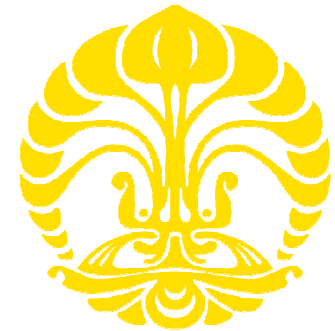




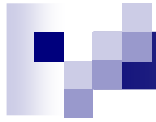
Faisal Yunus



UNIVERSITAS
INDONESIA

Departemen Pulmonologi dan Ilmu
Kedokteran Respirasi FKUI – RS
Persahabatan Jakarta

Upload : 1 Mei 2009

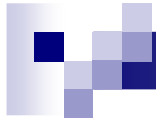


RESPIRASI

➤ Ventilasi

➤ Difusi

➤ Perfusi

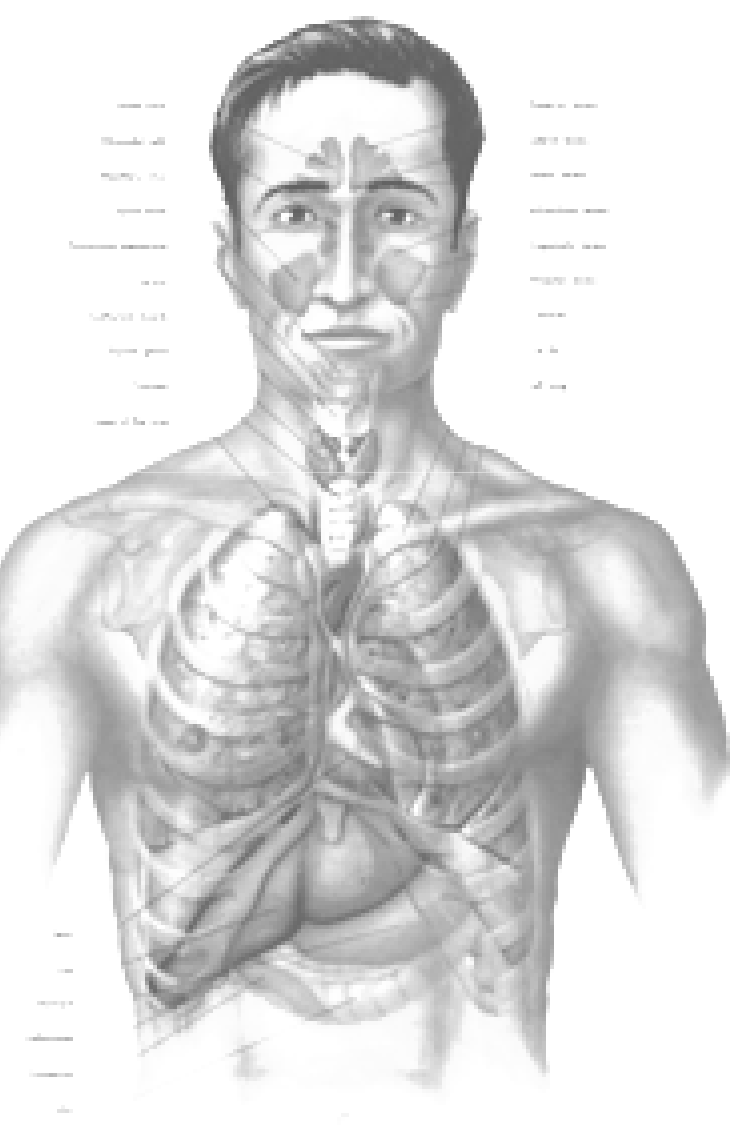


VENTILASI

Peristiwa masuk dan keluar udara ke dalam paru

- ✓ Inspirasi
- ✓ Ekspirasi

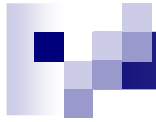
respiratorik



- Saluran respiratorik atas :
 - Hidung
 - Sinus
 - Tenggorokan
- Saluran respiratorik bawah :
 - Bronkus
 - Bronkiolus
 - Alveolus

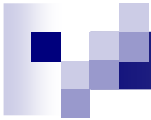
Sal. napas atas dan bawah erat
berhubungan karena merupakan 1 unit

50-80% asma anak disertai rinitis
20% pasien rinitis juga menderita asma



SPIROMETRI

Alat untuk mengukur ventilasi yaitu mengukur volume statik dan volume dinamik paru



VOLUME STATIK

- ▣ Volume tidal (VT)
- ▣ Volume Cadangan Inspirasi (VCI)
- ▣ Volume Cadangan Ekspirasi (VCE)
- ▣ Volume Residu (VR)



VOLUME STATIK

- ▣ Kapasiti Vital (KV)
- ▣ Kapasiti Vital Paksa (KVP)
- ▣ Kapasiti Residu Fungsional (KRF)
- ▣ Kapasiti Paru Total (KPT)



VOLUME DINAMIK

- ◇ Volume ekspirasi paksa detik pertama (VEP_1)
- ◇ Maximal voluntary ventilation (MVV)



INDIKASI PEMERIKSAAN

- ✓ Setiap keluhan sesak
- ✓ Penderita asma stabil
- ✓ Penderita PPOK stabil
- ✓ Evaluasi penderita asma tiap tahun dan penderita PPOK tiap 6 bulan



INDIKASI PEMERIKSAAN

- ✓ Penderita yang akan dianestesi umum
- ✓ Pemeriksaan berkala pekerja yang terpajan zat
- ✓ Pemeriksaan berkala pada perokok



TUJUAN PEMERIKSAAN SPIROMETRI

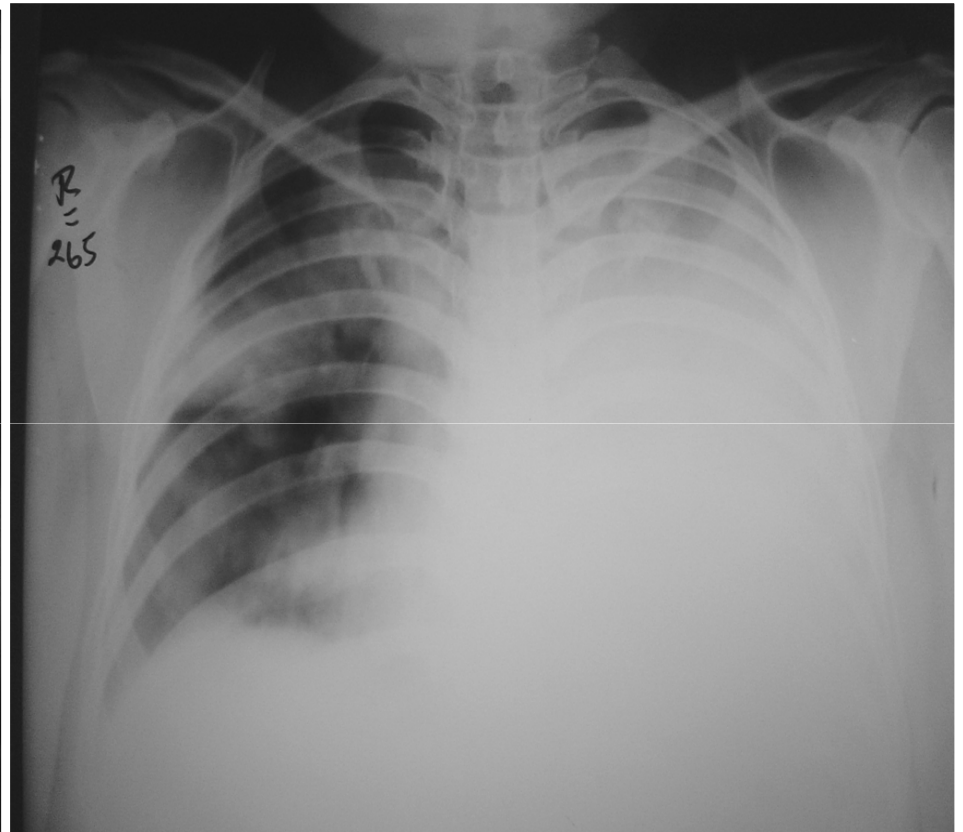
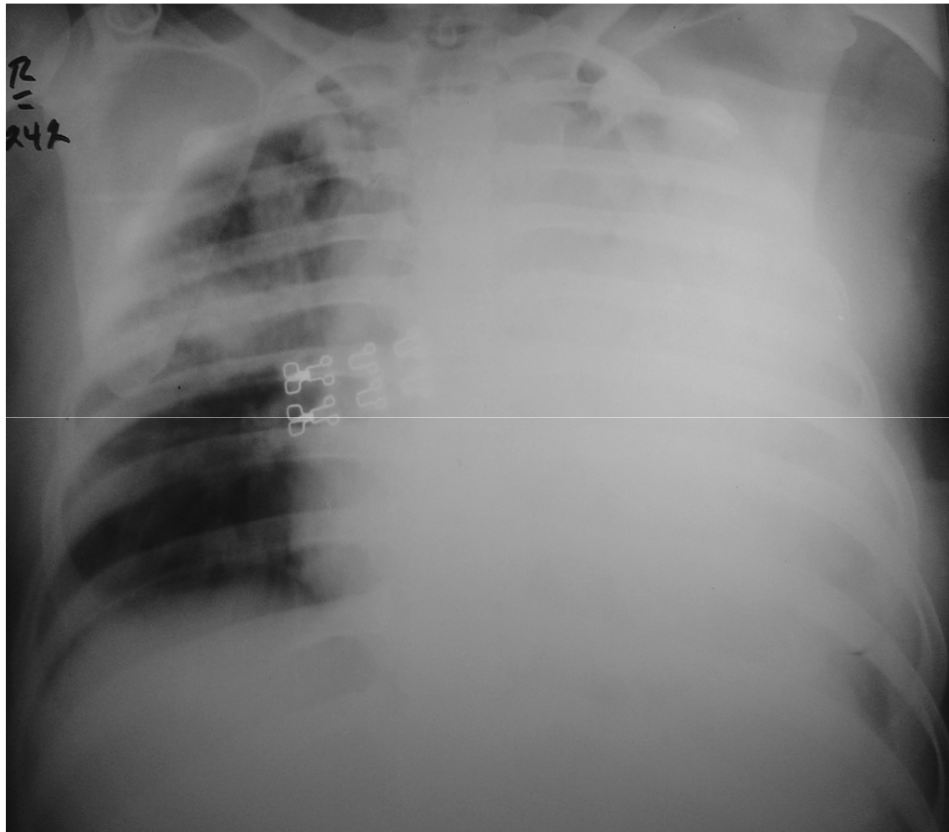
- ☑ Menilai status faal paru
(normal, restriksi, obstruksi, campuran)
- ☑ Menilai manfaat pengobatan
- ☑ Memantau perjalanan penyakit
- ☑ Menentukan prognosis
- ☑ Menentukan toleransi tindakan bedah



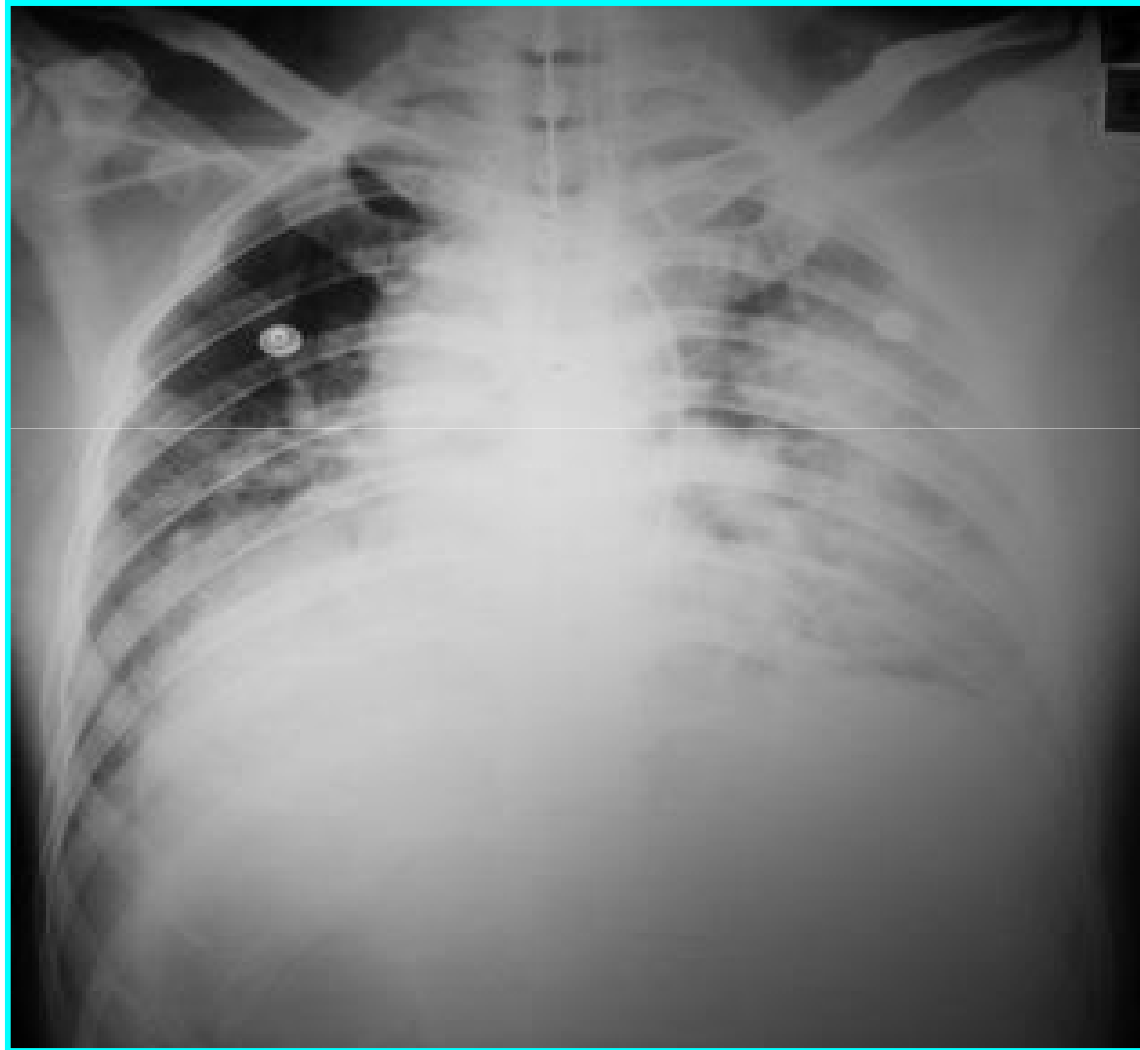
GANGGUAN VENTILASI

- ✓ Restriksi : gangguan pengembangan paru

ARDS



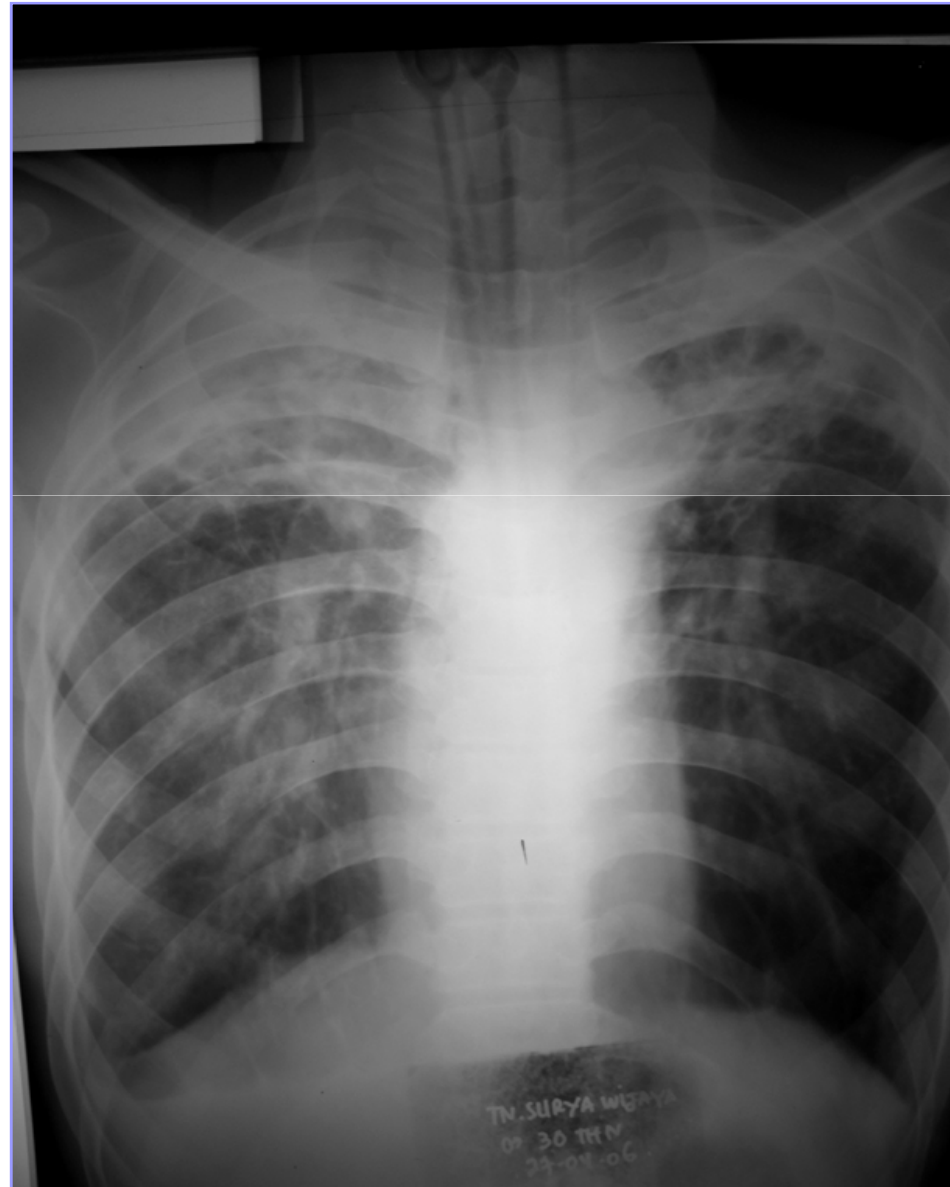
PNEUMONIA



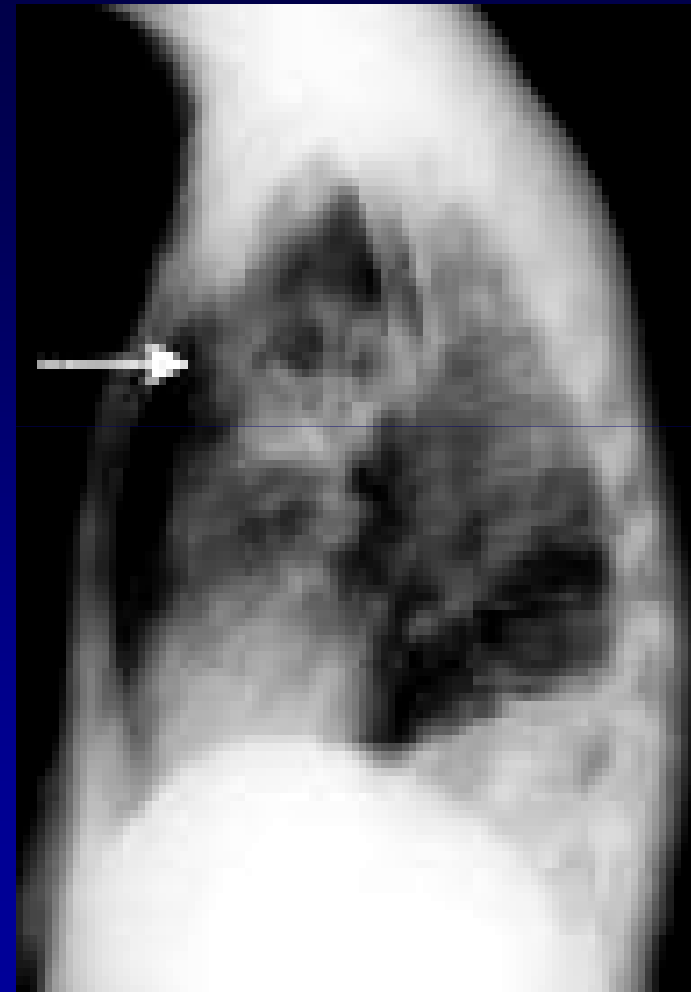
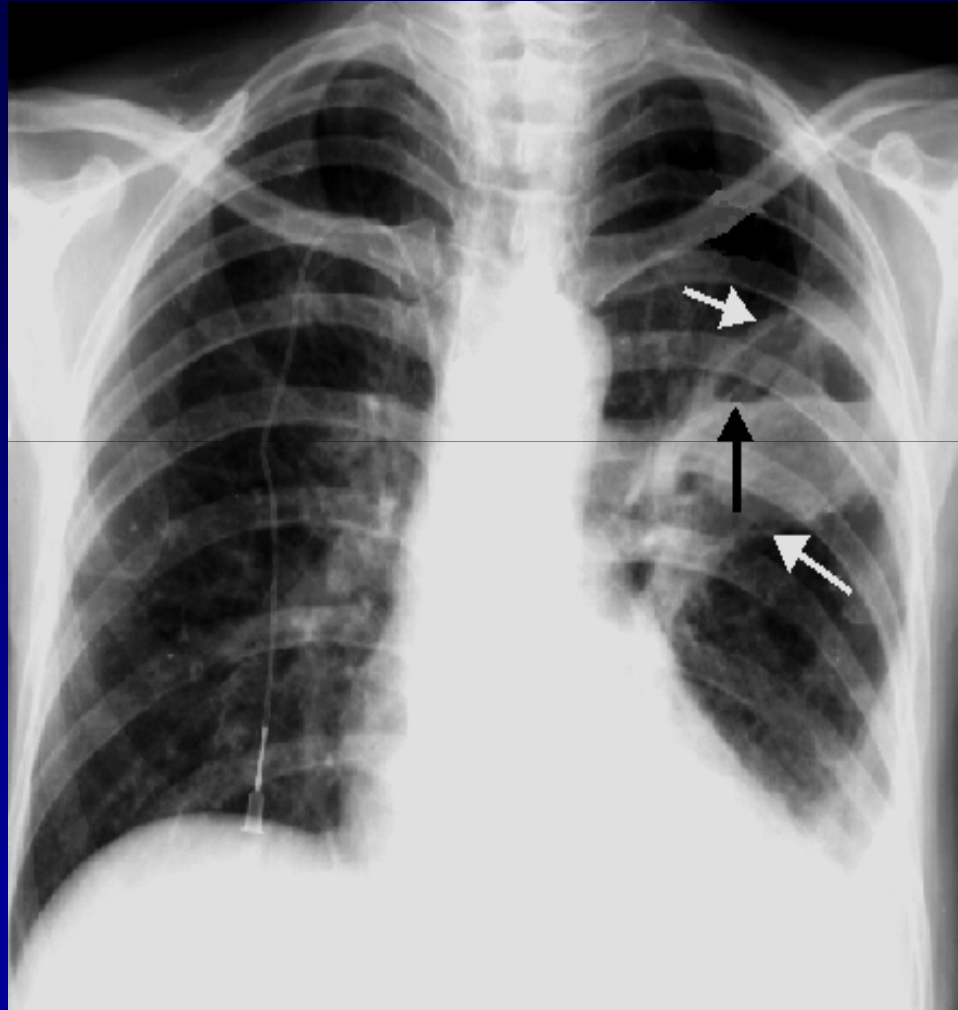
ATELEKTASIS



