **careful clinical examination**, checking **thyroid function** and **liver function tests**.
- Topical therapy with **20% aluminium chloride hexahydrate** may be beneficial
- **Botulinum toxin** has an anticholinergic effect at the neuromuscular junction, epidermal injections may produce remission of symptoms of between 4 and 12 months duration
- **Surgical sympathectomy may be beneficial in resistant cases**. Division of the **T1** ganglia for facial symptoms, **T2** and **T3** for palmar, **T4** for axillary disease
- **Compensatory sweating is the most common adverse effect following surgery and may be seen in up to 50% of cases**

## Lymphoedema

- Due to impaired lymphatic drainage in the presence of normal capillary function.
- Lymphoedema causes the accumulation of protein rich fluid, subdermal fibrosis and dermal thickening.
- Characteristically fluid is confined to the **epifascial space** (skin and subcutaneous tissues); **muscle compartments are free of oedema**. It involves the foot, unlike other forms of oedema. There may be a '**buffalo hump**' on the dorsum of the foot and the **skin cannot be pinched** due to subcutaneous fibrosis.



## Causes of lymphoedema

Primary	<ul style="list-style-type: none"> <li>• Congenital &lt; 1 year: sporadic, Milroy's disease</li> <li>• Onset 1-35 years: sporadic, Meige's disease</li> <li>• &gt; 35 years: Tarda</li> </ul>
Secondary	<ul style="list-style-type: none"> <li>• Bacterial/fungal/parasitic infection (filariasis)</li> <li>• Lymphatic malignancy</li> <li>• Radiotherapy to lymph nodes</li> <li>• Surgical resection of lymph nodes</li> <li>• DVT</li> <li>• Thrombophlebitis</li> </ul>

## Indications for surgery

- Marked disability or deformity from limb swelling
- Lymphoedema caused by proximal lymphatic obstruction with patent distal lymphatics suitable for a lymphatic drainage procedure
- Lymphocutaneous fistulae and megalymphatics

## Procedures

Homans operation	Reduction procedure with preservation of overlying skin (which must be in good condition). Skin flaps are raised and the underlying tissue excised. Limb circumference typically reduced by a third.
Charles operation	All skin and subcutaneous tissue around the calf is excised down to the deep fascia. Split skin grafts are placed over the site. May be performed if overlying skin is not in good condition. Larger reduction in size than with Homans procedure.
Lymphovenous anastomosis	Identifiable lymphatics are anastomosed to sub dermal venules. Usually indicated in 2% of patients with proximal lymphatic obstruction and normal distal lymphatics.

Carotid Angiography is the Gold Standard

But Duplex is usually Done

& Most Surgeons make operative decisions Based on it

- Peak Systolic velocity in CCA / ICA
- End Diastolic Velocity in CCA / ICA
- plaque Estimate

→ you can classify stenosis to  $\begin{matrix} < 50\% \\ 50-69\% \\ 70-99\% \end{matrix}$  & total

Medical  $\left\{ \begin{array}{l} \text{Smoking} \\ \text{Statins} \\ \text{B Blockers} \\ \text{Aspirin} \end{array} \right\}$

CEA

CAS

↳ if stroke happened post op  
→ OT → exploration → thromboembolectomy  
→ Shunt or not  
ICA test → Clamped for 1 minute  
or Positive Shunt

if tandem lesion 5 options endovascular & open

Recommend Synchronous CEA <sup>any</sup> & Retrograde  
Innominate Artery Stenting

ABCD2 scoring  $\geq 4$

- 300mg Aspirin Daily immediately
- Specialist assessment & investigation within 24 hours
- measures for 2ry prevention introduced

$\leq 3$

- 300mg Aspirin Daily  
→ 1 week



## Carotid artery disease

Transient ischaemic attacks are an important event since there subsequent risk of ischaemic stroke is high. Extra cranial thromboembolic events account for 70% of all strokes and 80% of all TIA's.

TIA's are, by definition, transient. The neurological defect usually resolves within 24 hours (typically within 6 hours). Loss of consciousness is rare.

Transient visual disturbance may occur (amaurosis fugax).

### Assessment

- Carotid artery duplex (to assess disease extent)
- ECG (to exclude atrial fibrillation)
- CT scan of the head (to exclude other causes) *MRI 1st choice*
- Measurement of serum cholesterol, blood pressure, serum blood glucose

### Treatment

- Smoking cessation
- Post TIA patients should receive aspirin 75mg once daily. If a patient has a TIA whilst on aspirin, then this should be changed to clopidogrel (compliance with dipyridamole is generally poor)
- Atorvastatin 80mg daily has shown the greatest benefit for the reduction in subsequent neurological events
- Males with 50-99% stenosis of internal carotid should undergo carotid endarterectomy. Females with 70-99% stenosis should undergo carotid endarterectomy
- Asymptomatic patients with stenosis greater than 70% have a reduction in stroke risk of 30% at 3 years with surgery. However, surgeons with complication rates of greater than 3% should not perform such cases as it would skew the benefit.
- For symptomatic patients surgery should be performed within the first two weeks *Refer within 1 week*
- The only surgical technique found to impact on outcome was that of a patch placement (which should be used in all cases of CEA)
- In selected patients monitoring of cerebral blood flow through use of transcranial doppler or assessment of stump pressures may be useful. In most cases of TCD the only findings are of non clinically significant air microemboli.
- Carotid artery angioplasty and stent placement is used only selectively
- Car drivers need not tell the DVLA following a TIA. However, lorry and coach drivers should do so.

Table-1: ABCD2 Scoring Criteria.

A	Age	≥60 years	1 point
B	Blood pressure	≥140/90 mm Hg	1 point
C	Clinical features	Unilateral weakness	2 points
	Speech impairment without weakness		1 point
D	Duration	≥60 minutes	2 points
		10-59 minutes	1 point
D	Diabetes	Presence of diabetes mellitus	1 point

*4 or above*



## ACAS Asymptomatic Carotid Atherosclerosis Study

→ North America

→ Compare CEA & Best medical Management

→  $\geq 60\%$  stenosis By Angiography  
→  $75\%$  By Duplex

Death, Stroke, TIA →  $5.1\%$  CEA  
→  $11\%$  medical tt

## ACST Asymptomatic Carotid Surgery Trial

→ Europe

→ Compare CEA + medical vs medical

→  $> 60\%$  stenosis By Ultrasound

Stroke →  $6.4\%$  CEA  
→  $11.8\%$  medical tt

Criticized - Now more Aggressive medical tt

GALA trial → GA vs LA in CEA  
No Difference

## CAS Carotid Artery Stenting

→ High grade lesion →  $> 80\%$

→ High risk anatomic factor

→ previous CEA & Recurrent Stenosis

→ Ipsilateral neck Radiation

→ previous ablative neck Surgery

→ Stenosis Below clavicle

→ Contralateral Vocal Cord paralysis

→ presence of tracheostomy

CREST - compare CEA vs CAS

30 days death & stroke →  $4.4\%$  vs →  $2.3\%$

2-5 years Similar follow up results

Still not finished



## Carotid endarterectomy trials

Trial Name	Key features	Outcomes	Reference
North American Symptomatic Carotid Endarterectomy Trial  <i>(NASCET)</i>	Rates of perioperative stroke and death at 30 days High grade angiographic lesions 70-99% Morbidity of surgery	Perioperative stroke and death 6.5% Overall permanent risk of stroke and death 2% Wound infections 9% Cranial nerve injury 8%	North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade stenosis. <i>N Engl J Med.</i> 1991;325:445-53
European Carotid Surgery Trial	Patients with ipsilateral carotid artery territory events (e.g. amaurosis, TIA) randomised to surgery. All types of stenotic lesions randomised	High grade stenoses fared best with surgery (six fold reduction in risk) Low grade stenoses had the least benefit (risks outweighed benefits)	MRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. European Carotid Surgery Trialists' Collaborative Group. <i>Lancet.</i> 1991;337(8752):1235-43
Asymptomatic carotid surgery trial  <i>ACST</i>	Asymptomatic people with 60% stenosis or greater	Risk of CVA halved (from 12% to 6%)	MRC Asymptomatic Carotid Surgery Trial (ACST) Collaborative Group <i>Lancet</i> 363: 1491-1502



# Diabetic Foot Infection

1 ischemia      2 neuropathy      3 infection

- typically tibial & peroneal arterial Occlusion Disease
- ~~Atypical~~ inflammatory Signs of infection Diminished
- Unexplained hyperglycemia usually prompt search for source

Tenderness / fluctuance

Osteomyelitis → MRI, Bone Scan, tagged WBC  
→ Simple Sterile metallic probe  
if hits Bone can be Diagnostic  
66% Sensitivity      85% Specificity

X-Ray → FB, Gas, Osteolysis, joint effusion  
& anatomy for management

Minor Ulcers → local wound care → 7-10 days  
→ Anti Biotics  
→ Saline-impregnated gauze  
→ Acco minodenture pad around the lesion

limb threatening Infection → hospitalization  
→ Immobilization  
→ IV antibiotics      Cultures from Depth  
moderate → 3 weeks  
Severe / osteomyelitis → 4-6 weeks

Control infection Before revascularization

Short delay < 5 days

long waits to sterilize the wound is inappropriate

Angioplasty should be used 1st opt if significant  
Comorbidities / Life expectancy < 1-2 years

Long term results favor Surgery if there are  
- Good vein      - medically fit patient

Amputation Not a failure it is acceptable modality  
Because Modern Advances in prosthesis & Aggressive rehabilitation



# Leg ulcers

Chronic leg or vascular ulcers typically manifest as arterial, neurotrophic, or venous ulcers. They are distinct with regard to their location, appearance, bleeding, and associated pain and findings.

## Ulcer types

<b>Arterial ulcers</b>	Distally located May have irregular edges initially but may then progress to smooth edges Base lined by grey, unhealthy granulation tissue Ischaemic pain may be present, especially when limb is elevated Stigmata of arterial disease often present (loss of hair, pulses and skin pallor)
<b>Neurotrophic ulcers</b>	Punched out appearance with deep sinus Usually appear over pressure points Surrounding chronic inflammatory response Often hyperaemic and bleed easily Often altered sensation
<b>Venous ulcers</b>	Located circumferentially on lower leg between mid calf and malleoli Larger and shallower than other ulcers Moist granulating base and irregular edges Surrounding skin may show stasis dermatitis Aching of limb may be present which improves on limb elevation
<b>Diabetic ulcers</b>	Cause often multi-factorial with neuropathy and vascular aetiology co-existing Presenting features may provide a clue as to the dominant underlying cause

## Management

Arterial involvement should be screened for by clinical palpation of pulses and measurement of ABPI. Diabetes may cause calcification of the vessels and artificially raised ABPI and may be suspected if ABPI is  $>1$ .

Suspicion of arterial disease should prompt further evaluation with a duplex scan and / or magnetic resonance angiography.

Identifiable arterial lesions in the setting of ulceration are usually an indication for treatment, this is particularly true if mixed ulcers are present.

# DVT

## Duplex

acute vs chronic thrombosis

- echolucent
- large veins
- partially compressible
- echodense & heterogeneous
- shrunk veins
- fail to collapse completely

& the Use of Doppler → Flow  
→ lack of Respiratory variations  
→ Flow augmentation

④ pt & reversible management of DVT 3 month anticoagulation  
- pt & active cancer 3 month but LMWH oral/marine

Thrombolysis newer # modality

- Young pt without clear etiology  
look for anatomic risk eg May-Thurner

Severe Symptoms / phlegmasia cerulea dolens

if  $\downarrow$  → Catheter directed thrombolysis → infusion  
if  $\downarrow$  → open venous thrombectomy → mechanical  
± fasciotomy

if lack of flow AVF can be created as  
Adjunctive measure

Class I → Suspicion of Ischemia  
→ Superficial or early UV  
→ UV during pregnancy

Class II → mild edema - ABI required if 0.9-0.8  
→ UV medium severity  
→ Ht & prevention of recurrence of v. ulcers ← if 0.8  
→ UV during pregnancy ← Safe

Class III → Gross UV - ABI required if >1.3  
→ Post thrombotic venous insufficiency not safe  
→ Gross Edema calcified Arteries  
→ Ht & prevention of v. ulcers



Neuropathic and diabetic ulcers are treated primarily by focusing on the underlying cause and optimising diabetic control (which is often poor). Shoes should be carefully inspected, regular chiropody performed and patient education.

Venous ulcers are treated with compression therapy. Both 4 layer bandages or prescribed compression hosiery are used. Any co-existing arterial disease may need to be treated first.

A sudden change in morphology in a long standing ulcer may represent a malignant transformation (Marjolin's ulcer) and if suspected then a punch biopsy should be performed.

Some chronic ulcers that fail to heal may be considered for skin grafting.

## Compression stockings

- Compression stockings are useful for treating conditions associated with chronic venous insufficiency, including post-thrombotic syndrome, varicose veins, venous eczema, lipodermatosclerosis, and venous ulcers.
- They provide graduated pressure from the distal to proximal portion of the leg and increase venous blood flow by improving the action of the calf-muscle pump.

### Strength of compression

British standard for class of compression

Classification	Pressure provided
Class I	14-17 mmHg <u>3</u>
Class II	18-24 mmHg <u>6</u>
Class III	25-35 mmHg <u>10</u>

European compression stockings apply a different amount of pressure (e.g. European class II = 23-32 mmHg.)

Contra indication:

→ Ischemia

→ Neuropathy

→ Cardiac Failure

→ Bypass Surgery

→ Local condition of skin

→ Allergies



**Table 2 Villalta Scale for the Assessment of Postthrombotic Syndrome<sup>18,38</sup>**

Subjective Symptoms*	Objective Signs*
Heaviness	Pretibial edema
Pain	Induration of the skin
Cramps	Hyperpigmentation
Pruritus	New venous ectasia
Paresthesia	Redness
	Pain during calf compression
	Ulceration of the skin

\*Each sign or symptom is graded with a score between 0 and 3. The presence or absence of leg ulcer is noted.

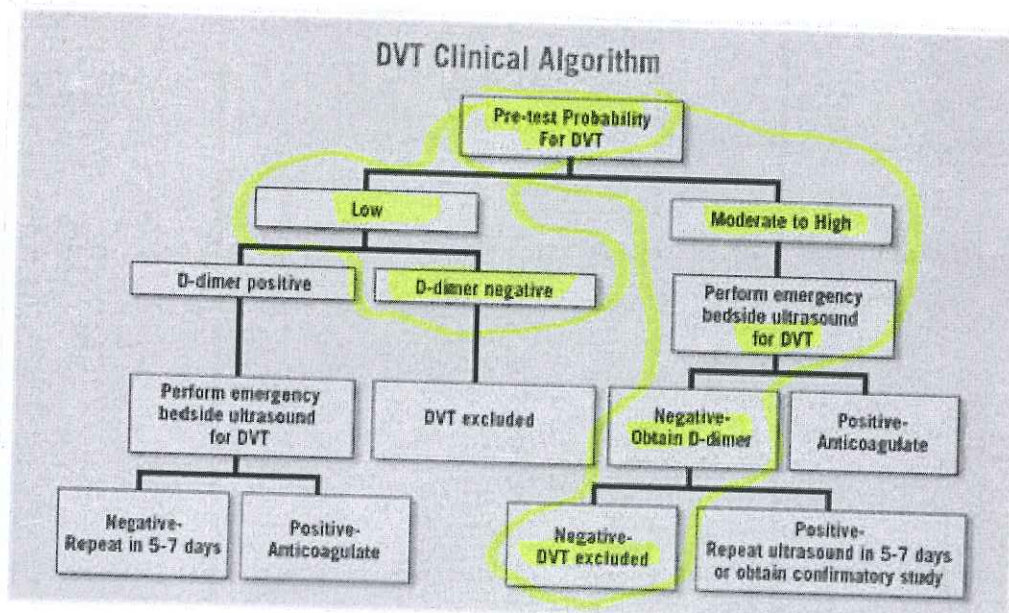
*Clinical History*

Active cancer (ongoing treatment or within last 6 months, or palliative)	1	
Paralysis, paresis or recent plaster immobilisation of lower extremities	1	
Recently bedridden >3 days and/or major surgery within 4 weeks	1	
Local tenderness	1	
Thigh and calf swollen	1	
Calf swelling 3 cm > asymptomatic side (measured 10 cm below tibial tuberosity)	1	
Pitting oedema in symptomatic leg only	1	
Dilated superficial veins (non-varicose) in symptomatic leg only	1	
Alternative diagnosis as or more likely than DVT	-2	
Low probability: $\leq 0$	Moderate probability: 1-2	High probability $\geq 3$

Wells Clinical probability score

- ① Immobilisation  
② Cancer → Surgery  
③ Pain + local tenderness  
④ Swelling  
⑤ Dilated veins  
⑥ measured  
⑦ unilateral Edema

<5 no PTS    5-9 mild PTS    10-14 moderate PTS    > or = 15 severe PTS





# Eosophagogastric

6 from where

## Diagnosis and staging of oesophageal cancer

Patients over 55 years with new onset dyspepsia and patients at all ages with alarm symptoms for malignancy should undergo an upper GI endoscopy. Any area of mucosal abnormality should have a least 6 biopsies taken to ensure an accurate sample. Small nodular lesions in conjunction with Barretts oesophagus should be considered for endoscopic mucosal resection (where adequate tissue will be provided for histological assessment). Endoscopy, though the gold standard, has a miss rate of 10%. Many of these failed diagnoses are the result of inadequate or poor biopsy technique. Where tumour is visualised but cannot be traversed by the endoscope the options are between the use of thinner paediatric type endoscopes or other imaging. Dilatation at first endoscopy, prior to staging is not advisable as tumour perforation will dramatically reduce the option for potentially curative resection.

Once a diagnosis of oesophageal cancer has been made further staging is required. This will consist of a spiral CT scan, PET CT, and endoscopic ultrasound (EUS). EUS is more sensitive (91%) than conventional CT for regional nodal disease. However, PET CT is more sensitive than EUS for regional and distant nodal disease. One confounder that favors EUS is the avid uptake of the primary tumour which can mask the appearances of peritumoural nodes. There is no evidence to support the use of MRI scanning in primary staging.

Patients with lower oesophageal and junctional tumours should also undergo staging laparoscopy, as peritoneal metastasis from these tumours are poorly visualised using other staging modalities.

**MUCOSAL ABNORMALITIES SUSPICIOUS FOR OESOPHAGEAL CANCER SHOULD HAVE AT LEAST SIX BIOPSIES.**

# Prognosis of oesophageal cancer

## Stage grouping

### Prognosis (5 year survival)

Stage	TNM	5 year survival
I	T1, N0, M0	60%
IIa	T2, N0, M0 or T3, N0, M0	50%
IIb	T1,2, N1, M0	35%
III	T3, N1, M0 or T4, N0, M0	15%
IV	All others	3.4%

The prognosis may be altered by the use of adjuvant therapies. In the 7th Edition of the AJCC cancer staging manual for oesophageal cancer survival rates with adjuvant treatments are given as 50% at 5 years for stage IIa.

### Lymph node positivity related to T stage

T1a	18%
T1b	55%
T2	60%
T3	80%
T4	100%

The risk of lymph node metastasis in oesophageal cancer is directly related to T stage.



preoperative Gastrostomy tube is to be avoided  
→ complicated preparation of the stomach  
→ wound infection

Very common

Trans  
Mucosal

Ivor Lewis  
2 stage

McKeown  
3 field



# Treatment of oesophageal cancer

Treatments for SCC's and adenocarcinomas of the oesophagus differ. This is primarily due to the positive outcomes that are observed when localised SCC's (particularly of the proximal oesophagus are treated with radical chemoradiotherapy (obviating the need for surgery).

Only those patients whose staging investigations are negative for metastatic disease should be considered for surgery.

## Surgical options

<b>Endoscopic mucosal resection</b>	Treatment for early localised adenocarcinoma of the distal oesophagus. Survival mirrors that of surgical resection for Tis and T1 disease
<b>Transhiatal oesophagectomy</b>	Most commonly used for junctional (type II) (1) tumours where limited thoracic oesophageal resection is required. Less morbidity than two field oesophagectomy
<b>Ivor Lewis oesophagectomy</b>	Two stage approach for middle and distal tumours. Very commonly performed, intrathoracic anastomosis will result in mediastinitis in event of anastomotic leak. Lower incidence of recurrent laryngeal nerve injury
<b>McKeown oesophagectomy</b>	Three field approach, may be useful for proximal tumours. Anastomotic leakage is less serious. Higher incidence of recurrent laryngeal nerve injury

## Neoadjuvent and adjuvent treatment

- Neoadjuvent radiotherapy alone prior to resection confers little benefit and is not routinely performed (2)
- Preoperative chemotherapy is associated with a survival advantage (OE02 trial)
- Peri operative (pre and post operative) chemotherapy confers a survival advantage in junctional tumours
- Post operative chemotherapy is not generally recommended following oesophageal resections outside clinical trials

Pre-operative      Neoadjuvent

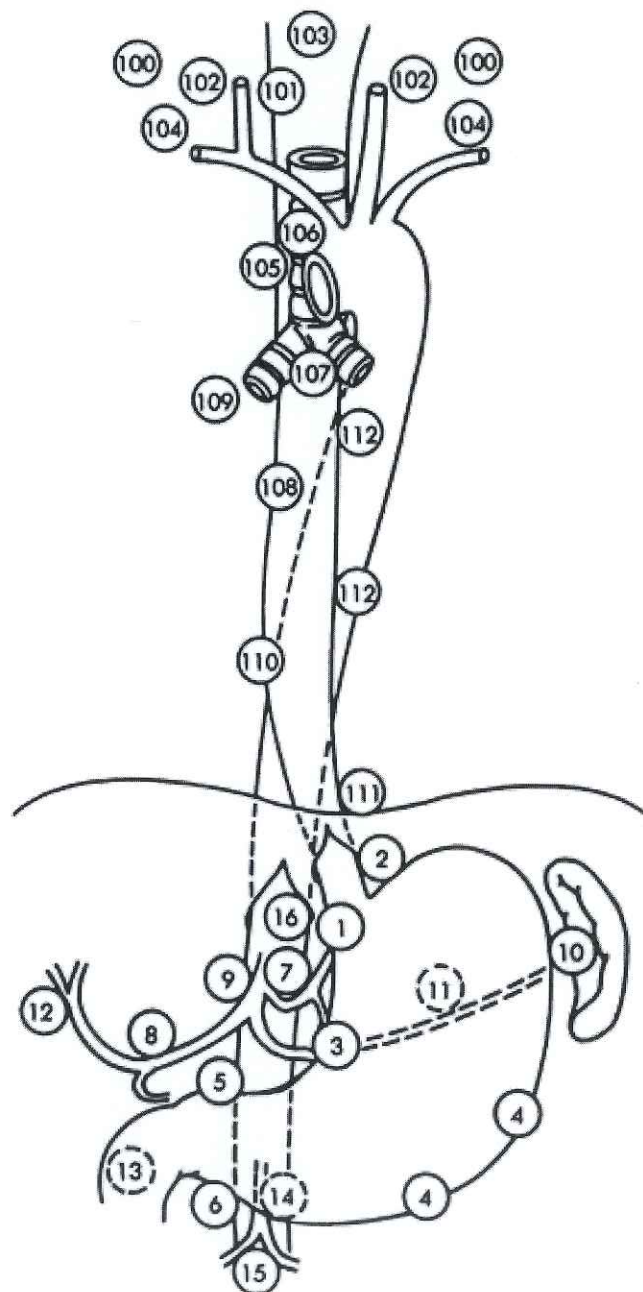


Absolute contraindication for TME

- 1) Distant mets "Biopsy proved"
- 2) Trachobronchial invasion "Bronchoscopy"
- 3) Aortic invasion "CT, MRI, EUS"
- 4) Too much oesophageal fixation  
prior oesophageal operation/radiation

## Palliation strategies

- Combination chemotherapy improves quality of life and survival in non operable disease (3)
- Trastuzumab may improve survival in patients with HER 2 positive tumours
- Oesophageal intubation with self expanding metal stents is the treatment of choice in patients with occluding tumours >2cm from the cricopharyngeus
- Covered metal stents are useful in cases of malignant fistulas
- Laser therapy and argon plasma coagulation may be useful as therapies for tumour overgrowth and bleeding
- Photodynamic therapy and ethanol injections confer little benefit and should not be routinely used





- Respiratory

- Leak

- Stricture

- Chylothorax

- Goo

# Complications from oesophagectomy

Oesophageal resections are technically complex to perform and the requirement to explore two visceral cavities and the need for lung collapse can result in a number of complications systemically. In addition oesophageal tissue is not an ideal substance with which to perform an anastomosis since it lacks a serosa. In most units oesophageal resection is complemented with gastric mobilisation a process that can result in vascular compromise. This coupled with the potential for nutritional compromise (a process that can be avoided with careful patient preparation) can create a recipe for anastomotic leaks.

## Respiratory complications

A combination of lung collapse, advancing age, previous smoking and pain may all result in impaired ventilation following oesophagectomy. Patients should usually receive supplementary humidified oxygen, the majority should usually be nursed in a high dependency or ITU environment. Some surgeons will routinely ventilate patients for 24-48 hours following resection to allow greater control of ventilation. Once extubated analgesia and physiotherapy are important in minimising the extent and effect of basal collapse. Invasive monitoring of CVP and IAP are useful as they will allow fine tuning, patients can become hypotensive, which may be best managed with inotropic support, rather than additional fluids if CVP is adequate. Fluid overload and pulmonary oedema can result from the excessive use of IV fluids, as can tissue oedema at the anastomosis. ←

## Routine contrast imaging of the anastomosis

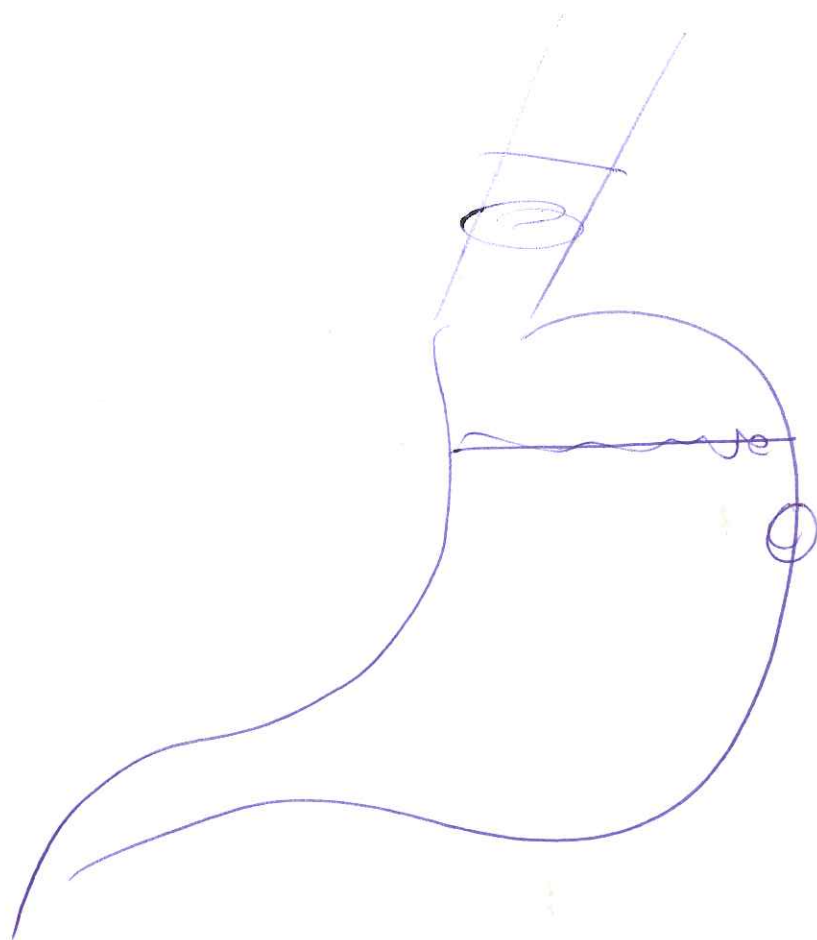
Radiological leaks in the absence of clinical signs do not generally alter the management of patients following oesophagectomy. Gastrograffin is a useful agent in identification of significant leaks. However, if it is normal then the exclusion of small leaks will rely on barium based media. In spite of the fact that studies have failed to show any benefit from routine contrast studies of oesophageal anastomoses some surgeons will continue to request them. The argument in favor of this being that such investigations seldom result in harm.