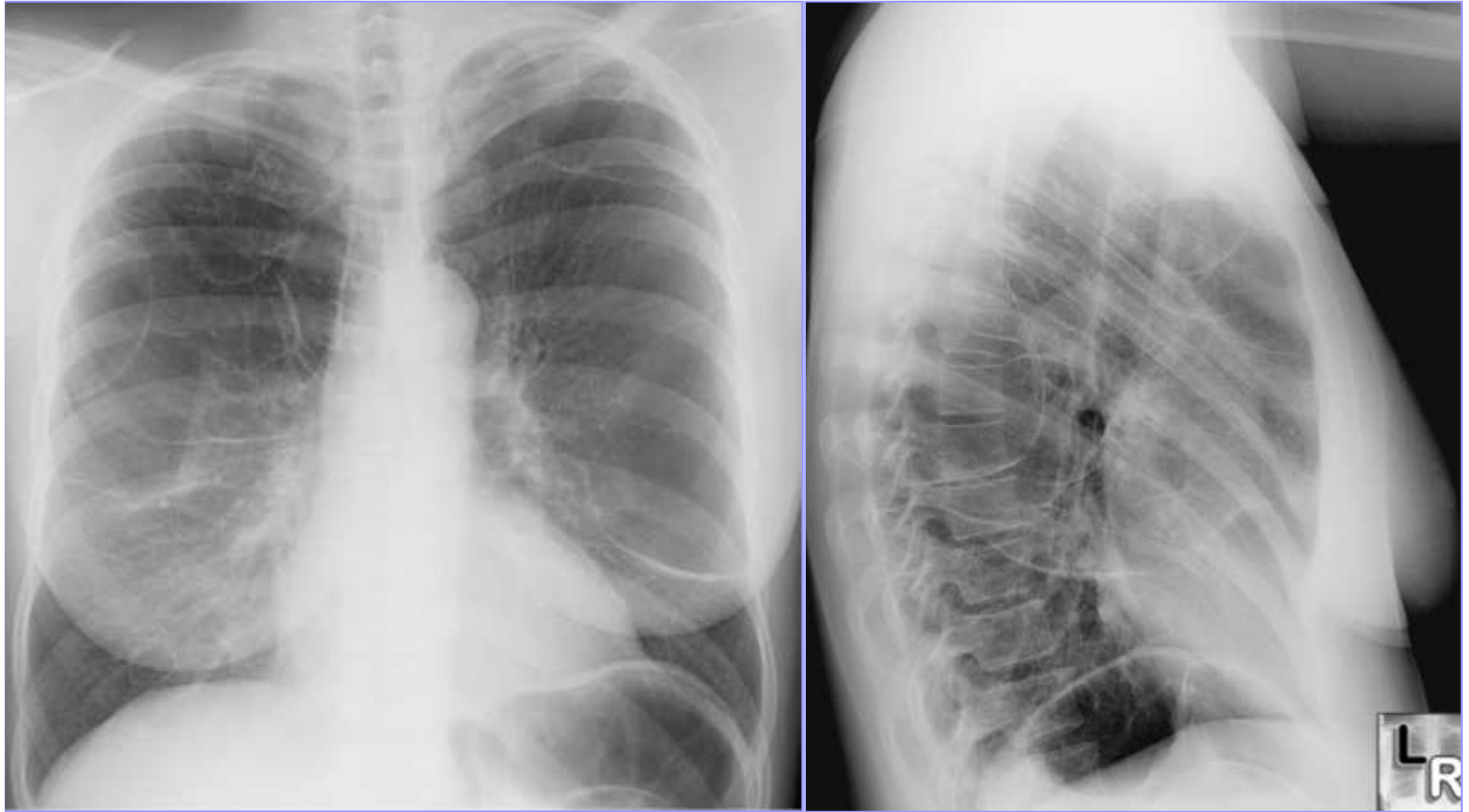
DESTROYED LOBE



ABSES PARU



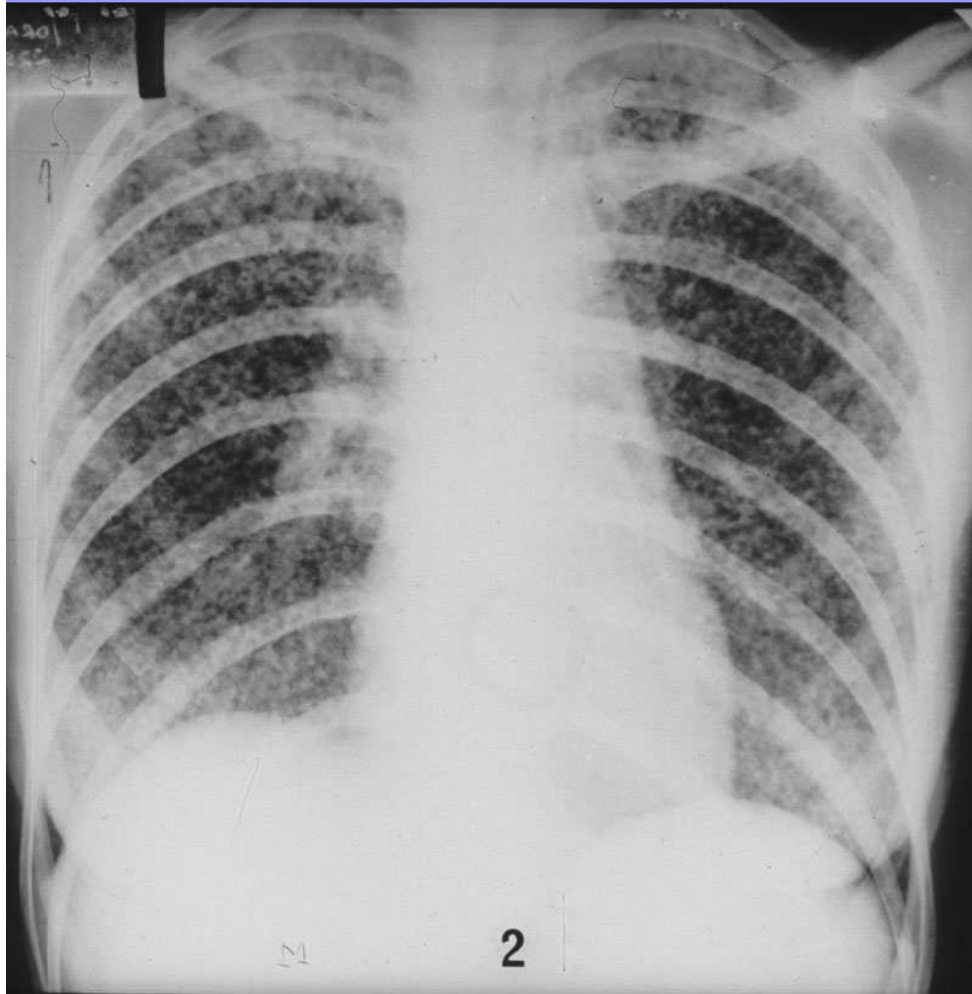
BULLA



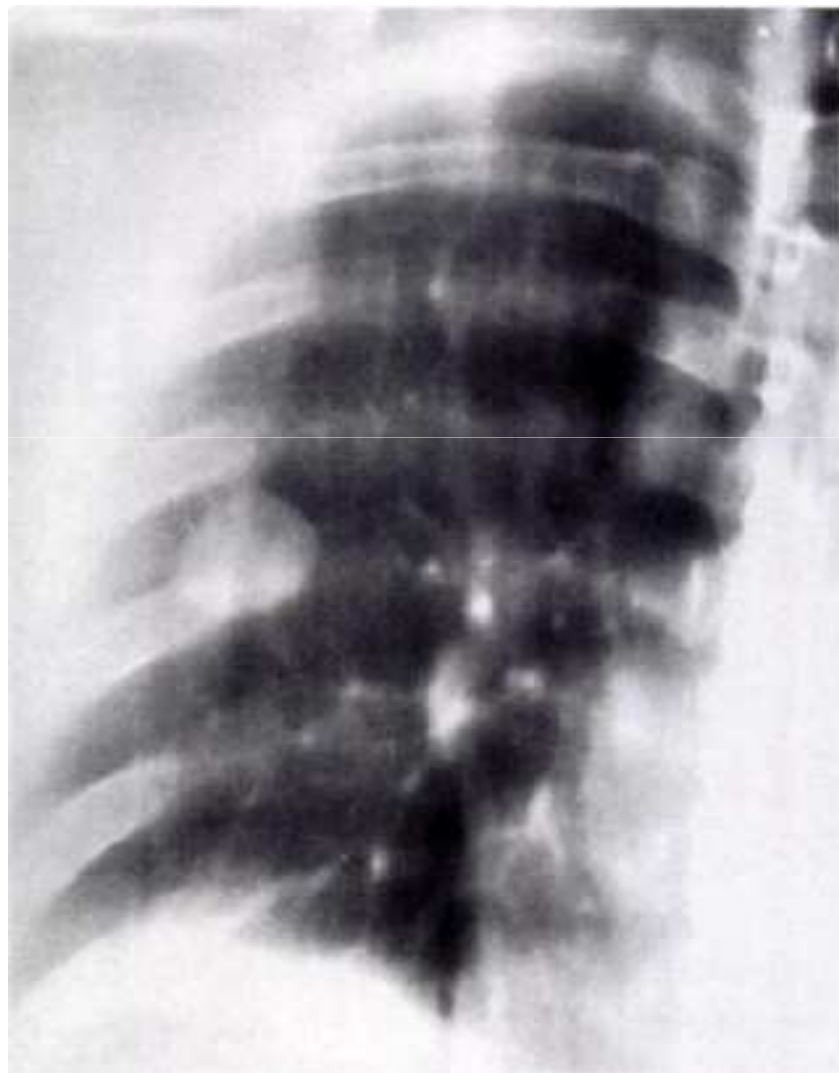
BULLA



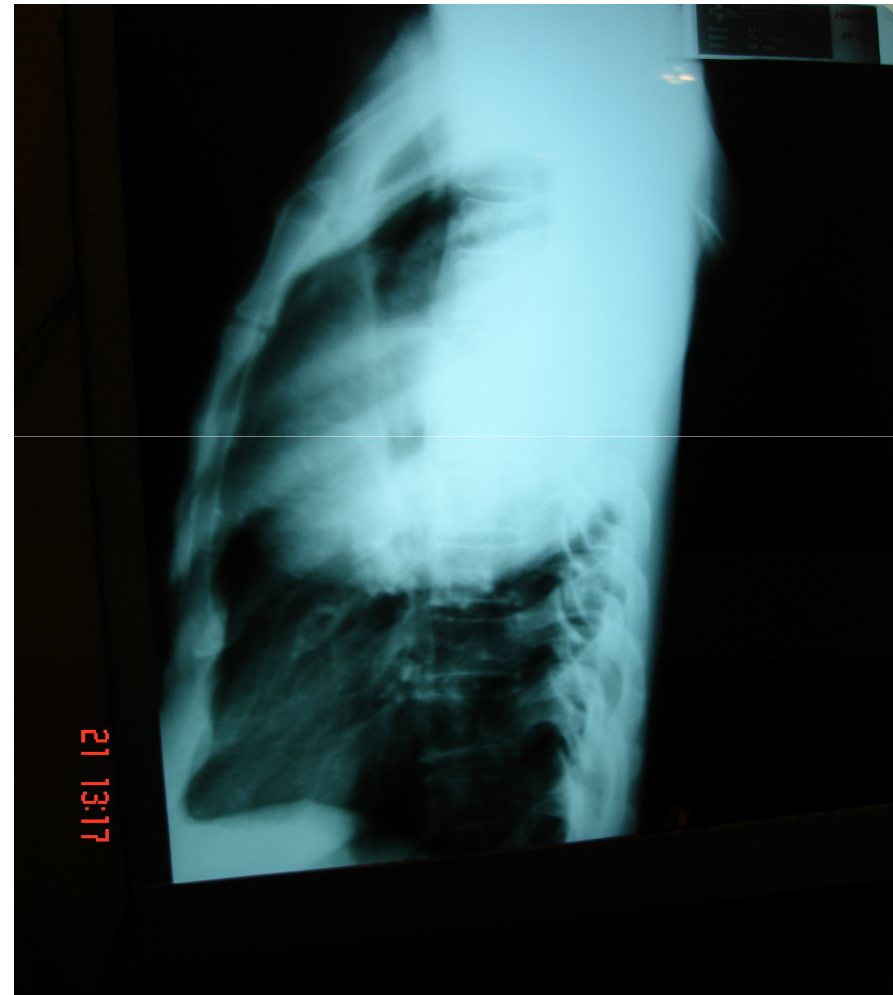
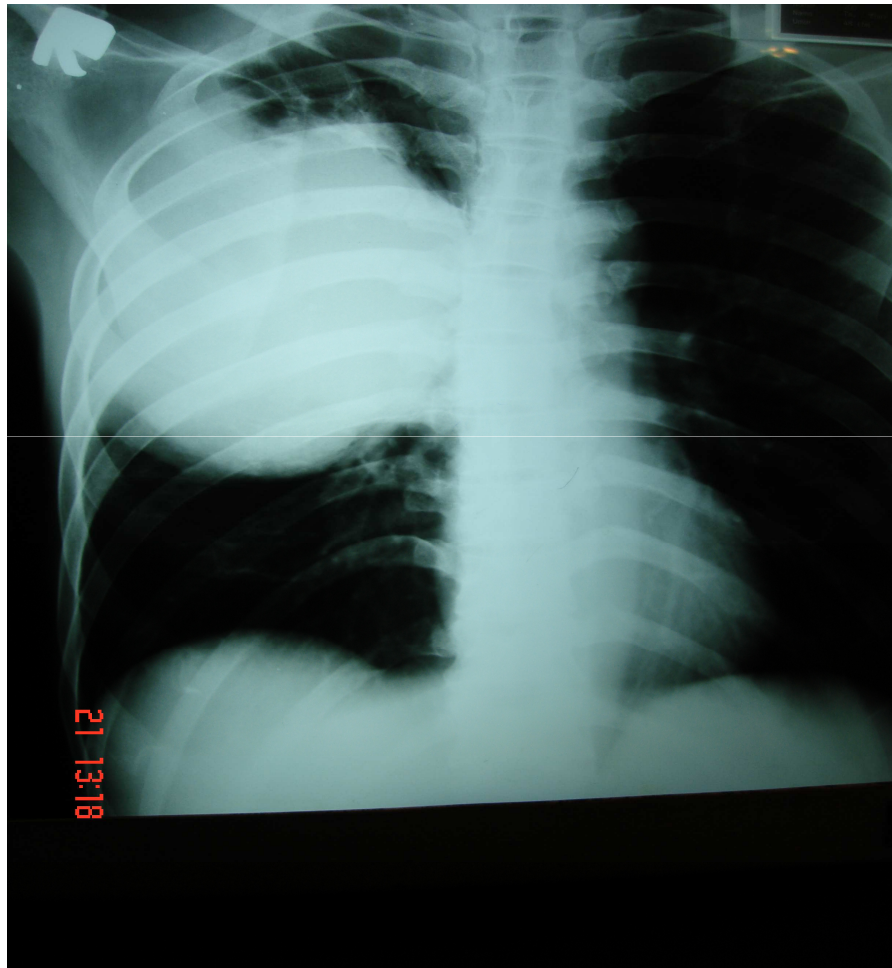
TB MILIER