## Anastomotic leaks

Following oesophagectomy the anastomotic leak rates reported range from 5 to 20%. The higher figures will often arise from those who include sub clinical radiological leaks (see above). Major leaks resulting in morbidity are usually of the order of 5-10%. Early leaks occurring in the first 3 days after surgery are generally the result of technical factors and may manifest themselves either as physiological disturbance or frank leakage of lumen contents from drains. Contrast imaging will usually demonstrate the site of leak. Small localised leaks may be amenable to endoscopic clipping although this is

But Not Usual





exceptional. More usually the patient should be returned to theatre and the factor addressed. Complete gastric necrosis is a recognised event and where it occurs the usual rule is to resect the stomach and create an oesohagostomy. In such critically unwell patients the option of definitive primary repair is not advisable. Definitive reconstruction is usually performed months later.

Leakage from the gastric staple line constitutes a major leak, but is rare. Where it occurs surgery is needed.

The majority of leaks are usually from the oesophagogastric anastomosis and result from ischaemia. They present later and unless they are very large are generally managed conservatively with a nil by mouth regimen. Chest drains are left in situ. If a feeding jejunostomy has been sited then enteral feeding may be possible otherwise TPN will be needed.



## Other complications

<b>Anastomotic strictures</b>	Typically present with delayed dysphagia OGD and imaging needed to exclude recurrence Treatment is with <b>endoscopic dilatation</b> May be avoided by use of anvils >25mm if stapling
<b>Chylothorax</b>	May occur in up to <b>5%</b> of cases (more so in transhiatal procedures) May be avoided by <b>preoperative administration of cream</b> to identify duct if divided Otherwise presents when re-feeding starts Options lie between <b>watchful waiting or early surgery</b>
<b>Gastric outlet obstruction</b>	May present with reflux symptoms which are severe <b>Routine use of pyloroplasty may decrease the risk</b> (although not often practised with laparoscopic resections)

Where gastric outlet obstruction does occur due to lack of pyloroplasty, it may be managed with endoscopy and botox or dilatation. Given that not all cases will require such interventions and that those who do, tend to respond favorably, forms the argument of those who do not routinely perform pyloroplasty.

**Chyle leaks** are more common following transhiatal procedures and may cause considerable nutritional compromise. **Significant fluid collections should be drained** but **repeated thoracocentesis** may result in the development of **infection**. **Lipid rich TPN** is helpful as these patients may lose lipid. **Lipid laden diets may worsen the condition**. **Refractory cases may require surgery**.

# Squamous cell carcinoma of the oesophagus

Early squamous cell carcinoma of the oesophagus is rare in the west. The main risk factors for developing SCC of the oesophagus are smoking and heavy alcohol consumption. Most early tumours are located in the mid thoracic oesophagus. Lymph node metastasis are more common in these tumours and these are present in 10% of patients with T1 lesions that are superficial with over 50% of patients with sub mucosal infiltration showing evidence of lymph node metastasis.

Staging of the condition is with PET CT/ EUS and laparoscopy for lower lesions.

## Treatment

- Early, localised, proximal tumours should be treated with chemoradiotherapy
- Mid and distal oesophageal tumours can be treated with either surgery or chemo radiotherapy
- More advanced proximal tumours without disseminated disease can be considered for McKeown type oesophagectomy

## Prognosis

(In those treated for cure)

- Node negative disease = 85-90%
- Nodal involvement = 45%

**IN THE MOST RECENT BSG GUIDELINES THE RECOMMENDATION IS THAT PROXIMAL SCC'S OF THE OESOPHAGUS THAT ARE LOCALISED SHOULD BE TREATED WITH RADICAL CHEMORADIOOTHERAPY.**



"alarm" Symptoms Dysphagia weight loss GI Bleeding  
Oesophagitis anemia

DD hiatal hernia achalasia cancer

Good Response to trial of PPI is Diagnostic of GORD

## workup

1<sup>st</sup> Ba Swallow → 2<sup>nd</sup> Upper GI Endoscopy  
to show

- Strictures → Benign  
→ Malignant
- Relation of stomach  
→ Diaphragm  
→ ? hernia
- Confirmatory if pt has  
manometric Evidence of  
achalasia

shows

- Oesophagitis
- Barrett's oesophagus
- Cancer
- if pt has Atypical &  
Extra Oesophageal Symptoms

if Oesophagitis  
if normal Anti Reflux Surgery is justified

3<sup>rd</sup> Ambulatory pH testing → 4<sup>th</sup> Manometric Studies

for - Atypical Symptoms

- if Surgery being Considered
- Done if pt off antacids

Considered by  
Surgeons Before Surgery  
to rule out  
motility disorders  
eg. achalasia &  
Scleroderma

Upper limit of normal of  
fraction of time of pH < 4 is  
< 4%

Para Oesophageal Hernia

Type I Sliding  
Type II para oesophageal  
Type III mixed  
Type IV II or III  
+ other organ

→ Symptomatic → Surgery  
→ Asymptomatic  
"Controversy"  
Better to Repair  
Due to progression of Symptoms

Cameron Ulcer

Bleeding anaemia  
Due to constriction by  
Diaphragm



## Surgery for GORD

Up to 20% of adults in Westernised countries will experience intermittent heartburn, reflux symptoms or both. The symptom burden is highly variable with some individuals requiring little more than occasional relief with oral antacid medication. More significant symptoms may require proton pump inhibitor therapy. Some patients will be considered for surgery.

### Pathophysiology of reflux

In normal individuals a functional lower oesophageal sphincter will prevent retrograde flow. The normal lower oesophageal sphincter is 3-4cm long and exerts a pressure of between 10 and 25mmHg. Contraction of the sphincter is enhanced by drugs such as metoclopramide. Relaxation of the sphincter occurs with cigarette smoking, alcohol and caffeine consumption. It does, of course, relax and contract in response to physiological stimuli. Most episodes of oesophageal reflux occur during transient post prandial lower oesophageal sphincter relaxations. In the early stages of developing reflux disease the reflux typically occurs as a result of an increase in these transient relaxations rather than as a result of a persistent fall in sphincter pressure. In severe GORD the sphincter pressures are generally lower, this loss of sphincter function is perpetuated by reductions in the length of the intra abdominal oesophagus (e.g. in obesity). The next event is a crural widening and development of hiatus hernia. This loss of normality may worsen reflux, although there is no evidence to suggest that, in itself, it is the cause of it.

### Diagnosis

As a baseline all individuals will usually undergo an upper GI endoscopy. Consideration may be given to empirical treatment without investigation in a young patient with minimal symptoms burden. By definition, the number of patients who fulfill this criterion in hospital practice is small. Whilst endoscopic stigmata of severe reflux may be present, a proportion of patients will have normal endoscopic appearances. In many cases this simply reflects the widespread use of proton pump inhibitors. Adverse endoscopic appearances have been shown to correlate with subsequent findings on pH study. All cases that are being considered for surgery or where the diagnosis remains unclear should be considered for pH and manometry studies.

During pH monitoring a reflux episode is said to occur when the pH falls below 4. The other components include:

- Percentage total time pH less than 4
- Percentage upright time pH less than 4
- Percentage supine time pH less than 4
- Number of reflux episodes
- Number of episodes greater than 5 minutes
- Longest reflux episode time



Total → Nissen

partial

↓ posterior → Toupet

↓ Anterior → Watsons

---

Postop • prophylactic antiemetics 1-2 days  
• avoid meat, veget, 4-6 weeks

### DeMeester Scoring system

The DeMeester score is usually cited as being the gold standard score applied to pH studies. It is indeed fortunate that the score is calculated using a computer as the mathematics can become complex!. In their 1986 paper where they proposed the revised score DeMeester issues the following summary explanation of the scoring the domains outlined above: This system uses a uniform scoring unit and pH monitoring parameters taken from both the day and night-time segments of the pH recording. The score quantitates the degree of departure that a patients reflux pattern exceeds physiologic reflux found in asymptomatic control volunteers, and directly correlates with the degree of reactive, epithelial change characteristic of reflux oesophagitis. Scores above 14.7 are usually pathological(1).

### Treatment options

These range from lifestyle modification and simple over the counter remedies in mild cases to surgery. Case selection is important where surgery is considered. If cases are appropriately selected then good results with surgery are seen (2, 3).

Surgery may be performed as either an open or laparoscopic procedure. The majority of cases in the UK are performed laparoscopically. The best described total fundoplication procedure is the Nissen; in this procedure the gastric fundus is mobilised (either with or without division of short gastrics) to encase and re-enforce the entire OG junction. The long term results of the procedure are good, although in the early weeks following surgery some patients do experience transient dysphagia.

Development of dysphagia represents a poor functional outcome for patients and in attempts to avoid this the alternative option of partial fundoplication is sometimes undertaken. This may be fashioned posteriorly as a Toupet procedure or anteriorly as in a Watsons. In the latter procedure the posterior oesophagus is anchored to the crural repair which helps reduce the hiatus hernia, a procedure that is challenging (but not impossible) to perform laparoscopically. In partial fundoplication surgery the short gastric vessels are usually preserved. The partial fundoplications are reported to have a higher long term failure rate.

**IN THE VAST MAJORITY OF PATIENTS AN INCREASE IN THE NUMBER OF TRANSIENT LOS RELAXATIONS ACCOUNTS FOR REFLUX. IN MANY CASES THE SPHINCTER TONE BETWEEN EPISODES IS NORMAL. HYPOTONICITY OF THE SPHINCTER IS A USEFUL PROBLEM TO IDENTIFY IN MANOMETRIC STUDIES AS THESE PATIENTS HAVE THE MOST TO GAIN FROM ANTI-REFLUX SURGERY.**



# Dilemma

Radiofrequency

is The Best

Benefit 90%

PDT

Photo  
Dynamic  
Therapy

PDT

↑ Residual  
30-50%

Endoscopic  
Mucosal  
Resection

EMR

- Stricture
- Perforation
- Islands

Targets  
Lesions  
not Good



## Barrett's oesophagus

Barrett's oesophagus is a condition characterised by the metaplastic transformation of squamous oesophageal epithelium to columnar gastric type epithelium. Three types of this metaplastic process are recognised; intestinal (high risk), cardiac and fundic. The latter two categories may cause difficulties in diagnosis. The most concrete diagnosis can be made when endoscopic features of Barrett's oesophagus are present together with a deep biopsy that demonstrates not just goblet cell metaplasia but also oesophageal glands.

Barrett's can be sub divided into short (<3cm) and long (>3cm). The length of the affected segment correlates strongly with the chances of identifying metaplasia. The overall prevalence of Barrett's oesophagus is difficult to determine but may be in the region of 1 in 20 and is identified in up to 12% of those undergoing endoscopy for reflux.

A proportion of patients with metaplasia will progress to dysplasia and for this reason individuals identified as having Barrett's should undergo endoscopic surveillance (every 2-5 years). Biopsies should be quadrant and taken at 1-2cm intervals. Biopsies need to be adequate. Where mass lesions are present consideration should be given to endoscopic sub mucosal resection. Up to 40% of patients will be upstaged from high grade dysplasia to invasive malignancy with such techniques.

It would seem sensible to offer acid suppression treatment with proton pump inhibitors to those with Barrett's changes, and it has been shown to induce partial regression of the columnar lined segment. In addition the dilemma arises as to how best treat high grade dysplasia in Barrett's. The options include photodynamic therapy (PDT), radiofrequency ablation, endoscopic mucosal resection and oesophagectomy. In the case of PDT, residual high grade dysplasia may persist in between 30 and 50% of patients.

Radiofrequency ablation confers greater benefit with up to 90% of patients being cleared of high grade dysplasia. The use of sequential EMR may result in stricture formation or perforation and is likely to leave mucosal islands in the event that the complications mentioned are to be avoided and thus its main role probably lies in targeted lesion excision rather than Barrett's eradication. Since not all cases of high grade dysplasia will progress to malignancy the morbidity and mortality of resectional surgery does not seem justified.

There is debate surrounding the management of patients with small, favourable cancers removed during EMR (T1sm). Whilst the likelihood of lymphatic involvement and recurrence in this group is likely to be low the long term data to support this as a treatment strategy are lacking. It may be an option in those with significant co-morbidities who would not withstand a resection.



11

## Dysphagia

The term dysphagia refers to a subjective difficulty in swallowing. Distinction in the history should focus on identifying those with problems in the voluntary or involuntary phases of the swallow cycle. Problems with the voluntary phase are usually the result of underlying neurological abnormality. In these situations patients will not usually describe the obstructive symptoms of food sticking but rather may have difficulty in initiating swallowing. Assessment of these patients is usually undertaken by speech and language therapists. Patients may cough or choke when they swallow, videofluoroscopy is a useful investigation in some cases.

The table below identifies the most common conditions.

<b>Extrinsic</b>	<ul style="list-style-type: none"><li>• Mediastinal masses</li><li>• Cervical spondylosis</li></ul>
<b>Oesophageal wall</b>	<ul style="list-style-type: none"><li>• Achalasia</li><li>• Diffuse oesophageal spasm</li><li>• Hypertensive lower oesophageal sphincter</li></ul>
<b>Intrinsic</b>	<ul style="list-style-type: none"><li>• Tumours</li><li>• Strictures</li><li>• Oesophageal web</li><li>• Schatzki rings</li></ul>
<b>Neurological</b>	<ul style="list-style-type: none"><li>• CVA</li><li>• Parkinson's disease</li><li>• Multiple Sclerosis</li><li>• Brainstem pathology</li><li>• Myasthenia Gravis</li></ul>

Difficulty  
Initiation

## **Schatzki rings**

Schatzki rings are an intrinsic occlusion of the lumen of either the distal oesophagus or OG junction. They are seldom malignant but may cause symptoms of dysphagia. They are fairly common and may be identified in up to 14% of barium swallows. In patients with symptoms attributable to the ring, benefit may be gained from endoscopic dilation.



DD pseudo Acalasia "obstruction 2M to Aesophagus"  
↳ Upper GI Endoscopy

Diffuse Oesophageal Spasm

- Simultaneous, frequent contractions
- Normal LES
- frequent chest pain

Chagas Disease Trypanosoma cruzi

destroy myenteric plexus → South America

Ba Swallow

• Upper Endoscopy

• Manometry Study → Aperistaltic Oesophageal Body

→ incomplete/Absent relaxation of LES

• X-Ray → Absent Gastric Air bubble on all wet swallows  
→ dilated oesophagus

Options

→ pharmacological "Ca Channel Blockers, Nitrates"

- temporizing therapy "Bridge to Surgery"
- poor Surgical Candidates

→ Endoscopic injection of Botox

- Recurrence < 6 months
- poor Candidates for Surgery & Endoscopy

→ Pneumatic Dilatation

- less effective in Young pts
- pt unfit for lap. myotomy

Standard

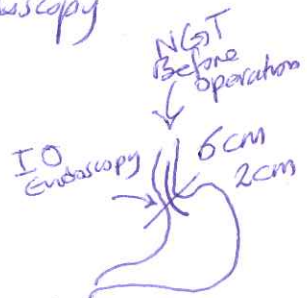
→ Myotomy - < 40y pt "ideal"

- Heller Myotomy + Dor fundoplication

→ trans latal Oesophagectomy

not Done if  
concern that  
myotomy incomplete

- Sigmoid oesophagus & Significant tortuosity or Angulation
- poor emptying inspite of myotomy
- mega oesophagus



## Achalasia

- Loss of ganglion cells in Auerbach's plexus
- Physiologically non-relaxing sphincter and absent peristalsis, emptying occurs via hydrostatic pressure
- Gastric bubble may be absent
- Regurgitation is frequent
- Gold standard for diagnosis is physiology studies
- Histology shows absent ganglion cells in dilated segment and evidence of chronic inflammation
- Treatment is with either Heller's cardiomyotomy or forceful dilatation, a recent trial showed no overall difference in outcomes between the techniques. Outcomes with botulinum toxin are inferior (30% improvement)

The risk of SCC of the oesophagus increases up to 30 fold after 15 years of symptoms. It is unclear whether surgery reduces this risk. The condition usually has a poor prognosis.

## Smooth muscle tumours of the Upper GI tract

Leiomyomas are benign smooth muscle tumours and occur most frequently in the oesophagus. They are usually asymptomatic and most are less than 2cm in size. Lesions which are larger than this should arouse the suspicion of a sarcomatous type lesion. Where the lesion appears benign it is reasonable to confirm the diagnosis with endoscopic ultrasound and repeat this investigation 12 months later to confirm that the lesion is not expanding in size. Lesions suspected of being a sarcoma should be formally staged and generally be managed with a resectional procedure. Symptomatic benign leiomyomas may be enucleated thoracoscopically.



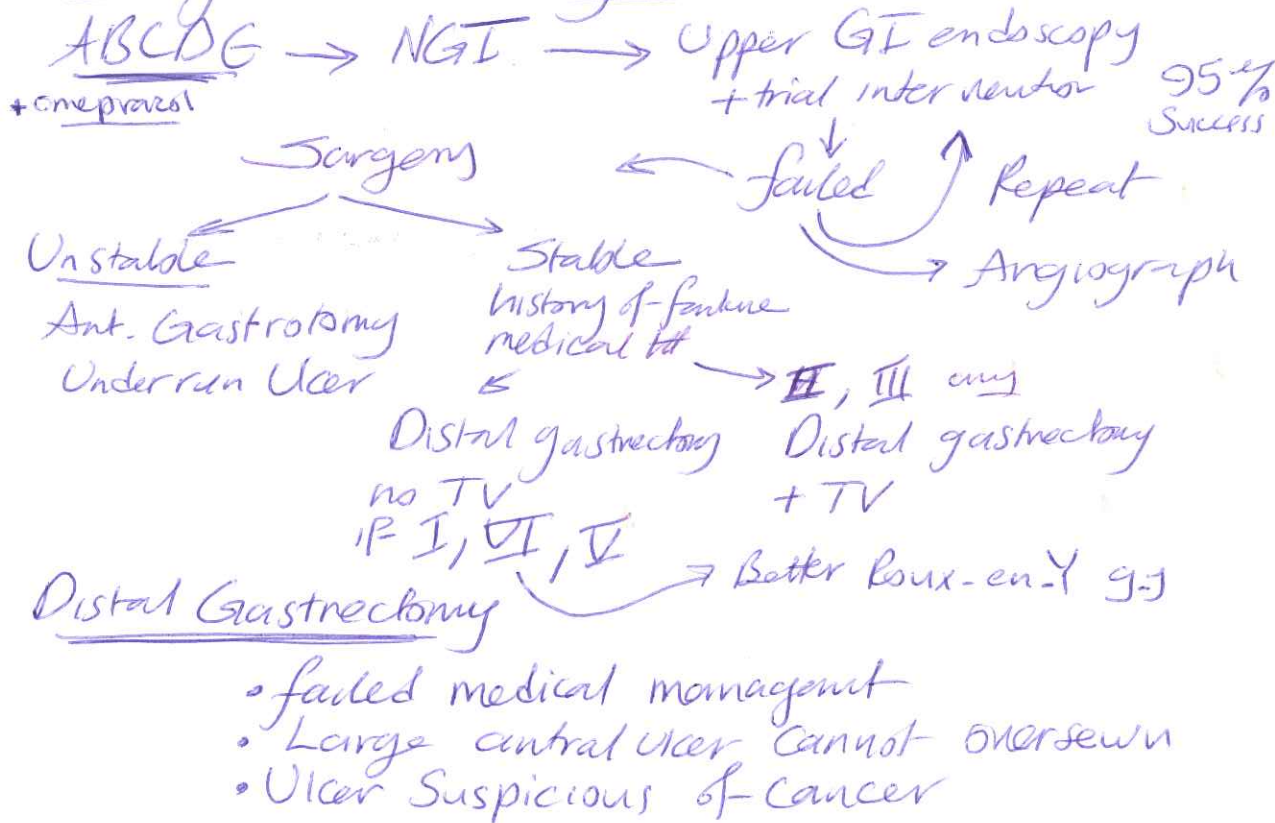
# Bleeding Gastric Ulcer

Aetiology • NSAIDs • H pylori • Zollinger-Ellison  
• neoplasm

## Classification "Modified Johnson"

Type		
I	lesser curve	Etiology varies, Not Related to hyper secretion
II	2 ulcers → stomach → Body of Duodenum	Acid hyper secretion
III	prepyloric	Acid hyper secretion
IV	GE Junction	Varies, Not Related to hypersecret
V	any location	NSAIDs

## Management of Bleeding GU



## By Endoscopy Combined Therapy

Epinephrine injection +  
or  
Thermal Coagulation  
• placement of  
Haemochip

# Causes of upper GI haemorrhage

Causes of upper GI bleeding in patients subjected to upper GI endoscopy.

Finding	Relative frequency	
Peptic ulcer	44%	1
Oesophagitis	28%	2
Gastritis/ erosions	26%	3
Erosive duodenitis	15%	4
Varices	13%	5
Portal hypertensive gastropathy	7%	6
Malignancy	5%	7
Mallory Weiss Tear	5%	8
Vascular malformation	3%	9

In up to 20% of patients subjected to upper GI endoscopy for suspected upper GI bleeds no overt cause is found.

## Forrest classification of peptic Ulcers

			3 days Risk of Rebleeding
1a	Actively Bleeding Ulcer	pulsatile	20%
1b		non-pulsatile	10%
2a	Non Bleeding	Visible vessel	15%
2b		Adherent Clot	<5%
2c		Haematin Covered Base	7
3	not Bleeding	Clean Base	3

During Endoscopy	Active Bleeding	90%
first managed	Visible vessel	50%
management	adherent clot	25%
	"Remove Clot"	



## Bleeding Duodenal Ulcer

again ABCDE → 2 trial of Endoscopy then

### Surgery indications

- 1- Unstable inspite Resuscitation
- 2- Rebleeding after 2 trials of Upper GI
- 3- Continuous slow Bleeding Requiring 3 units of Blood per day

Before operation or GI you may

• Gastrin Serum level

• monoclonal stool antigen test "take 1 hour"

<sup>Sensitivity ↑</sup> rapid Stool antigen test "take 5 minute"

## Perforated Ulcer

Giant Ulcer > 2-3cm options

Depending on:

- patient condition
- size of perforation
- Degree of contamination
- Surgeon Experience

- omental patch
- controlled tube duodenostomy
- jejunal pedicled graft
- jejunal serosal patch
- free omental plug
- partial Gastrectomy
- pyloric Exclusion

# Management of upper gastro-intestinal haemorrhage

Management of upper GI bleeding depends upon the site of the lesion and the stability of the patient. Variceal and non variceal haemorrhage are identified and managed separately in most UK guidance.

Lesion	Treatment
Varices	<p>Lower portal pressure (terlipressin, beta blockers, TIPSS)</p> <p>Endoscopic rubber band ligation</p> <p>Sengaksten tube insertion (if other measures fail)</p>
Haemorrhagic gastritis	<p>Often diffuse bleeding</p> <p>Targeted haemostatic therapy if specific focal bleeding point</p> <p>Argon plasma coagulation if diffuse bleeding</p> <p>Consider anti fibrinolytic (tranexamic acid)</p> <p>Total gastrectomy if in extremis and endoscopic therapy fails</p> <p>All should have PPI</p>
Bleeding gastric ulcer	<p>Dual therapy (e.g. endoclip and adrenaline)</p> <p>PPI infusion post procedure</p> <p>Biopsy to exclude cancer</p> <p>If endoscopic therapy fails may require gastrotomy and over sewing of bleeding point</p> <p>Distally sited large ulcers may require distal gastrectomy</p>
Bleeding gastric cancer	<p>Attempt conventional methods to stop bleeding, definitive cancer surgery best performed electively</p>
Duodenal ulcers	<p>Dual endoscopic therapy (e.g. adrenaline and clip)</p> <p>High dose PPI infusion</p> <p>Ulcer under-running may be required if endoscopy fails</p>



# Management of oesophageal varices

## Grade of varices

Grade	Description
1	Varices that collapse to inflation of the oesophagus with air
2	Varices between grades 1 and 3
3	Varices which are large enough to occlude the lumen

Surgery has no role in primary prophylaxis. Its role in acute variceal bleeding is exceedingly limited, because therapy with endoscopic treatment controls bleeding in 90% of patients. A transjugular intrahepatic portosystemic shunt (TIPSS) is a viable option and is less invasive for patients whose bleeding is not controlled. However, if TIPSS is not available, then staple transection of the oesophagus is an option when endoscopic treatment and pharmacologic therapy has failed.

Consider surgery for the prevention of rebleeding when pharmacologic and/or endoscopic therapy have failed. As per the Baveno II consensus conference on portal hypertension, failure is defined as a single episode of clinically significant rebleeding (transfusion requirement of 2 units of blood or more within 24 hours, a systolic blood pressure < 100 mm Hg or a postural change of >20 mm Hg, and/or a pulse rate greater than 100 bpm)

Secondary prophylaxis is used to prevent rebleeding. Variceal hemorrhage has a 2-year recurrence rate of approximately 80%.

### Nonselective beta-blockers

Propranolol and nadolol significantly reduce the risk of rebleeding and are associated with prolongation of survival. Studies comparing propranolol with sclerotherapy in the prevention of variceal rebleeding demonstrated comparable rates of variceal rebleeding and survival, but sclerotherapy was associated with significantly more complications.

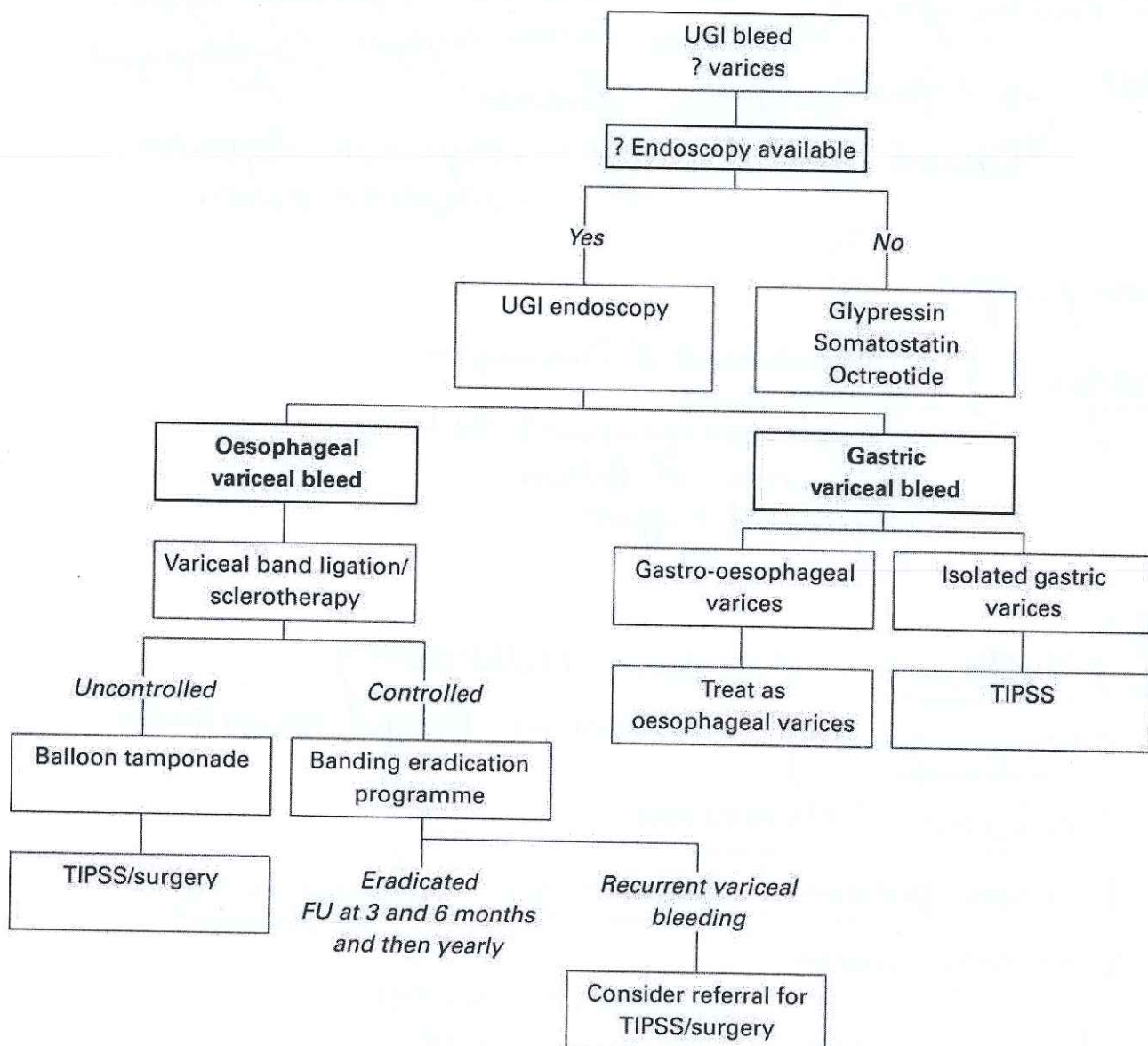
In the UK the British Society of Gastroenterology recommends that propranolol be administered to all patients with grade II and III varices.

### Endoscopic sclerotherapy

Endoscopic sclerotherapy is usually performed at **weekly intervals**. Approximately 4-5 sessions are required for the eradication of varices, which is achieved in nearly 70% of patients.

### Endoscopic variceal ligation

Endoscopic variceal ligation (EVL) is considered the **endoscopic treatment of choice in the prevention of rebleeding**. Sessions are repeated at 7- to 14-day intervals until variceal obliteration (which usually requires 2-4 sessions). This procedure is associated with lower rebleeding rates and a lower frequency of esophageal strictures. **Fewer sessions** are required to achieve variceal obliteration than are required for sclerotherapy.



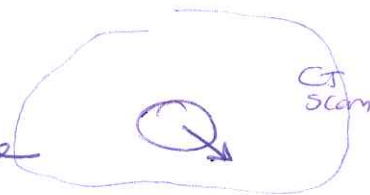


# Boerhaave's Syndrome

Mackler's triad → Subcutaneous Emphysema  
→ Vomiting  
→ Chest pain

Site typically transmural rupture

left posterolateral 2-3cm proximal to GEJ



- Plain Radiographs → Chest Effusion, pneumo hydro-  
→ Abdomen Subcut. Emphysema / Subdiaphragmatic Air
- Contrast → Esophagography 'Route'  
→ Diluted Barium only in high risk Aspiration  
• Suspected fistula
- CT
- Oesophagoscopy

Management

- Debridement & Drainage
- Control leak
- Complete reexpansion of the lung
- prevention of Reflux
- Nutritional Support
- Anti Biotic tt

## Range

- 1<sup>st</sup> closure or out buttressing
- Oesophagectomy immediate vs Delayed reconstruction
- exclusion & diversion
- T-tube placement & Drainage " Distal to the perforation"
- Drainage alone

Closed in 2 layers → mucosa Vicryl  
→ muscle Silk  
→ Reinforcement

## Iatrogenic perforation of the oesophagus

The oesophagus can be damaged either from within such as during endoscopy or may be subjected to external trauma during surgery. Most iatrogenic perforations occur during endoscopy. Endoscopic injury typically occurs at two main sites; proximally at the oesophageal introitus and distally at the site of pathology. The latter is the most common occurrence (80% cases). The overall mortality from iatrogenic perforations is 20%, with patients suffering from advanced underlying malignancy representing the highest risk group.

In many cases the injury is suspected at the time. Cervical perforations will result in neck pain, torticollis and palpable crepitus in the neck. Intra pleural perforations may result in pneumothorax or effusion. Both sub cutaneous emphysema and abdominal signs may be seen with distal perforations, the former typically occurring in those with mediastinal rather than intra pleural perforations.

### Management

Iatrogenic of the cervical oesophagus is usually managed without surgery. Collections should be percutaneously drained, nutritional support implemented and antibiotics administered. Consideration may be given to surgical closure of the defect if early imaging suggests mediastinal communication.

Distal perforations are managed according to the underlying disease. If a tumour is inoperable then a self expanding stent may be inserted to seal the leak. If a patient has operable disease then immediate surgery may be performed. However, this is a high risk strategy.



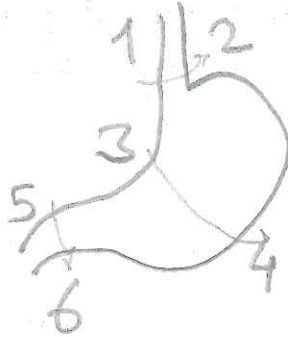
## Caustic injury to the oesophagus

- Injury with alkaline materials is more severe than acids
- Penetration beyond mucosa gives severe injury
- Initial management is supportive, airway control is essential
- Early upper GI endoscopy will help in assessment of severity (see below)

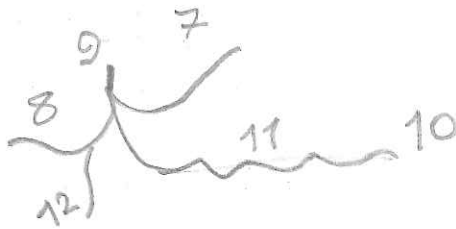
Grade	Description
Grade 0	Normal
Grade 1	Mucosal oedema and hyperaemia
Grade 2a	Superficial ulcers
Grade 2b	Grade 2a plus deep or circumferential ulcers
Grade 3a	Small scattered areas of multiple ulceration and areas of <u>necrosis</u> with brown-black or greyish discoloration
Grade 3b	Extensive necrosis

- 80% of patients with grade 3 burns will develop strictures
- OGD should not usually be performed after 24 hours
- Resectional surgery with delayed reconstruction may be considered in selected severe cases and has superior outcomes compared with conservative management.

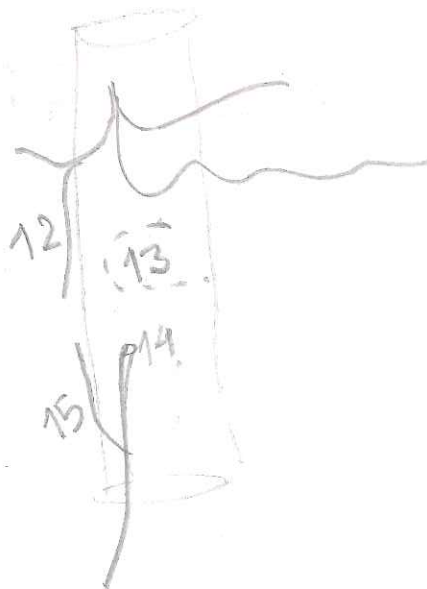
D1



D2



D3



D4



para aortic



## Gastric Cancer

### Gastric cancer nodal stations

Node	Location
1/2	Right, left cardia
3/4	Lesser, greater curvature
5	Suprapyloric
6	Infra pyloric
7	Along left gastric artery
8	Along common hepatic artery
9	Along coeliac axis
10	Splenic hilum
11	Splenic artery
12	Hepatoduodenal ligament
13	Posterior to pancreatic head
14	Root of SMA
15	Along middle colic artery
16	Para-aortic

#### N1 Nodal stations

Right cardia, left cardia, lesser curve, greater curve, suprapyloric, infrapyloric.

#### N2 Nodal stations

Left gastric, hepatic, coeliac, splenic hilum, splenic artery, hepatoduodenal ligament.

- workup → extent of the disease, Clinical Staging  
→ risk stratification
- Personal history "Syndromes" Lynch BRCA FAP
- Normal physical examination usually you may find
  - Krukenberg's tumor
  - Virchow's node
  - Sister Mary Joseph node
  - Pectus Blumner's Shelf
- Jaundice
- Ascites
- Paraneoplastic Syndrome
  - Acanthosis nigricans
  - STP
  - Circinate Erythema
  - Dermatomyositis
  - Sebaceous Keratosis Remphryoid

- Upper GI Endoscopy • ~~Ba study~~ & Biopsy
  - CT scan for staging (chest included if GE tumor)
  - EUS → Depth of tumor & Nodal staging  
→ FNA
  - PET-CT The Best after Ht in 20% of the cases
  - Diagnostic Laparoscopy
    - Liver mets avoiding Non therapeutic operation
    - Doing feeding Jejunostomy
- Rare in selected patients in GE junction or whole Body tumors  
high probability of having distant mets

## Classification

WHO → Adenocarcinoma → intestinal  
→ Diffuse ] Lauren classifier  
→ Papillary  
→ Tubular

→ Mucinous

→ Signet-ring

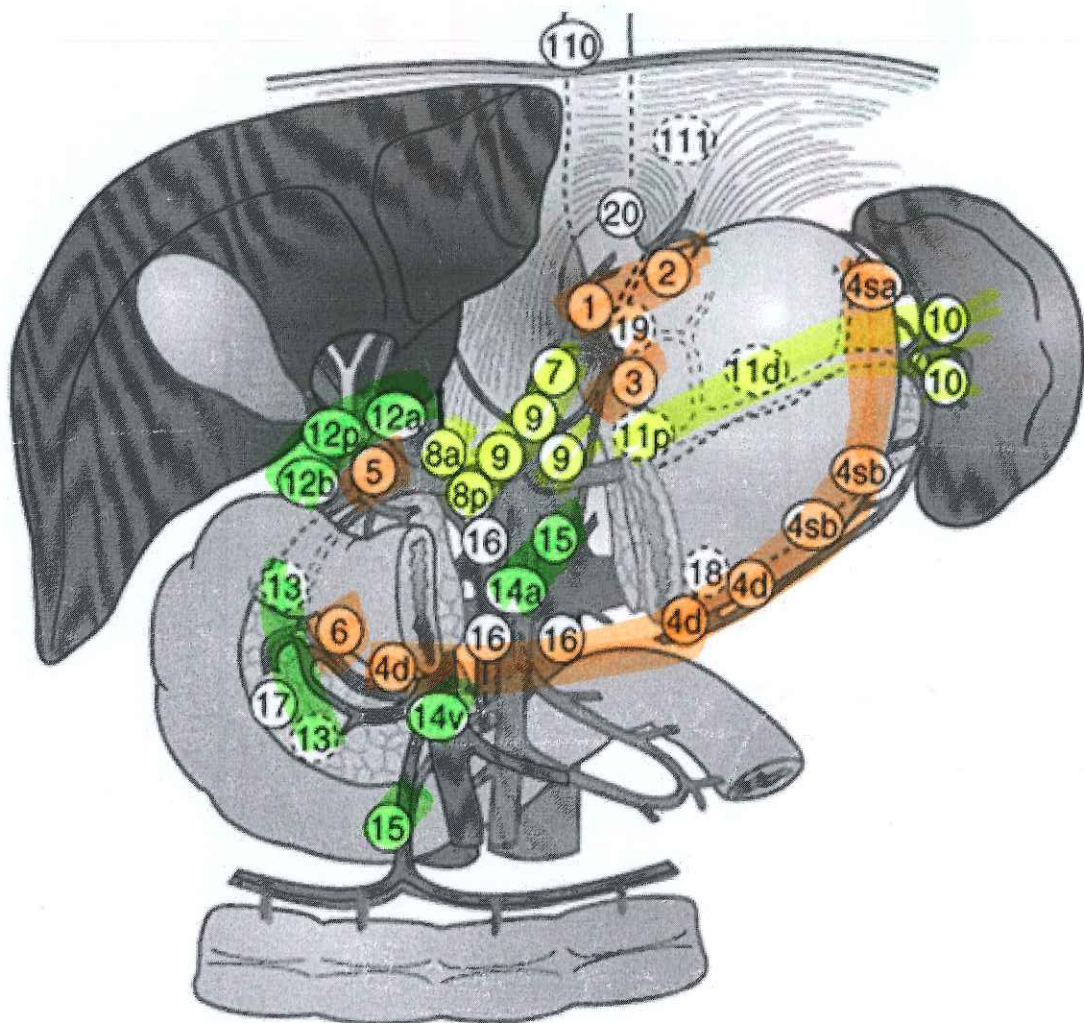
### Clinically

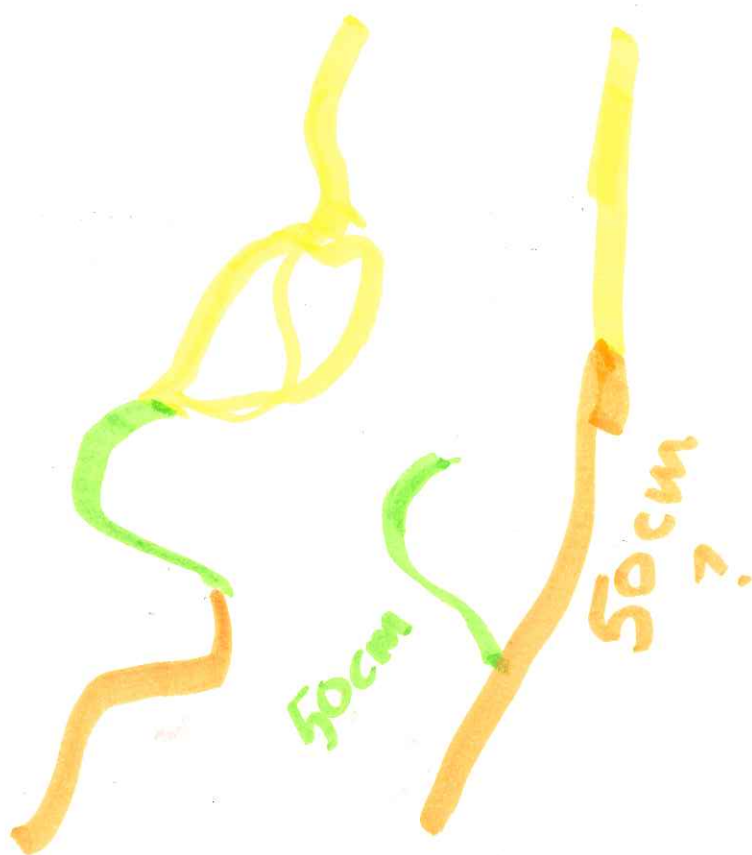
→ early  
→ locoregionally Advanced  
" Resectable  
→ non-resectable  
→ metastatic



## Extent of resection

Resection	Nodes
D1	Perigastric lymph nodes
D2	Common hepatic, left gastric, coeliac axis and splenic artery
D3	Stations 12-15
D4	Para-aortic







## Reconstruction following gastric resection

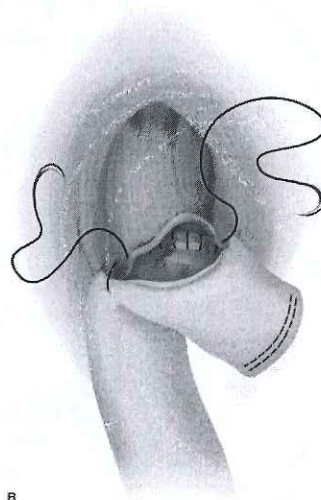
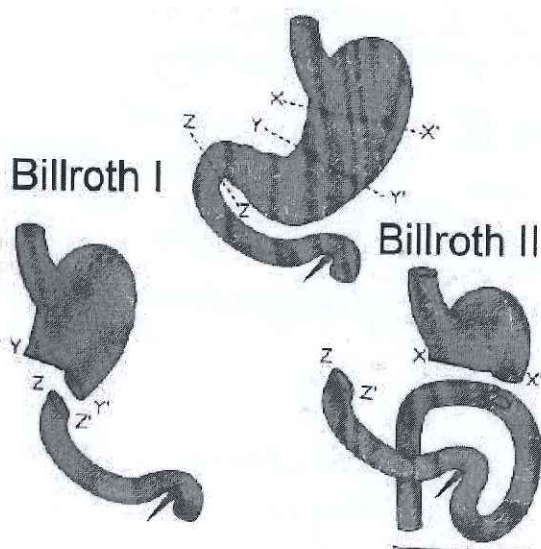
Reconstructive options include those in which duodenal continuity is restored. This is basis of the traditional Billroth I gastrectomy in which the stomach is anastomosed primarily to the duodenum. This is not a technique which is attractive with more advanced tumours as recurrence of the tumour at the gastric bed will lead to gastric outflow obstruction.

The technique favored by most surgeons is a **Roux en Y reconstruction**. In which a segment of jejunum is mobilised and brought up to the stomach or distal oesophagus. Approximately 50cm downstream the duodeno-jejunal loop is anastomosed onto this segment. Shorter lengths may lead to reflux and worsening symptoms.

A gastrojejunostomy type reconstruction is an option where there is a significantly sized gastric remnant. Superior function occurs with those that are retrocolic. Anterior gastrojejunostomy, though technically easier to perform, is associated with considerable disruption to gastric emptying. The exception to this is those cases where a palliative approach is being adopted since the anterior gastrojejunostomy is less likely to be compromised by tumour recurrence.

the optimal length of the proximal jejunum to the point of anastomosis with duodeno-jejunal segment after gastrectomy:

**SHORT LIMBS INCREASE THE RISK OF REFLUX. LONG LIMBS COMPROMISE ABSORPTIVE FUNCTION. A LENGTH OF 40-60 CM IS OPTIMAL.**



Source: Zinner MJ, Ashley SW: *Maingot's Abdominal Operations*, 12th Edition; [www.accesssurgery.com](http://www.accesssurgery.com)

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III early → Tis T1 → Limited to mucosa → Gastrrectomy with D1/D2 lymphadenectomy  
- EMR endoscopic mucosal Resection in selected pts but not Standardized

Locoregionally Advanced Resectable

→ Neoadjuvant therapy then Surgery (MAGIC Trial)

Locoregionally Advanced But initially non resectable

intention to convert in to potentially resectable  
"not yet standardized"

Metastatic → • palliation according to Symptoms

Post operatively → Adjuvant chems radiation & 5FU following R0 Resection of T3, T4  
• Node +ve

• Resection margin f-at least 5cm Due to:  
Spread via Submucosal & Subserosal lymphatics

R0 involves Resection of Tumor + lymphatics + LN + Organs involved

### Siewert type I

- trans hiatal / trans thoracic Oesophagectomy  
+ - proximal Gastrrectomy  
+ - Gastric pull up & cervical/thoracic oesophago-gastrostomy

### Siewert type II

• controversial  
• Intra operative assessment  
• experienced Surgeon + frozen sections for margins  
- Total Gastrrectomy  
or - Trans hiatal Oesophagectomy

### Siewert type III

extended total Gastrrectomy + Segment of Oesophagus

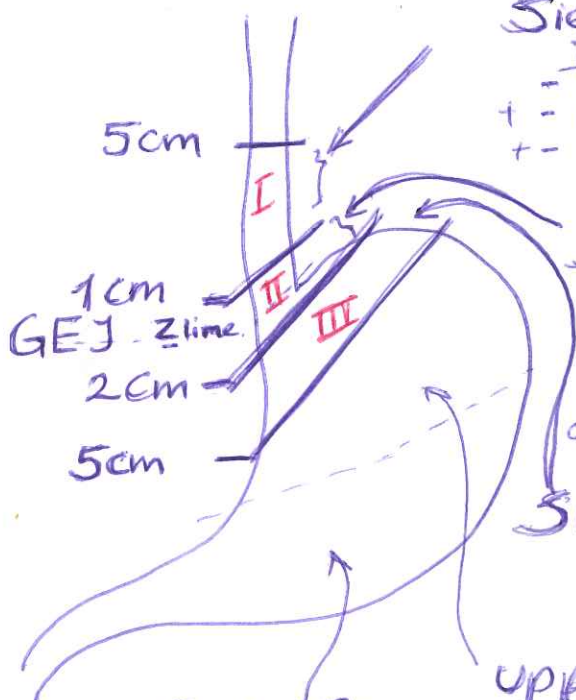
upper 1/3 tumors

- Total Gastrrectomy  
• Oesophago-jejunostomy

Distal 2/3

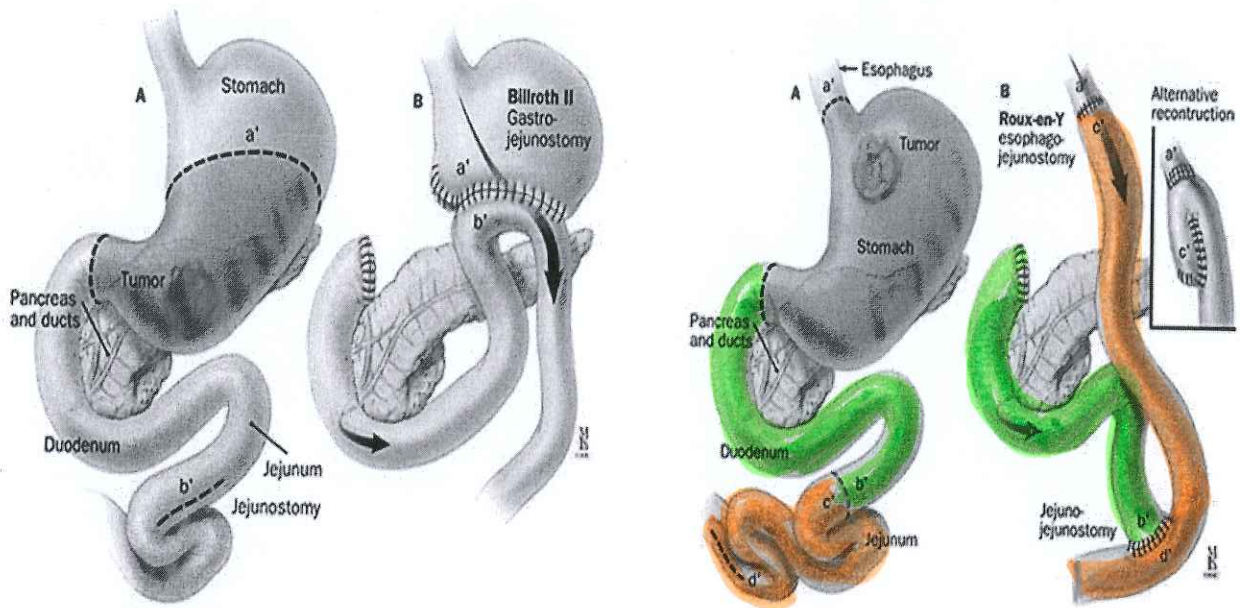
Subtotal Gastrrectomy &

Bilroth II or Roux-en-Y reconstruction





# POSTGASTRECTOMY SYNDROMES



The extent of Lymphadenectomy  
 Till now no survival benefit of D2 over D1  
 , Better D2 after neoadjuvant chemotherapy

15 Lymph node

Postop

NGT → Beyond the anastomosis

POD 2 → Feeding Through Jejunostomy

POD 4 → Drains Removed if Bil & Amylase < 3 times of plasma  
 oral feeding when tolerated

Contrast Swallow if leak suspected

Dietition help - Small frequent meals  
 - multi vitamins

- B12, Iron Supplementation

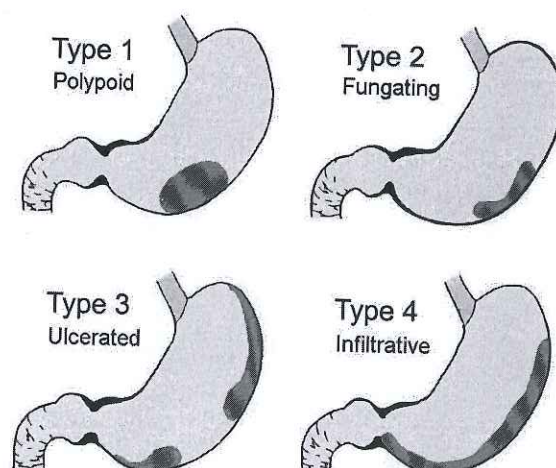
POD 6-7 Discharge

## Duodenal stump leaks

Gastric resections where duodenal continuity is not restored may be complicated by the development of a stump dehiscence. Ischaemia and poor technique are often cited as causative factors. Most surgeons place drains adjacent to the stump following gastrectomy. Leaks in the first few days following surgery are generally best managed by an operative approach. Delayed leaks can usually be managed conservatively by prolonged drainage, nutritional support and antibiotics. Pancreatic secretions can be reduced by the administration of octreotide. Prolonged, high output drainage is usually the sign of distal obstruction and if this is confirmed by imaging then revisional surgery will be required.

## Gastric lymphoma

- The most common cause of gastric lymphoma is gastric involvement with generalised non gastric primary lymphoma
- Primary gastric lymphoma accounts for 5% of all gastric malignancies
- Most primary gastric lymphomas are B cell lymphomas
- Endoscopic features are vague and seldom diagnostic, usually discovered incidentally on biopsy
- Treatment of localised disease is usually surgical resection, systemic disease is treated with chemotherapy
- Disease regression of early lesions has been reported following eradication of *Helicobacter pylori*



Growth patterns of advanced gastric cancer according to the Borrmann classification.



# Junctional oesphagogastric cancer

## Classification

<b>Type I</b>	Distal oesophagus
<b>Type II</b>	Cardia (true junction)
<b>Type III</b>	Proximal stomach

Junctional tumours are difficult to classify and staging should include diagnostic laparoscopy as these tumours may develop peritoneal disease.

Adjuvant treatment is indicated in operable cases.

The surgical approach is to perform either a total gastrectomy with limited transhiatal dissection for more distal lesions. Proximally sited tumours are probably best suited to oesphagogastric resection with thoracotomy. Both gastric and oesophageal nodal stations should be resected.

Lymph node disease patterns in type II junctional cancers:

- Mediastinal 2.1%
- Paraoesophageal 15.6%
- Abdominal 56-72%

Proximal gastric cancers involving the junction are usually best treated with radical gastrectomy and transhiatal dissection. Type I tumours will typically require formal oesophageal resection. Sub mucosal spread of the tumour makes a total gastrectomy with associated tumour sampling a more pragmatic option.

## Polyps

Fundic gland polyp

Hyperplastic polyp

Adenomatous polyp

GTST

Pancreatic heterotopia

Petz-Jeghers

Juvenile

/ ? Carcinoid

→ Inflammatory fibroid?

## Gastritis

Type A

Type B

Reflex gastritis

Erosive gastritis



Stress Ulceration

Moutriers disease "gastropathy"



# Gastric polyps

Gastric polyps are a relatively common lesion identified at upper GI endoscopic examination. The lesions comprise; fundic gland polyps, hyperplastic polyps, adenomas, GIST, pancreatic heterotopia and carcinoids. The majority of other gastric lesions will typically present as exophytic masses rather than polyps. Although, there is, a degree of overlap in some cases.

Polyp type	Key features	Management
Fundic gland polyp 	Most common type of polyp Usually less than 0.5cm in diameter Commonly associated with H Pylori infection and PPI use Many have minimal risk of associated malignancy Lesions associated with polyposis syndromes and large size are higher risk	Endoscopic polypectomy for lesions >1cm Consider polyposis screening if lesions are multiple in young patient Endoscopic follow up may be appropriate
Hyperplastic polyps  chronic atrophic gastritis ~B~	Usually present in atrophic inflamed gastric mucosa Prevalence declining in west as H Pylori now commonly treated Typically occur in the antrum	Eradicate H Pylori if present (lesions often regress) Large polyps (>2cm) at the sites of previous resection have increased risk of dysplasia and should be excised Follow up endoscopy should be considered once causative agent removed Endoscopic surveillance may be required if polyps persist

GIST Usually incidental / Asymptomatic / 3cm  
Symptomatic  $\geq 9$ cm

Upper GI, CT

EUS, FNA, Biopsy is not mandatory

Causes complications  $\rightarrow$  Bleeding, dissemination

indications if - mets, unresectable

- neo Adjuvant therapy considered
- lymphoma is Suspected

types Spindle cell 70%  
Epithelioid 20%  
mixed 10%

Exon 11 70%  
Exon 9 10% poor Clinical Course

Immunohistochemistry KIT Tyrosine Kinase Receptor  
95%

CD 34 or platelet growth factor receptor  $\alpha$  PDGFR $\alpha$   
(CD 117)

III Resection no need for formal or Lymphoectomy  
1cm Gross margin

Imatinib

neo Adjuvant  
Adjuvant  
palliation

Levone  
 $\rightarrow$  Sunitinib

Tyrosine Kinase inhibitor

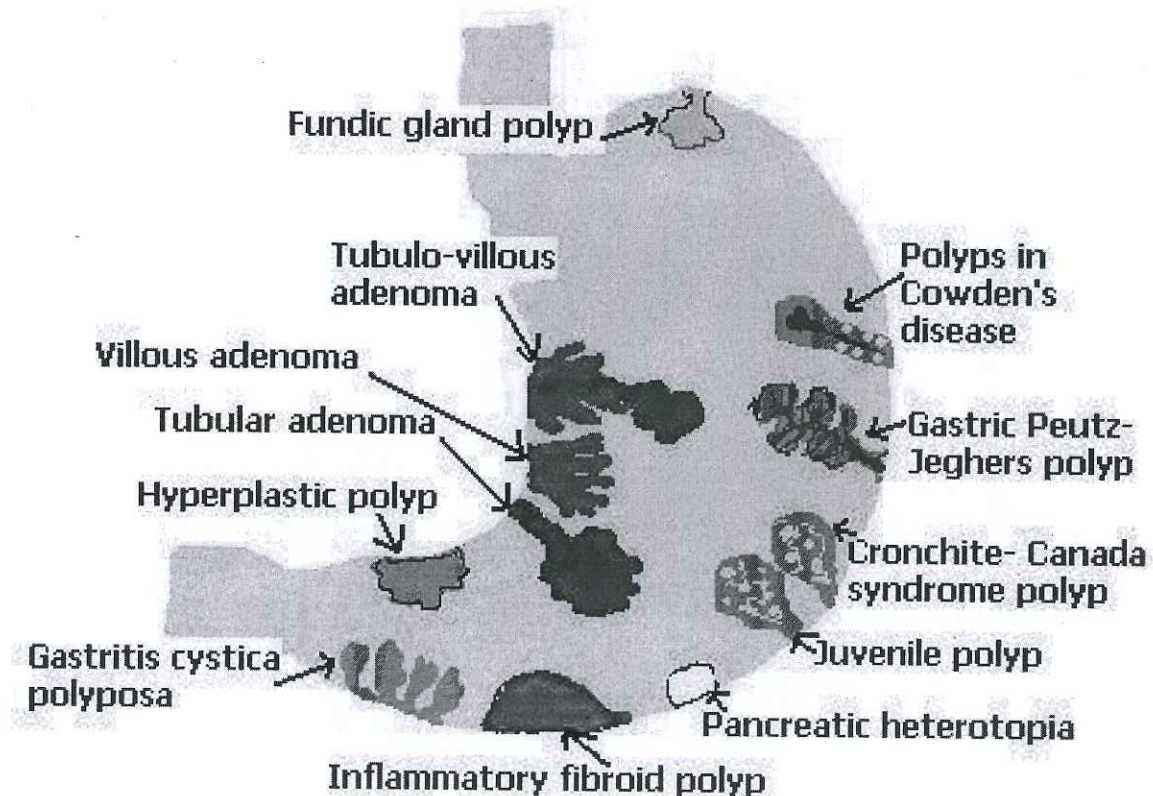
if Recurrent.