NODUL PARU



TUMOR PARU



TUMOR PANCOAST

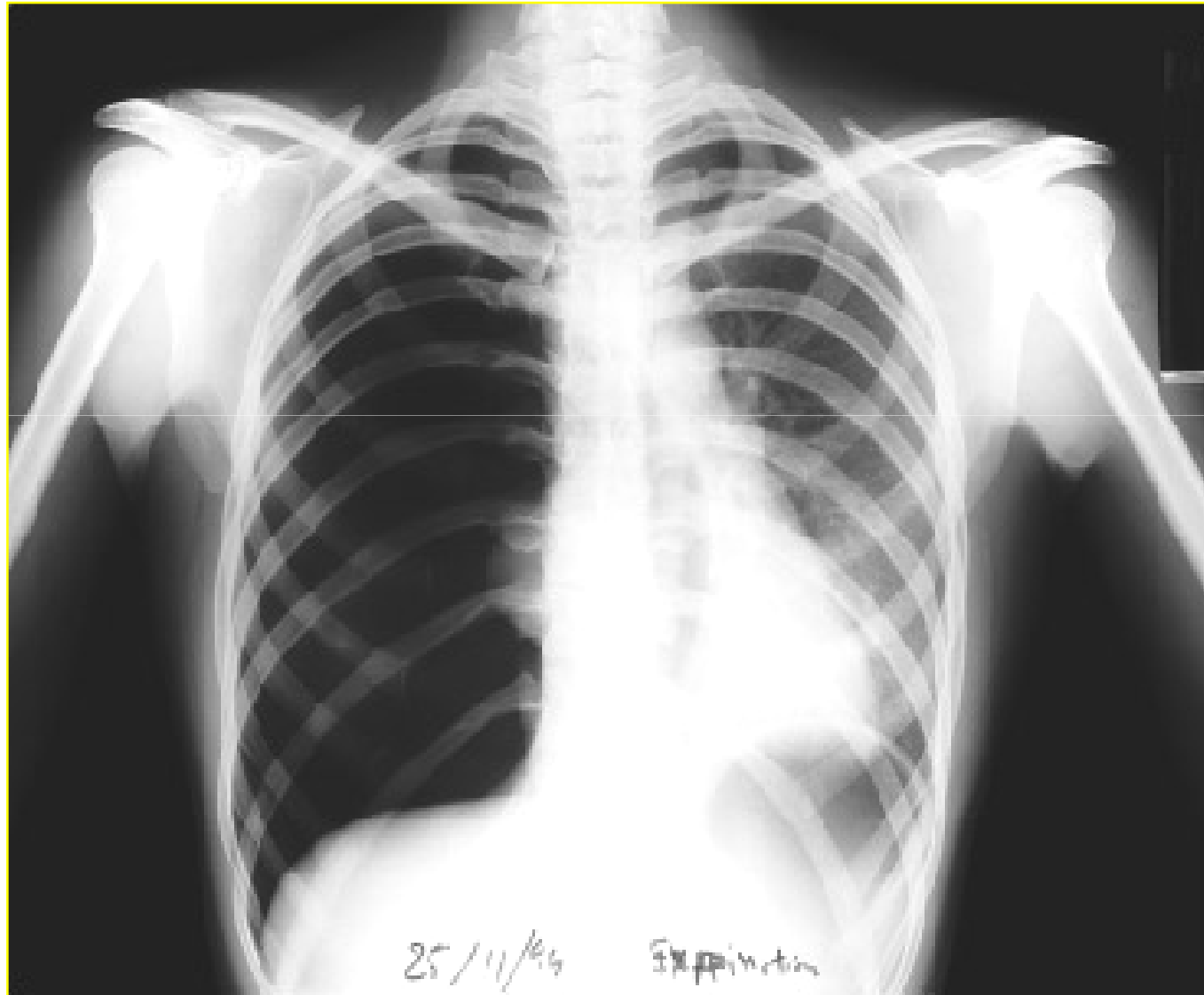




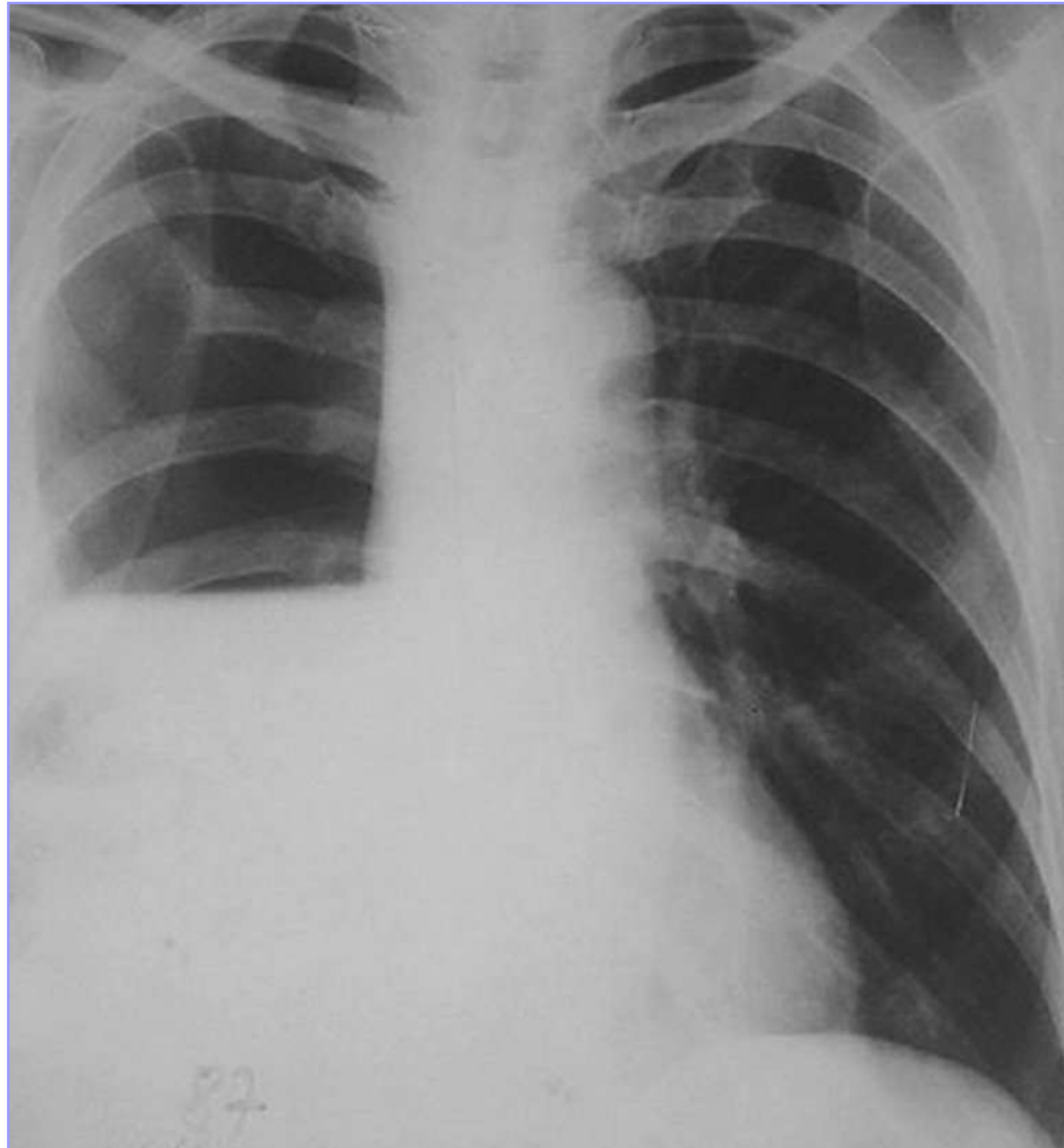
GANGGUAN VENTILASI

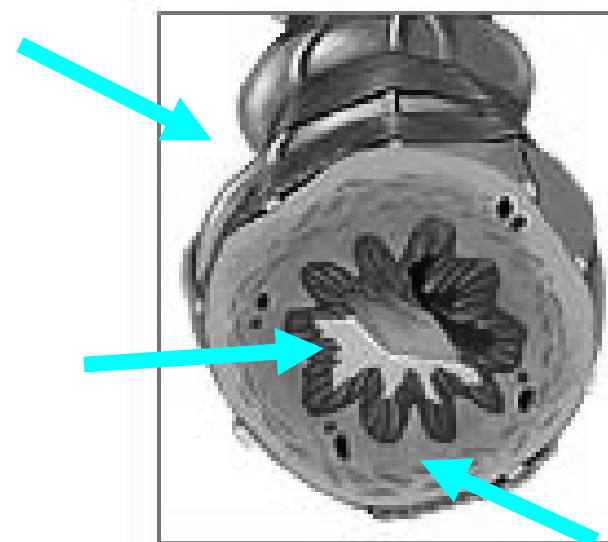
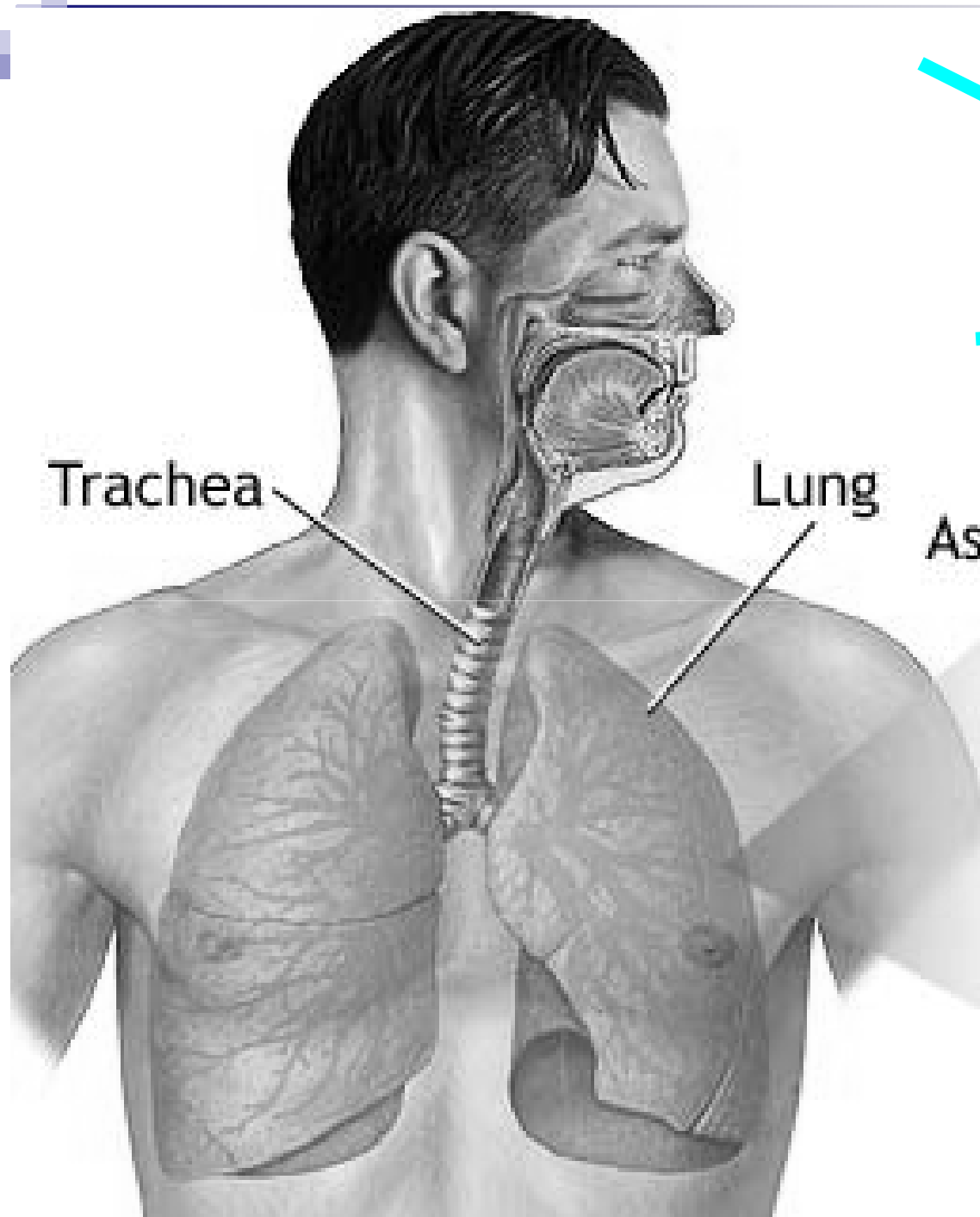
- ☑ Obstruksi : perlambatan aliran udara ekspirasi