Surgery if  $\rightarrow$  emergency  $\rightarrow$  Bleeding, perforation, obstruct  
 $\rightarrow$  resectable, stable or responsive to imatinib  
 $\rightarrow$  focal progression  
may consider removal of resistant tumor  
if not all possible



Adenomatous polyps	May occur <b>sporadically</b> Associated with <b>dysplasia</b> May be pedunculated or sessile Most often associated with chronic gastric metaplasia <b>In polyps &gt;2cm malignancy risk is 50%</b>	<b>Endoscopic resection and subsequent endoscopic follow up</b>
GIST	Often located in <b>sub mucosa</b> and superficial biopsies may be normal	<b>Formal excision (usually surgically) with clear margins</b>
Pancreatic heterotopia	Two main types One type consists of <b>nodules at the OG junction</b> The other type is found in the <b>antrum and has a central dimple</b> Pancreatic tissue is identified histologically in both polyp types	<b>No specific treatment is required</b> All polyps containing pancreatic tissue can develop "pancreatic" diseases

## BENIGN TUMOURS AND TUMOUR- LIKE LESIONS OF STOMACH





## British Society of Gastroenterology guidance on gastric polyps

- All types of gastric polyp detected at endoscopy need to be sampled for which forceps biopsy usually suffices
- Biopsy of intervening non-polypoid gastric mucosa is recommended for all hyperplastic and adenomatous polyps
- If *Helicobacter pylori* is detected in patients with hyperplastic and adenomatous polyps, it should be eradicated
- All gastric polyps with dysplastic foci and symptomatic polyps should be completely removed
- All gastric adenomatous polyps should be removed when safe to do so
- If adenomatous polyps are detected, an examination of the whole stomach should be made for mucosal abnormalities and any such abnormalities should be biopsied
- Repeat gastroscopy should be performed at 1 year for all polyps with dysplasia that have not been removed
- Repeat gastroscopy should be performed at 1 year following complete polypectomy for high risk polyps

Polyp type	Prevalence (frequency relative to other polyps)	Gastric location	Size	Endoscopic appearance	Pathological features of background gastric mucosa	Comments
Fundic gland	13–77%	Fundus and upper body	<1 cm	Smooth, glassy, transparent; usually multiple polyps are found	<i>Helicobacter pylori</i> -associated gastritis is rare	Associated with PPI use; may regress; dysplasia found in patients with FAP
Hyperplastic	18–70%	Random, adjacent to ulcers or stoma sites, or in the cardia if related to acid reflux	Generally <1 cm	Small polyps have a smooth dome; large polyps are lobulated, and erosions are common	Atrophic gastritis with intestinal metaplasia; <i>Helicobacter pylori</i> -associated gastritis (25%)	Found in patients with gastritis; dysplasia is rare (<3%) and found in polyps <2 cm
Adenoma	0.50–3.75% (in Western hemisphere)	<i>Incisura angularis</i> , found more in the antrum than fundus	<2 cm	Velvety, lobular surface; exophytic, sessile or pedunculated; usually solitary (82%)	Atrophic gastritis with intestinal metaplasia	May be accompanied by coexistent carcinoma
Inflammatory fibroid	0.1–3.0%	Submucosal, found near the pyloric sphincter	Median 1.5 cm; generally <3 cm	Single, firm, sessile, well-circumscribed, ulceration is common	Pernicious anemia commonly found; atrophic gastritis	Etiology is believed to be reactive, but genetic mutations are common
Peutz–Jeghers	Rare	Random	<1 cm	Pedunculated with a velvety or papillary surface	Normal	Risk of adenocarcinoma, but rare in gastric polyps
Juvenile	Rare	Found more in the body than in the antrum	Variable	More rounded than hyperplastic polyps; superficial erosions; multiple polyps are usually found	Normal	Polyps may exclusively involve stomach; risk of adenocarcinoma but rare in gastric polyps

Abbreviations: FAP, familial adenomatous polyposis; MEN, multiple endocrine neoplasia; ZES, Zollinger–Ellison syndrome.

Medscape

Source: Nat Rev Gastroenterol Hepatol ©2009 Nature Publishing Group



# Gastritis

Type of gastritis	Features
Type A	<p>Autoimmune</p> <p>Circulating antibodies to parietal cells, causes reduction in cell mass and hypochlorhydria</p> <p>Loss of parietal cells = loss of intrinsic factor = B12 malabsorption</p> <p>Absence of antral involvement</p> <p>Hypochlorhydria causes elevated gastrin levels- these stimulate enterochromaffin cells and these may form adenomas</p> <p><i>3 Acid B</i></p> <p><i>Fundus &amp; body</i></p> <p><i>(hyperplastic polyp)</i></p>
Type B	<p>Antral gastritis</p> <p>Associated with infection with <i>helicobacter pylori</i></p> <p>Intestinal metaplasia may occur in stomach and require surveillance endoscopy</p> <p>Peptic ulceration may occur</p> <p><i>Pylori</i></p> <p><i>Peptic</i></p>
Reflux gastritis	<p>Bile refluxes into stomach, either post surgical or due to failure of pyloric function</p> <p>Histologically evidence of chronic inflammation, and foveolar hyperplasia</p> <p>May respond to therapy with prokinetics</p>
Erosive gastritis	<p>Agents disrupt the gastric mucosal barrier</p> <p>Most commonly due to NSAIDs and alcohol</p> <p>With NSAIDs the effects occur secondary to COX 1 inhibition</p>
Stress ulceration	<p>This occurs as a result of mucosal ischaemia during hypotension or hypovolaemia</p> <p>The stomach is the most sensitive organ in the GI tract to ischaemia following hypovolaemia</p> <p>Diffuse ulceration may occur</p> <p>Prophylaxis with acid lowering therapy and sucralfate may minimise complications</p>
Menetriers disease	<p>Gross hypertrophy of the gastric mucosal folds, excessive mucous production and hypochlorhydria</p> <p>Pre malignant condition</p> <p><i>pH losing gastropathy</i></p>



## CHRONIC ATROPHIC GASTRITIS

### Type A

- A  $\Rightarrow$  Anemia  
Due to pernicious anemia
- Affects "FB"  
Fundus and body
- Low acid secretion  
Achlorhydria  $\downarrow$   
 $\uparrow$  Gastrin secretion
- $\therefore$  G cell hyperplasia
- most common cause of  
macrocytic anemia due to  
B12 deficiency

### Type B

- B  $\Rightarrow$  Bacteria  
Due to Helicobacter pylori
- Affects pro pylorus  $\downarrow$   
and antrum
- Defective mucosal barrier  
due to H pylori  $\downarrow$   
Gastric and duodenal  
ulcers
- Risk of low grade  
B cell malignant  
lymphoma (marginal)

Hyperplastic Polyp

Both types have an increased risk of gastric adenocarcinoma  
(Adapts to chronic inflammation by turning into  
the intestinal mucosa)

chart by Medicowesome





# 1 Risks following Definitive Ulcer Surgery

- 1 Diarrhea
- after truncal vagotomy
  - 5-10% - after 1-2 hours of meals
  - resolve spontaneously
  - medical Cholestyramine  
Loperamide
  - Surgery: Reversed jejunal interposition  
100 cm Distal to Ligament of Treitz

- 2 Dumping Syndrome 5-10% Distal Gastrectomy  
pyloroplasty  
pyloromyotomy
- early 30-60 minutes • Fatigue • palpitation • nausea • vomiting • Diarrhea  
• Light-headed • Cramps
- Late 2-3 hours vasomotor

- 3 - III Octreotides Surgery Reversal needle

- Alkaline Reflux Gastritis after elimination of  
pyloric sphincter operation  
2%  
epigastric pain - nausea

• III Cholestyramine

- 4 or Surgery Billroth II Roux-en-Y GT

- Early Satiety Due to Gastric stasis, Small Gastric Remnant

III prokinetics "erythromycin no metoclopramide"  
increase of TV

- Gastric pacing
- completion Gastrectomy
- Small frequent meals

- 5 following Billroth II

Afferent loop Syndrome | Efferent loop Syndrome

- post prandial epigastric pain
- bilious vomiting
- Epigastric pain
- distension
- bilious vomiting

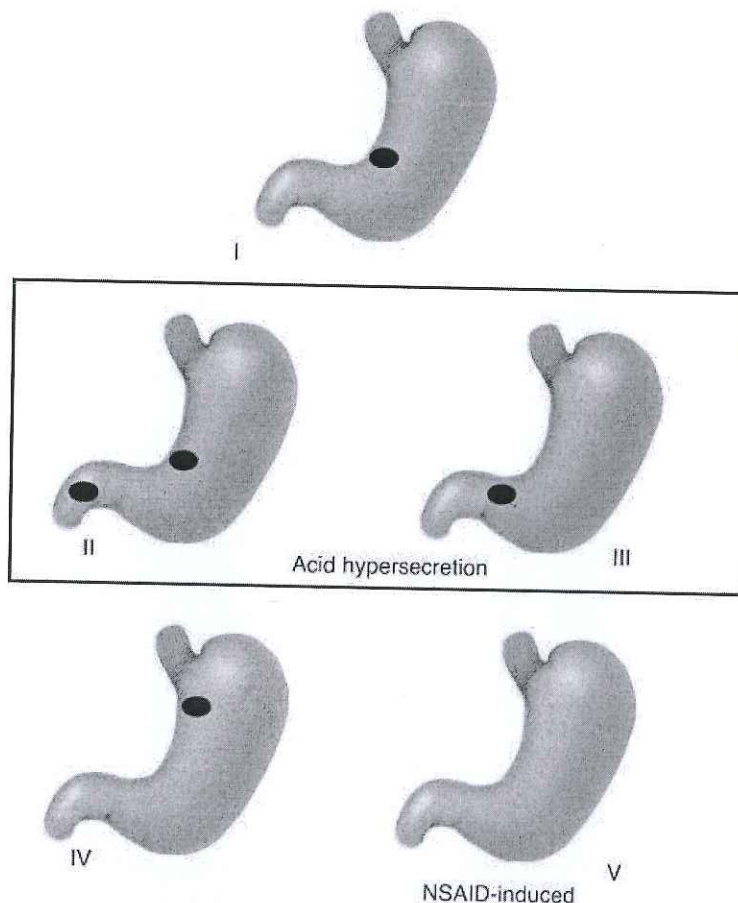
III Surgically

## Benign gastric ulcers- classification

Benign gastric ulcers have traditionally been classified in terms of the anatomical location. Traditionally, the exact anatomical location of ulcers was important because it guided the resectional and acid ablating procedures that preceded the development of PPI therapy.

Type of ulcer-Frequency		Location
I	50%	Body and lesser curvature above the antrum
II	25%	Body of stomach and associated duodenal ulcer
III	20%	Pre pyloric
IV	<10%	Near OG junction

Ulcers of types II and III are most often associated with acid hypersecretion and types I and IV are least associated with this as an underlying aetiology.





# Helicobacter Pylori

Infection with *Helicobacter Pylori* is implicated in many cases of duodenal ulceration and up to 60% of patients with gastric ulceration.

It is a gram negative, helical shaped rod with microaerophilic requirements. It has the ability to produce a urease enzyme that will hydrolyse urea resulting in the production of ammonia. The effect of ammonia on antral G cells is to cause release of gastrin via a negative feedback loop.

Once infection is established the organism releases enzymes that disrupt the gastric mucous layer. Certain subtypes release cytotoxins cag A and vac A gene products. The organism incites a classical chronic inflammatory process of the gastric epithelium. This accounts for the development of gastric ulcers. The mildly increased acidity may induce a process of duodenal gastric metaplasia. Whilst duodenal mucosa cannot be colonised by H-Pylori, mucosa that has undergone metaplastic change to the gastric epithelial type may be colonised by H- Pylori with subsequent inflammation and development of duodenitis and ulcers.

In patients who are colonised there is a 10-20% risk of peptic ulcer, 1-2% risk gastric cancer and <1% risk MALT lymphoma. Conversely, infection is associated with a decreased risk of oesophageal adenocarcinoma (relative risk of oesophageal adenocarcinoma in *H Pylori* positive individuals =0.56; 95% CI =0.46-0.68).

## Testing

Test	Sensitivity	Specificity	Indications
C13/ C14 breath tests	81-100%	80-99%	Diagnosis of infection Confirmation of eradication Cannot be performed if antibiotics administered in previous 4 weeks
Blood tests (IgG)	80-100%	69-95%	Initial diagnosis Cannot confirm eradication
Rapid urease testing (Clo)	80-95%	90-100%	Diagnosis and confirm eradication
Histology	83-95%	90-100%	Gold standard, site specific
Culture	80-90%	95-100%	Gold standard, site specific, difficult to culture

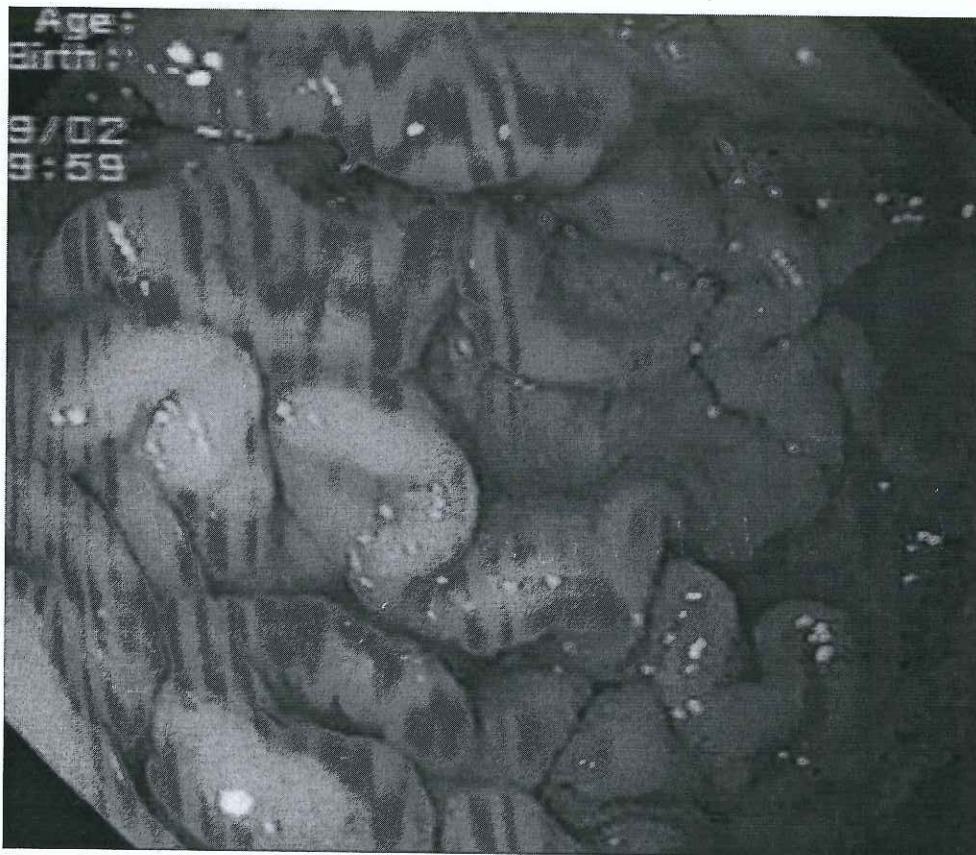


## Menetriers disease

Menetriers disease is a rare form of acquired gastropathy characterised by giant rugal folds in the gastric body, foveolar hyperplasia and markedly decreased or absent oxyntic glands with antral sparing. It typically presents with abdominal pain, vomiting and peripheral oedema. Serum albumin is often low and hypochlorhydria is often present. 2

At endoscopy rugal hypertrophy is present. However, antral sparing of the disease is often seen. An enlarged gastric fold is defined as one which measures greater than 1cm endoscopically, that persists after air insufflation. Deep full thickness biopsies are needed for histological diagnosis as the pit to gland ratio cannot be determined on superficial biopsies.

The risk of malignancy in association with this condition is 10% during a 12 month period. Treatments include cetuximab and/ or gastrectomy.





## Gastric emptying

- The stomach serves both a mechanical and immunological function. Solid and liquid are retained in the stomach during which time repeated peristaltic activity against a closed pyloric sphincter will cause fragmentation of food bolus material. Contact with gastric acid will help to neutralise any pathogens present.
- The amount of time material spends in the stomach is related to its composition and volume. For example a glass of water will empty more quickly than a large meal. The presence of amino acids and fat will all serve to delay gastric emptying.

### Controlling factors

Neuronal stimulation of the stomach is mediated via the vagus and the parasympathetic nervous system will tend to favor an increase in gastric motility. It is for this reason that individuals who have undergone truncal vagotomy will tend to routinely require either a pyloroplasty or gastro-enterostomy as they would otherwise have delayed gastric emptying.

The following hormonal factors are all involved:

Delay emptying	Increase emptying
Gastric inhibitory peptide	Gastrin
Cholecystokinin	
Enteroglucagon	

### Diseases affecting gastric emptying

All diseases that affect gastric emptying may result in bacterial overgrowth, retained food and eventually the formation of bezoars that may occlude the pylorus and make gastric emptying even worse. Fermentation of food may cause dyspepsia, reflux and foul smelling belches of gas.

### Iatrogenic

Gastric surgery can have profound effects on gastric emptying. As stated above any procedure that disrupts the vagus can cause delayed emptying. Whilst this is particularly true of Vagotomy this operation is now rarely performed. Surgeons are divided on the importance of vagal disruption that occurs during an oesophagectomy and some will routinely perform a pyloroplasty and other will not.

When a distal gastrectomy is performed the type of anastomosis performed will impact on emptying. When a gastro-enterostomy is constructed, a posterior, retrocolic gastroenterostomy will empty better than an anterior one.

### **Diabetic gastroparesis**

This is predominantly due to neuropathy affecting the vagus nerve. The stomach empties poorly and patients may have episodes of repeated and protracted vomiting. Diagnosis is made by upper GI endoscopy and contrast studies, in some cases a radio nucleotide scan is needed to demonstrate the abnormality more clearly. In treating these conditions drugs such as metoclopramide will be less effective as they exert their effect via the vagus nerve. One of the few prokinetic drugs that do not work in this way is the antibiotic erythromycin.

### **Malignancies**

Obviously a distal gastric cancer may obstruct the pylorus and delay emptying. In addition malignancies of the pancreas may cause extrinsic compression of the duodenum and delay emptying. Treatment in these cases is by gastric decompression using a wide bore nasogastric tube and insertion of a stent or if that is not possible by a surgical gastroenterostomy. As a general rule gastroenterostomies constructed for bypass of malignancy are usually placed on the anterior wall of the stomach (in spite of the fact that they empty less well). A Roux en Y bypass may also be undertaken but the increased number of anastomoses for this in malignant disease that is being palliated is probably not justified.



DD

## Chole lith iasis if Symptomatic

- Haemolysis
- Elevated Liver enzymes
- Low platelets
- PV • Pancreatitis • Appendicitis
- Acute fatty liver • Hepatitis

### Historically

- IV antibiotics
- Bowel rest
- narcotics
- Broad spectrum Antibiotics

operation at any time of pregnancy

Because recurrence as high as

92 % in 1st trimester

64 % in 2nd Trimester

44 % in 3rd Trimester

if needed ERCP can be Done in

## Chole docho lith iasis

• minimal Radiation  
Exposure  
& Shielding

# Abdominal pathology in pregnancy

The same causes of an acute abdomen encountered in routine surgical practice may also occur in pregnancy. However, complication rate in this situation are far higher. This is because of diagnostic delays and occasional reluctance to proceed with treatment.

Appendicitis is the most common non obstetric cause of abdominal pain in pregnancy resulting in laparotomy and the foetal loss rate approaches 35%. Because of diagnostic uncertainty the perforation rate is 55% (hence the high rate of foetal loss). For this reason, many consider a negative laparotomy rate of 35% an acceptable compromise in the pregnant women.

Biliary disease is also common in pregnancy and gallstones may form as a complication of biliary stasis (progesterone causes reduced gallbladder contraction). Acute cholecystitis occurs in 8/100,000 pregnancies and early surgery (in the second trimester) is usually advised.

*Better  
at any  
time  
USA*

Pancreatitis may occur in the pregnant women (1 in 1000). The two most common causes are gallstones and hypertriglyceridaemia. Cholesterol secretion in the hepatic bile increases in the second and third trimester compared to bile acids and phospholipids, leading to supersaturated bile; in addition, fasting and postprandial gallbladder volumes are greater, with reduced rate and volume of emptying. This large residual volume of supersaturated bile in the gallbladder of the pregnant patient leads to the retention of cholesterol crystals and eventual gallstones. The formation of biliary sludge and stones is strongly associated with frequency and number of pregnancies.

Up to 10% of patients develop stones or sludge over the course of each pregnancy, with obesity and increased serum leptin being risk factors. After delivery gallbladder motility becomes normal when sludge as well as stones may disappear.

Diagnosis of pancreatitis is similar to that of the non pregnant women and amylase levels are only mildly affected by pregnancy and lipase levels should not alter at all. The main controversies centre on which procedure should be used to clear the CBD of stones, although most agree that if pancreatitis was severe, then ERCP should be used, in spite of the radiation risk.



# HepatoBiliary

## Bile

Bile is produced at a rate of between 500ml and 1500mL per day. Bile is composed of bile salts, bicarbonate, cholesterol, steroids and water. There are three main factors regulating bile flow; hepatic secretion, gall bladder contraction and sphincter of oddi resistance. Bile salts are absorbed in the terminal ileum (and recycled to the liver). Over 90% of all bile salts are recycled in this way, such that the total pool of bile salts is recycled up to six times a day.

### Primary bile salts

Cholate and chenodeoxycholate.

### Secondary bile salts

Formed by bacterial action on primary bile salts. These are deoxycholate and lithocholate. Of these deoxycholate is reabsorbed, whilst lithocholate is insoluble and excreted.

### Pathophysiology of gallstones

Bile salts have a detergent action. They aggregate to form micelles and these have a lipid centre in which fats may be transported. Excessive quantities of cholesterol cannot be transported in this way and will tend to precipitate, resulting in the formation of cholesterol rich gallstones.

*The total size of the bile acid pool is decreased following cholecystectomy. This is because the gallbladder has a storage function that is lost post operatively. Because bile is not stored it flows continuously into the duodenum. and enterohepatic recycling is increased. For these reasons although surgery reduces the size of the bile acid pool it improves the solubility of cholesterol in bile.*

Chlonorchis  
sinensis

asymptomatic

↓  
Expectantly

→ very  
Fruit  
US chole-stomy

Intra op. cholangiogram

↓  
+ve

↙  
Duct > 8mm  
Stone > 5mm  
↘  
Stone < 5mm  
leave it

→ trans cystic  
Explor.

→  
Early  
ERCP  
in One Day  
or So  
post op.

↓ Fail  
formal Explor.



## Gallstones

Up to 24% of women and 12% of men may have gallstones. Of these up to 30% may develop local infection and cholecystitis. In patients subjected to surgery 12% will have stones contained within the common bile duct. The majority of gallstones are of a mixed composition (50%) with pure cholesterol stones accounting for 20% of cases.

The aetiology of CBD stones differs in the world, in the West most CBD stones are the result of migration. In the East a far higher proportion arise in the CBD de novo.

The classical symptoms are of colicky right upper quadrant pain that occurs post prandially. The symptoms are usually worst following a fatty meal when cholecystokin levels are highest and gallbladder contraction is maximal.

### Investigation

In almost all suspected cases the standard diagnostic work up consists of abdominal ultrasound and liver function tests. Of patients who have stones within the bile duct, 60% will have at least one abnormal result on LFT's.

Ultrasound is an important test, but is operator dependent and therefore may occasionally need to be repeated if a negative result is at odds with the clinical picture. Where stones are suspected in the bile duct the options lie between magnetic resonance cholangiography and intraoperative imaging.

The choice between these two options is determined by the skills and experience of the surgeon. The advantages of intra operative imaging are less useful in making therapeutic decisions if the operator is unhappy about proceeding the bile duct exploration and in such circumstances pre operative MRCP is probably a better option.

### Treatment

Patients with asymptomatic gallstones rarely develop symptoms related to them (less than 2% per year) and may therefore be managed expectantly. In almost all cases of symptomatic gallstones the treatment of choice is cholecystectomy performed via the laparoscopic route. In the very frail patient there is sometimes a role for selective use of ultrasound guided cholecystostomy.

During the course of the procedure some surgeons will routinely perform either intra operative cholangiography to either confirm anatomy or to exclude CBD stones. The latter may be more easily achieved by use of laparoscopic ultrasound. If stones are found then the options lie between early ERCP in the day or so following surgery or immediate surgical exploration of the bile duct. When performed via the trans cystic route this adds little in the way of morbidity and certainly results in faster recovery. Where transcystic exploration fails the alternative strategy is that of formal choledochotomy. The exploration of a small duct is challenging and ducts of less than 8mm should not be explored. Small stones that measure less than 5mm may be safely left and most will pass spontaneously.



# Acute cholecystitis | RUQ Pain + Fever + AWBC

US → peri cholecystic fluid  
→ Normal Caliber CBD  
→ Sonographic Murphy's Sign

leucocytosis & neutrophilia helps to  
Distinguish it from Biliary colic

Hepato biliary  
Imino  
diacehic  
Acute

HIDA scan  
is the Gold Standard  
• Unvisualized GB after 60 minutes  
is Diagnostic for cholecystitis  
• measurement of Ejection fraction "EF"  
by HIDA allows identification of  
Biliary Dyskinesia

III Early operation, whatever the  
Timing of presentation  
Lap chole → 100% conversion Rate  
→ cholecystostomy "critically ill"  
→ Subtotal chole.  
"partial"

persistent Abdominal

Pain, Fever, hyperbilirubinaemia

- CBD retained Stone

- Biliary leak

- Biliary Injury

→

US

→ collections

→ Dilatation

→ ERCP

→ CT for Percutaneous  
Drainage



### **Timing of surgery in acute cholecystitis**

Patients with acute cholecystitis should generally undergo surgery early in their illness unless there are compelling contra indications (2).

### **Risks of ERCP**

- Bleeding 0.9% (rises to 1.5% if sphincterotomy performed)
- Duodenal perforation 0.4%
- Cholangitis 1.1%
- Pancreatitis 1.5%

# Development of gallstones

## Cholesterol stones

- Cholesterol synthesised by HMG Co A reductase, the action of 7 $\alpha$  hydroxylase leads to subsequent bile acid formation.
- Solubility of cholesterol in bile depends upon bile acids and the phospholipid lecithin. This phospholipid structure aggregates around cholesterol (which is usually insoluble). A careful balance helps prevent gallstone aggregation.
- Stones develop because of cholesterol saturation (combination of obesity and hormonal influence), nucleation (see below) and subsequent stone growth.
- Marked mucin hypersecretion occurs early in gallstone growth. The subsequent gel matrix may trap cholesterol crystals. These cholesterol monohydrate crystals aggregate and stones form. Removal of the gallbladder prevents mucin secretion and prevents cholesterol aggregation.

## Pigment stones

- In the Western world, 30% of patients have black pigment stones
- Brown pigment stones commonest in Asia and reside outside the gallbladder (i.e. bile duct)
- Black pigment stones form within sterile gallbladder, they are comprised largely of calcium bilirubinate
- Normally most bilirubin, the breakdown product of hemoglobin, is conjugated in the liver to bilirubin monoglucuronide and subsequently to water-soluble bilirubin diglucuronide. Unconjugated bilirubin is poorly soluble in water. In case of hemolysis, biliary excretion of bilirubin may increase 10-fold with increased risk of calcium bilirubinate precipitation. This phenomenon explains the high prevalence of black pigment stones in chronic haemolytic disorders, such as sickle cell anemia, hereditary spherocytosis, and Gilbert syndrome.
- Brown pigment stones form in bile ducts, they are composed of unconjugated bilirubin and calcium salts, protein and cholesterol levels vary. They commonly occur in association with infection and biliary parasites.

*Brown pigment stones have the highest incidence of being located in the CBD. They are also the most prone to infective complications. Black pigment stones are more closely associated with an underlying metabolic disorder.*

**TPN IS MORE TYPICALLY ASSOCIATED WITH PIGMENT RATHER THAN CHOLESTEROL GALLSTONES.**



**PATIENTS WITH TERMINAL ILEAL RESECTION HAVE IMPAIRED ENTEROHEPATIC RECYCLING AND DEVELOP CHOLESTEROL STONES.**

*The loss of bile salts which are not reabsorbed results in cholesterol supersaturation of bile, this can predispose to cholesterol stone formation. This matter has been contested over the years but cholesterol rich stones are probably most likely.*

**Acute acalculary cholecystitis** In a frail, elderly patient a **percutaneous cholecystostomy** is a reasonable option as surgery can be challenging and may result in either an open conversion to a sub total cholecystectomy or a cholecystostomy. Percutaneous decompression may be preferable, the route chosen by the radiologist is often a matter for debate, **trans hepatic drains cause fewer problems if they fall out following insertion (but the insertion is more dangerous).** **Trans abdominal drains can result in biliary peritonitis if they fall out too soon.**

# On OTC Table Cholangiogram

## Cholangitis

Tokyo guidelines for  
Diagnosis

Charcot's triad

→ Fever  
→ Pain  
→ Jaundice

• Reynolds  
pentad  
confusion  
hypotension

↓ 2 of charcot's +

- Laboratory evidence of inflammation  
↑ WBC, ↑ CRP, ↑ ESR

- Abnormal LFT's +

- Abnormal imaging studies

Biliary Dilatation, inflammation, etiology

→ Stone  
→ Stent  
→ Malignancy

anti Biotics Quinolone + metronidazole  
or Tazocin

Decompression ERCP, PTC

Surgical "historical" But if  
Post Rou-en-Y Gastric operation  
& no expertise to do PTC



## Common bile duct stones

In the West CBD stones typically originate in the gallbladder and migrate into the CBD. Primary CBD stones may develop de novo and underlying parasitic infections are a recognised precipitant. The incidence of CBD stones in patients with symptomatic gallstone is approximately 10-20%. In those patients with normal CBD on USS and normal LFTs the incidence of CBD stones at the time of cholecystectomy is unlikely to exceed 5% and is the rationale for not performing OTC as a routine.

The diagnosis of CBD stones is suggested by dilated ducts on USS and deranged LFTs in the presence of gallstones. USS in itself is not a sensitive test for CBD stones. The gold standard investigation for CBD stones are usually taken to be ERCP or on table cholangiography (though these too, can have a false positive). The greatest risk factors for CBD stones being found at ERCP include; age >55 years, dilated ducts on USS and serum bilirubin >30 g /L, in such patients the likelihood of finding a stone is 70%.

**IN PATIENTS AGED LESS THAN 55 YEARS WITH NORMAL CBD ON USS AND NORMAL LFT'S THE INCIDENCE OF CBD STONES IS 5%.**

### Locating CBD stones

The best investigations for identifying CBD stones include MRCP and EUS. The latter is invasive and highly operator dependent and as a result MRCP remains the most popular and accurate modality. CT cholangiography has not demonstrated equivalent accuracy (1).

### Treating CBD stones

The choices lie between endoscopic removal (together with sphincterotomy) and laparoscopic exploration of the CBD. There is no evidence to recommend one technique over the other and thus the choice of approach remains the discretion of the operating surgeon (2). Where laparoscopic CBD exploration is performed there is no standard mandate for routine insertion of a T Tube.

### Cholecystectomy or not?

Once the CBD is cleared the decision has to be taken as to whether to proceed with removal of the gallbladder. Previous studies have shown that up to 64% can remain asymptomatic following endoscopic duct clearance alone, a persuasive figure in patients with high morbidity. However, the 36% who run into problems can develop considerable morbidity and it is for this reason that most would recommend surgery once the CBD is clear (4).



Total Bilirubin may be normal  
or slightly elevated

AST, ALT may high Due to vascular injury

PTC should be performed in all patients with  
suspected bile duct injury in whom  
ERCP is not technically feasible or not definitive

## Bismuth - Strasberg

Type A Leak from Cystic duct  
or Accessory hepatic duct

Endoscopic Sphincterotomy  
& Endobiliary Stent  
ERCP

Type B Ligation of posterior  
segment hepatic duct

hepatico jejunostomy  
in Symptomatic PG.

Type C Bile leak from injured  
posterior hepatic duct

PTC +  
hepatico jejunostomy

Type D lateral injury of  
in complete transection

ERCP  
H-J if refractory

Type E Circumferential injury  
Ligation, transection

PTC +  
hepatico jejunostomy

- 1 > 2cm
- 2 < 2cm
- 3 confluence
- 4 above confluence
- 5 = 6 + others

Recognized intra operative → Do nothing  
Expertise, Vascular Inj, hemodynamics  
Thermal, injury understood

48-72 hours, pt clinically well  
injury understood

After 72 Drain and operation  
6 to 8 weeks



# Bile duct strictures

## Aetiology

Most benign bile duct strictures are the result of iatrogenic injury during surgery. The commonest cause of malignant strictures is pancreatic cancer. The underlying disease process will determine the tempo of onset. In most cases it is only once the stricture is sufficiently narrow to restrict biliary flow that symptoms will occur. Cholangitis may occur in severe cases and is more likely in benign rather than malignant processes.

The etiology of bile duct strictures is sometimes obvious at the time of presentation. In unclear cases, clues from the patient's history may help in making an accurate diagnosis. Most of the benign biliary strictures following injury during cholecystectomy go unrecognized at the time of surgery (as many as 75% of cases). Presentation after more than 5 years may occur in 30% of cases; therefore, a history of recent or past cholecystectomy should be sought in all cases. Information about the postoperative period, especially excessive drainage from surgical wounds and drains and episodes of fever, jaundice, and abdominal distention, are important in patients presenting shortly after surgery.

The location of benign strictures resulting from cholecystectomy varies according to the nature of the surgery. In open procedures the CBD is the commonest site, in laparoscopic procedures the lesions are often shorter and located at the level of the common hepatic duct.

Other causes of strictures include primary sclerosing cholangitis, with strictures, beading, and irregularities of the intrahepatic and extrahepatic bile ducts. Approximately 70% of PSC cases are associated with inflammatory bowel disease. The extent and distribution of bile duct involvement is variable.

Abdominal radiotherapy, HIV/ AIDS, liver transplantation, trauma and recurrent sepsis are also recognised as being causes.

## Diagnosis

- USS --->MRCP --->ERCP
- CT scanning to exclude extrinsic malignancy
- LFT's and tumour markers

## Treatment

Biliary decompression, usually via ERCP. Non resectable malignant strictures are best palliated with metallic stent insertion. Treatment of PSC is palliation with repeated stenting and decompressive episodes until the patient comes to transplantation. Treatments for benign strictures include stents or surgical bypass. Choosing between these options depends upon the site of the lesion and the status of the patient.

# Cholecystoduodenal fistula

- considered in elderly & IO
- Abdominal film, US, CT

Rigler's triad

- pneumobilia
- obstruction
- ectopic gallstone

- / Exploration with aim  
Clear all stones from GIT
- / Cholecystectomy & fistula take down  
Rarely indicated



## Haemobilia

Hemobilia is defined as bleeding into the biliary tree from an abnormal communication between a blood vessel and bile duct. It is a rare condition that is often difficult to distinguish from common causes of gastrointestinal bleeding. The most common causes of hemobilia in modern times are iatrogenic trauma, accidental trauma, gall-stones, tumors, inflammatory disorders, and vascular disorders.

Portal venous bleeding into the biliary tree is rare, minor, and self-limited unless the portal pressure is elevated. Arterial hemobilia, the most common source, can be dramatic, however. Clinical sequelae of hemobilia are related to blood loss and the formation of potentially occlusive blood clots in the biliary tree. The classic triad of symptoms and signs of hemobilia are upper abdominal pain, upper gastrointestinal hemorrhage, and jaundice.

When hemobilia is suspected, the first evaluation is upper gastrointestinal endoscopy, which rules out other sources of hemorrhage and may visualize bleeding from the ampulla of Vater. Upper endoscopy is only diagnostic of hemobilia in about 10% of cases, however. If upper endoscopy is diagnostic and conservative management is planned, no further studies are necessary. Ultrasound or CT may be helpful in demonstrating intrahepatic tumor or hematoma. Evidence of active bleeding into the biliary tree may be seen on contrast-enhanced CT in the form of pooling contrast, intraluminal clots, or biliary dilation. CT may also show risk factors associated with hemobilia, such as cavitating central lesions and aneurysms. Arterial angiography is now recognized as the test of choice when significant hemobilia is suspected and will reveal the source of bleeding in about 90% of cases. Cholangiography demonstrates blood clots in the biliary tree, which may appear as stringy defects or smaller spherical defects. The latter may be difficult to distinguish from stones.

The treatment is directed to the underlying cause.

pain  
jaundice  
mass

## Choledochal cysts

Choledochal cysts most commonly present in the first year of life. The classical symptoms and signs consist of right upper quadrant pain, jaundice and right upper quadrant mass. They are rarer in the West with an incidence of 1 in 200,000.

### Todani classification

Cyst type	Features
Type 1	Most common Fusiform dilation of the common bile duct
Type 2	Diverticulum of the common bile duct
Type 3	Choledochoceles
Type 4	Second most common Cyst extension in to intra-hepatic ducts
Type 5	Intra- hepatic cystic disease with no choledochal cyst

### Complications of cysts

The major concern is the increased risk of malignancy in association with the cyst. The risks are lower in the West. However, an association with cholangiocarcinoma is recognised. For this reason the usual treatment of choledochal cysts is excision of the cyst, rather than simple drainage procedures. Reconstruction of the biliary system with hepaticojejunostomy may be required. Formal liver resection for intra hepatic disease may be needed.



# Hepatocellular carcinoma

Hepatocellular carcinoma is the second leading cause of cancer deaths globally. Up to 750,000 cases are reported annually. Unfortunately the incidence approximates to the death rate so there are few long term survivors[1]. The disease occurs most commonly in those with chronic hepatitis and established liver cirrhosis. Therefore, these individuals should be closely screened for the development of HCC with serum AFP and liver USS every 6-12 months. Rising AFP and liver USS showing a nodule greater than 1cm in diameter makes HCC much more likely and such patients should then undergo MRI scanning.

The presence of adenomas in an otherwise healthy liver is a recognised risk factor for HCC [2, 3] and many surgeons will remove liver adenomas for this reason[4].

## Diagnosis

The aim is to avoid unnecessary percutaneous biopsy. Radiologically on CT the classical feature is a suspicious lesion which is highlighted during the arterial phase with washout during the venous phase, this reflects the hypervascularity of the lesions. The risk of tumour seeding as a result of a liver biopsy is 2.7% with a median time interval between biopsy and seeding of 17 months[5]

## Barcelona Clinic Liver Classification

There are many classification systems for addressing the management and prognosis, the BCLC system has the convenience of categorising disease extent with treatment and prognostic outcomes. In determining the ideal treatment modality for HCC the key points are not just disease extent, but also the functional state of the liver and patient.

⇒⇒ Doxo rubi cin

⇒ Sora fe nib



Stage	Features	Treatment	Prognosis-5 yr survival
Stage 0	Child-Pugh A Single lesion (less than 2cm) Normal portal pressures	Resection	<u>40-70%</u>
Stage A	Single nodule greater than <u>3cm</u> or multiple nodules (no more than 3) Child Pugh A/ B	If associated disease then radiofrequency ablation If no associated disease then transplantation	May be up to 70% in some
Stage B	Multiple nodules Child Pugh A/B	Trans arterial chemo-embolisation (usually with doxorubicin)	26% at 3 years
Stage C	Advanced tumours Invasion of portal vein Child Pugh A/B	Sorafenib	Usually survive 10.7 months
Stage D	Child Pugh stage C Advanced tumours	Best supportive care	Less than 6 months survival

In selected patients the best outcomes are achieved with surgical resection, or transplantation where surgical resection is precluded. Anatomical resections with minimum 2cm margins provide the best outcomes. At the present time there is no evidence to recommend treatment with adjuvant chemotherapy.

## Sorafenib

This is an oral multi tyrosine kinase inhibitor. It is the only drug that has been currently demonstrated to extend survival in individuals with advanced hepatocellular cancer. The improvement in survival is from a median of 7 months to 10 months.

### **PORTAL VEIN THROMBOSIS IS A CONTRA INDICATION TO TRANSARTERIAL CHEMO-EMBOLISATION**

*Extensive disease is best managed with medical therapy, there is no evidence to support the use of radiotherapy or local therapies in lesions that are as extensive as those described. Sorafenib has been demonstrated to prolong survival in this situation. A disease of this stage would be a contra indication to liver transplantation.*



15-20% Synchronous

30-50% metachronous

Triphasic CT → visualized Best on venous phase  
hypo-intense low-attenuating masses

MRI →  $\epsilon$  Gd T2-weighted images

PET/CT → may change clinical management in up to 20%

No Biopsy required / Repeat Colonoscopy

Folinic Acid

FOLFOX

Fluorouracil

Oxaliplatin

neoadjuvant  
Before

5 year survival 35-58% if solitary 50%-54% survival

Decision of Resection Depend on

all mets can be removed (R0) while preserving  
enough volume of Liver after Resection  
to avoid Liver Failure

FLR up to 20%

"2 adjacent lobe  
contiguous segments"

- Use neoadjuvant chemotherapy
- PVE portal vein embolization

CVP in Liver Resection < 5 mmHg

Less Back Bleeding from Cava, hepatic vein

CELM → CT → hypodense  
MRI T<sub>1</sub> hypointense  
T<sub>2</sub> hyperintense

## Liver metastasis from colorectal cancer

Approximately 70% of patients with metastatic colorectal cancer will have disease that is confined to the liver.

Detection is usually made using CT scanning. Colorectal metastases will usually be hypovascular relative to the surrounding liver tissue and appear to be hypoattenuating on CT. On MRI scanning they will usually appear as hypodense lesions on T<sub>1</sub> weighted image and hyperdense on T<sub>2</sub> weighted images. Only 15% of patients will have disease that is surgically resectable.

### Classification of resectable disease

Resection category	Features
Usually resectable	Four or fewer segments or deposits in the liver Residual liver volume >40% Vena cava not involved Contra lateral portal pedicle
Potential resection	Involvement of 5-6 segments Contra lateral named vascular structure involvement Central hepatectomy Vascular reconstruction
Not resectable	Involvement of two portal branches Involvement of three hepatic veins Marked extra hepatic disease (e.g. portal nodes, non resectable distant disease)

### Role of chemotherapy

Use of FOLFOX 4 chemotherapy regime is standard. The agents used include; oxaliplatin, fluorouracil and folinic acid. This is typically given prior to liver resection. A regime lasting 3 months is usually favored as it provides the best compromise between treatment related toxicity and improvement in outcome.

Recurrence is seen in up to 60% of patients undergoing surgical resection of liver metastasis. Usually within the first 1-2 years.

→ hypophosphatemia common after major hepatic resection  
→ PT, INR  
→ bile leak



## Liver remnant function

Liver volume after hepatic resection is linked to liver function. This is also linked to the physiological state of the underlying liver. The liver remnant that is to be left following resection is termed the future liver remnant (FLR). The patient outcome is usually good when the FLR is >20% of the total liver volume (TLV) compared with when it is less than 20%. Individuals with severe cholestasis or underlying liver disease usually require FLR of 40%. The calculated TLV is derived from a close association between patient size and liver size based on the following formula;

$TLV (cm^3) = -794.41 + 1267.28 \times \text{Body surface area (square metres)}$ .

Thus the standardised FLR volume calculation uses the measured FLR volume from CT volumetry as the numerator and the calculated TLV as the denominator:

Standardised FLR (sFLR) = measured FLR / TLV

In practical terms volumetry is usually assessed by CT volumetry, alternative measures of function include technetium-99m mebrofenin hepatobiliary scintigraphy, urea-nitrogen synthesis rate and indocyanine green clearance.

Individuals whose liver is at risk following resection (i.e. FLR less than 40%) may be optimised by pre-operative portal vein embolisation. This induces enlargement of the normal liver and improves function.

**2 SEGMENTS ON THE IPSILATERAL SIDE CORRELATE APPROXIMATELY TO 20-30% OF LIVER VOLUME.**

hemangioma → once 6-12 months follow up  
only symptomatic large ones

→ small Asymptomatic

→ Reassure  
Discharge 055

Focal Nodular Hyperplasia

→ Radiologist →  
Sure  
"MRI"

Reassure  
Discharge

No Biopsy

hepatic Cystadenoma

→ Resection  
10% malignant

hepatic Adenoma

→ Resection Specially if > 5cm

- "Difficult Differentiation of CA"
- Risk of Rupture & Hge

Workup

Routine + CEA, AFP, CA 19-9

Radiology

CT triphasic  
→ MRI

But 10% of lesions that remain  
indeterminate may be malignant

Biopsy only if

- Result will change management
- lesion is symptomatic
- or Radiologically concerning for malignancy

Although

proceeding with Resection  
without Biopsy is Reasonable



## Benign liver lesions

Haemangioma	<ul style="list-style-type: none"> <li>• <b>Most common</b> benign tumours of mesenchymal origin</li> <li>• Incidence in autopsy series is <b>8%</b></li> <li>• Cavernous haemangiomas may be enormous</li> <li>• Clinically they are reddish purple hypervascular lesions</li> <li>• Lesions are normally separated from normal liver by ring of fibrous tissue</li> <li>• On ultrasound they are typically <b>hyperechoic</b></li> </ul>
Liver cell adenoma ♀ OCP	<ul style="list-style-type: none"> <li>• 90% develop in women in their third to fifth decade</li> <li>• Linked to use of <b>oral contraceptive pill</b></li> <li>• Lesions are <b>usually solitary</b></li> <li>• They are usually <b>sharply demarcated from normal liver</b> although they usually <b>lack a fibrous capsule</b></li> <li>• On ultrasound the appearances are of <b>mixed echoity and heterogeneous texture</b>. On CT most lesions are hypodense when imaged prior to administration of IV contrast agents</li> <li>• In patients with haemorrhage or symptoms <b>removal of the adenoma</b> may be required</li> </ul>
Mesenchymal hamartomas	<p>Congenital and benign, usually present in infants. May compress normal liver</p>
Liver abscess	<ul style="list-style-type: none"> <li>• Biliary sepsis is a major predisposing factor</li> <li>• Structures drained by the portal venous system form the second largest source</li> <li>• Common symptoms include <b>fever, right upper quadrant pain</b>. <b>Jaundice</b> may be seen in 50%</li> <li>• Ultrasound will usually show a <b>fluid filled cavity</b>, <b>hyperechoic walls</b> may be seen in chronic abscesses</li> </ul>
Amoebic abscess	<ul style="list-style-type: none"> <li>• Liver abscess is the most common extra intestinal manifestation of amoebiasis</li> <li>• Between 75 and 90% lesions occur in the <b>right lobe</b></li> <li>• Presenting complaints typically include <b>fever and right upper quadrant pain</b></li> <li>• Ultrasonography will usually show a <b>fluid filled structure with poorly defined boundaries</b></li> <li>• Aspiration yield sterile odourless fluid which has an anchovy paste consistency</li> <li>• Treatment is with <b>metronidazole</b></li> </ul>

US  
Important

TMT

Mix

Cavity



# Liver mass & Chronic Liver disease

- Should presumed malignancy until proven otherwise
- Screening for CLD US/AFP Recommended
- Regenerative nodules or Adenoma high risk of malignancy

MRI of HCC - arterial phase enhancement  
- early washout of contrast on The Delayed phase

Staging Chest CT, Serum AFP  
& Bone scan if indicated

Child's classification	"CTP classification"
Albumin	Child -
Bilirubin	Turcotte -
Coagulation "INR"	Pugh
Dulness "Ascites"	Class A 5-6
Encephalopathy	Class B 7-9
	Class C 10-15 points

Class C → no resection

Class B → considered for minor resection

Class A → for resection But suboptimal if

- portal hypertension
- Oesophageal, Gastric varices or Bleeding
- Thrombocytopenia in case of hypersplenism  
<100,000 contraindication

FLR Future Liver remnant in Cirrhosis  
40-90% designed



Hyatid cysts	<ul style="list-style-type: none"> <li>• Seen in cases of <i>Echinococcus</i> infection</li> <li>• Typically an intense fibrotic reaction occurs around sites of infection</li> <li>• The cyst has no epithelial lining</li> <li>• Cysts are commonly unilocular and may grow to 20cm in size. The cyst wall is thick and has an external laminated hilar membrane and an internal enucleated germinal layer</li> <li>• Typically presents with malaise and right upper quadrant pain. Secondary bacterial infection occurs in 10%.</li> <li>• Liver function tests are usually abnormal and eosinophilia is present in 33% cases</li> <li>• Ultrasound may show septa and hyatid sand or daughter cysts.</li> <li>• Percutaneous aspiration is contra indicated</li> <li>• Treatment is by sterilisation of the cyst with mebendazole and may be followed by surgical resection. Hypertonic swabs are packed around the cysts during surgery</li> </ul>
Polycystic liver disease	<ul style="list-style-type: none"> <li>• Usually occurs in association with polycystic kidney disease</li> <li>• Autosomal dominant disorder</li> <li>• Symptoms may occur as a result of capsular stretch</li> </ul>
Cystadenoma	<ul style="list-style-type: none"> <li>• Rare lesions with malignant potential</li> <li>• Usually solitary multiloculated lesions</li> <li>• Liver function tests usually normal</li> <li>• Ultrasonography typically shows a large anechoic, fluid filled area with irregular margins. Internal echos may result from septa</li> <li>• Surgical resection is indicated in all cases</li> </ul>

Clearly distinguishing between adenomas and malignancy is difficult and most surgeons would offer resection. They are usually best formally resected rather than simply enucleated.

Because of the uncertainty in making the diagnosis lesions suspicious of being focal nodular hyperplasia are usually submitted for laparoscopic biopsy. Imaging with MRI scanning is the most sensitive tool for diagnosis of these lesions.



# Options of H of HCC

- Resection
- Transplantation if Milan Criteria
  - 1 lesion  $< 5$  cm
  - $\leq 3$  or few lesions  $\leq$  or equal to 3 cm
- Radiofrequency ablation
  - extensive tumour burden
  - decompensated liver disease

→ Specially if  $< 3-4$  cm
- Transarterial chemo-embolization
- Systemic chemotherapy + Sorafenib
  - metastatic
  - Recurrent

Option of PVE portal vein embolization  
monitor the effect <sup>10</sup>-30 days after

---

intraoperative, low CVP is Good  
"Balance"

/IOUS "intraoperative Ultrasound"

Size of margin is Not oncologically relevant as long as it proves to be histologically negative



Most **small haemangiomas** have characteristic imaging appearances and if small and asymptomatic, the patient can be **reassured** and **discharged**.

## Hepatic cystadenoma

- Rare, multilocular tumours of the liver derived from **biliary endothelium**.
- Most commonly affect the **right lobe**.
- Up to 85% cases involve females
- **95% are mucinous**
- Usually diagnosed **incidentally on USS**. They typically appear as **anechoic lesions with internal septation** and often a **well defined wall**.
- They are usually benign, although **10% undergo malignant transformation**.
- Differential diagnoses include **focal nodular hyperplasia**, **adenoma**, **angiomyolipoma** and **hepatic cystadenocarcinoma**.
- Treatment of benign lesions is **surgical excision (usually enucleation)** or **lobectomy**.

**UP TO 10% OF CYSTADENOMAS ARE MALIGNANT AND DISTINGUISHING BETWEEN BENIGN AND MALIGNANT DISEASE (EVEN ON BIOPSY IS DIFFICULT). SURGICAL RESECTION IS THEREFORE RECOMMENDED.**

## Focal nodular hyperplasia of the liver

- **Focal nodular hyperplasia is the second most common benign liver lesion after haemangioma.**
- They are usually **asymptomatic**.
- They have **no malignant potential**.
- A **central stellate scar** may be identified on imaging in up to 70% of cases.
- They **can usually be distinguished from liver cell adenoma on MRI scanning**.
- They require no specific treatment and if a radiologist is confident of the imaging appearances then can be discharged from follow up.

*FNH is a benign condition and therefore treatment is directed at the underlying pathology (in this case gallstones). If an experienced radiologist is confident of the MRI appearances then no further action need be taken as regards the FNH. With the increasing use of intra operative laparoscopic USS, consideration could be given to imaging the lesion intra operatively. However, there is no indication for biopsy or resection of these lesions.*

Clonorchis sinensis

Caroli's Disease

It not choledochal cysts

It is infection because of fluke



## Cholangiocarcinoma

Cholangiocarcinoma can affect any area of the bile ducts, either within or outside the liver. Tumors occurring in the bile ducts within the liver are referred to as **intrahepatic**, those occurring in the ducts outside the liver are **extrahepatic**, and tumors occurring at the site where the bile ducts exit the liver may be referred to as **perihilar**. A cholangiocarcinoma occurring at the junction where the left and right hepatic ducts meet to form the common bile duct may be referred to eponymously as a **Klatskin tumor**.

Histologically, most tumours are adenocarcinomas.

Many present with no known risk factors. Conditions which increase the risk of cholangiocarcinoma include; **primary sclerosing cholangitis**, infection with *Clonorchis sinensis*. Congenital cystic disorders of the biliary tract, such as **Carolis disease** carry a lifetime risk of 15% of developing the condition. **Gallstones in themselves do not increase the risk of the condition**, long standing ductal stones (especially if associated with parasitic infection) may do so.

Most cases are diagnosed radiologically and **MRCP** is used increasingly frequently. Staging is with CT/ liver MRI and sometimes EUS. Most cases are advanced at presentation and treated with **metallic stent insertion**. **Surgical resection (and rarely transplantation)** offers the only chance of cure, these tumours are highly **chemoresistant** although such agents may be used in the palliative setting.

*Most are located in the **peri hilar region**. The region between the **upper border of the pancreas and the ampulla of vater is the next most common site**.*





## Gallbladder cancer

- Commonest cancer site in the biliary tract
- Represents 2% of all cancers
- Up to 90% cases associated with gallstones
- A polyp - carcinoma sequence does not apply in the gallbladder
- Malignancy is more likely in a gallbladder polyp larger than 1cm diameter
- 60% are located in the fundus
- 25% of patients with porcelain gallbladder will be associated with malignancy
- Treatment of T1 (mucosal disease) is by open cholecystectomy and regional nodal sampling
- T2-T4 disease is managed by formal resection of segments IVb and V
- Overall survival is less than 10% at 5 years.

*Most gallbladder polyps less than 1cm in diameter are benign and are usually cholesterol polyps. They do not require specific treatment. Repeated ultrasound at 6 months will ensure that the lesion has not increased in size.*

me benda zole  
Al benda zole

benzi mida zole

---

Puncture PAIR  
Aspiration  
Injection &  
Re-Aspiration



## Echinococcus granulosus

This is a cestode that primarily resides in the intestine of dogs. It characteristically has three segments. The eggs are passed in the dogs faeces and may be ingested by other animals including humans. These may then form hydatid cysts in the tissues of the new host. Rupture of the cyst may allow further systemic infection. Cyst rupture may also result in an anaphylactic shock type response. Minor leakage may result in pain, flushing and urticaria.

The cyst wall is composed of two layers, the pericyst (which originates from host tissue) and the endocyst (which is derived from the organism). They usually grow at a rate of 1cm per year.

In the UK, infection hotspots include Wales and the Western Islands of Scotland. Symptoms usually occur when the cyst size exceeds 5cm.

### Treatment

- Systemic therapy with mebendazole or albendazole is usually used.
- Surgical resection is an option for large single cysts. The area surrounding the cyst is surrounded by cetrimide soaked packs. The cystic cavity is aspirated and then the cyst excised. Biliary communication is directly sutured.
- Puncture Aspiration Injection and Re-aspiration (PAIR) technique is indicated for multiple or deep seated cysts. Cysts should be purely cystic or cyst plus sand (Gharbi types I and II). The cavity is aspirated, then instilled with sodium chloride. The procedure is covered with benzimidazole for 4 days prior to the procedure and for 3 months after the procedure.

## Hydatid cysts

Hydatid cysts are endemic in Mediterranean and Middle Eastern countries. They are caused by the tapeworm parasite *Echinococcus granulosus*. An outer fibrous capsule is formed containing multiple small daughter cysts. These cysts are allergens which precipitate a **type 1 hypersensitivity reaction**.