PNEUMOTORAKS

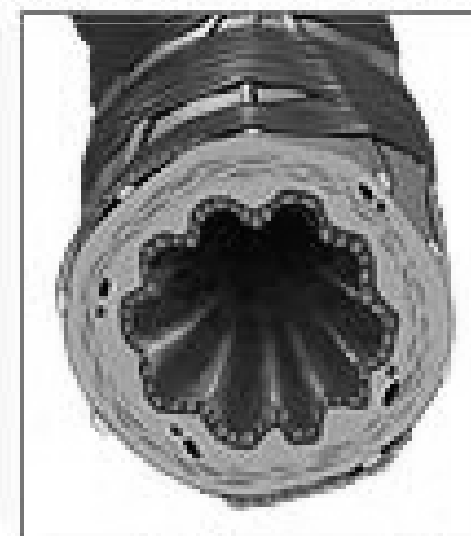


HIDROPNEUMOTORAKS



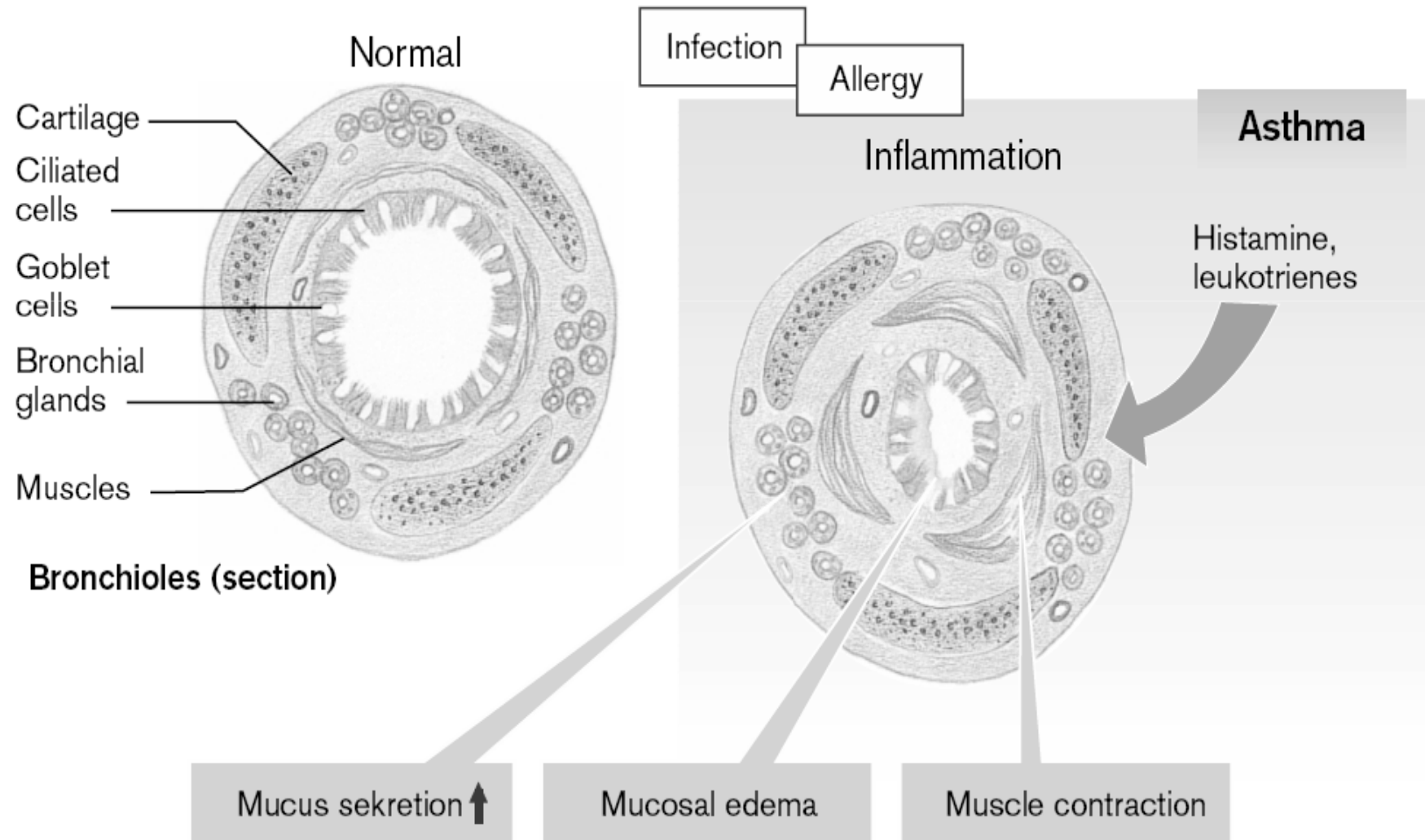


Asthmatic bronchiole



Normal bronchiole

Obstruksi saluran napas pada asma



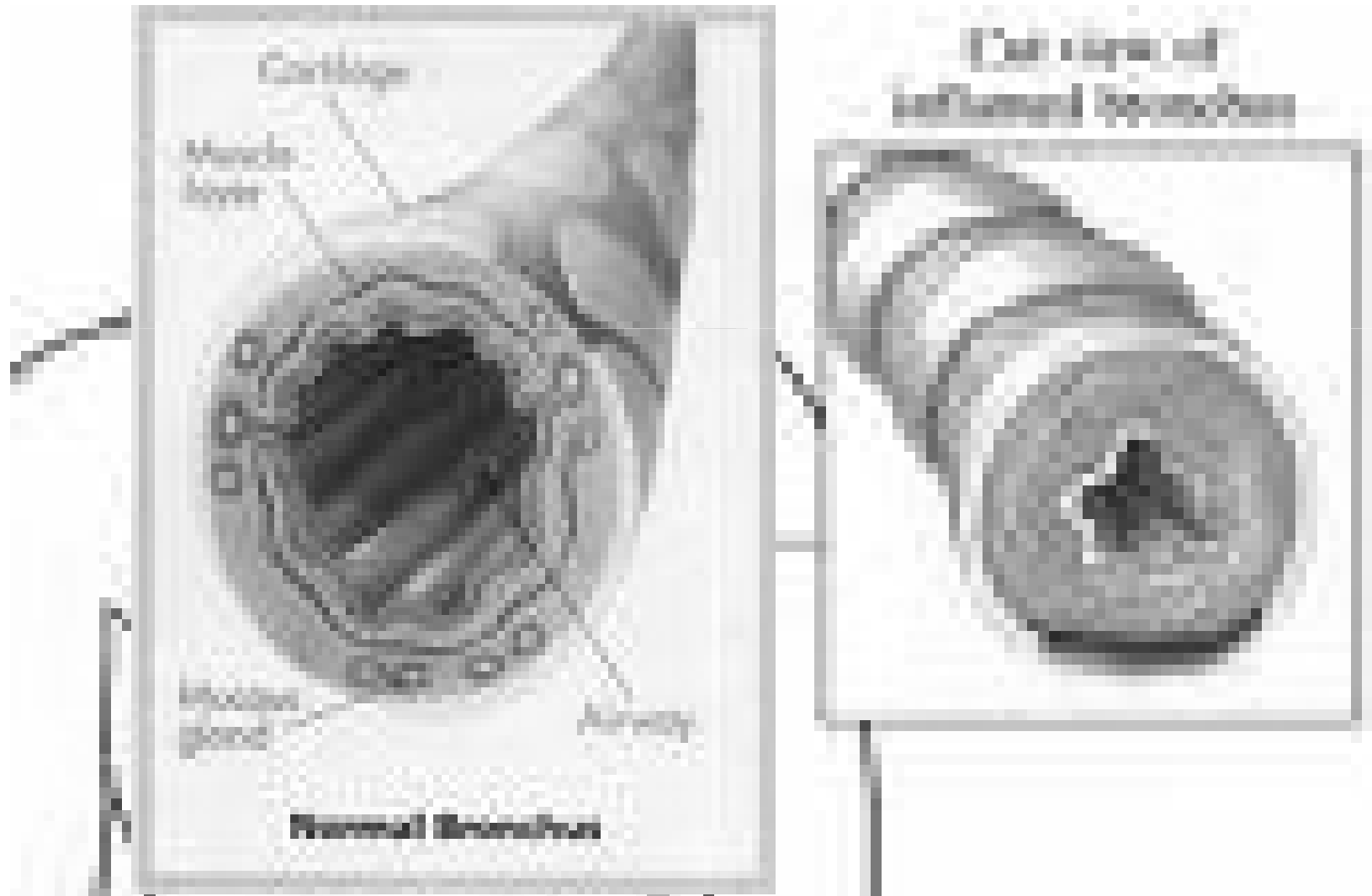
Normal bronchiole



Asthmatic bronchiole

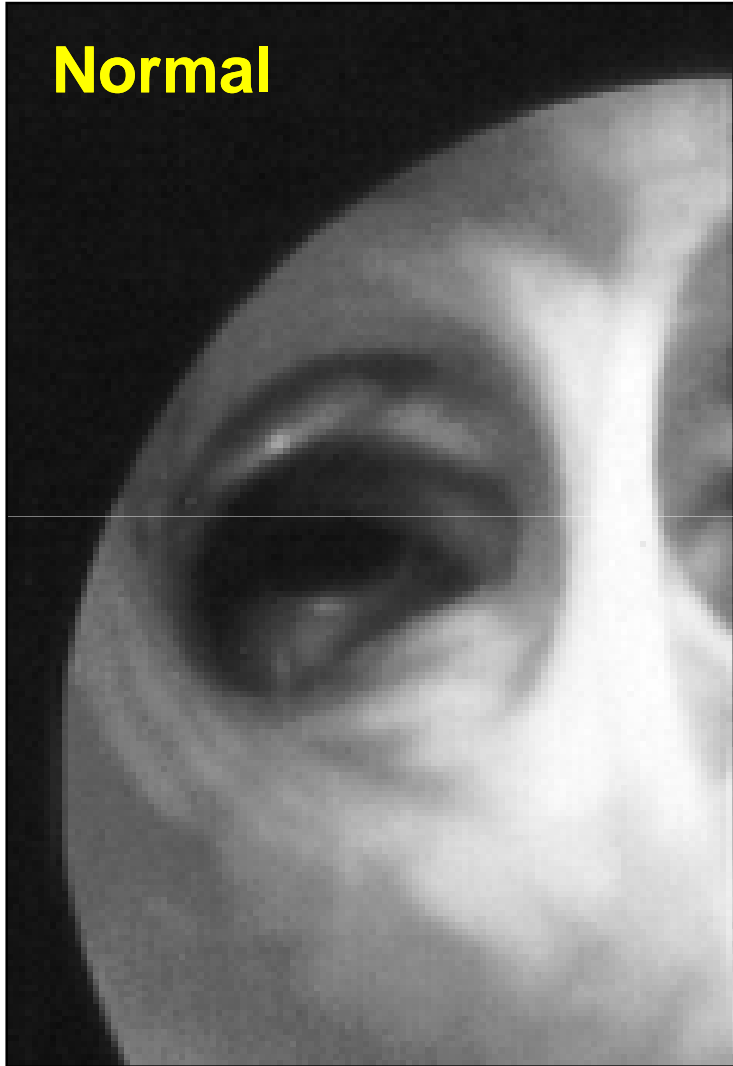


ASMA BRONKIAL

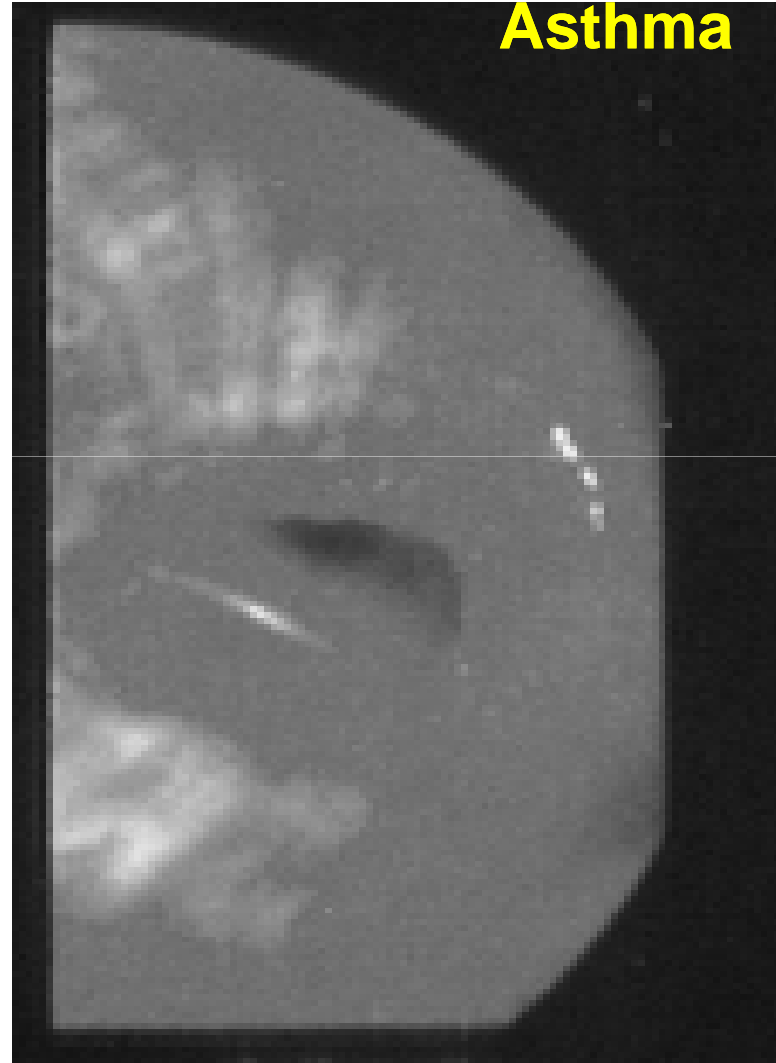




Normal



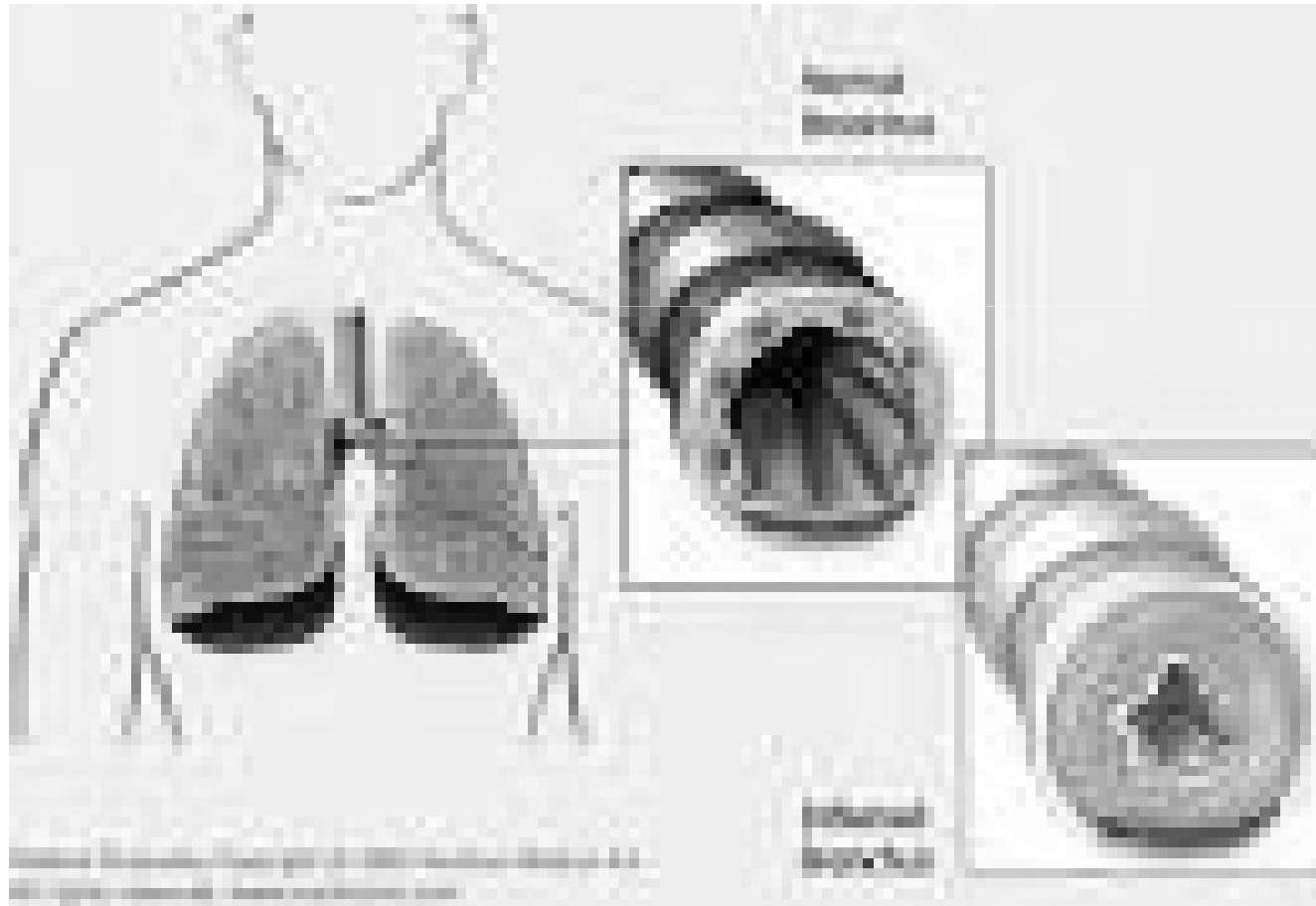
Asthma





BRONKITIS KRONIK

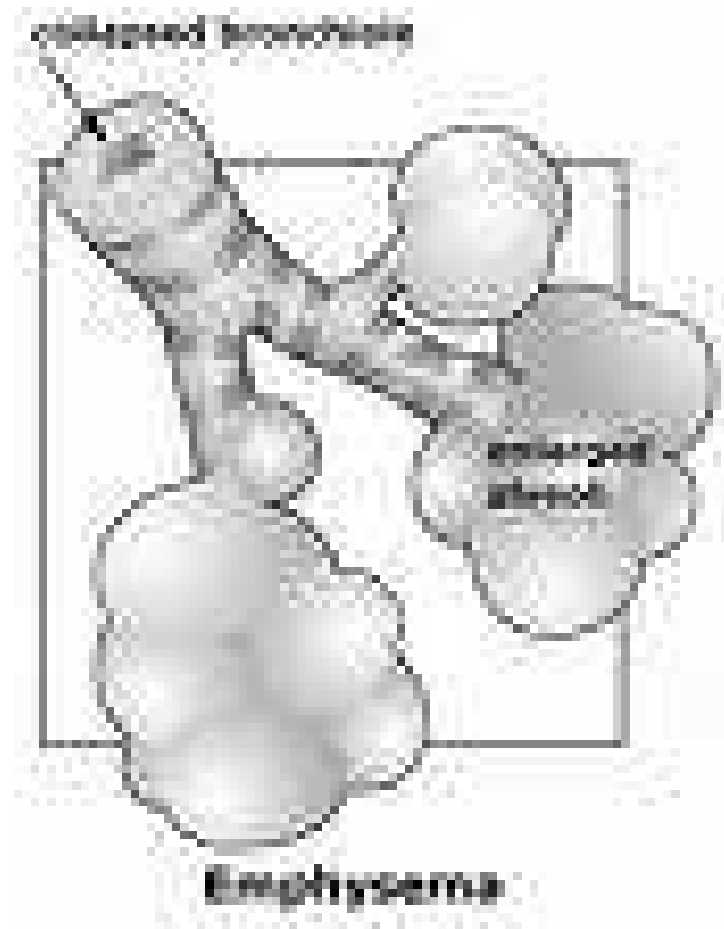
BRONKITIS KRONIK

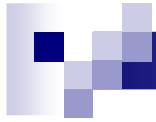






EMFISEMA

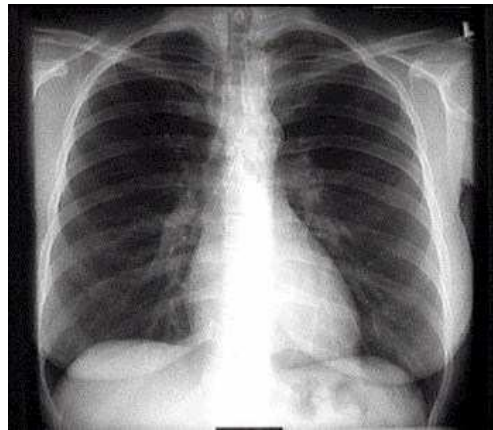




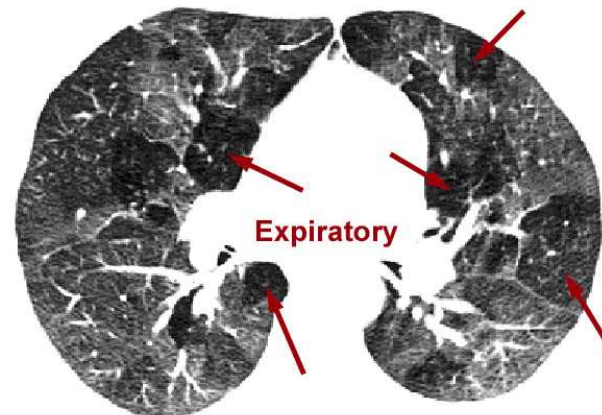
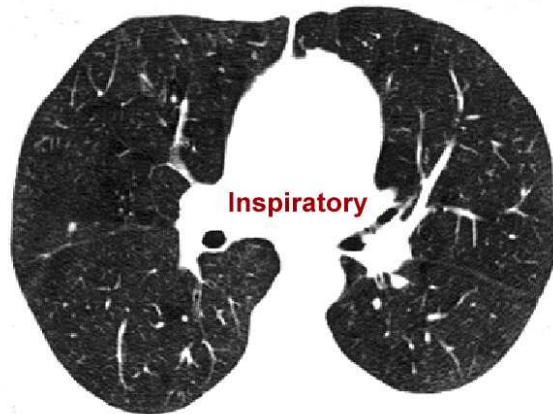
EMFISEMA



Normal

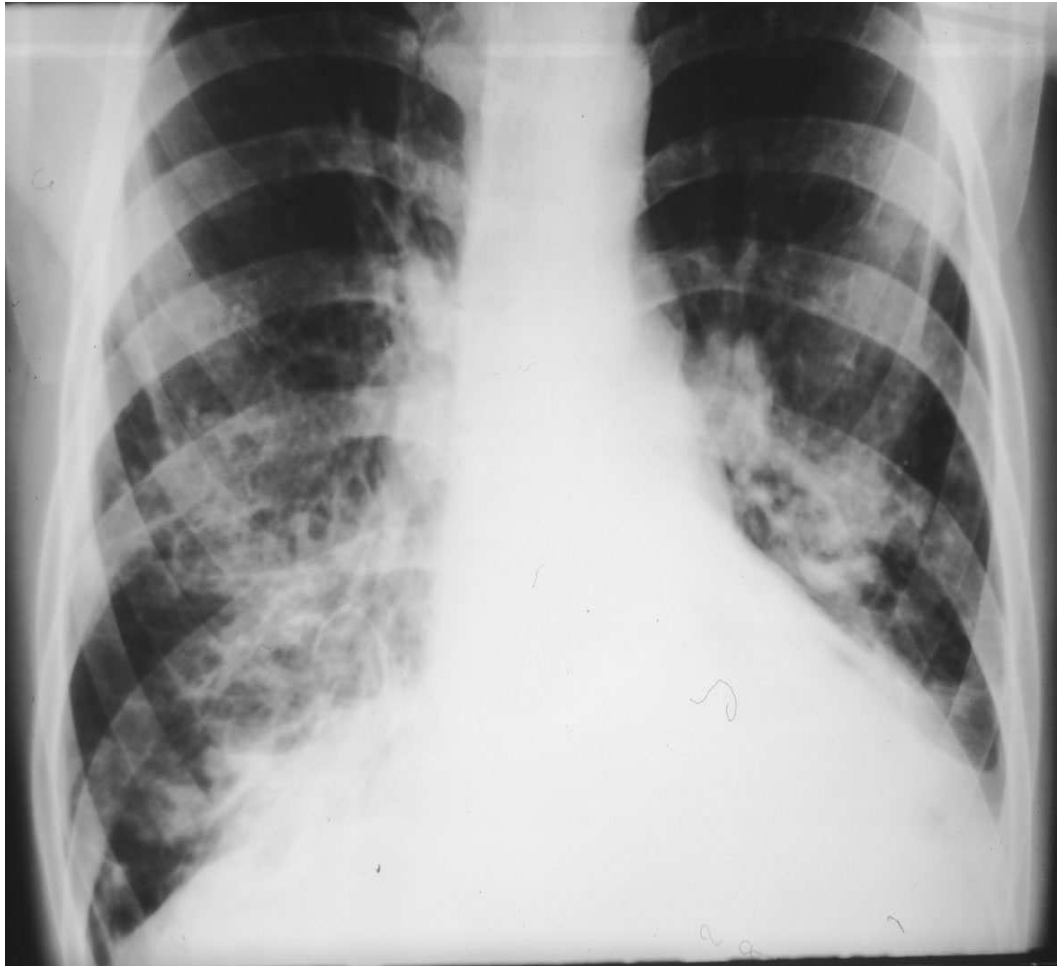


Hyperinflation



Air trapping

BRONKIEKTASIS

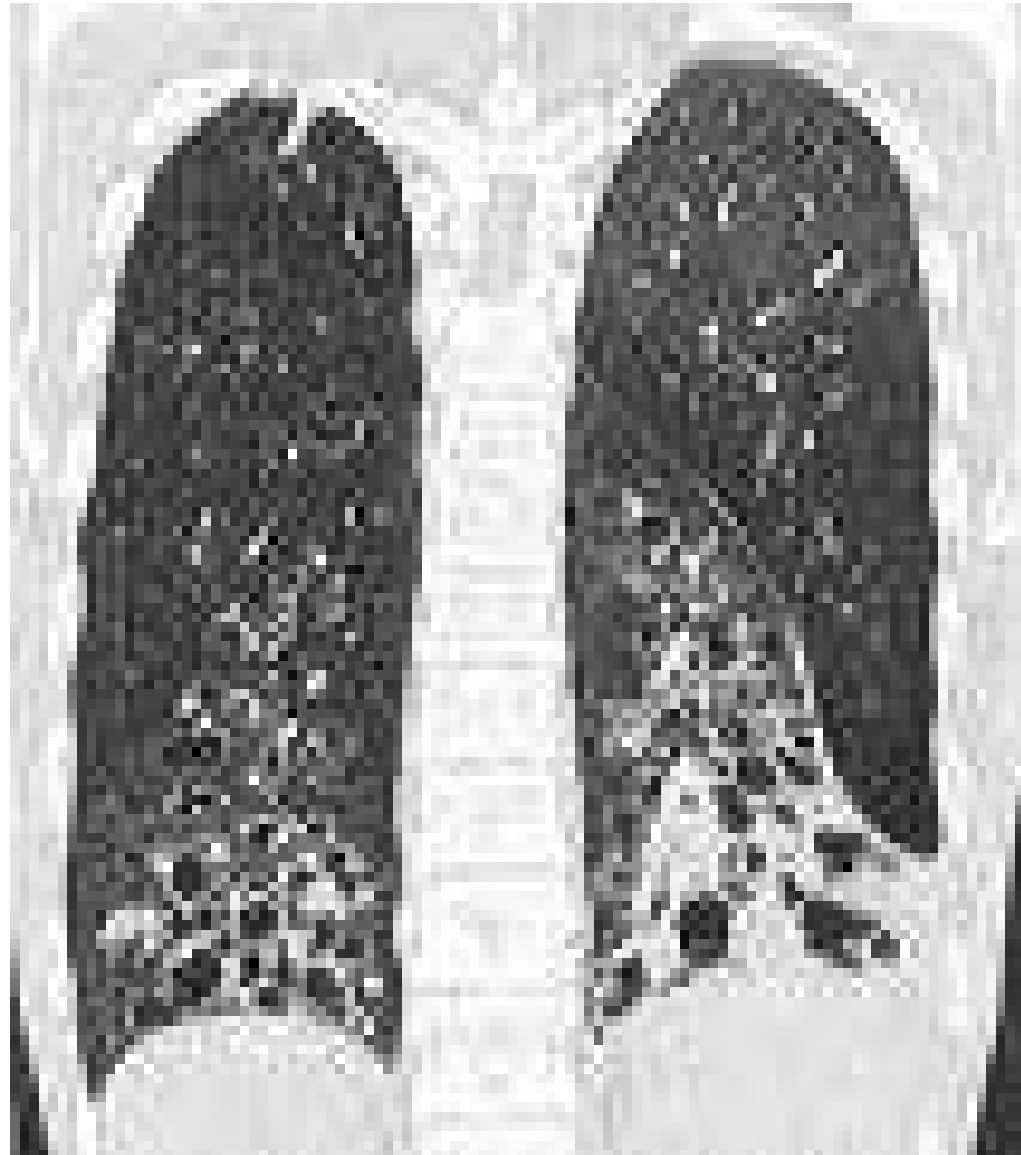




BRONKIEKTASIS



BRONKIEKTASIS



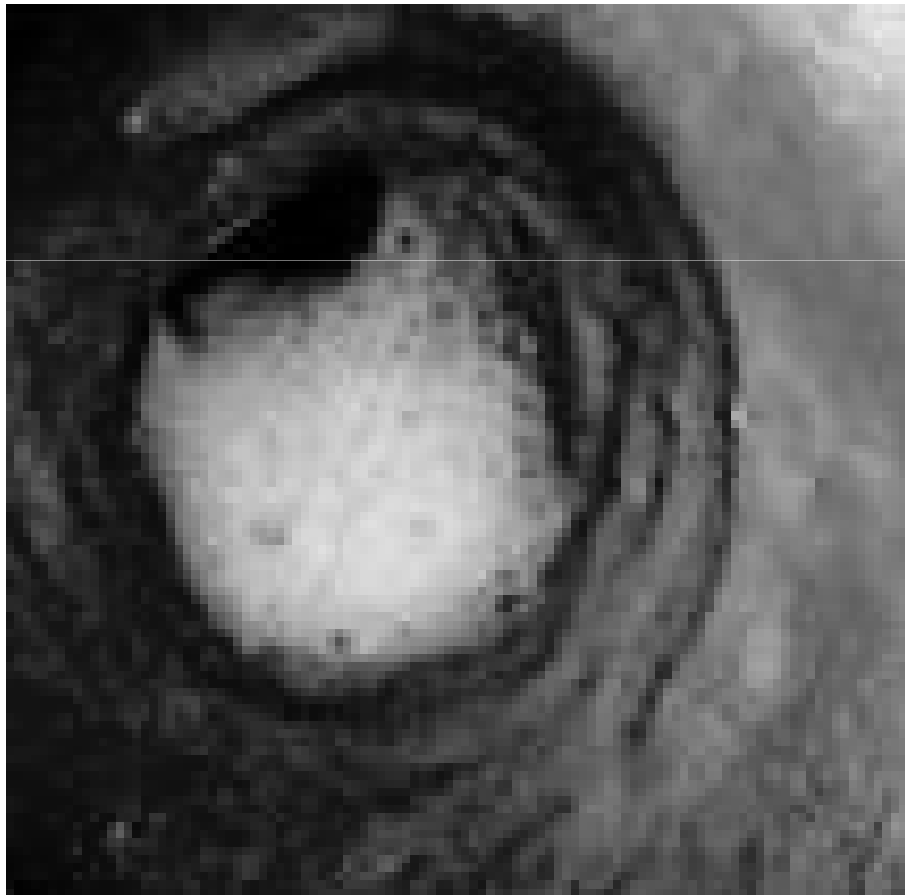


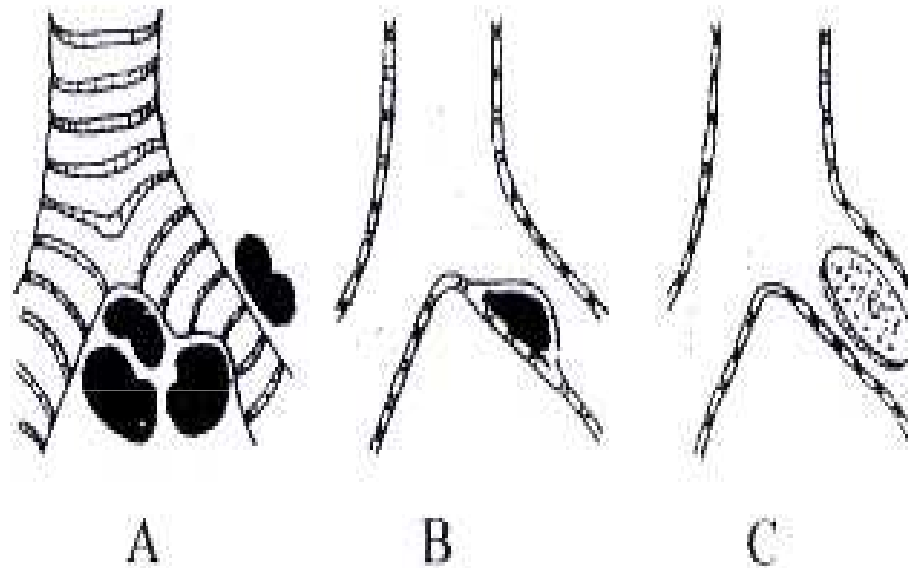
BRONKIEKTASIS



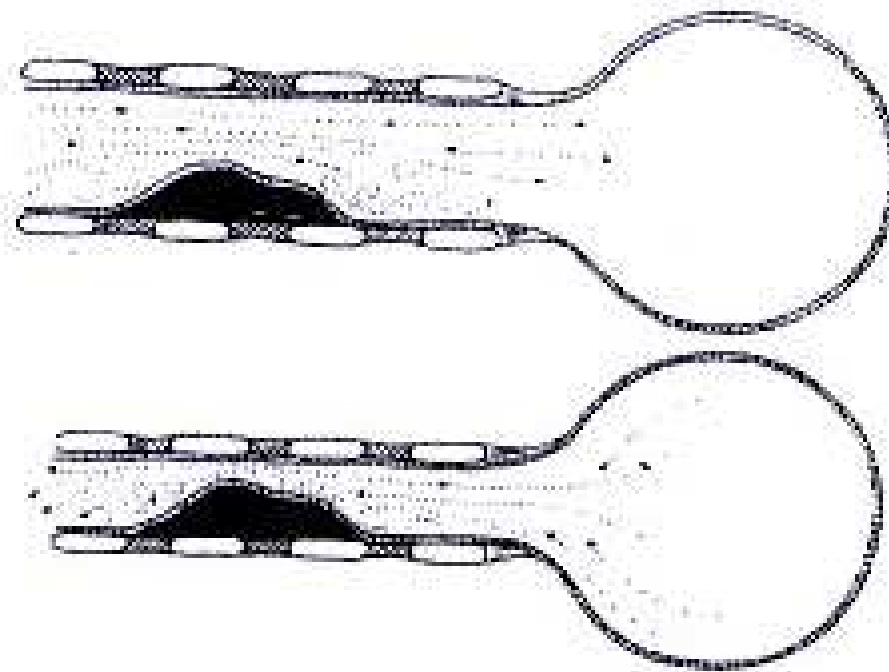


BRONKIEKTASIS





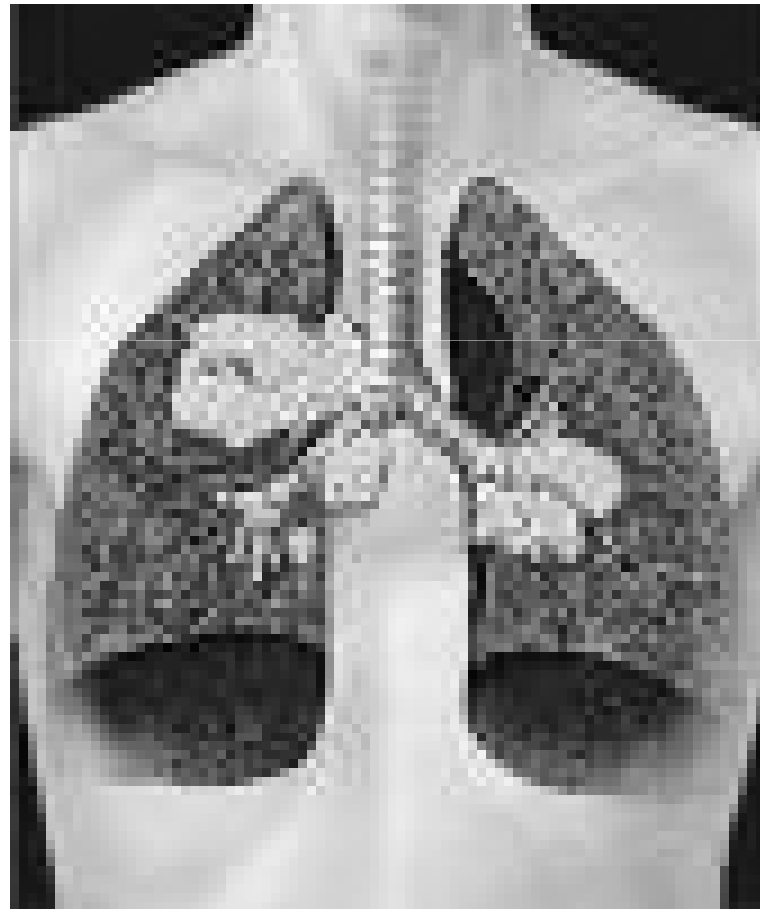
Gambar ■ Penyebab obstruksi bronkus adalah ektramural (A), intramural (B) dan intraluminal (C)



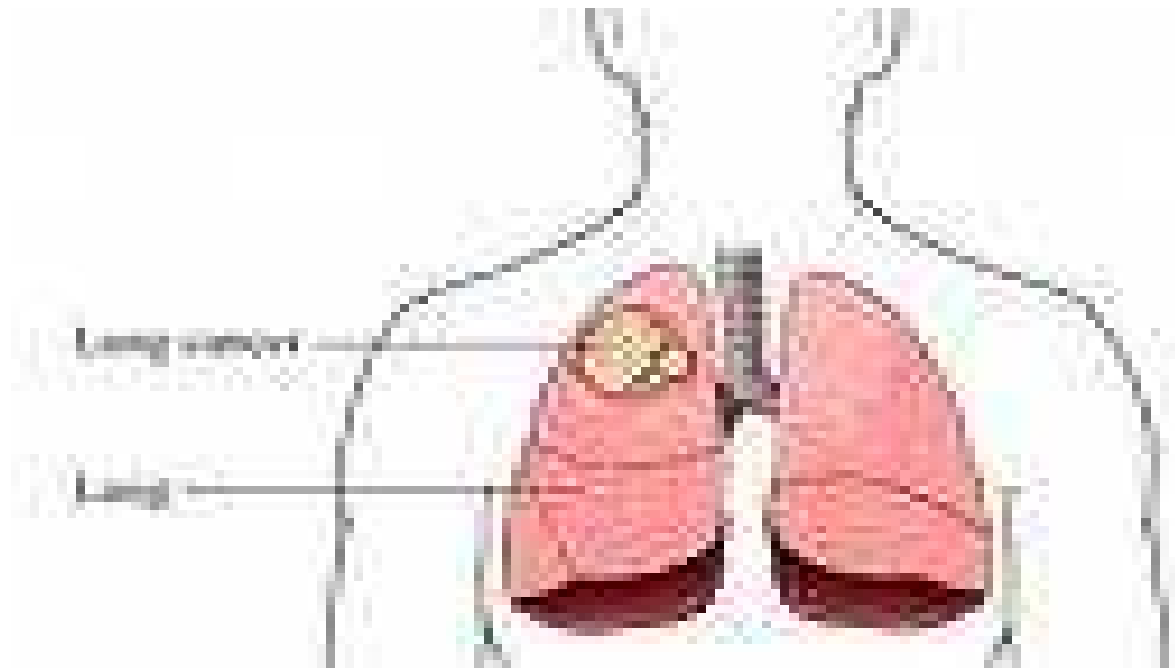
Gambar ■ *The bypass partial bronchial obstruction*



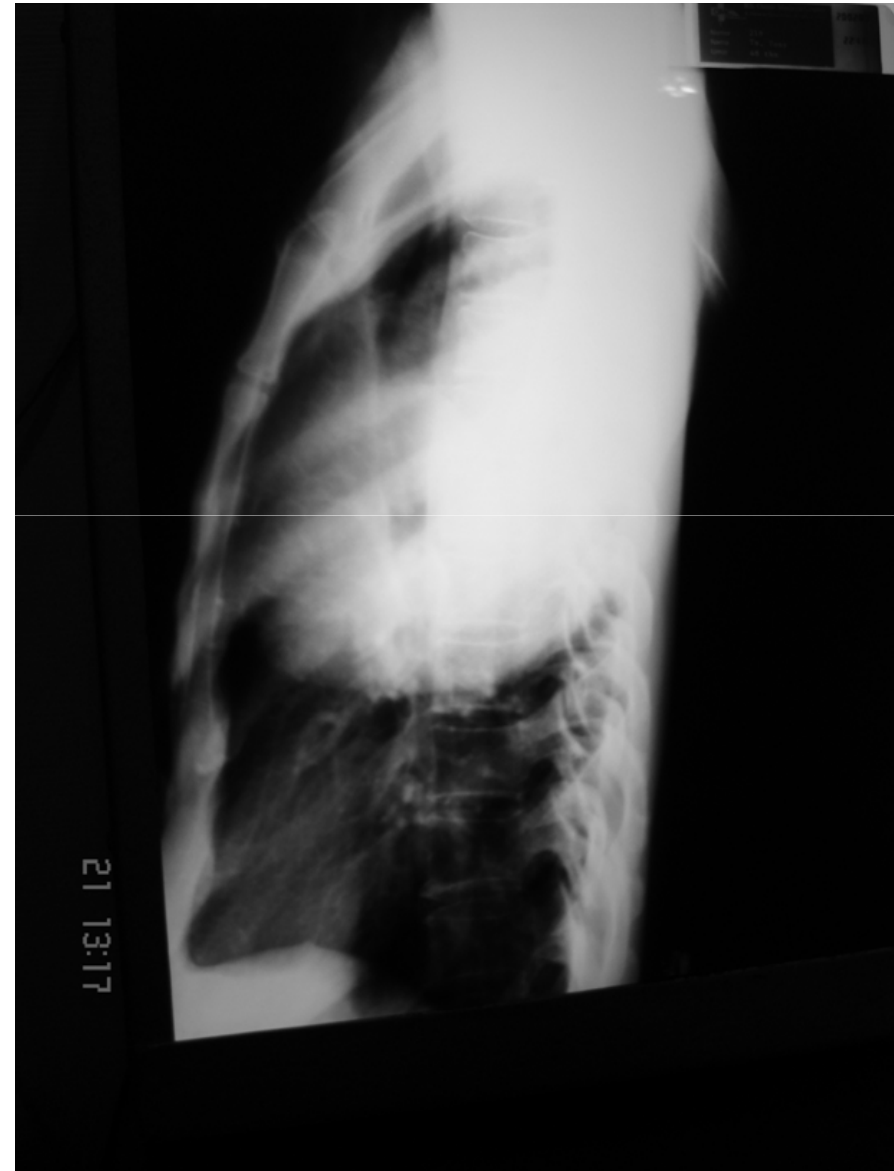
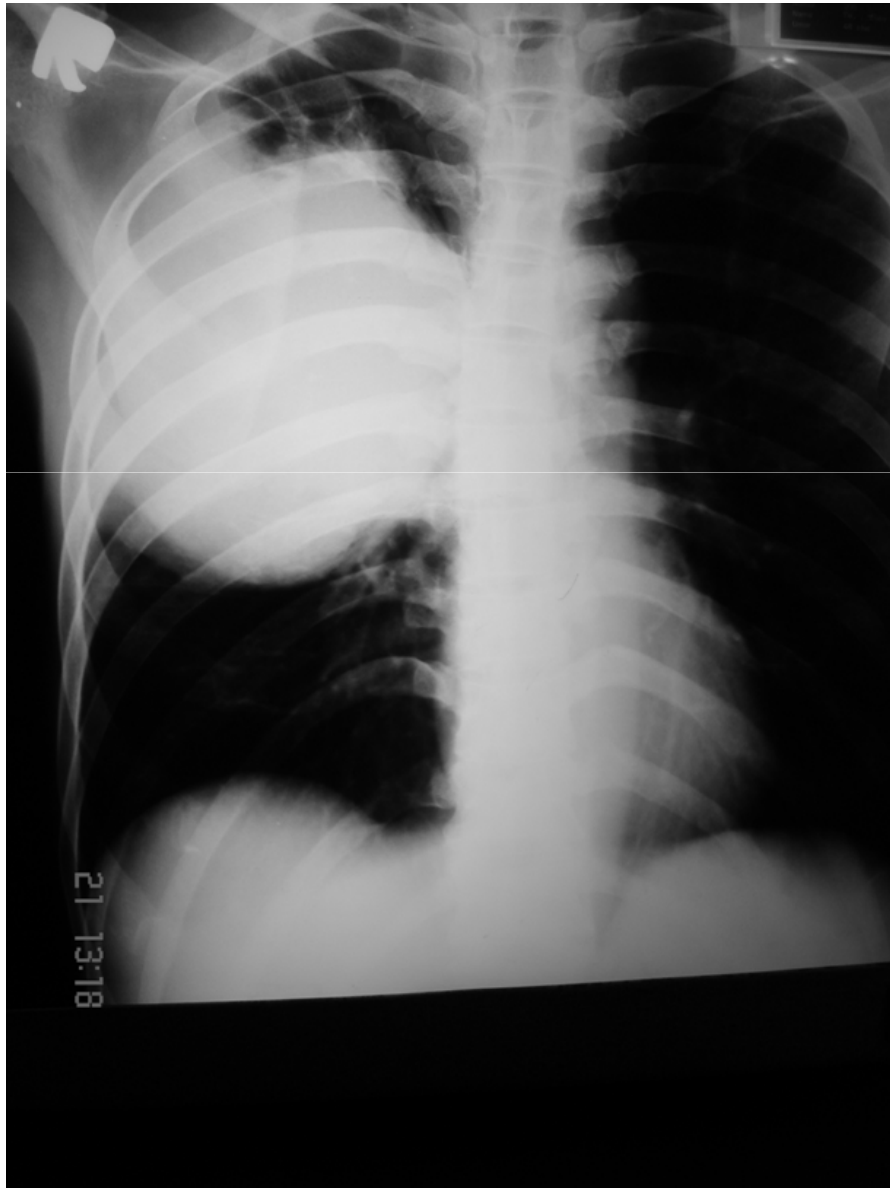
TUMOR PARU



TUMOR PARU



Lung Cancer



TUMOR DI SALURAN NAPAS







GANGGUAN VENTILASI

- ✓ Restriksi : gangguan pengembangan paru



RESTRIKSI

- ✓ $KV < 80\%$ nilai prediksi
- ✓ $KVP < 80\%$ nilai prediksi
- ✓ Restriksi ringan $80\% > KV < 60\%$
- ✓ Restriksi sedang $60\% > KV > 30\%$
- ✓ Restriksi berat $KV < 30\%$



GANGGUAN VENTILASI

- ☑ Obstruksi : perlambatan aliran udara ekspirasi



OBSTRUKSI

- ✓ $VEP_1 < 80\%$ nilai prediksi
- ✓ $VEP_1 / KVP < 75\%$
- ✓ Obstruksi ringan $75\% > VEP_1 / KVP < 60\%$
- ✓ Obstruksi sedang $60\% > VEP_1 / KVP > 30\%$
- ✓ Obstruksi berat $VEP_1 / KVP < 30\%$



PEMERIKSAAN FAAL PARU

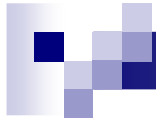
- ✎ Alat
- ✎ Teknisi
- ✎ Subjek



PERSIAPAN ALAT

Kalibrasi minimal

1 kali seminggu



PERSIAPAN TEKNISI

- Terlatih
- Mengerti tujuan
- Dapat menilai hasil



PERSIAPAN SUBJEK

- ✓ Mengerti tujuan pemeriksaan
- ✓ Bebas rokok minimal 2 jam
- ✓ Tidak boleh makan terlalu kenyang
- ✓ Berpakaian tidak ketat



CARA PEMERIKSAAN

- ✓ Subjek berdiri / duduk
- ✓ Melakukan manuver setelah keadaan *steady state*
- ✓ Pemeriksaan dilakukan sampai didapat 3 hasil yang dapat diterima dan dua diantaranya reproduksibel



HASIL YANG DAPAT DITERIMA

- ✓ Permulaan uji harus baik
- ✓ Pemeriksaan selesai
- ✓ Waktu ekspirasi minimal 3 detik
- ✓ Grafik flow – volume mempunyai puncak



REPRODUKSIBILITI

- ~ Ditentukan setelah didapat 3 manuver yang dapat diterima
- ~ reproduksibiliti bila nilai terbesar perbedaannya kurang dari 5% atau kurang dari 100 ml untuk nilai KVP dan VEP_1



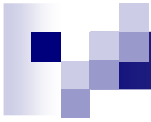
PEMERIKSAAN YANG TIDAK BAIK

- ✓ Permulaan ekspirasi ragu-ragu/
lambat
- ✓ Batuk selama ekspirasi
- ✓ Manuver valsava
- ✓ Ekspirasi tidak selesai




PEMERIKSAAN YANG TIDAK BAIK

- ✓ Terdapat kebocoran
- ✓ *Mouth piece* tersumbat
- ✓ Meniup lebih dari 1 kali



- Jumlah pemeriksaan maksimal adalah 8 kali
- Bila telah delapan kali tetapi belum didapat yang diharapkan, maka pemeriksaan diulang pada hari yang lain

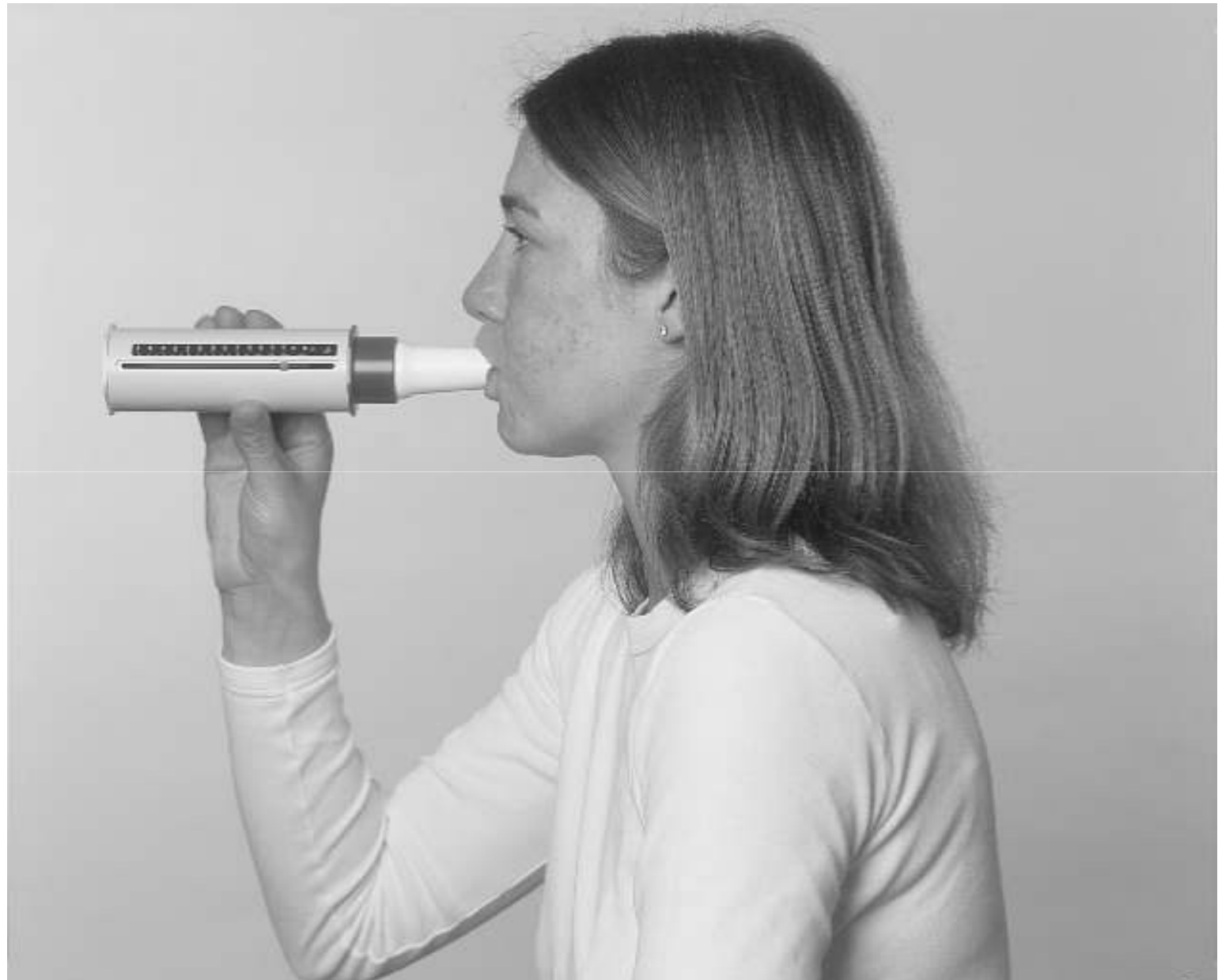


HASIL

- ☑ Normal KVP dan KV
> 80% nilai prediksi
- ☑ $VEP_1 > 80\%$ nilai prediksi
- ☑ $VEP_1 / KVP > 75\%$