Clinical features are as follows:

- Up to 90% cysts occur in the liver and lungs
- Can be asymptomatic, or symptomatic if cysts > 5cm in diameter
- Morbidity caused by cyst bursting, infection and organ dysfunction (biliary, bronchial, renal and cerebrospinal fluid outflow obstruction)
- In biliary rupture there may be the classical triad of; biliary colic, jaundice, and urticaria

CT is the best investigation to differentiate hydatid cysts from amoebic and pyogenic cysts.

Surgery is the mainstay of treatment (the cyst walls must not be ruptured during removal and the contents sterilised first).

*In fit patients with hydatid disease the best option is generally surgical excision. During the operation the operating field is draped with drapes impregnated with hypertonic saline to minimise the dangers associated with cyst spillage. Options range from peeling off the endocyst layer from the exocyst layer, with marsupialisation of the cyst cavity. Peripherally sited lesions may be considered for formal resection. Medical therapy with mebendazole may be used to provide peri-operative cover. There is no role for percutaneous treatment.*

*The instillation of sclerocidal agents into a lesion communicating with the bile ducts carries a risk of sclerosing cholangitis and is therefore contra indicated. Surgical resection and direct closure/ repair of ductal involvement would be usual.*



# DD Pancreatic Cysts

→ Inflammatory  
→ Neoplastic

Benign

aggressive

- ③ Serous Cystic neoplasm  
Lympho-epithelial Pan. Cyst-  
Simple Pancreatic Cyst-

- ① Intraductal papillary muc. N.  
Solid Pseudopapillary N.  
② mucinous Cystic N.  
Cystic NET

most Common

↓ IPMN, MCN, SCN

- Multifocality
- nodule
- Central Stellate Scar
- Ductal connectivity
- nodules

CT / MRCP → EUS + FNA

ERCP uncommonly used & main duct pancreatic dilatation to establish diagnosis neoplasia vs pancreatitis

→ Biochemical  
CEA  
Amylase

→ molecular DNA  
KRAS, DNA Quantity

Surveillance is accepted approach  
& may be less accepted in young patients

Progression to Carcinoma

- Main duct involvement "The most Reliable"
- mural nodule
- Cytology

Minimally invasive Spleen-preserving  
Distal pancreatectomy

Frozen sections of margins

## Intraductal Papillary Mucinous Neoplasms

IPMN's are epithelial neoplasms that affect either the main pancreatic duct or one of its branches and produce mucin. Main duct IPMN's are more likely to exhibit severe dysplasia/ invasion than lesions occurring in branches. In addition main duct IPMN's are usually larger and of pancreatobiliary differentiation within their epithelium. Those affecting branching ducts, apart from being smaller, will usually show gastric foveolar differentiation.

Family history is a well established risk factor for the development of these lesions. Some conditions, such as Peutz- Jaegers, are more strongly associated than others.

Symptoms of IPMN's include abdominal pain, back pain, anorexia, weight loss and recurrent episodes of pancreatitis.

### Diagnosis

A variety of diagnostic approaches are available to evaluate a potential IPMN. Some centers rely heavily on magnetic resonance cholangiopancreatography (MRCP), although high-resolution CT and endoscopic ultrasound (EUS) are emerging as the most accurate modalities. A CT of an IPMN will usually reveal a pancreatic cyst with ectasia of the main pancreatic duct or multiple cysts attributable to dilatation of side branch ducts with occasional multicentric growth. Some patients will present with a mixed-type lesion with characteristics of both main duct and branch duct IPMNs. EUS might reveal mucus secretion from a prominent papilla of Vater sometimes referred to as 'fish mouth papilla' because of its patulous appearance. Endoscopic retrograde cholangiopancreatography (ERCP) might reveal dilated pancreatic ducts or nodules in the cyst wall that represent a potential invasive transformation of the epithelium. Increased serum levels of tumor markers, such as carcinoembryonic antigen (CEA) or cancer antigen 19-9 (CA19-9), are sometimes detected in patients with an IPMN with an associated invasive carcinoma.

### Management

The decision as to whether to observe or resect is complex. A patient is defined as high risk if they fulfill the high risk criteria defined below (Sendai criteria);

#### Sendai consensus guidelines

SB-IPMN >30mm

Nodules "intramural"

Pancreatic duct dilatation >6mm

Symptomatic lesion

Suspicious cytology



# Pancreatic Pseudocyst

## Workup

evaluation of pancreatic function → Exocrine  
→ Endocrine

exocrine → Steatorrhea  
Formal Fecal Fat Content

Daily fat excretion  $> 7g$  → Abnormal

Endocrine → Hb A1C + other Labs  
& Nutritional Status

Acute pancreatitis

early →

peripancreatic fluid  
collection

→ 6 weeks  
persistence of  
fluid collection

Pseudocyst

No clear history of pancreatitis  
EUS → FNA

†† in Symptomatic only

MRCP, ERCP for ductal Anatomy

Endoscopic internal Drainage is 1<sup>st</sup> Line therapy

if fail  
→ then Surgical Cystogastrostomy  
Cystojejunostomy

Defining risk:

Size of cyst mm	Nodule present	Frequency of carcinoma %
<10	-	3.2
<20	No	9.2
<20	Yes	25
20-30	No	23.8
20-30	Yes	25
>30	No	25.8
>30	Yes	44

In practice this means that IPMN's between 20-30mm will undergo EUS and FNA together with CA19-9 and CEA measurements.

Lesions which are high risk are typically treated with formal pancreatic resection.

### **LESIONS AFFECTING THE MAIN DUCT ARE HIGHER RISK THAN THOSE AFFECTING BRANCHES**

*Lesions which are between 20-30 mm are considered moderate risk and should be further evaluated using EUS and blood tests for CEA and CA19-9. Percutaneous biopsy is not generally performed.*



## Pancreatic stents

Both benign and malignant biliary obstruction may be treated by placement of stents. These may be either plastic tubes or self expanding metallic stents. They can be placed either percutaneously, at ERCP, or, less commonly now, open surgery. Complications include blockage, displacement and those related to the method of insertion.

### Metallic Vs Plastic stents

Metallic stents	Plastic stents
Expensive	Cheap
Embed in surrounding tissues	Do not usually embed
Displacement rare	Displacement common
Blockage rare	Blockage common
Contraindicated in resectable malignant disease	May be used as a bridge to resectional surgery

*A plastic stent is the best option for biliary decompression in resectable disease. Surgical bypasses have no place in the management of operable malignancy as a bridge to definitive surgery.*

Fistula → Soft pancreas



## Pancreatic fistula following pancreatic resection

- Pancreatic fistula are the single biggest cause of morbidity following pancreatic resection
- Incidence is approximately 15%, risk lower in distal pancreatectomy
- Clinically significant fistula will have amylase three times the serum amylase level and will give rise to symptoms such as fever and tachycardia
- Risk of fistula is increased if there is a soft pancreas (22%), age over 70 years, long period of jaundice (rather than severity), coronary artery disease and blood loss over 1000ml

### Pancreaticogastrostomy vs Pancreaticojejunostomy

The theory behind pancreaticogastrostomy was that gastric acid would neutralise the pancreatic enzymes and lead to lower fistula rates. There is currently no robust evidence to suggest that this is in fact true (1) and pancreatico jejunostomy seems a reasonable option.

### Does stenting help?

The data relating to stents is conflicting. Internal stents may migrate and occlude the anastomosis and worsen the situation. In one study the presence of a stent was found to make no difference (2). Data relating to external pancreatic stents seems to favor this approach (3). At the present time the decision as to which stent to choose is probably best left to the discretion of the operating surgeon.

### Role of octreotide

The abolition of pancreatic secretions as a means to abolition of pancreatic fistula would seem logical. This has been investigated by numerous groups. One meta analysis suggests that administration reduces the fistula rate but not mortality (4). Others have found no benefit (5)(6). None of the literature seems to suggest that the use of octreotide resulted in harm.

**SOFT PANCREATIC TISSUE IS A WIDELY ACCEPTED RISK FACTOR FOR THE DEVELOPMENT OF POST OPERATIVE PANCREATIC FISTULA. PRE OPERATIVE CHEMORADIOTHERAPY DECREASES THE RISK.**

## Pancreatic injury in splenectomy

The tail of the pancreas lies adjacent to the hilum of the spleen in 75% of cases and is thus vulnerable to injury. Injury to the pancreatic tail may cause a pancreatic fistula. The management of such injuries is highly patient specific. Initial management is easier if a drain was placed at the time of surgery. In most cases distal pancreatic fistulae will heal with conservative management and nutritional support. The use of TPN in avoidance of pancreatic stimulation may be beneficial and considered at an early stage. The literature relating to the use of octreotide in this situation is sparse, a 2012 Cochrane review into the use of somatostatin in preventing fistulas following pancreatic surgery highlighted variable practice, poor literature and conflicting results. They did conclude by suggesting that it may be beneficial in reducing pancreatic fistulas after pancreatic surgery, but highlighted that this had no impact on mortality. It should probably not be routinely given for pancreatic fistulas following iatrogenic injury during splenectomy, but could be considered in the event that the fistula did not resolve.

*Early surgery and ERCP is not routinely used in these circumstances. Octreotide could be considered if the situation did not improve but is not first line management. Most fistulas close spontaneously.*



- Cause  
 Stone 40%  
 Alcohol 35%  
 other hypertriglyceridemia, ERCP  
 anatomic Abnormalities "Divisum"  
 Trauma  
 Viral

- 20-30% have necrosis

<u>Ranson's</u>	Age > 55	Ca < 8 mg/dl
	WBC > 16	Hematocrit ↓ > 10%
	Glucose > 200	Hypoxia $P_{aO_2}$ < 60 mmHg
	AST > 250	BUN > 5 mg/dl
	LDH > 350	Base D. > 4 mEq/L
		Fluid Sequestration > 6L

3 or more

Severe acute pancreatitis

CT restricted to patient with Severe pancreatitis

+++ monitor + Resuscitate + Pain control + Colonic Support "Naso Jejunum"  
 anti.Biotics ??

if Sepsis or MODS → CT Guided FNA → if -ve conservative  
 if +ve

Surgical Drainage or Radiological Drainage  
 if possible after 4 weeks in Severely ill pt at the time of FNA

allow Demarcation of necrosis

early if Abdominal Compartment

may Done Laparoscopically - endoscopic trans gastric trans duodenal → Closed Continuous Lavage

postop Complications + Cholecystectomy

MODS, Bleeding, fistula, pseudocyst, Abscess

mesenteric & Splenic venous thrombosis  
 Arterial pseudo Aneurysm

# Pancreatitis

Pancreatitis is a common surgical emergency. In most cases the main aetiological factor is gallstone disease. In some specific areas the proportion that is attributable to alcohol is rising. In 80% of cases the condition is little more than self limiting.

## Diagnosis

The diagnosis is usually suspected from the clinical history taken together with a known (or suspected) history of exposure to appropriate risk factors. Both serum amylase and serum lipase levels may be used for diagnosis. Because of the possibility for false positive results in other abdominal conditions, a value in excess of three times the normal range should generally be accepted as diagnostic. In patients where there is diagnostic doubt a CT scan should be performed.

## Aetiology

In most cases this is due to gallstone disease. The gallstones implicated are usually small since the diameter of the CBD is usually 6-7mm and the diameter of the ampullary area is 2-3mm. Alcohol and gallstones account for up to 75% of all cases. In children trauma and viral diseases such as mumps are the commonest causes. Suspicion of a viral aetiology is provided by diarrhoea that is rare with the other causes.

## Assessment of severity

The majority of patients with severe attacks of pancreatitis have early evidence of organ dysfunction. Deteriorating organ function is associated with a mortality in excess of 50%. Those patients who have organ dysfunction are highly likely to have pancreatic necrosis (35%). The risk of these complications can be anticipated by the various severity scoring systems that are used.

In the UK guidelines (1) issued in 2005 the major determinants of a severe attack were deemed to be:

- Obesity
- APACHE Score >8 in first 24 hours
- Any of the following after 48 hours: CRP >150, Glasgow Score >3, persisting organ failure

9

## Imaging

All cases should undergo abdominal ultrasound as a minimum investigation. Where this fails to show gallstones, it may need to be repeated. USS may fail to show stones smaller than 4mm (which can still cause pancreatitis)..

CT scanning is performed where there is diagnostic doubt (UK guidance). CT scanning is also indicated at 6-10 days in those patients with severe attacks. The severity of disease may be expressed using the Balthazar index. Worse



Octreotide  
"Sandostatin"  
in "Carcinoid"  
Syndrome

clinical outcomes are seen where there is extensive necrosis affecting the pancreatic head, free intra-abdominal fluid and extensive peri-pancreatic inflammation.

The technique of scanning is important and intravenous contrast should be used. The timing of injection is crucial and **necrosis is defined as a non enhancing area >3cm.**

## Management

- **Aggressive IV fluid** administration to maintain urine output >0.5ml/kg/hr.
- **Invasive monitoring** for high risk patients
- **Early enteral feeding via NG route** (even non nutritive better than nothing)(3)
- **Antibiotic therapy continues to be debated.** A Cochrane review conducted in 2010 (2) concluded that the overall evidence in favor of antibiotics was marginal, but favored **beta lactam** rather than quinolone/ imidazole combinations.
- **ERCP should be performed early** in those with gallstone related biliary obstruction (4) Sphincterotomy should generally be performed irrespective of whether stones are found, if the attack is severe and gallstones the aetiology.
- Administration of drugs such as **octreotide has no benefit** (1).
- All patients with gallstone pancreatitis who are fit enough should undergo **cholecystectomy once medically stable** either during the index admission or within 2 weeks of it. **Imaging of the bile duct should be performed pre or peri operatively.**
- Patients with **>30% necrosis** and symptoms should undergo **radiologically guided FNA and culture of the areas**, this is to allow conservative management of non infected cases.
- Patients with **infected necrosis** should generally undergo surgical **debridement and closed lavage systems.**

## Complications

- **Bleeding** may occur following debridement and may be best managed with **interventional radiology**
- **Splenic vein thrombosis**, may result in portal gastropathy. This may require **splenectomy.**
- **Development of pseudocysts**, these take at least 4 weeks to form. Treatment is usually with **laparoscopic cystogastrostomy.**

**PRIOR TO SURGERY IT IS IMPORTANT TO PROVE THE MATERIAL IS INFECTED. SOMETIMES THIS IS NOT POSSIBLE IN AN UNSTABLE PATIENT.**



# Chronic Pancreatitis

Causes , alcohol

, autoimmune

, traumatic stricture  
pancreatic divisum ] duct outflow obstruction

, micronutrient deficiency "tropical pancreatitis"

, Idiopathic / hereditary 20-30%

trypsinogen gene chromotrypsin C

Cystic fibrosis

protease inhibitor

CT pancreatic protocol

MRCP - EUS + FNA

ERCP should avoided for Diagnostic purpose

Operations provide long term relief in  
85% of patients only

interruption of neuronal pathway not effective  
may used temporary only

1, lateral Pancreatic jejunostomy

2, Whipple procedure

3, Duodenal Sparing Pancreatic head Resection (DSPHR)

## ERCP- complications

ERCP is an important therapeutic intervention for a number of hepatobiliary disorders. It is more prone to complications than any other type of endoscopic intervention, non-invasive methods should be used for diagnostic purposes whenever possible.

### Pancreatitis

Pancreatitis is the most common serious complication of ERCP and a transient rise in pancreatic amylase may be noted in up to 75% of patients undergoing the procedure. The incidence is approximately 3.5%.

#### Risk factors for post ERCP pancreatitis

Normal bilirubin

Young age

Pancreatic duct injection

Precut sphincterotomy

Balloon dilatation of sphincter

Sphincter of Oddi dysfunction

3.5%

#### Reducing the risk of pancreatitis

- Administration of indomethacin
- Temporary pancreatic duct stents
- Wire guided cannulation

### Bleeding

- Occurs most often following sphincterotomy and is intra luminal
- Occurs in 1.3% of cases
- Severe haemorrhage has an incidence of less than 1 in 1000

1.3%

### Perforation

- Occur in 0.6% - 1% of cases
- Both malignancy and pre cut access increase the risk of perforation

1%

### Cholangitis

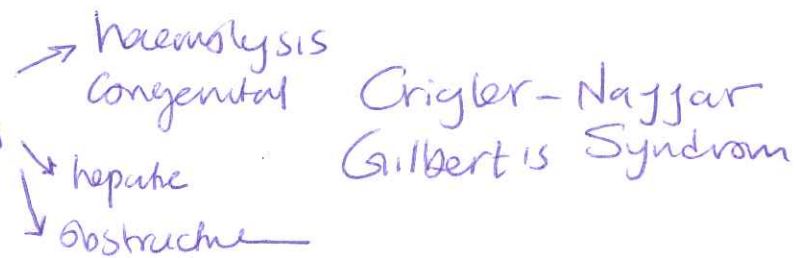
- Occurs in 1% of cases
- Incidence may be reduced by use of antibiotics when an obstructed duct is not completely cleared

1%

**ADMINISTRATION OF INDOMETHACIN AND POTENTIALLY DICLOFENAC REDUCES THE RISK OF POST ERCP PANCREATITIS. IRONICALLY NORMAL BILIRUBIN, YOUNG AGE AND SPHINCTER OF ODDI DYSFUNCTION ARE ASSOCIATED WITH THE GREATEST RISK OF POST ERCP PANCREATITIS.**



# malignant Jaundice



Painless jaundice, middle old age → Malignancy

US → CT, MRI

→ ERCP Palliating jaundice

Should not be done if not required → post op infection

may appropriately be taken for resection without a Tissue diagnosis

- Resectable
- Good health status
- mass percutaneous
- jaundice

ERCP → Biopsy

EUS → FNA

PET/CT → if extrapancreatic CT finding  
specifically if Biopsy can not be done

CA 19-9 prognostic information

Should ideally withdrawn after palliation of jaundice

borderline resectable → neo Adjuvant chemo-Radio

On resectable → palliative Systemic chemotherapy  
→ appropriate clinical trial

Resectable → Surgery

+ 6-10 weeks Adjuvant chemo-Radio

## Pancreatic fistula

200 mL

< 200 mL  
low output

> 200 mL  
high output

- Bowel rest
- Subcutaneous Octreotide
- Parenteral Nutrition

**PANCREATITIS IS THE COMMONEST MAJOR COMPLICATION  
FOLLOWING ERCP**



①

- MEN 1 - 17q HPT
- pituitary tumors
  - Adrenocortical tumors
  - Carcinoid tumors
  - non-medullary thyroid tumors

11q13

Pancreatic NETs

- Non functional
- Gastrinoma
- Insulinoma
- Various

②

- Von Hippel-Lindau (VHL)
- pheochromocytoma
  - "Bilateral"
  - Retinal & cerebellar hemangioblastoma
  - Renal Cell Carcinoma

3p25-26

- Non functional
- Various including Cystic

③

- Neurofibromatosis 1  
Von-Recklinghausen
- neurofibroma
  - Café au lait spots
  - pheochromocytoma

17q11.2

Somatostatinoma

Inherited disorders  
= pancreatic  
neuroendocrine tumor

Neurolytic  
Migratory  
Erythema

Usually  
Malignant

④

- Tuberous Sclerosis
- Cardiac rhabdomyomas
  - Renal Cysts
  - Angiomyolipomas

9q33  
16p13.3

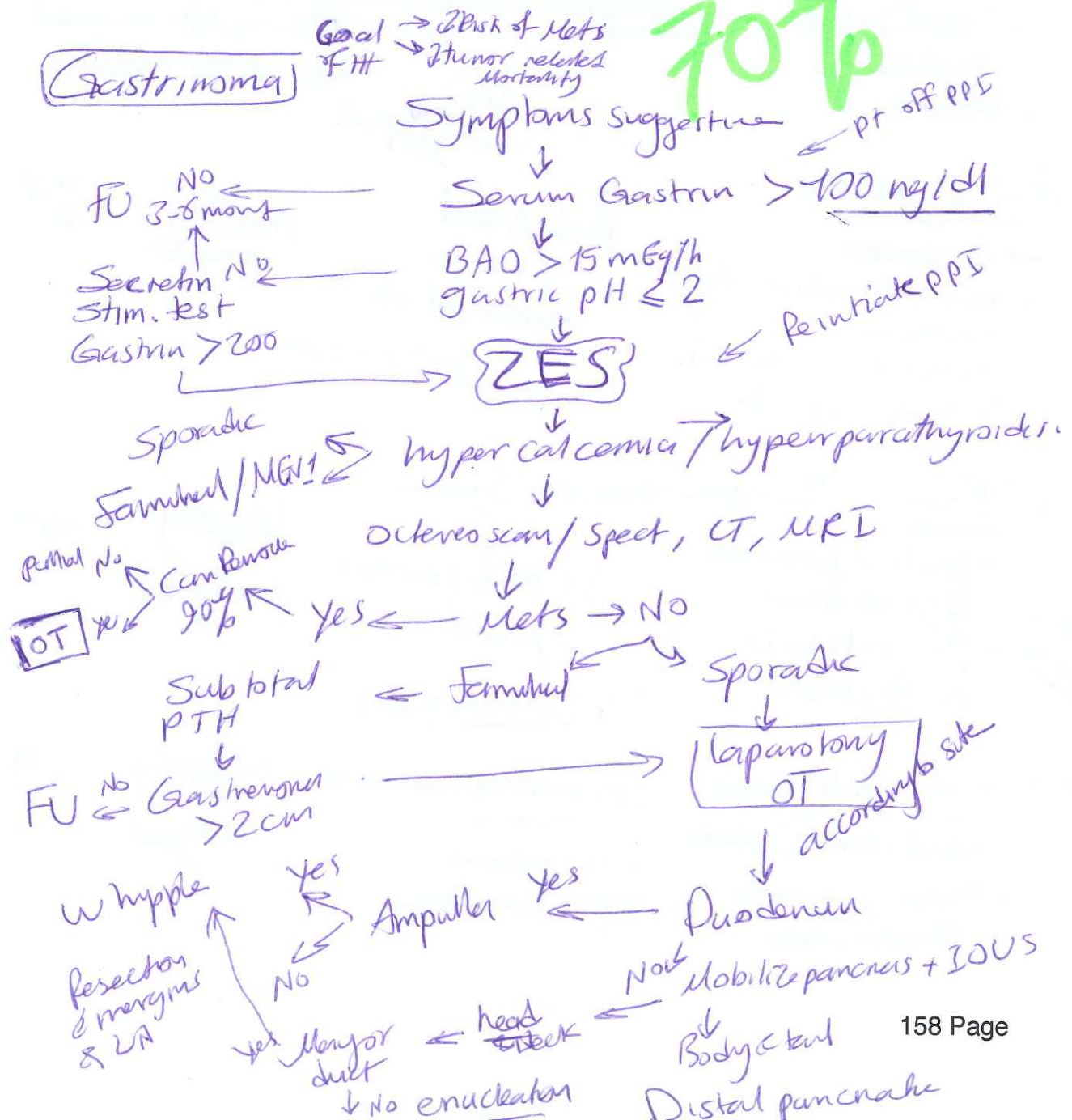
Insulinoma

# Endocrine

## Glucagonoma

- **Rare** pancreatic tumours arising from the **alpha cells** of the pancreas.
- Glucagon levels markedly elevated.
- Symptoms include **diarrhoea**, **weight loss** and **necrolytic migratory erythema**.
- A serum level of glucagon  $>1000\text{pg/ml}$  usually suggests the diagnosis, imaging with **CT scanning** is also required.
- Treatment is with **surgical resection**. However, careful staging is needed, for these tumours are **usually malignant and non resectable**.

**GLUCAGONOMA IS STRONGLY ASSOCIATED WITH NECROLYTIC MIGRATORY ERYTHEMA.**





# functional pancreatic NETs

## ① Gastrinoma

- Gastric A. hypersecretion
- peptic Ulcer
- Diarrhea
- Oesophagitis

Gastrinoma  $\Delta$   
- extra pancreatic  
- any where in the gland

Malignant incident

50%

1st

(100 ng/dl)

## ② Insulinoma

- hypoglycemia
- Sweating
- Tachycardia
- Tremulousness
- Confusion
- Seizures

Evenly distributed  
head, body, tail

10%

2nd

Whipple's triad

- hypoglycemia
- ~~50~~ 50 mg/dl documented
- relieved by glucose

(10 ~~pmol~~  $\mu$ g/ml)

## ③ Glucagonoma

- Diabetes
- Necrolytic Migratory Erythema
- Stomatitis - Glossitis
- Angular cheilitis

Body & tail  
Large  
Spread outside

Mostly malignant

3rd

(1000 pg/ml)

## ④ VIPomas "Verner-Morrison Syndrome"

- Watery Diarrhea
- Hypokalemia
- Achlorhydria or Acidosis

WDHA Syndrome

Distal pancreas  
Spread

Mostly malignant

4th

20 times/day

## ⑤ Somatostatinomas

- Gall stone Diabetes
- hyperglycemia
- Steatorrhea

- pancreaticoduodenal groove
- ampullary
- perampullary

Mostly malignant

5th

# Insulinoma

- Insulin producing tumours of the pancreatic  $\beta$  cells
- Incidence of 1 per 1,000,000 per year
- 90% of lesions are benign
- Most tumours less than 2cm in size
- Between 5 and 10% have MEN type 1
- 75% of patients with MEN 1 will develop pancreatic islet cell tumours

## Typical features of insulinoma

Symptomatic hypoglycaemia during fasting

Concomitant blood glucose of less than 3mmol/L

Relief of hypoglycaemia by use of glucose

## Testing

When neuroglycopenic symptoms occur blood is taken for serum insulin levels, serum glucose, C-peptide and pro insulin concentrations. The plasma insulin concentration is  $>10$  micro U/ml in patients with the disorder.

## Tumour localisation

- USS (25% accuracy), endoscopic USS better (75% accuracy)
- CT scanning (pancreatic protocol=40% accuracy)
- Malignant insulinomas are larger and diagnostic accuracy with MRI is nearly 100% in such cases
- Somatostatin receptor scintigraphy (50% accuracy)

## Treatment

Since the majority of tumours are benign; the blind segmental resection of the pancreas (e.g. Whipples) cannot be justified, this may be considered acceptable for malignant lesions. The best approach at laparotomy is to corroborate pre operative imaging with intraoperative ultrasonography to identify the lesion. Tumours may be close of the pancreatic duct and this must be appreciated by the operating surgeon. The perioperative use of octreotide reduces the amount of pancreatic drainage, but not overall complications.

THE VAST MAJORITY OF SUCH LESIONS ( $> 2$  CM) ARE BENIGN AND  
THUS ENUCLEATION IS PREFERRED OVER FORMAL RESECTION.

APUD Amin precursor uptake & Decarboxylation  
- Enterochromaffine - Argentaffine  
- Neural crest origin, neuroendocrine cells  
- Octreotide scan



# Diagnosis

Clinical picture  $\rightarrow$  Labs investigation  $\rightarrow$  Localization

(Labs)

Insulinoma  $\rightarrow$  Serum Insulin  
& for DD of surreptitious Insulin Use  
 $\rightarrow$  proinsulin  $\rightarrow$  C-peptide  
for DD of surreptitious oral hypoglycemic  
 $\rightarrow$  Urine tests for Metformin & Sulfonylurea

VIPoma  $\rightarrow$  Clinical picture + <sup>diarrhea + cramps</sup> Peristalsis

\* Exclude other causes of Diarrhea  
 $\rightarrow$  Stool Samples -ve for infection & Blood  
 $\rightarrow$  Colonoscopy  
\* Serum VIP normal ( $<50$  pg/ml)  
\* pH, K

Nonfunctional NET Chromogranin  $\rightarrow$

\* Surgical Approach is the Ht

if Liver Mets  $\rightarrow$  Debulking if  $\geq 90\%$  of the tumor can be eliminated

$\rightarrow$  CT / MRI

$\rightarrow$  Somatostatin

Scintigraphy

$\rightarrow$  Endoscopic

Ultrasound

$\rightarrow$  Percutaneous

transhepatic portal V. Sample

$\rightarrow$  Arterial stimulation  $\odot$

& hepatic V. Sampling

"Imamura test"

$\rightarrow$  Debulking  
Symptom control

Octotide

## Carcinoid syndrome

- Carcinoid tumours secrete serotonin *5HT*
- Originate in neuroendocrine cells mainly in the intestine (midgut-distal ileum/appendix)
- Can occur in the rectum, bronchi
- Hormonal symptoms mainly occur when disease spreads outside the bowel

*urine* *plasma*  
*HIAA* *chromogranin A*

### Clinical features

- Onset: years
- Flushing face
- Palpitations
- Pulmonary valve stenosis and tricuspid regurgitation causing dyspnoea
- Asthma
- Severe diarrhoea (secretory, persists despite fasting)

### Investigation

- 5-HIAA in a 24-hour urine collection
- Scintigraphy
- CT scan

### Treatment

- Octreotide
- Surgical removal



# DD Incidentaloma

## Functional

- Cortical Adenoma
  - aldosterone
  - cortisol
  - Androgen
- pheochromocytoma
- Cortical Carcinoma
- Congenital Adrenal hyperplasia
- Nodular hyperplasia
- "Cushing's disease"

## Non functional

- Cortical Adenoma
- Cortical Carcinoma
- Neuroblastoma
- Ganglioneuroma
- Cysts  $\begin{cases} \text{true} \\ \text{pseudo cyst} \end{cases}$
- hemangioma
- Myolipoma / Lipoma
- Granuloma - Amyloidosis

- Mets

Biopsy only  
justified here

## CT Adrenal protocol

non contrast  $\rightarrow$  60 seconds  $\rightarrow$  15 minutes  
+ contrast delayed

### Benign Adenoma

- CT attenuation  $< 10$  Hounsfield Unit in non contrast
- wash out  $> 60\%$

$> 10$  U. not necessarily malignant

"Lipid rich adenoma"

### Malignancy

- Size  $> 4$  cm
- Irregular margin
- heterogeneity

- hyperdensity

- invasion

- LN

• calcification

• Delayed washout

$< 50\%$

- mets at 10 minutes

## pre op medical

pho  $\rightarrow$  phenoxybenzamine  
7-10 days;  
 $\rightarrow$  then  $\beta$  Blockers

Severe hypercortisolism

$\rightarrow$  Adrenolytic agent

- Ketoconazole / Mifepristone

Cushing's  $\rightarrow$  stress dose of  
Steroids

Aldosteronoma

$\rightarrow$  Spironolactone



## Incidental adrenal lesions

Incidentaloma of the adrenal glands have become increasingly common as CT scanning of the abdomen is widely undertaken. Prevalences range from 1.5-9% in autopsy studies. Overall, 75% will be non functioning adenomas. However, a thorough diagnostic work up is required to exclude a more significant lesion.

### Investigation

- Morning and midnight plasma cortisol measurements
- Dexamethasone suppression test
- 24 hour urinary cortisol excretion
- 24 hour urinary excretion of catecholamines
- Serum potassium, aldosterone and renin levels

### Management

The risk of malignancy is related to the size of the lesion and 25% of all masses greater than 4cm will be malignant. Such lesions should usually be excised. Where a lesion is a suspected metastatic deposit a biopsy may be considered. Smaller, innocent lesions are usually followed up by serial CT scans at 6, 12 and 24 months.

## Conns syndrome

*Aldosterone producing Adenoma vs Adrenal hyperplasia*

Primary aldosteronism is due to autonomous adrenal cortical tissue secreting excessive amounts of aldosterone. It may be discovered following investigation of hypertension or hypokalaemia.

A single benign adenoma of the adrenal gland is the commonest cause.

Aldosterone is produced by the zona glomerulosa of the adrenal gland and controls the re-absorption of sodium in the distal renal tubule via  $\text{Na}^+/\text{K}^+$  and  $\text{H}^+$  pumps. Through this process the sodium that is re-absorbed draws water back into the circulation leading to expansion of the circulating volume.

Hyperkalaemia will also increase aldosterone release and hyperaldosteronism is a feature of liver disease, cardiac failure and nephrotic syndrome. Patients with early disease will usually have normal serum potassium levels. Diagnosis is made by venous sampling for aldosterone, renin and cortisol. Imaging with CT/ MRI allows localisation of the adenoma. Once the disease has been localised the usual treatment is to medically control the hypertension and proceed to laparoscopic adrenalectomy.

*Selective venous sampling is imperative*

*For localization*

*Confirmation  
placement*

*Lateralization*

*Supporting evidence*

*→ pre ACTH adrenal vein C:IVC C  $\geq 3$*

*Dominant A/C: Nondominant A/C  $\geq 4$*

*Dominant A: Nondominant A  $> 3$*

*Dominant A/C: IVC A/C  $> 1.5$*

*Non dominant A/C: IVC A/C  $< 1$*

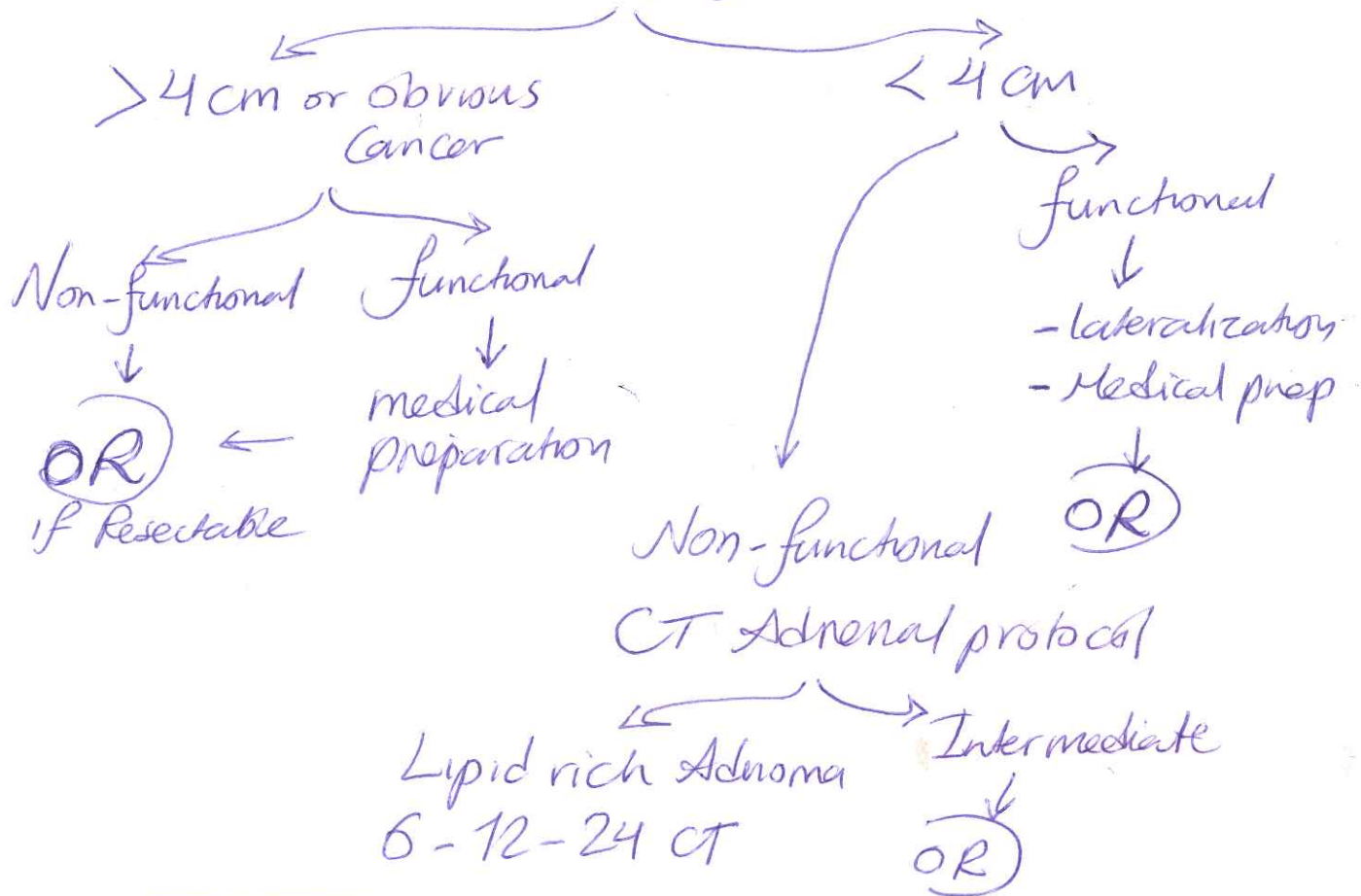
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*A: Aldosterone  
C: Cortisol*



# Incidentaloma

Clinical / Imaging / Biochemical



## Post op medications

pres →  $\alpha$  Blocker Stop immediately  
→  $\beta$  Blockers wean  
→ Glycemic control

Cushing → Steroids Replacement  
weaned to physiologic doses

# Cushings syndrome

## Overview and presenting features

This is characterised by increased circulating levels of glucocorticoids. The two variants include; ACTH dependent which is due to pituitary or ectopic tissue origin and ACTH independent, which is of adrenal origin. The incidence of Cushings syndrome is 10 cases per million in the west, the numbers swell considerably if iatrogenic hypercortisolism is included. **ACTH producing adenomas of the pituitary (Cushings disease)** are usually microadenomas and therefore **MRI of the brain** is the investigation of choice, associated biochemical investigation is also needed. Ectopic ACTH is most commonly secondary to lung cancer. ACTH independent Cushings syndrome may be due to both carcinomas and adenomas. Imaging and histology are combined in formulating the diagnosis and distinguishing between them can be difficult. The commonest symptoms of Cushings include; obesity, facial plethora and menstrual irregularity which are seen in over 80% of cases. Hypertension is seen in 75% of cases.

## Presenting features:

Obesity 95%

Hirsutism 80%

Hypertension 80%, Myopathy 60%, Buffalo hum 55%, Easy bruising 40%

## Investigation

Investigations include 24 hours urinary cortisol measurements and dexamethasone suppression testing. Imaging with CT/MRI is used to localise lesions (if ACTH independent disease).

## Treatment

Treatment is directed to the cause. Pituitary lesions are managed with transphenoidal hypophysectomy. Adrenal lesions and carcinomas may require adrenalectomy. **Mitotane** may be used as medical therapy. The mode of action of this drug is not well understood but it causes suppression of adrenal activity without cellular destruction. Patients with refractory or advanced malignant disease of the adrenal may be offered **cisplatin** chemotherapy, results are poor. Very occasionally radiotherapy is used. However, these tumours are often radio resistant.

**FUNCTIONING ADRENOCORTICAL ADENOCARCINOMA: MITOTANE IS THE FIRST LINE TREATMENT FOR ADVANCED DISEASE AND OFFERS REASONABLE PALLIATION. CHEMOTHERAPY WITH CISPLATIN AND RARELY RADIOTHERAPY MAY BE CONSIDERED.**



# Investigations Incidentalomas

## Biochemical

phes → plasma fractionated meta nephries  
or 24-hour Urine metanephries

"Usually > 2 times of Normal"

Aldosteronoma → K

→ Aldosterone / renin activity

→ Aldosterone to renin Ratio

"+ve if > 20"

Cushing → 24-hour Urinary free Cortisol  
→ Dexamethasone Suppression test

1mg at 11pm → Serum cortisol 8 Am

↳ Next step Serum ACTH

Others  
• midnight  
Serum/  
salivary  
cortisol level

Androgen over production → DHEAS  
de hydro epi androsterone Sulfate

## 2<sup>nd</sup>/Surgical hypertension

- |                         |                               |
|-------------------------|-------------------------------|
| - Renal artery stenosis | - intrinsic renal dysfunction |
| - hyper Aldosteronism   | - hypercortisolism            |
| - hyper Thyroidism      | - pheochromocytoma            |
| - Medications           | - Sleep Apnea                 |

## pheochromocytoma intra operative

monitoring + fluids + Drugs

hypertension "Manipulation"

- nitroprusside
- nicardipine
- esmolol

hypotension

"Legation & Remnant"

- fluids
- vasoactive pressor

## Phaeochromocytoma

F DOPA PET/CT

MIBG

Meta iodo benzyl  
guanidine

Neuroendocrine tumour of the chromaffin cells of the adrenal medulla. Hypertension and hyperglycaemia are often found.

- 10% of cases are bilateral.
- 10% occur in children.
- 11% are malignant (higher when tumour is located outside the adrenal).
- 10% will not be hypertensive.

Familial cases are usually linked to the Multiple endocrine neoplasia syndromes (considered under its own heading).

Most tumours are unilateral (often right sided) and smaller than 10cm.

### Diagnosis

Urine analysis of vanillymandelic acid (VMA) is often used (false positives may occur e.g. in patients eating vanilla ice cream!)

Blood testing for plasma metanephrine levels.

MRI is preferred over CT (which can precipitate a crisis). A SPECT MIBG scan will identify the lesion and any associated lesions in over 90% of cases.

### Treatment

Patients require medical therapy first. An irreversible alpha adrenoreceptor blocker should be given, although minority may prefer reversible blockade(1). Labetolol may be co-administered for cardiac chronotropic control. Isolated beta blockade should not be considered as it will lead to unopposed alpha activity.

These patients are often volume depleted and will often require moderate volumes of intra venous normal saline perioperatively.

Once medically optimised the phaeochromocytoma should be removed. Most adrenalectomies can now be performed using a laparoscopic approach(2). Intra operatively the patients blood pressure will require careful management and inotropes may be needed following tumour removal.

**Localization:** MIBG scans are more sensitive than pentetreotide labeled scans. Although the latter may be used if MIBG is non diagnostic. F DOPA PET/CT scanning is an emerging tool that may be more widely used for localising lesions, but is not currently widely available. Non labeled PET/CT is really only helpful in identifying rapidly dividing highly metabolic tumours, since these are often larger it is unusual for them to not be visible with conventional techniques. Angiography has no routine diagnostic role



## PTH Physiology

Parathyroid hormone is secreted by the **chief cells** of the parathyroid glands. It acts to **increase serum calcium concentration** by stimulation of the PTH receptors in the **kidney and bone**. PTH has a plasma **half life of 4 minutes**.

### Effects of PTH

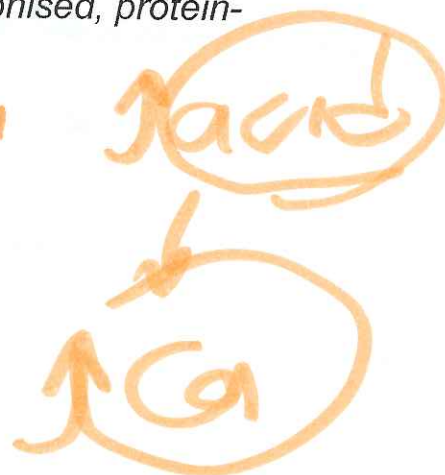
<b>Bone</b>	Binds to <b>osteoblasts</b> which signal to <b>osteoclasts</b> to cause resorption of bone and release calcium
<b>Kidney</b>	Active <b>reabsorption of calcium and magnesium</b> from the distal convoluted tubule. <b>Decreases reabsorption of phosphate.</b>
<b>Intestine via kidney</b>	Increases intestinal calcium absorption by <b>increasing activated vitamin D</b> . Activated vitamin D increases calcium absorption.

A **fall in ionised plasma calcium levels** causes the chief cells of the parathyroid glands to secrete parathyroid hormone (PTH).

Fifty percent of extracellular calcium occurs as non-ionised, protein-(albumin-)bound calcium.

The **degree of ionisation increases inversely with pH**.

**Calcitonin causes increased renal calcium excretion.**



## Hyper Calcaemia

non-PTH mediated

- Malignancy / PTHrP
- Granulomatous disease
- Endocrinopathies
- Medications
- Immobilization

PTH-mediated

- Hyperparathyroidism -
- <sup>Benign</sup> familial hypocalcaemic hypercalcaemia

<u>1m</u> <u>hyperparathyroidism</u>	→ Benign Solitary Adenoma	80-85%
	→ Double Adenoma	5%
	→ Multigland hyperplasia	15-20%
	→ Parathyroid Carcinoma	<1%

## Normocalcaemic primary HPT

Ca → high Normal + PTH → elevated + Bone loss

BFHH Benign familial hypocalcaemic hypercalcaemia

24 hours Urine low <40mg + Normal-elevated PTH

50 investigations are

- for confirmation
- Ca
  - PTH
  - 24-hour Urinary Ca "to exclude BFHH"
  - ALP "10-40% of patients have Bone turn over"
  - DEXA "Dual-energy X-Ray Absorption"

Localization  $^{99m}$ -Sestamibi with SPECT

- Ultrasound

optional

- 4D CT

- Angiography SVS "Selective venous Sampling"

medicolegal → indirect laryngoscopy

Surgical techniques

- 3
- Image guided Exploration + intra operative rapid PTH assay
  - Intraoperative Gamma probe - guided after Sestamibi inject
  - Image guided video parathyroidectomy "popular/finest" after Sestamibi & US



# Parathyroid glands and disorders of calcium metabolism

## Hyperparathyroidism

Disease type	Hormone profile	Clinical features	Cause
Primary hyperparathyroidism	<ul style="list-style-type: none"> <li>• PTH (Elevated)</li> <li>• Ca (Elevated)</li> <li>• Phosphate (Low)</li> <li>• Serum Calcium : Creatinine clearance ratio &gt; 0.01</li> </ul>	<p>May be asymptomatic if mild</p> <p>Recurrent abdominal pain (pancreatitis, renal colic)</p> <p>Changes to emotional or cognitive state</p>	<p>Most cases due to solitary adenoma (80%), multifocal disease occurs in 10-15% and parathyroid carcinoma in 1% or less</p>
Secondary hyperparathyroidism	<ul style="list-style-type: none"> <li>• PTH (Elevated)</li> <li>• Ca or normal)</li> <li>• Phosphate (Elevated)</li> <li>• Vitamin D levels (Low)</li> </ul>	<p>May have few symptoms</p> <p>Eventually may develop bone disease, osteitis fibrosa cystica and soft tissue calcifications</p>	<p>Parathyroid gland hyperplasia occurs as a result of low calcium, almost always in a setting of chronic renal failure</p>

## PTH gland Exploration

### Superior PTH

2 cm<sup>2</sup> Superior to RLN cross of Inf thyroid Artery  
↳ then Retro Oesophageal  
↳ then Carotid Sheath

### Inferior Parathyroid

2 cm<sup>2</sup> around inferior pole of thyroid gland

then ↳ Thymus

then ↳ Thyroid gland

if all glands Removed But PTH still not ↓ > 50%

- consider other causes

Do - Bilateral Thymectomy "thoracotomy not justified expt if previously localized"

---

## In Remedial Parathyroidectomy

Two concordant localization studies is essential

US ↳ Intrathyroidal + Sestamibi  
↳ Carotid Sheath + SPECT  
+ FNA

others - CTA - 4D CT "Light up" - MRI  
C11 Methionine PET/CT

SUS for laterality & level "mediastinal vs Neck"

RISK ↳ RLN Injury  
↳ Permanent hyp PTH  
↳ Failure

Frozen Section  
Intra operative  
is essential



Tertiary hyperparathyroidism	<ul style="list-style-type: none"> <li>• Ca (Normal or high)</li> <li>• PTH (Elevated)</li> <li>• Phosphate levels (Decreased or Normal)</li> <li>• Vitamin D (Normal or decreased)</li> <li>• Alkaline phosphatase (Elevated)</li> </ul>	Metastatic calcification Bone pain and / or fracture Nephrolithiasis Pancreatitis	Occurs as a result of ongoing hyperplasia of the parathyroid glands after correction of underlying renal disorder, hyperplasia of all 4 glands is usually the cause
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### Differential diagnoses

It is important to consider the rare but relatively benign condition of **benign familial hypocalciuric hypercalcaemia**, caused by an **autosomal dominant** genetic disorder. Diagnosis is usually made by genetic testing and concordant biochemistry (**Serum Calcium : Creatinine clearance ratio <0.01**-distinguished from **primary hyperparathyroidism**).

### Treatment

*1/3 HPT > 0.01*

### Primary hyperparathyroidism

#### Indications for surgery

- Elevated serum Calcium > 1mg/dL above normal
- Hypercalciuria > 400mg/day
- Creatinine clearance < 30% compared with normal
- Episode of life threatening hypercalcaemia
- Nephrolithiasis
- Age < 50 years
- Neuromuscular symptoms
- Reduction in bone mineral density of the femoral neck, lumbar spine, or distal radius of more than 2.5 standard deviations below peak bone mass (T score lower than -2.5)

# Asymptomatic HPT

Screening "Surveillance"

Serum Ca  
annual Cr level  
annual Bone density

---

## Parathyroidism

in Remedial pTHectomy

Complete excision of all identifiable parathyroid  
implants including

- strap muscles
- thyroid lobes
- Ipsilateral Central LN dissection



## Secondary hyperparathyroidism

*Usually managed with medical therapy.*

*Indications for surgery in secondary (renal) hyperparathyroidism:*

- Bone pain
- Persistent pruritus
- Soft tissue calcifications

## Tertiary hyperparathyroidism

*Allow 12 months to elapse following transplant as many cases will resolve*

The presence of an autonomously functioning parathyroid gland may require surgery. If the culprit gland can be identified then it should be excised.

Otherwise total parathyroidectomy and re-implantation of part of the gland may be required.

## Hypercalcaemia

### Main causes

- Malignancy (most common cause in hospital in-patients)
- Primary hyperparathyroidism (commonest cause in non hospitalised patients)

### Less common

- Sarcoidosis (extrarenal synthesis of calcitriol )
- Thiazides, lithium
- Immobilisation
- Pagets disease
- Vitamin A/D toxicity
- Thyrotoxicosis
- MEN
- Milk alkali syndrome

### Clinical features

*Stones, bones, abdominal moans, and psychic groans*

High serum calcium levels result in decreased neuronal excitability. Therefore sluggish reflexes, muscle weakness and constipation may occur.

**PRIMARY HPT IS THE COMMONEST CAUSE OF HYPERCALCAEMIA IN NON HOSPITALISED PEOPLE**

## Surgery for parathyroid disease

Surgery for parathyroid disease means a parathyroidectomy. The issue of conventional or focused surgery is addressed below. In preparing the patient for surgery the majority of surgeons would still consider laryngoscopy a routine investigation. The risks of rebound hypocalcaemia and contained haematoma has so far thwarted efforts to conduct these procedures as daycases.

### Imaging

Imaging of patients with suspected parathyroid gland disease should usually include ultrasound examination as a minimum. In experienced and skilled hands this will often demonstrate the lesion. Where USS is inconclusive a sestamibi scan should be considered. This may be particularly useful where the gland is difficult to localise and a mediastinal location suspected

### Focused / Minimally invasive surgery Vs Conventional Surgery

The majority of patients with parathyroid disease will suffer from primary hyperparathyroidism. In such patients the usual disease pattern would be the involvement of a solitary adenoma. Whilst traditional 4 gland exposure offers and excellent prospect of a biochemical cure there is the concern that such approaches may be compromised by the development of later morbidity. Accurate neck imaging with ultrasound, sestamibi scans and the selective use of intra operative frozen section, PTH measurements (or both). May result in the decreased need to undertake more conventional neck dissection. This was the topic of an RCT over a decade ago, the results of which were that a minimally invasive approach was associated with less post operative hypocalcaemia and a shorter operating time(1, 2). The authors of this trial do emphasise that individuals with MEN should probably undergo conventional surgical exploration rather than a minimally invasive approach.

### Use of methylene blue

Some endocrine surgeons will routinely use methylene blue to facilitate the identification of parathyroid glands. There has been no randomised trial or formal evaluation of this process. However, the practice is safe in the majority of patients



## Parathyroid carcinoma

- Rare condition
- Equal gender ratio
- Marked hypercalcaemia, neck mass may be present and lesion usually larger than simple adenomas
- If suspected then en bloc resection of the affected half of the thyroid and adjacent soft tissues is performed
- Survival rates with en bloc, R0 resection = 89% overall (5 years)
- Simple parathyroidectomy = 53% survival rate

*When parathyroid cancer is suspected a radical excision is indicated **without** pre-operative tissue sampling. FNA assessments of these lesions are unreliable and core biopsy risks seeding the tumour through the strap muscles and may compromise cure. Histological criteria favouring malignancy include capsular invasion, mitoses and rosette like cellular architecture.*

*Where a parathyroid carcinoma is the suspected diagnosis encountered **intraoperatively** the only correct course of action is **radical resection**. Attempts at biopsy will disseminate the tumour, cause bleeding and compromise cure.*

*Parathyroid carcinomas account for up to 5% of tumours. Adenomas are often encapsulated. Lesions that are fibrotic and densely adherent to the gland may be a carcinoma. 85% cases of primary hyperparathyroidism are due to a single adenoma and this is the reason some surgeons favour a focussed parathyroidectomy.*

# Hypothyroidism

- I<sub>2</sub> deficiency
- Iodine
- I<sup>131</sup> radioactive
- post surgery
- drugs
- Hypothalamus / Pituitary



# Hypothyroidism

Hypothyroidism is an endocrine disorder in which the thyroid gland produces inadequate quantities of the thyroid hormones thyroxine (T4) and triiodothyronine (T3). The global prevalence of hypothyroidism is estimated to be 2-5% while subclinical hypothyroidism is thought to have a prevalence of 4.0-8.5% worldwide.

Iodine deficiency due to insufficient intake of dietary iodine is the most common cause of hypothyroidism worldwide; in iodine-replete countries, the predominant cause of hypothyroidism is the autoimmune condition Hashimoto's disease. Hypothyroidism has numerous causes such as treatment with radioactive iodine-131, injury to the hypothalamus gland or the anterior pituitary gland, medications, congenital absence or surgical removal of a functioning thyroid gland, and increased stress.

## Causes

Iodine deficiency is the most common cause of hypothyroidism worldwide. In iodine-replete areas of the world, hypothyroidism is most commonly caused by the autoimmune disease Hashimoto's thyroiditis; other causes may include an absent thyroid gland or central hypothyroidism due to impaired production of the hypothalamic hormone thyrotropin releasing hormone (TRH) or the anterior pituitary hormone thyroid stimulating hormone (TSH). Central hypothyroidism may occur following injury to these glands from physical trauma, mass effect (compression) by a tumor, autoimmune injury, vascular insufficiency, and myriad other causes. Congenital hypothyroidism is a rare cause of hypothyroidism and most commonly results from thyroid dysgenesis and has an incidence of approximately 1 in 4000 births.

## Diagnosis

Laboratory evaluation of thyroid stimulating hormone (TSH) levels in the blood is considered the best initial screening test for hypothyroidism. If an elevated TSH level is detected, this indicates that the thyroid gland is not producing adequate levels of thyroid hormone and subsequently free T4 levels are often obtained. However, measuring TSH levels alone fails to diagnose secondary and tertiary hypothyroidism, leading to further suggested blood testing if the TSH level is normal and hypothyroidism is suspected.

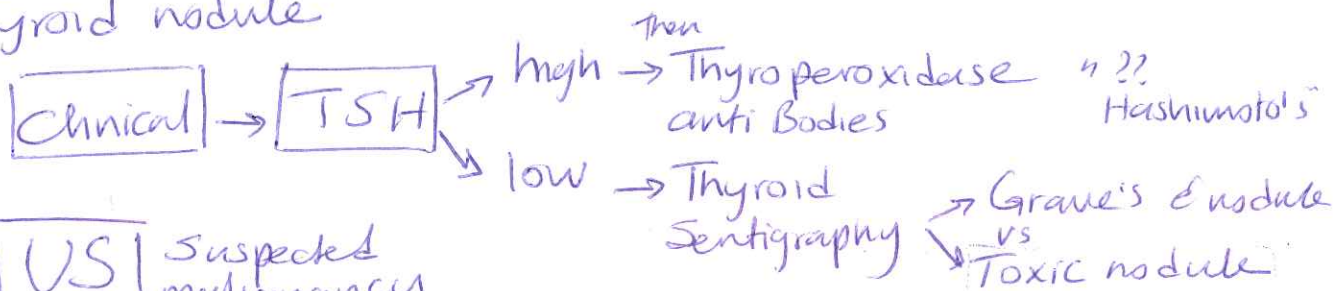
## Treatment

Patients with primary hypothyroidism should be treated with T4 using levothyroxine tablets (BNF) alone.

*Chronic hypothyroidism is associated with impaired myocardial contractility. Other cardiac manifestations of the condition may also be present. Proceeding with surgery may occur without adverse event. However, these patients are recognised as having a higher incidence of complications that is reduced by rendering them euthyroid first. The slow onset of action of thyroid hormones generally makes immediate perioperative administration of little benefit.*



# Thyroid nodule



US

Suspected malignancy

- hypoechogenic
- microcalcification
- irregular margins

- Chaotic vascular pattern
- extracapsular invasion
- LN involvement

FNAC Gold Standard for any - Solid - hypoechogenic - >10mm,

Thy 2 Benign → FU US in 6-12 months

Thy 1 Non Diagnostic → Repeat

USA → Atypia or follicular lesion of undetermined significance

Thy 3 Follicular neoplasm → lobectomy

Thy 4 Suspected malignancy → lobectomy + frozen or Total thyroidectomy

Thy 5 Malignant → Total thyroidectomy

if suspected papillary not follicular or other

in follicular neoplasm frozen section is not informative

- lobectomy
- avoid injury to contralateral RLN
  - " " parathyroid
  - " need for Life long thyroid hormone

The Only indication for thyroid Scintiscan is Suppressed TSH + Thyroid nodule

Radioiodine

Adjuvant therapy

Taken By Salivary / Gastric / excreted By Kidney

Before Giving

Stop TH medication or Give TSH to target thyroid

Exogenous Thyroxin

2 aims → function  
→ Suppress TSH → ↓ Recurrence

# Thyroid malignancy

## Papillary carcinoma

- Commonest sub-type
- Accurately diagnosed on fine needle aspiration cytology
- Histologically they may demonstrate psammoma bodies (areas of calcification) and so called 'orphan Annie' nuclei
- They typically metastasise via the lymphatics and thus laterally located apparently ectopic thyroid tissue is usually a metastasis from a well differentiated papillary carcinoma.