ARUS PUNCAK EKSPIRASI



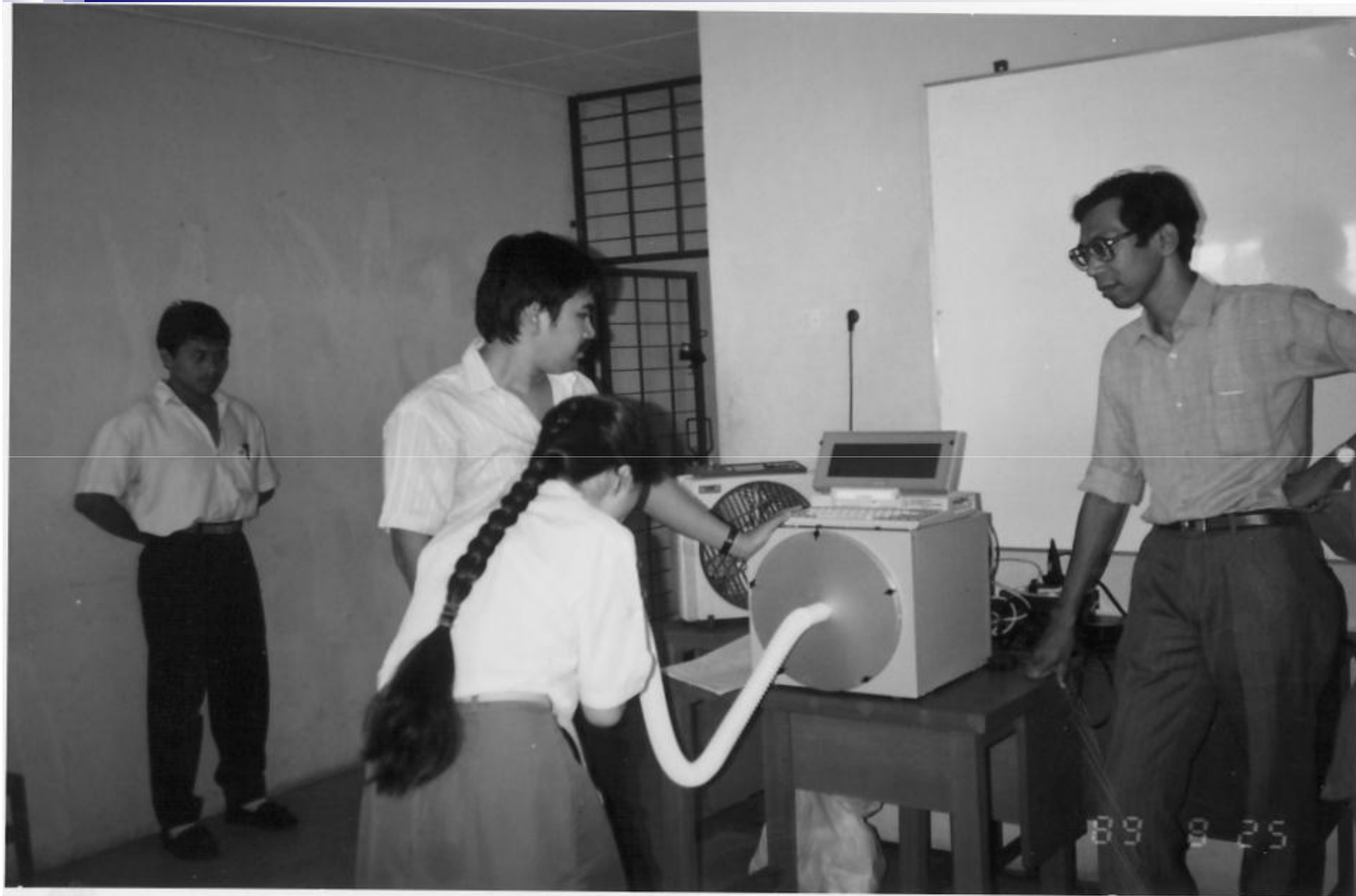


PEMERIKSAAN SPIROMETRI



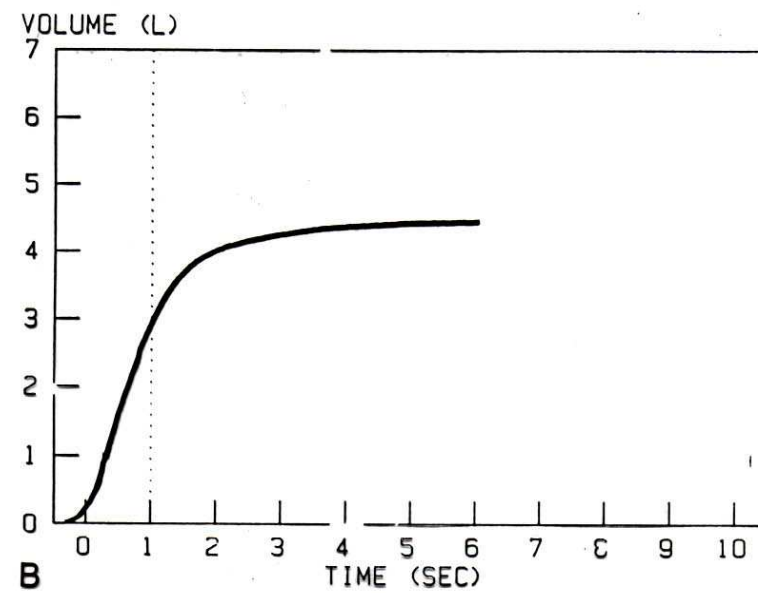
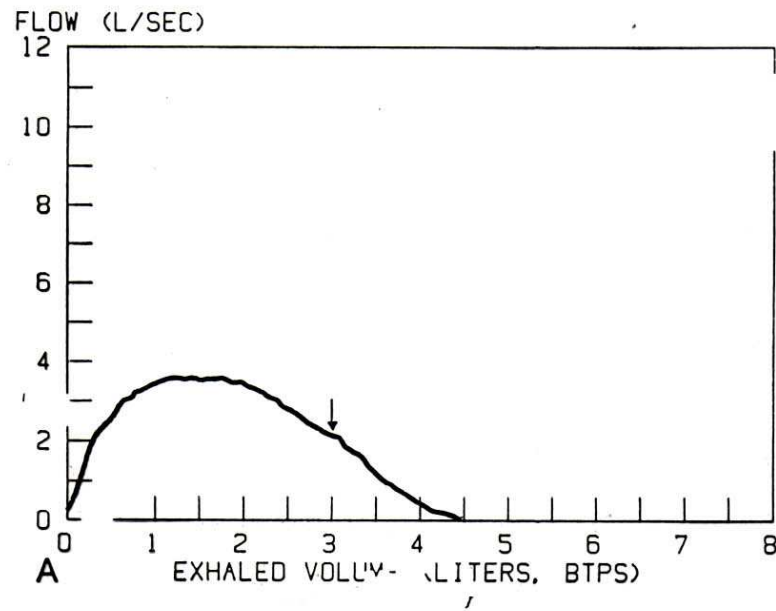
© 2003 Mayo Foundation for Medical Education and Research. All rights reserved.

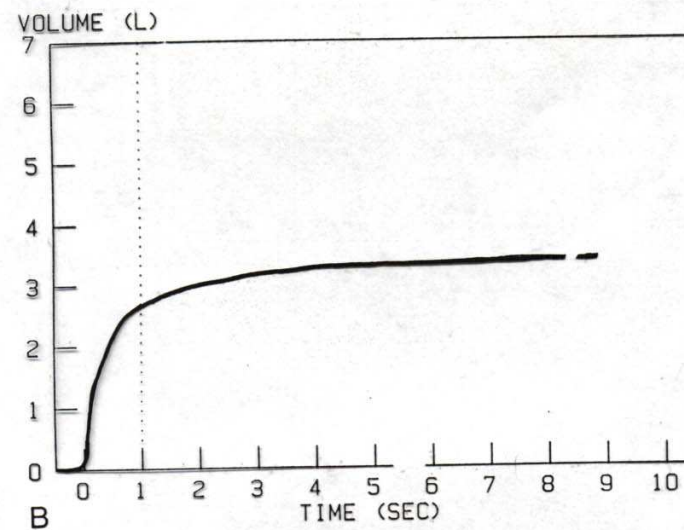
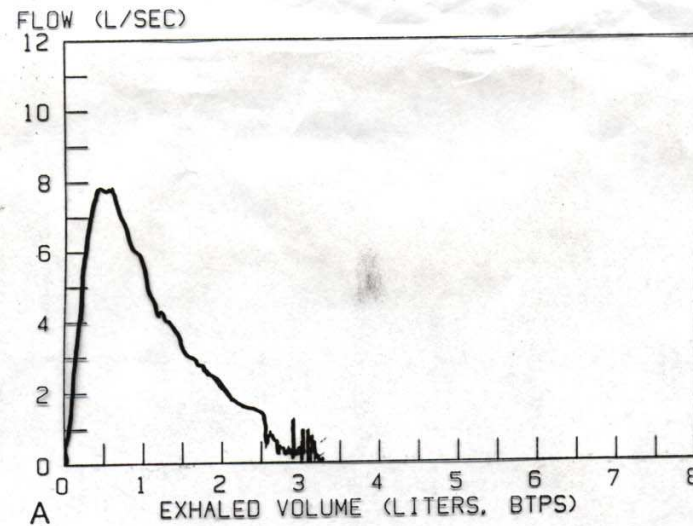






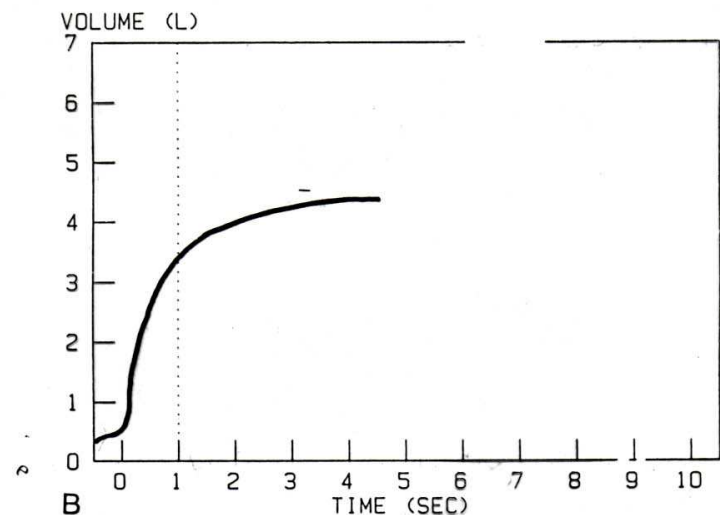
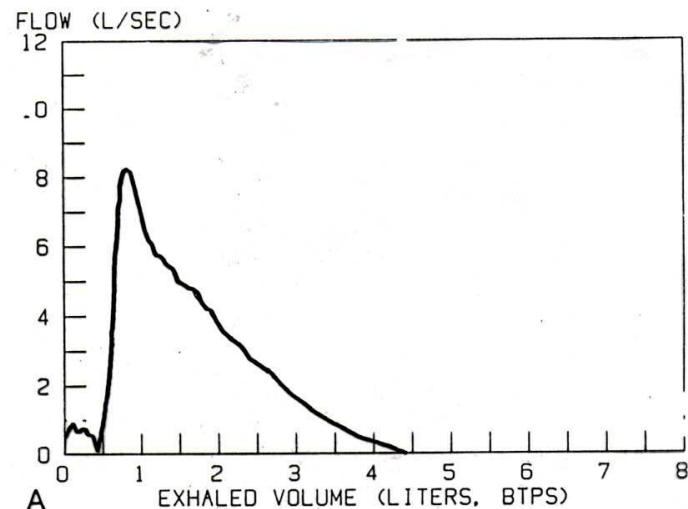
INTERPRETING THE RESULTS





Example 6.5.

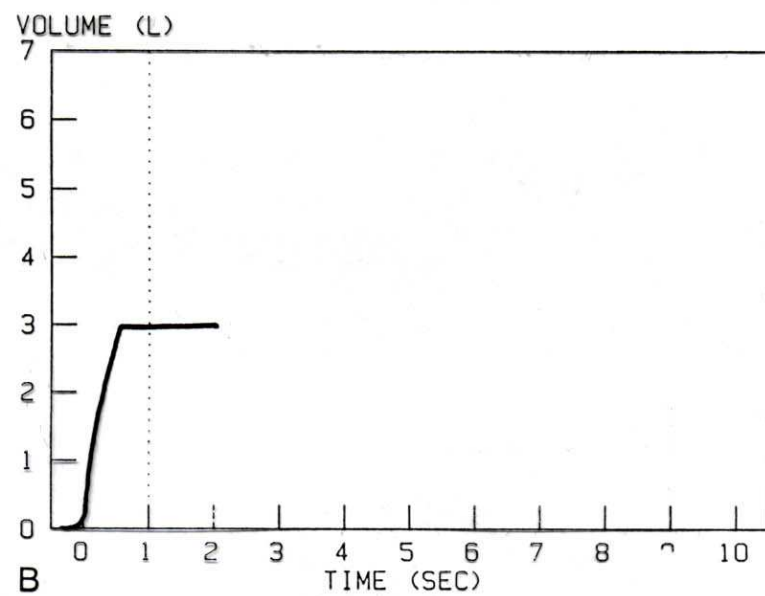
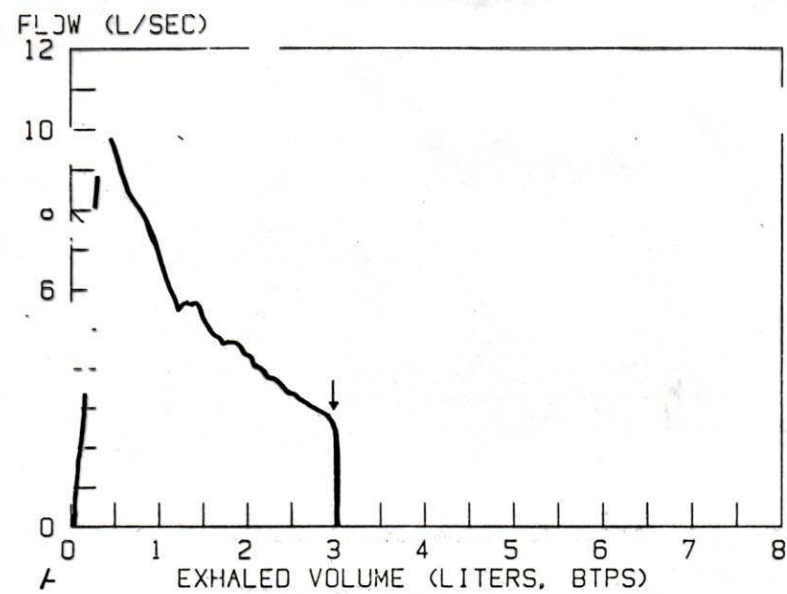
A, Frequently, patients with moderate to severe airways obstruction will cough toward the end of the maneuver, resulting in this flow-volume curve. This will not affect the results and can be overlooked if it did not cause the patient to quit the maneuver too soon. Urge him to "keep breathing out." B, Coughing, which occurs after the first second of the maneuver, appears as small undulations on the horizontal plateau of the spirogram.

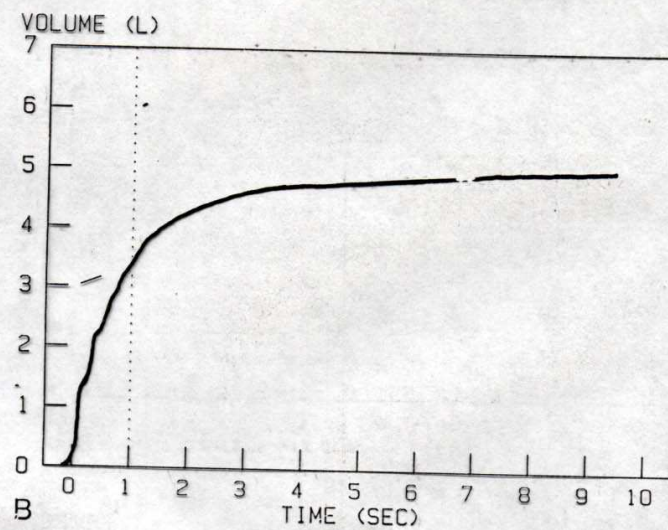
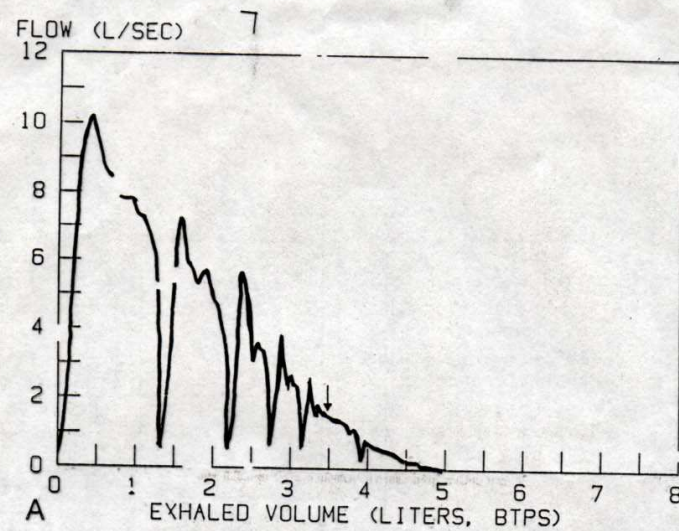


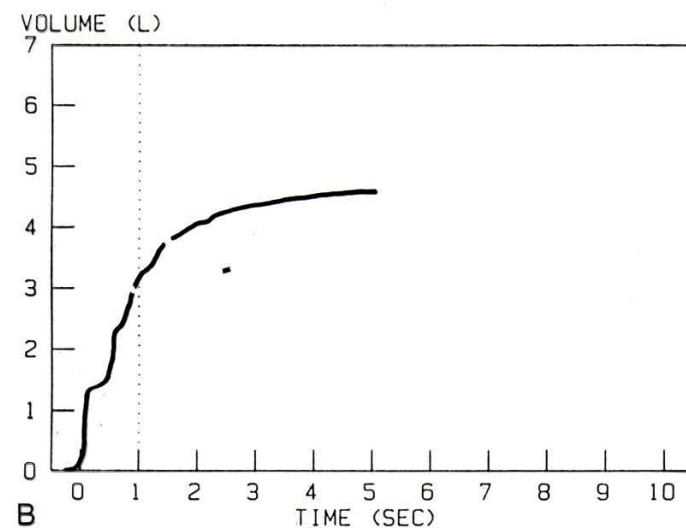
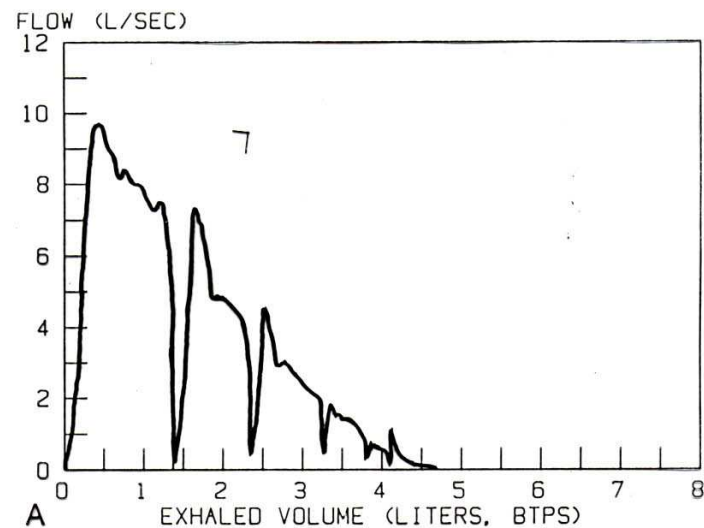
Example 6.2.

A, This flow-volume curve results when a patient starts and stops before beginning his maximal exhalation. This gives a small hump at the beginning of the graph. This fault may cause an inaccuracy in the timing of the maneuver. The patient should be instructed to "blast out the air at the beginning of the maneuver; don't hesitate." B, Hesitating after an initial start creates a small plateau at the beginning of a spirogram. Note that the zero time mark on our examples is the back-extrapolated "start of the maneuver" (refer to Chapter 7). If the patient hesitates or momentarily closes his glottis during the maneuver, it will look like this. In both cases, the patient should be instructed to "start faster" and "blast out the air at the beginning."

INTERPRETING THE RESULTS

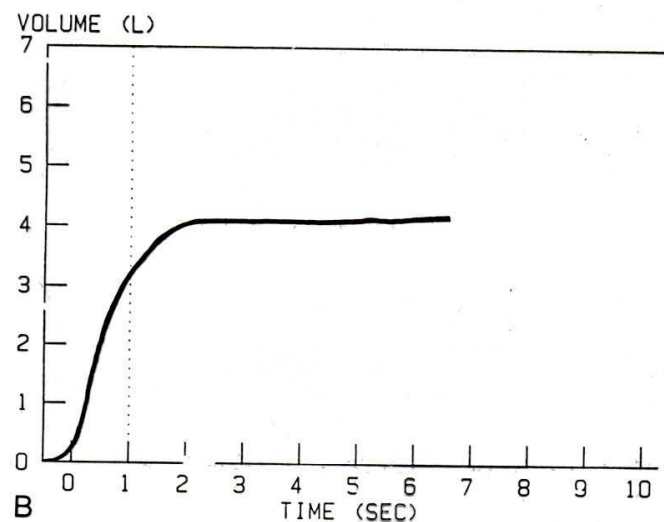
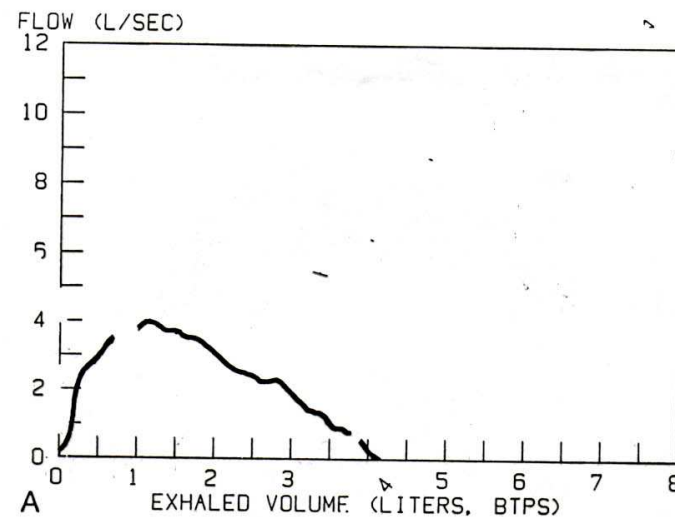






Example 6.4.