Psammoma  
Orphan Annie

## Follicular carcinoma

- Are less common than papillary lesions
- Like papillary tumours they may present as a discrete nodule. Although they appear to be well encapsulated macroscopically there invasion on microscopic evaluation.
- Lymph node metastases are uncommon and these tumours tend to spread haematogenously. This translates into a higher mortality rate.
- Follicular lesions cannot be accurately diagnosed on fine needle aspiration cytology and thus all follicular FNA's will require at least a hemi thyroidectomy.

Hurtle  
Cells

## Anaplastic carcinoma

- Less common and tend to occur in elderly females
- Disease is usually advanced at presentation and often only palliative decompression and radiotherapy can be offered.

## Medullary carcinoma

- These are tumours of the parafollicular cells (C Cells) and are of neural crest origin.
- The serum calcitonin may be elevated which is of use when monitoring for recurrence.
- They may be familial and occur as part of the MEN -2A disease spectrum.
- Spread may be either lymphatic or haematogenous and as these tumours are not derived primarily from thyroid cells they are not responsive to radioiodine.

## Lymphoma

- These respond well to radiotherapy
- Radical surgery is unnecessary once the disease has been diagnosed on biopsy material. Such biopsy material is not generated by an FNA and thus a core biopsy has to be obtained (with care!).



# Medullary Thyroid Cancer

Neuro endocrinal  
tumour

→ Sporadic

Germ-line mutation

MEN 2A/2B - familial MTC

- RET Gene testing - Screen → hyperpara thyroidism  
→ pheochromocytoma  
& Ht Before operation

FNA or Calcitonin  
(Suspicious or Diagnostic of MTC)

Neck US / Serum Calcitonin / CEA  
Ca / RET Gene testing

NO + Calcitonin  
    < 400 pg/ml  
    ↓ 40 ng  
Total thyroidectomy  
+ Central neck dissection

N1 or Calcitonin  
    > 400 pg/ml  
    ↓ 40 ng  
Neck CT  
Chest CT Liver CT  
or MRI

NO or minimal M1  
Total thyroidectomy &  
Central & lat neck dissection

Extensive  
M1  
palliative neck  
operation if needed

Follow up By Calcitonin and/or CEA

if patient RET mutation Carrier  
prophylactic Thyroidectomy is recommended  
based on specific mutation & level of Risk development

Level 3 needs Surgery within 1st 6 months of life

Level 2 5 years of life

Level 1 5-10 years

Can be postponed  
if US → no Abnormality  
↓  
family history less aggressive

*Hashimoto's thyroiditis is a recognised risk factor for thyroid gland lymphoma. Extensive nodal metastasis are often present and since the usual treatment is with chemo/radiotherapy the only role of the surgeon is to confirm the diagnosis. This can usually be achieved with image guided biopsy.*

*Anaplastic thyroid cancer, The prognosis is very poor and some palliation may be achieved by palliative radiotherapy.*

*Hurthle cell lesions are a subtype of follicular thyroid cancer and considered to have an adverse prognosis. Almost all cases should be considered for total thyroidectomy and some surgeons would also undertake central nodal dissection.*

Theme from 2013 Exam

*Papillary carcinomas may be multifocal in up to 80% of cases and therefore most surgeons would advocate a total thyroidectomy in those patients whose tumours exceed 1cm in diameter. The minimum procedure for smaller tumours is total lobectomy and isthmusectomy. High risk features (male sex and age) make a nodal dissection of the level VI nodes sensible.*

*Renal cell carcinoma are the tumour type most likely to metastasise to the thyroid. These will often have a clear cell morphology histologically. Clear cell sarcomas are very rare and thyroidal metastasis from them rarer still.*

## **USS features of thyroid malignancy**

- Hypoechoity
- Microcalcifications
- Lymphadenopathy
- Loss of halo
- Irregular margins



## Thyroid FNA results

Result	Interpretation	Action
THY 1	Inadequate	Repeat (of follow up USS if cyst only)
THY 2	Non neoplastic (with the descriptive report documenting the features consistent with a colloid nodule or thyroiditis). Cysts may be classified as Thy2 if benign epithelial cells are present.	Repeat USS +/- FNA at 3-6 months
THY 3	Follicular lesion (or suspected follicular neoplasm)	Hemithyroidectomy
THY 4	Suspicious of malignancy	Surgical resection (unless lymphoma where core Bx may be considered)
THY 5	Diagnostic of malignancy	Surgical resection (except lymphoma or if non operable)

Thyroid peroxidase  
Microsomal  
Hashimoto's

Antibodies to TSH  
Graves



## Blood testing in thyroid disease

Assay	Usage
Thyroid peroxidase (microsomal) antibodies	<ul style="list-style-type: none"> <li>Found in autoimmune disease affecting the thyroid (Hashimotos 100%) and Graves (70%)</li> </ul>
Antibodies to TSH receptor	<ul style="list-style-type: none"> <li>Individuals with Graves disease (95%)</li> </ul>
Thyroglobulin antibodies	<ul style="list-style-type: none"> <li>Not useful for clinically distinguishing between different types of thyroid disease, may be used as part of thyroid cancer follow up</li> </ul>
Calcitonin	<ul style="list-style-type: none"> <li>Released from the parafollicular cells</li> <li>Usually found in patients with medullary carcinoma of the thyroid</li> </ul>

## Hormonal changes in thyroid disease

Disorder	T3/ T4	TSH
Primary hyperthyroidism	High	Low
T3 thyrotoxicosis	T3 high only	Low
Secondary hyperthyroidism	High	High
Primary hypothyroidism	Low	High
Secondary hypothyroidism	Low	Low
Sick euthyroid	Low	Low

Bleeding hematoma

- tracheomalacia

- N. Injuries 1dp

- hypoparathyroidism

- hypocalcemia

- other Injuries



## Complications following thyroid surgery

The major immediate risk following thyroidectomy is **haemorrhage**. A tension haematoma deep to the cervical fascia is usually the result of reactionary haemorrhage from an arterial source. This results in the development of laryngeal oedema and airway compromise. The treatment is by **urgent wound decompression of all layers prior to return to theatre for haemostasis**. Subcutaneous haematomas and seromas may accumulate under skin flaps and can often be managed conservatively or by simple aspiration.

In patients with longstanding large goitres there is the risk of **tracheomalacia**. This is characterised by the development of flaccidity of the tracheal cartilage. This can result in airway compromise. In the normal situation the tracheal diameter increases slightly during inspiration and narrows during expiration. In tracheomalacia these processes are exaggerated and the **trachea may collapse in expiration resulting in stridor**. In the immediate situation an **endotracheal tube will need to be inserted**.

Recurrent laryngeal nerve injury is recognised following thyroid surgery and may be unilateral or bilateral depending upon the procedure performed. The **risk is 1.8% at one month which declines to 0.5% at three months following first time explorations**. It is rare for nerve injury alone to result in airway compromise. However, it may occur when nerve injury is associated with minor degrees of laryngeal oedema (such as following intubation).

Hypoparathyroidism is a recognised complication following thyroid surgery and damage to the blood supply to the parathyroid glands is probably the commonest cause. The **incidence of permanent hypoparathyroidism is in the region of 1 to 3%**. It can **present dramatically in the first 2-5 post operative days**. In the emergency setting treatment is with intravenous **calcium gluconate**. Oral calcium carbonate is used in the longer term.

**RLN INJURY IS A RARE COMPLICATION (1%). NEUROPRAXIA IS MORE COMMON THAN DIVISION.**



## Hypocalcaemia following thyroidectomy

Thyroidectomy carries a risk of devascularising the parathyroid glands. This risk is lessened in unilateral surgery. If damage to the parathyroid glands is noted intraoperatively then the affected tissue should be autotransplanted either into a sternocleidomastoid muscle pocket or into brachioradialis muscle.

Post operatively hypocalcaemia may present as a crisis on the ward with the features of tetany and cardiovascular instability. The treatment of this is with intravenous calcium gluconate. The risks of post operative hypocalcaemia following thyroidectomy is 5%, in 80% of these the situation resolves over the following 12 months.

## Thyroglossal cyst

A thyroglossal cyst usually develops from a persistence of part of the thyroglossal duct. Because of this embryological origin they usually lie in the midline. Whilst they may occur at any site of embryonic descent the most common location is immediately inferior to the hyoid. The thyroglossal duct communicates with the foramen caecum in the tongue and therefore protrusion of the tongue will usually result in upward movement of the cyst. Up to half of thyroglossal cysts are not diagnosed until adult life. The tract can lie dormant for years or even decades until some kind of stimulus leads to cystic dilation. Infection can sometimes cause the transient appearance of a mass or enlargement of the cyst, at times with periodic recurrences. Spontaneous drainage may also occur. Differential diagnosis are ectopic thyroid, enlarged lymph nodes, dermoid cysts and goitre. The usual treatment is a Sistrunks procedure, via a transverse incision the cyst, duct and branches are removed. The dissection continues to the foramen caecum and this will routinely necessitate the removal of the central aspect of the hyoid. If there has been a history of recent infection then it is sensible to administer antibiotics perioperatively.



# Others

## Vancomycin

Tinnitus is usually the first manifestation of vancomycin **ototoxicity**. Irreversible vestibular damage can result from the ototoxicity.

Vancomycin is excreted **renally**. Liver impairment does not affect its elimination from the body.

Side effects are more common in elderly patients, due to the reduced volumes of distribution and reduced renal reserve.

Auditory and renal function should be monitored regularly in the elderly. A reduced dose should be used, if there is renal impairment.

Oral vancomycin is not normally significantly absorbed systemically. However, after multiple doses or in inflammatory bowel disease, absorption can cause systemic side effects.

## Hypertrophic pyloric stenosis

occurs in approximately 3:1,000 live births. **Males** (especially first born) are affected approximately four times as often as females. Family clustering occurs.

Pyloric stenosis is associated with other congenital defects, including tracheo-oesophageal fistula.

The vomiting usually starts after three weeks of age, but symptoms may develop as early as the first week of life, and as late as the fifth month.

Non-bilious vomiting is the initial symptom, which progressively becomes more vigorous. As vomiting continues, there is a progressive loss of fluid, hydrogen ion, and chloride, leading to a hypochloraemic metabolic alkalosis.

The diagnosis is established by palpating the pyloric mass. The mass is firm, movable, approximately 2 cm in length, olive shaped, hard, best palpated from the **left side**, and located above and to the right of the umbilicus in the mid-epigastrium beneath the liver edge.

Imaging procedures (USS or barium meal) are reserved for those infants in whom the diagnosis remains in doubt.

## Erythropoietin (EPO)

EPO is released in response to hypoxia (not hypercapnia) and anaemia. It is mostly synthesised in the **kidney**, hence EPO requirement in renal failure, although the **liver** may contribute up to 20% of EPO production.

It specifically stimulates red blood cell (RBC) production, and it is less effective in iron deficient states.

Side effects of EPO treatment include increased blood pressure.



② Study → Journal Impact factor ↙  
→ Date

③ type of study Level of Evidence ↙

④ → PICO Question ↔ hypothesis

⑤ Bias ← Confounding

what & what Done  
to eliminate it

Sample Size

what & what Done  
to minimize it  
at time of Design  
Restriction

In meta analysis

Literature Search Bias / Search strategy  
foreign language exclusion / translation  
Bias

→ inclusion & exclusion criteria

"take care"

Drug waste purity Bias

Matching

→ Reminiscence  
→ confounders

Randomisation / minimisation  
at time of analysis

Stratification

Standardisation → age adjusted

Statistical adjustment

cont. var. | Multiple linear regression  
binary var. | logistic regression

Selection Bias / Randomisation  
Concealed Allocation

Performance Bias / Blinding

Observation Bias / Blinding action

Attrition Bias / Intention-to-treat  
analysis

⑥ End points → Clinical  
→ Surrogate

Validity

extent to which test measure  
what it is supposed to measure

others • power calculation

• Organisation of the Paper IMRAD

Result Stat. analysis appropriate

Reliability

the consistency of test Result on  
Repeated measure K Kaplan

0-8 good agreement

Discussion

- fairly comparison Don

• novel observation

• Existing Guidelines



# Miscellaneous

## Common epidemiological studies

### Case controlled study

A case-control study is a type of study design used widely, often in epidemiology. It is a type of observational study in which two existing groups differing in outcome are identified and compared on the basis of some supposed causal attribute. Case-control studies are often used to identify factors that may contribute to a medical condition by comparing subjects who have that condition/disease (cases) with patients who do not have the condition/disease but are otherwise similar (controls). They require fewer resources but provide less evidence for causal inference than a randomized controlled trial.

### Cohort study

A cohort study is often undertaken to obtain evidence to try to refute the existence of a suspected association between cause and effect; failure to refute a hypothesis often strengthens confidence in it. Crucially, the cohort is identified before the appearance of the disease under investigation. The study groups follow a group of people who do not have the disease for a period of time and see who develops the disease (new incidence). The cohort cannot therefore be defined as a group of people who already have the disease. Prospective (longitudinal) cohort studies between exposure and disease strongly aid in studying causal associations, though distinguishing true causality usually requires further corroboration from further experimental trials.

### Cross sectional studies

Cross-sectional studies involve data collected at a defined time. They are often used to assess the prevalence of acute or chronic conditions, or to answer questions about the causes of disease or the results of medical intervention. They may also be described as censuses. Cross-sectional studies may involve special data collection, including questions about the past, but they often rely on data originally collected for other purposes. They are moderately expensive, and are not suitable for the study of rare diseases. Difficulty in recalling past events may also contribute bias.

### Randomised control studies

These studies involve the experimenter allocating a specific exposure or intervention to a group of people who are randomly assigned to a particular group. They may be blinded or non blinded. The method of randomisation and the degree of blinding will have a direct impact on the potential bias of



PRISMA

27 point checklist  
+ 4 flow diagrams

Preferred Reporting Items for Systematic Review  
and Meta Analysis

CONSORT

25-item checklist  
+ flow Diagram

Consolidated Standards of Reporting Trials

TREND Transparent Reporting of Evaluation with Nonrandomised  
Design

STROBE

Strengthening The Reporting of  
Observational Studies in Epidemiology

the study. In order to establish the numbers need to enter the study it is usual to perform a power calculation.

## statistics

### Data types

Accurately classifying the data you seek to obtain is the first step in undertaking formal data analysis.

#### Title

#### Description

##### Nominal

Numbers are assigned to data that has no underlying numerical value (e.g. marital status)

##### Ordinal

Has numbers that can be assigned to a natural underlying order (e.g. tumour grades)

##### Discrete

Data has a discrete numerical value, that has to be a whole number (e.g. number of deaths)

##### Continuous

Data has a numerical value that may not be a whole number and often reflects a direct measurement (e.g. weight)

Knowing the data types allows us to direct the appropriate analysis. This is often conveniently achieved by plotting it on a graph. Where the data has a categorical nature, a histogram is often a useful starting point. Other types of data, particularly direct measurements, may be plotted as single data points. If we take the weight example from above then plotting a large number of data points may allow us to numerically determine the spread of the data. In particular whether it fits the normal distribution. Remember that if the mean, median and mode overlap numerically then the data will be normally distributed.

### Parametric vs Non parametric

Parametric methods of data analysis assume that the underlying data set has a normal distribution. Non parametric methods do not make assumptions about the nature of the underlying data.

#### Parametric tests

T Test

Paired T Test

#### Non parametric tests

Mann Whitney U

Chi Squared

Spearman's Rank Correlation

Wilcoxon signed rank test



## **Types of test**

### **T Test**

Direct comparison of data sets which are normally distributed

### **Mann Whitney U**

Ranked method for non parametric data

Wilcoxon matched pairs/ signed rank

Analog of the paired T Test, data must be interval, data based on magnitude of differences

### **Spearman's Rank Correlation**

Statistical dependence between 2 variables. May be used for continuous or discrete variables

### **Chi Squared test**

Test of association between two qualitative variables, valid if 80% expected frequencies exceed 5 or all exceed 1. Fishers exact test may be used for small samples

## **Continuous variables**

If a variable can take on a value at any point between its minimum and maximum value then it is termed a continuous variable. Otherwise it is called a discrete variable. Patient weights are an example of continuous variables as fractions of numbers are possible (if the equipment is accurate). Discrete variables could include factors such as polyp identification during colonoscopy (as partial polyps don't exist- though partial retrieval certainly can!)

## **Power calculations and statistical error**

### **Statistical error**

#### **Type 1 Error**

A test rejects a true null hypothesis. Analogous to false positive. It usually equates to the significance level assigned to a test.

#### **Type 2 Error**

A test fails to reject a false null hypothesis. It is related to the power of a test.

### **Statistical power**

The power of a test is the probability that the test will reject the null hypothesis when it is false (thereby avoiding a type 2 error). Increasing the power of a test will reduce the probability of a type 2 error. Usually a value of 0.8 is selected.

## Probability

### Pre-test probability

The proportion of people with the target disorder in the population at risk at a specific time (point prevalence) or time interval (period prevalence)

For example, the prevalence of rheumatoid arthritis in the UK is 1%

### Post-test probability

The proportion of patients with that particular test result who have the target disorder

Post-test probability = post test odds / (1 + post-test odds)

### Pre-test odds

The odds that the patient has the target disorder before the test is carried out

Pre-test odds = pre-test probability / (1 - pre-test probability)

### Post-test odds

The odds that the patient has the target disorder after the test is carried out

Post-test odds = pre-test odds x likelihood ratio

where the likelihood ratio for a positive test result = sensitivity / (1 - specificity)

## Recall Bias

Recall bias represents a major threat to the internal validity of studies using self-reported data. It arises with the tendency of subjects to report past events in a manner that is different between the two study groups. This pattern of recall errors can lead to differential misclassification of the related variable among study subjects with a subsequent distortion of measure of association in any direction from the null, depending on the magnitude and direction of the bias. Although recall bias has largely been viewed as a common concern in case-control studies, it also has been documented as an issue in some prospective cohort and randomized controlled trial designs.



SCC / BCC      Safety margin  
     $< 2 \text{ cm} \rightarrow 4 \text{ mm}$   
     $> 2 \text{ cm} \rightarrow 6 \text{ mm}$   
    Recurrent  $\rightarrow$  Mohs

Melanoma  
     $< 1 \text{ mm} \rightarrow 1 \text{ cm}$   
     $1-2 \text{ mm} \rightarrow 1-2 \text{ cm}$   
     $2-4 \text{ mm} \rightarrow 2-3 \text{ cm}$   
     $> 4 \text{ mm} \rightarrow 3 \text{ cm}$  }  $\rightarrow$  SNLB if  $> 2 \text{ cm}$   
    + SNLB if  $> 1 \text{ mm}$

BCC      Mohs      Specially Morpheo

## Positive predictive values

### Screening tests

- Sensitivity: proportion of true positives identified by a test
- Specificity: proportion of true negatives correctly identified by a test
- Positive predictive value: proportion of those who have a positive test who actually have the disease
- Negative predictive value: proportion of those who test negative who do not have the disease

Predictive values are dependent on the prevalence

- Likelihood ratio for a positive test result =  $\text{sensitivity} / (1 - \text{specificity})$
- Likelihood ratio for a negative test result =  $(1 - \text{sensitivity}) / \text{specificity}$

Likelihood ratios are not prevalence dependent

## False positive

A false positive may occur when a screening test falsely identifies individuals as having a condition when none is present. This is a price that is paid for having a sensitive screening test. In surgical practice both faecal occult blood testing and mammography probably generate the greatest burden and worry as a result of false positive results.

## Odds ratio

In studies with binary results (e.g. yes or no) the odds ratio or relative risk is used. OR rate of 1 implies that event may occur on either group, values of more or less than 1 indicate a skew to one group or the other. The risk ratio is 1 where the event may occur in either group or less than 1 if it is more likely in one group over the other.

Odds are a ratio of the number of people who incur a particular outcome to the number of people who do not incur the outcome. The odds ratio may be defined as the ratio of the odds of a particular outcome with experimental treatment and that of control.

Odds ratios are the usual reported measure in case-control studies. It approximates to relative risk if the outcome of interest is rare.

For example, if we look at a trial comparing the use of paracetamol for back pain compared to placebo we may get the following results



## Total number of patients

	Total number of patients	Achieved 50% pain relief
Paracetamol	60	40
Placebo	90	30

The odds of achieving significant pain relief with paracetamol =  $40 / 20 = 2$

The odds of achieving significant pain relief with placebo =  $30 / 60 = 0.5$

Therefore the odds ratio =  $2 / 0.5 = 4$

## Absolute risk reduction

The absolute risk reduction is the decrease in risk of a given activity or treatment in relation to a control activity or treatment. It is the inverse of the number needed to treat.

The absolute risk reduction is usually calculated for two different treatments. For example, consider surgical resection (X) versus watchful waiting (Y) for prostate cancer. A defined end point, such as 5 year survival is required. If the probabilities  $p_X$  and  $p_Y$  of this end point are known then the absolute risk reduction is calculated ( $p_X - p_Y$ ).

The inverse of absolute risk reduction is the *Number Needed to Treat*. This is useful in determining the cost Vs benefit of many treatments.

### Number needed to treat

Definition: how many patients would be need to receive a treatment to prevent one event. It is the absolute difference between two treatments.

## Impact factor

The impact factor of an academic journal is a measure reflecting the average number of citations to recent articles published in the journal. It is frequently used as a proxy for the relative importance of a journal within its field, with journals with higher impact factors deemed to be more important than those with lower ones. The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information. Impact factors are calculated yearly starting from 1975 for those journals that are indexed in the Journal Citation Reports.

Breast → Trastuzumab HER-2  
 Colorectal → Cetuximab EGFR → Metastatic Disease  
 IBD → Infliximab anti TNF $\alpha$   
 GIST → Imatinib  
                     Sunitinib Tyrosin Kinase Inhibitor  
 HCC → Sorafenib

PET/CT  
     → Oesophageal  
     → Stomach } change many  
                     met  
     → Liver  
     ↓ colorectal mets  
     ↓ pancreatic mass  
       + 5 suspected  
       extra panc. CT for lung



## Calculation

In a given year, the impact factor of a journal is the average number of citations received per paper published in that journal during the two preceding years. For example, if a journal has an impact factor of 10 in 2007, then its papers published in 2005 and 2006 received 10 citations each on average in 2007. The 2007 impact factor of a journal would be calculated as follows:

A = the number of times that articles published in that journal in 2005 and 2006, were cited by articles in indexed journals during 2007.

B = the total number of "citable items" published by that journal in 2005 and 2006. ("Citable items" are usually articles, reviews, proceedings, or notes; not editorials or letters to the editor.)

2007 impact factor =  $A/B$ .

(Note that 2007 impact factors are actually published in 2008; they cannot be calculated until all of the 2007 publications have been processed by the indexing agency.)

New journals, which are indexed from their first published issue, will receive an impact factor after two years of indexing; in this case, the citations to the year prior to Volume 1, and the number of articles published in the year prior to Volume 1 are known zero values. Journals that are indexed starting with a volume other than the first volume will not get an impact factor until they have been indexed for three years. Annuals and other irregular publications sometimes publish no items in a particular year, affecting the count. The impact factor relates to a specific time period; it is possible to calculate it for any desired period, and the Journal Citation Reports (JCR) also includes a five-year impact factor.

## Descriptive statistics

Descriptive statistics include a point estimate of the measured variable as well as a measure of the variability of the data around that point estimate. Typical examples of point estimates include; mean, median and mode. The two most commonly employed measurements of variability include standard deviation and the inter quartile range. The standard deviation is usually considered in association with the mean, while the inter quartile range is used alongside the median. Other measures of data variability include the standard error of the mean and confidence interval. The standard error of the mean represents the measure of variation around the point estimate of the mean of a group of sample means, as such it should only be used when describing the characteristics of more than one sample.

Adalimumab  
Infliximab  
Etanercept

TNF  $\alpha$  ~~in~~  
Inhibitors

Crohn's  
Rheumatoid  
Arthritis

Bevacizumab

Anti VEGF  
Vascular Endothelial  
Growth Factor

Colorectal  
Reperal

Trastuzumab

HER receptor

Breast  
Oesophagus

Imatinib

TKI  
Tyrosine Kinase  
Inhibitor

GIST  
Chronic myeloid  
Leukemia

Basiliximab

IL2 binding  
site

Renal transplant

Cetuximab

EGF Inhibitor  
K Ras  
Colorectal



## Funnel plots

- A funnel plot is a useful graph designed to check the existence of publication bias in systematic reviews and meta-analyses. It assumes that the largest studies will be near the average, and small studies will be spread on both sides of the average. Variation from this assumption can indicate publication bias.
- In common with confidence interval plots, funnel plots are conventionally drawn with the treatment effect measure on the horizontal axis, so that study size appears on the vertical axis, breaking with the general rule. Since funnel plots are principally visual aids for detecting asymmetry along the treatment effect axis, this makes them considerably easier to interpret.
- The funnel plot is not without problems. If high precision studies really are different from low precision studies with respect to effect size (e.g., due to different populations examined) a funnel plot may give a wrong impression of publication bias. The appearance of the funnel plot can change quite dramatically depending on the scale on the y-axis whether it is the inverse square error or the trial size

## Forest plots

A Forest plot is a graphical display designed to illustrate the relative strength of treatment effects in multiple quantitative scientific studies, addressing the same question. It is often used to graphically display meta analyses of randomised controlled trials.

The graph may be plotted on a natural logarithmic scale when using odds ratios or other ratio-based effect measures, so that the confidence intervals are symmetrical about the means from each study and to ensure undue emphasis is not given to odds ratios greater than 1 when compared to those less than 1. The area of each square is proportional to the study's weight in the meta-analysis. The overall meta-analysed measure of effect is often represented on the plot as a vertical line. This meta-analysed measure of effect is commonly plotted as a diamond, the lateral points of which indicate confidence intervals for this estimate.

A vertical line representing no effect is also plotted. If the confidence intervals for individual studies overlap with this line, it demonstrates that at the given level of confidence their effect sizes do not differ from no effect for the individual study. The same applies for the meta-analysed measure of effect: if the points of the diamond overlap the line of no effect the overall meta-

# 6 Sepsis Bundle



analysed result cannot be said to differ from no effect at the given level of confidence.

## Drug trials

Phase of trial	Description
Phase 0	Safety and efficacy data Usually sub therapeutic dose given Small number of patients
Phase I	Small number of patients Safe dose range Side effect profile Dose escalation studies often used
Phase II	Larger number of participants May be compared to existing therapies Adverse effect data captured
Phase III	Large number of participants Comparison to placebo or existing therapy Often randomised
Phase IV	Done following licensing Determine long term safety and efficacy

## Confidence intervals

A 95% confidence interval is often interpreted as indicating a range within which we can be 95% certain that the true effect lies. This statement is a loose interpretation, but is useful as a rough guide. The strictly-correct interpretation of a confidence interval is based on the hypothetical notion of considering the results that would be obtained if the study were repeated many times. If a study were repeated infinitely often, and on each occasion a 95% confidence interval calculated, then ninety five percent of these intervals would contain the true effect.

# Postoperative Complication

**Grade I** Any deviation from normal postop course without need for

- pharmacologic
- Surgical
- endoscopic
- Radiologic

Allowed therapeutic regimens are

- Drugs as antiemetics/antipyretics/analgesia
- Diuretics/electrolytes
- physiotherapy

also include wound infection opened at bedside

**Grade II** Requiring pharmacological Ht with Drugs other than such allowed for grade I complications

- Blood transfusion
- TPN

**Grade III** Require endoscopic <sup>Surgical</sup> or Radiological intervention

III a <sup>Not</sup> Under general anaesthesia

III b Under general anaesthesia

**Grade IV** life threatening complication including CNS complications <sup>stroke, large intracranial</sup> Requiring ICU management or Intermediate care

IV a Single organ dysfunction (including Dialysis)

IV b multiorgan dysfunction

**Grade V** Death of the patient

Suffix "d" at the time of Discharge

Disability

→ follow up to fully evaluate the complication