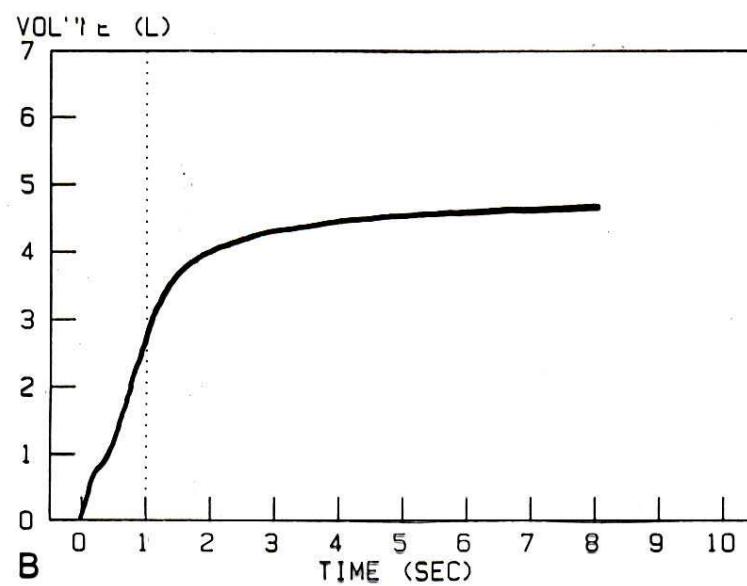
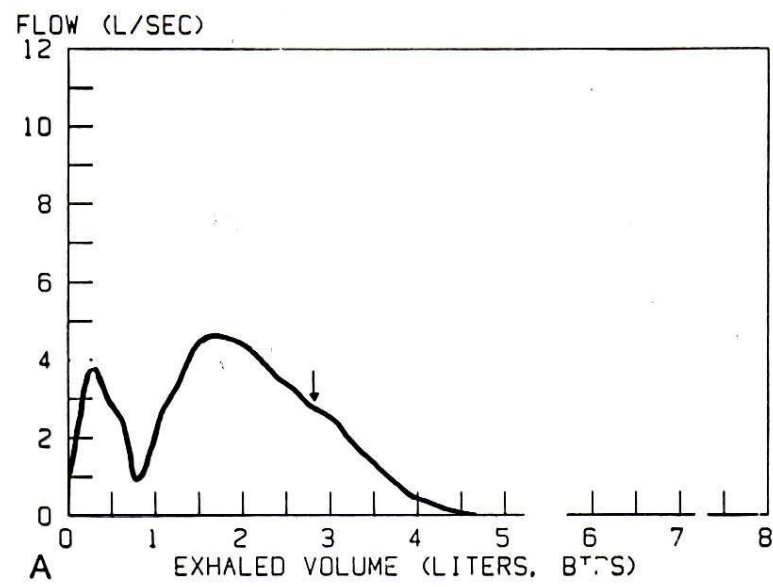
A, When the patient coughs during the maneuver, there are sharp decreases in flow as the patient's glottis narrows, quickly followed by increases in flow as the glottis opens. In this example, the coughing is significant and will adversely affect the results. This is an unacceptable maneuver. It may help to give the patient a drink of water and allow him to clear his secretions. *B*, Coughing is most easily detected by watching the patient but may also be recognized by small irregularities (ledges) on the spirogram.

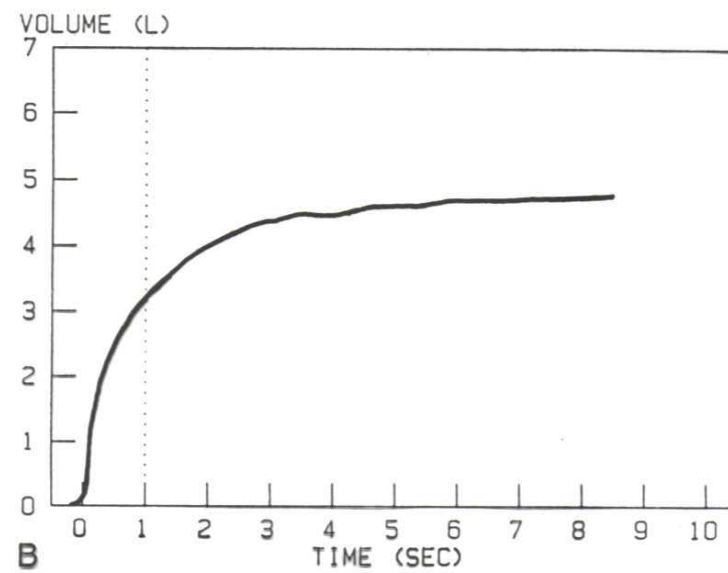
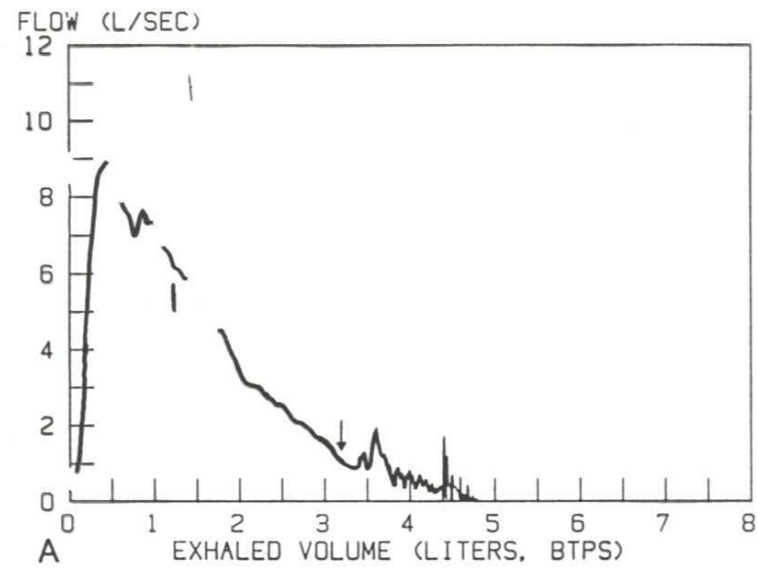


Example 6.3.

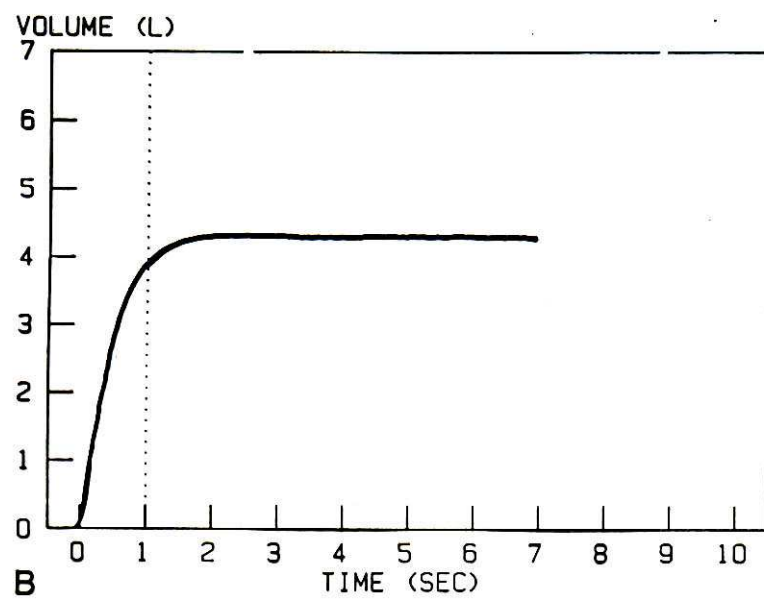
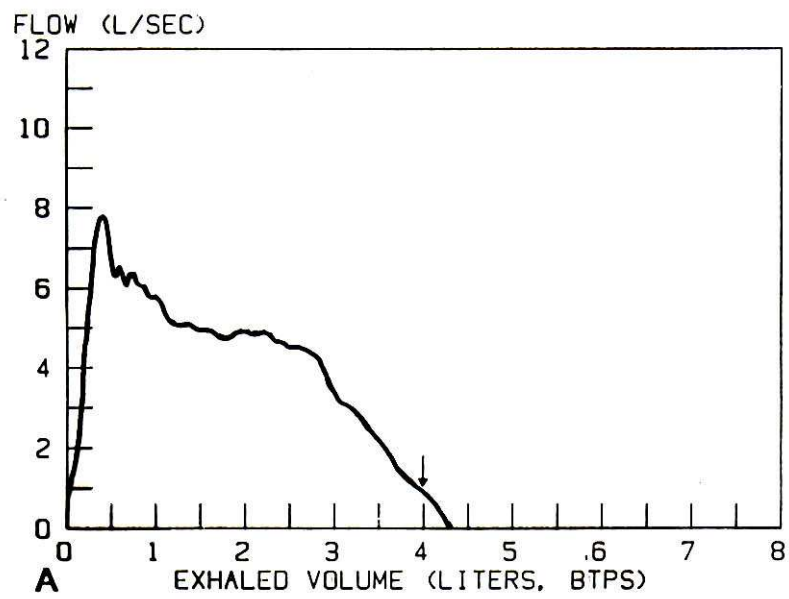
A. Note the loss of a distinct, sharp peak flow on this flow-volume curve. This is the most common mistake made by patients during spirometry maneuvers. It is caused by submaximal force being used at the beginning of the maneuver. The patient must be told to "start faster, really blast out the air at the beginning of the test." (Only rarely in a few young females will this pattern be reproducible, and therefore, acceptable.) B. A submaximal blast at the beginning of the maneuver is difficult to detect on a spirogram. It is difficult for the human eye to discern slight differences in slope (flow rate) during the steep portion of the spirogram.

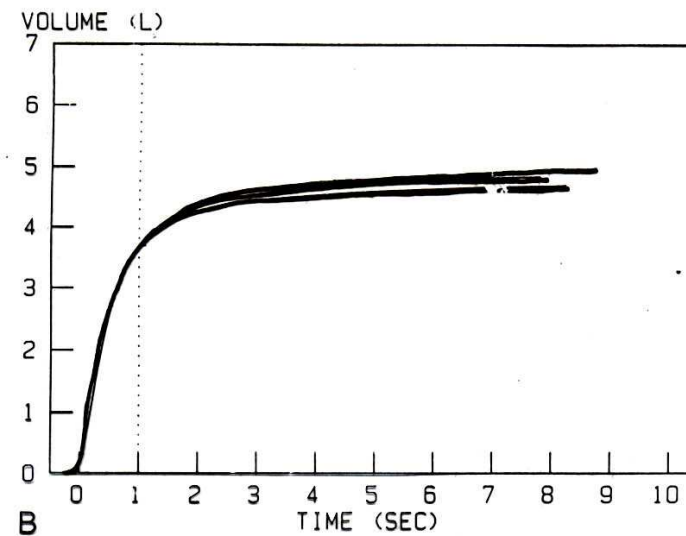
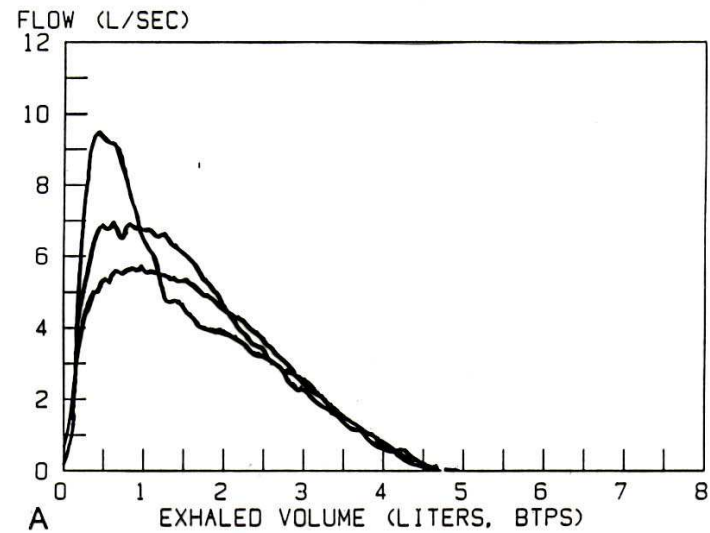
INTERPRETING THE RESULTS





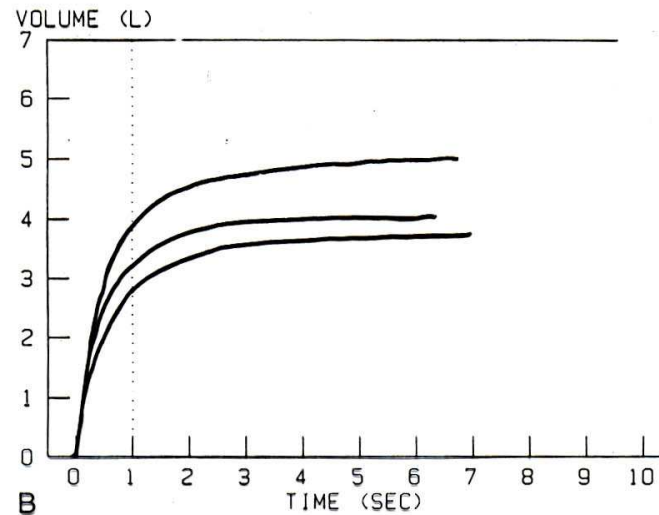
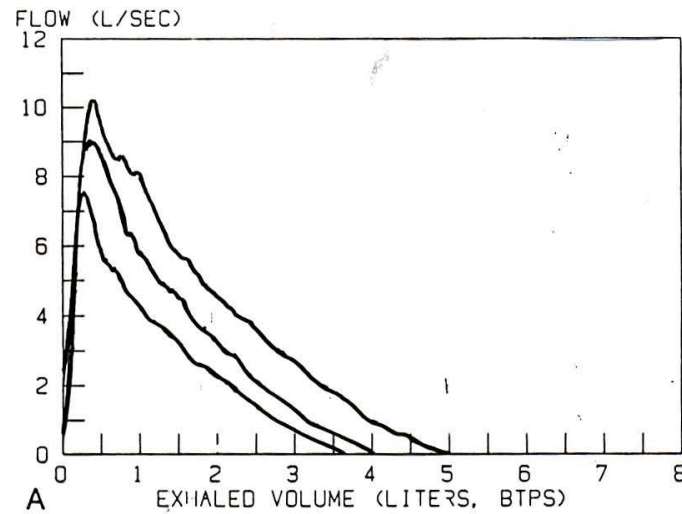
INTERPRETING THE RESULTS





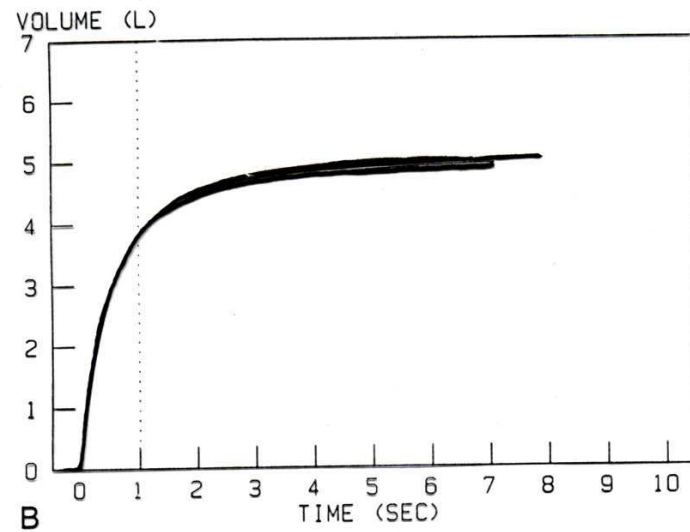
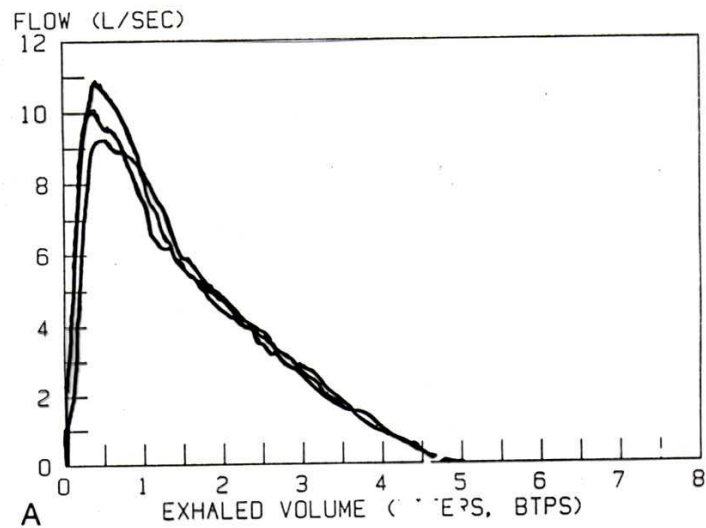
Example 6.11.

A, These three maneuvers have differing peak flows. You should demonstrate what it means to **blast** out at the onset of the maneuver. The best two peak flow rates should match each other within 1 liter/sec. B, Notice how difficult it is to tell from the spirogram that two of these efforts had submaximal peak flows.



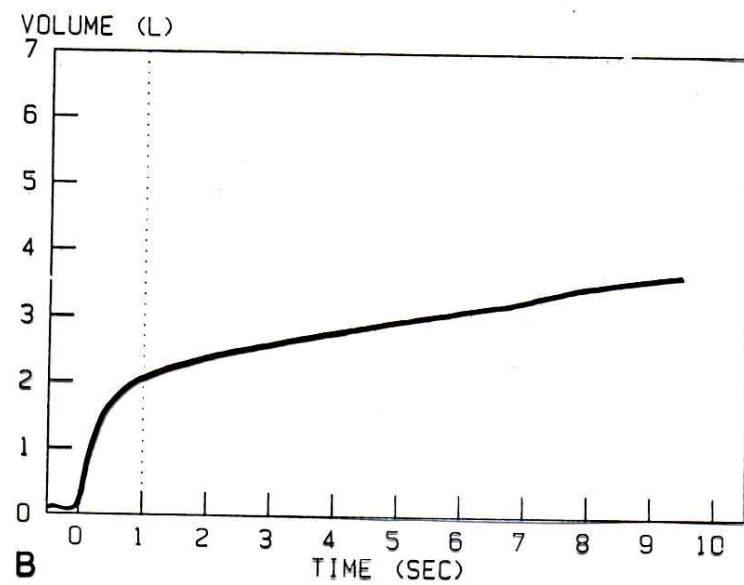
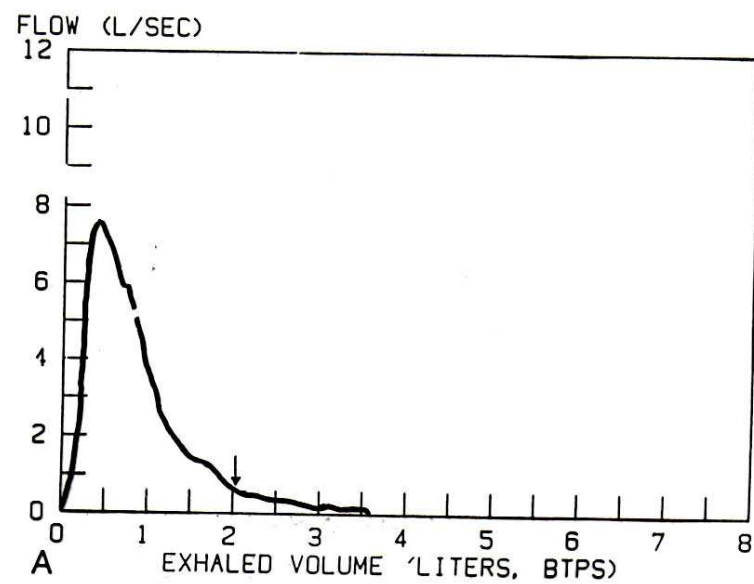
Example 6.10.

A, These three curves look similar in shape except that two of them are smaller and have lower volumes (3.7 and 4.0 L). The patient did not take as deep a breath as possible before these two maneuvers. Coach him to inhale as deeply as possible for the next maneuver. B, These three maneuvers are individually acceptable but the exhaled volumes are not reproducible. The patient did not take as deep a breath as possible before at least two of these maneuvers. You should tell him to concentrate on filling his lungs as fully as possible for the next maneuver.

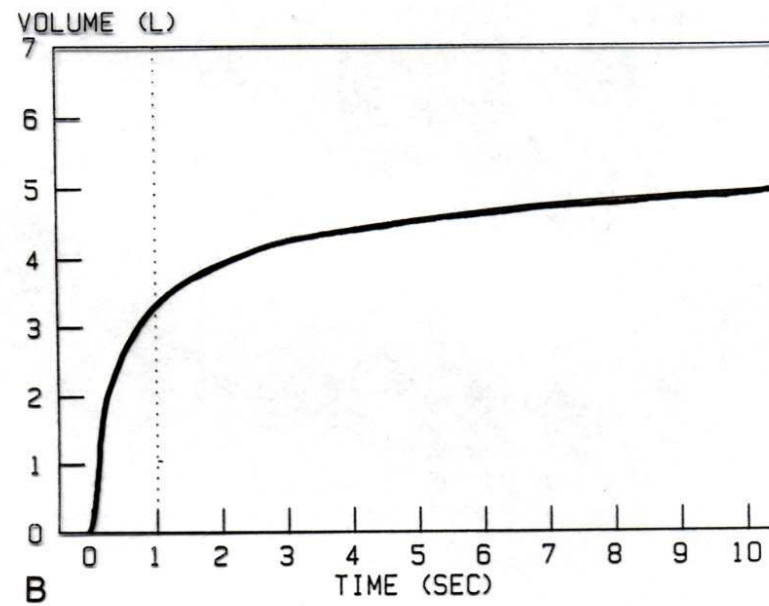
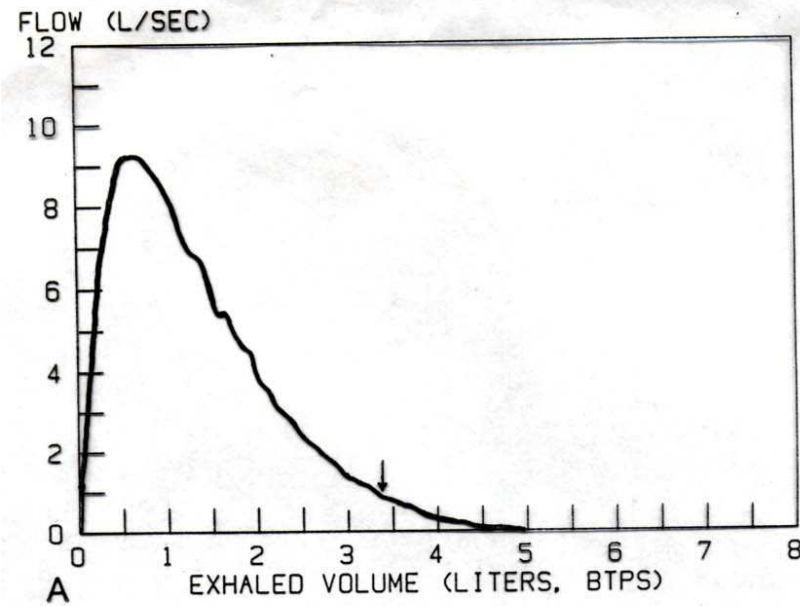


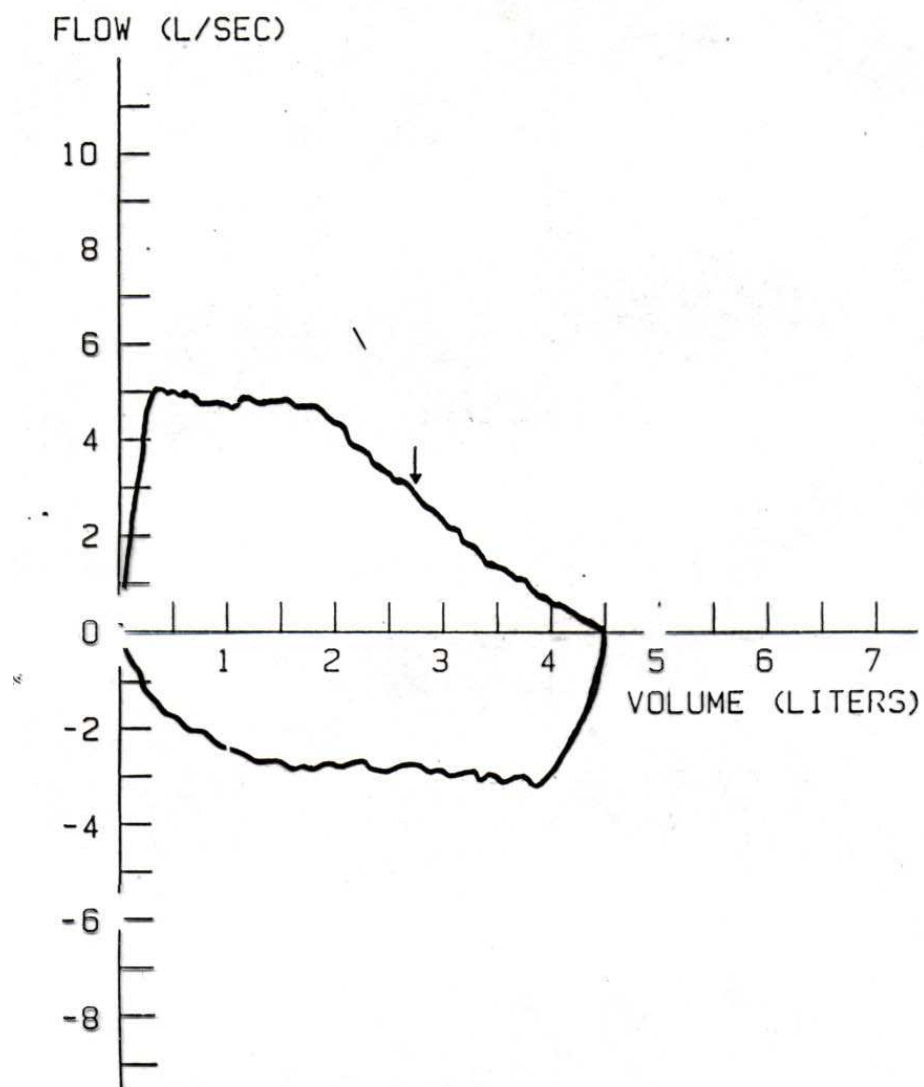
Example 6.9.

A, These three flow-volume curves demonstrate both acceptable and reproducible efforts. Note how they are almost indistinguishable from each other. Congratulate the patient (and yourself) for doing so well. B, This set of spirometers is great. This is what you are aiming for with each patient. Note that the three maneuvers are both acceptable and reproducible. They fall almost on top of each other.

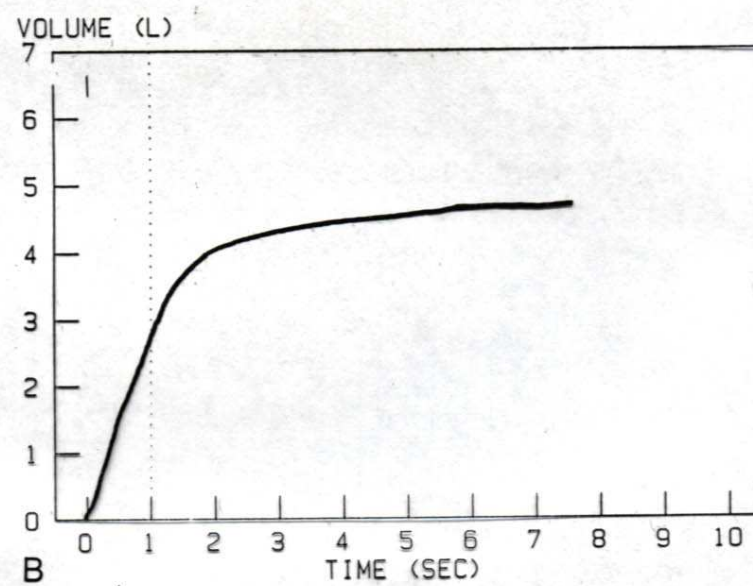
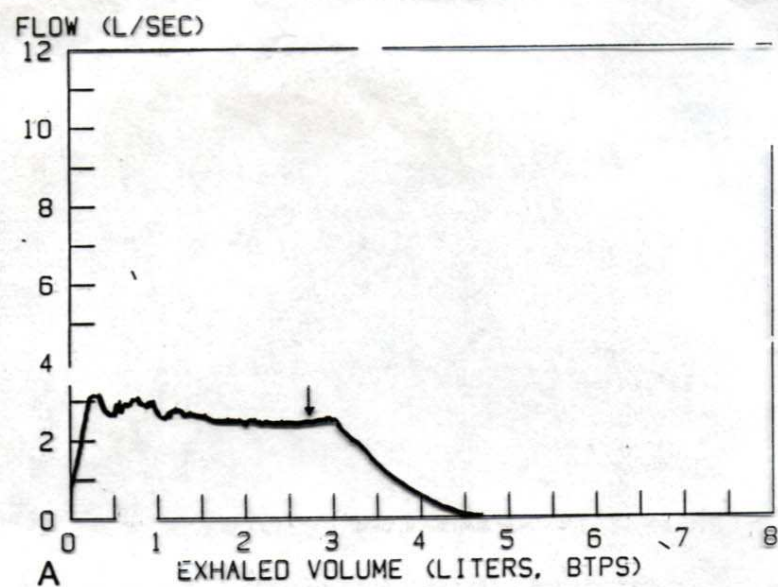


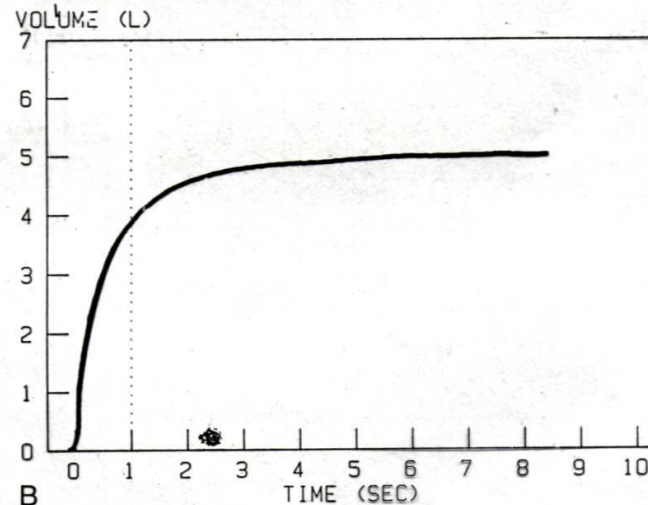
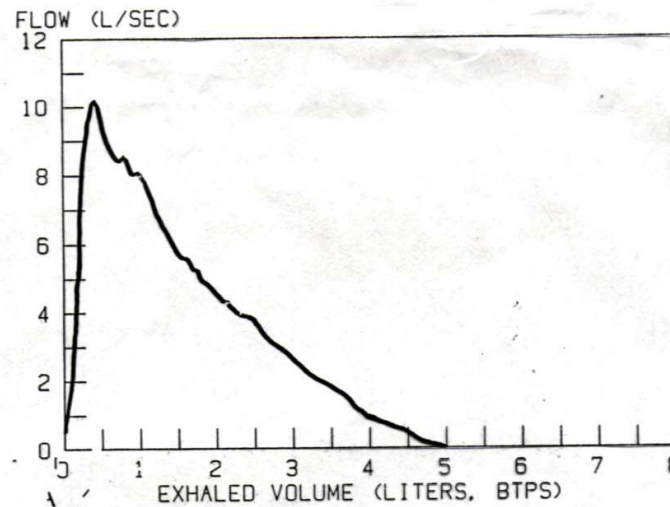
INTERPRETING THE RESULTS





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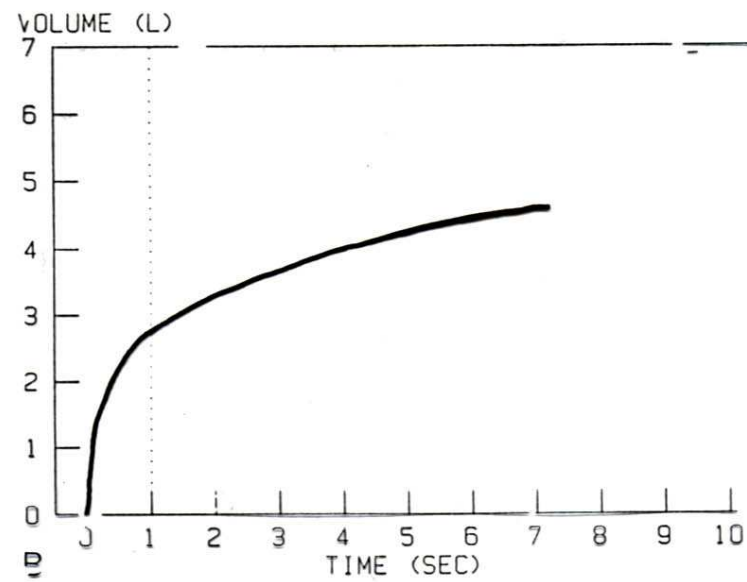
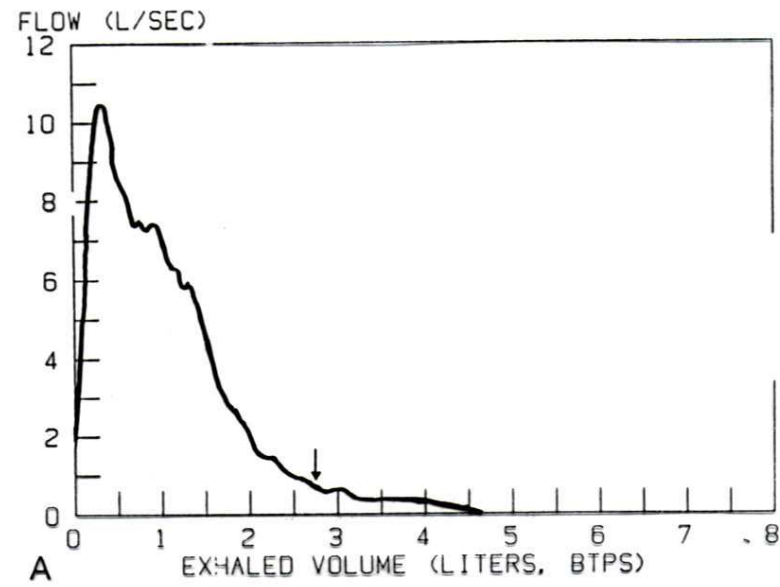


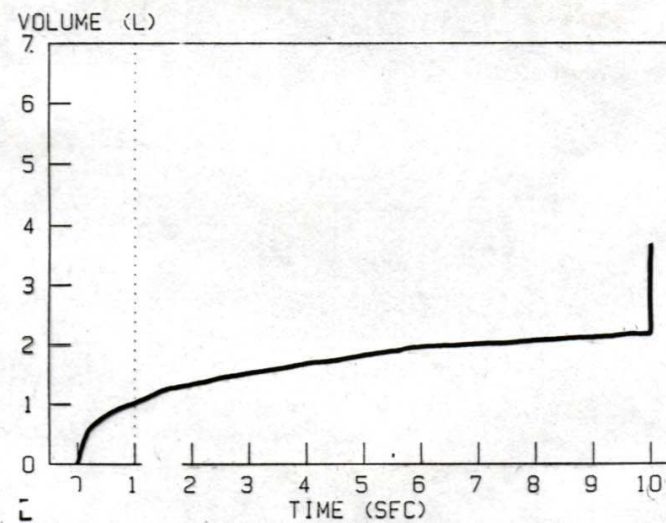
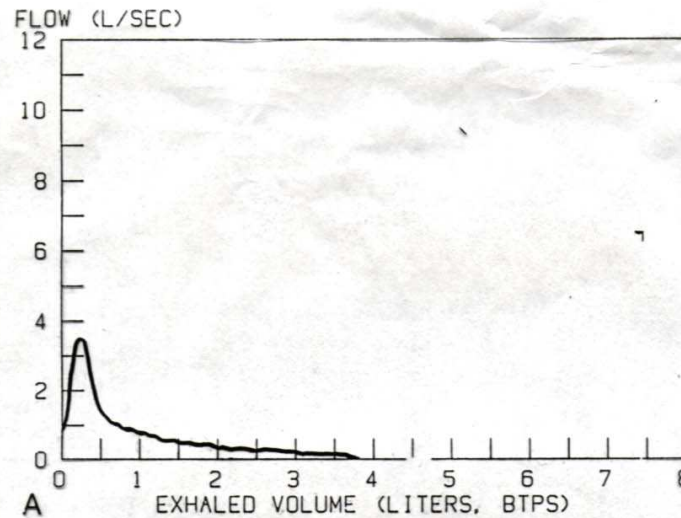


Example 6.1.

A, Examine the characteristics of this well-performed, acceptable flow-volume curve. Note the abrupt increase in flow at the onset of the maneuver, which results in an almost vertical line towards the peak flow. Note the sharpness of the peak with a relatively smooth, continuous decrease in the flow rates as the maneuver progresses. Note the acute angle formed with the horizontal baseline as the flow gradually decreases to zero at the end of the maneuver. *B*, A well-performed maneuver results in a spirogram starting with a steep slope upwards. The graph then smoothly reaches a plateau as exhalation continues for at least 6 sec. The final portion of the spirogram must be horizontal.

INTERPRETING THE RESULTS

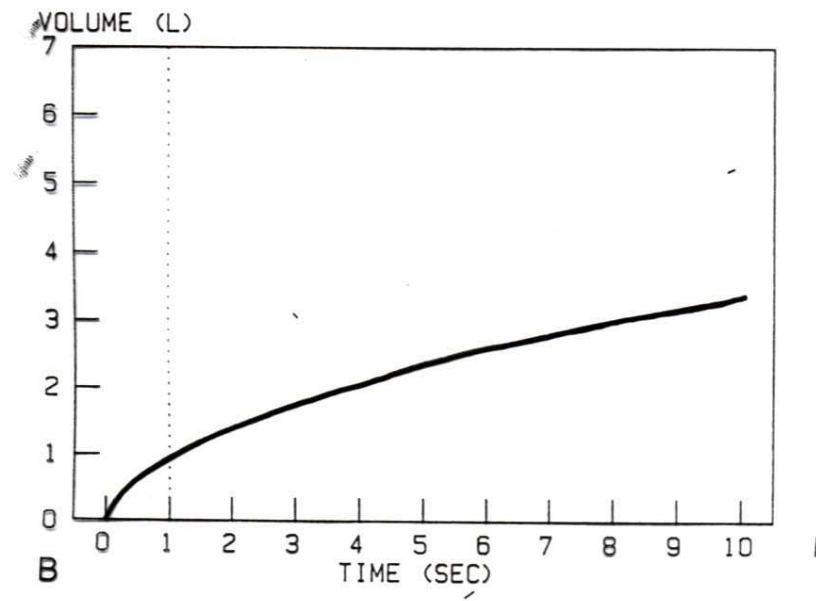
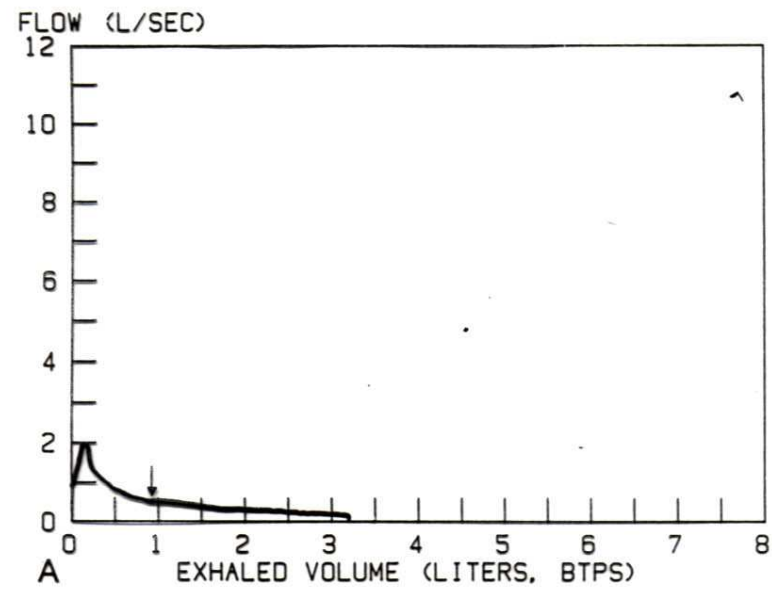




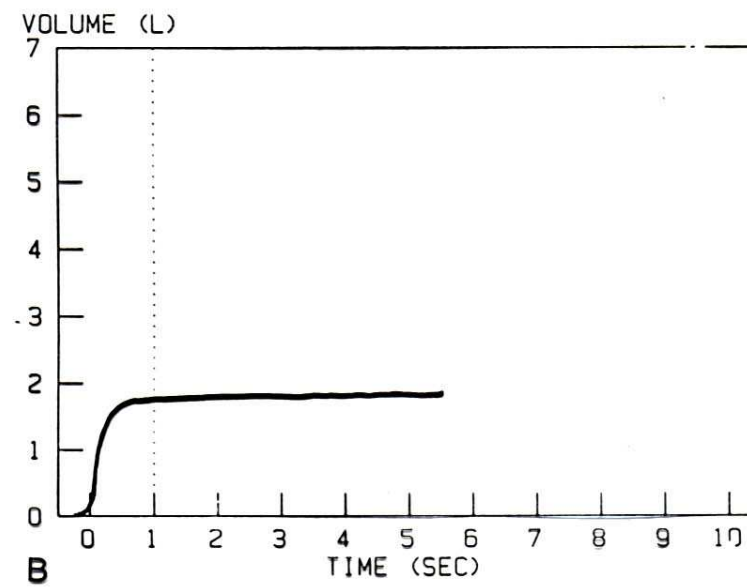
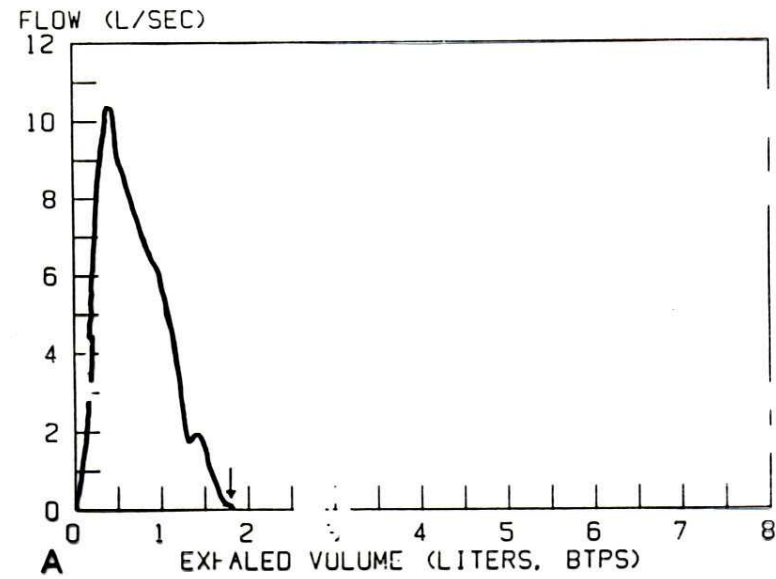
Example 6.8.

The graphs of some manual volume spirometers may end before the patient has exhaled all of his air, as in this example. Patients with severe COPD can frequently exhale for more than 10 sec, sometimes for as long as 30 sec. In this case, do not let the patient stop blowing out when he comes to the end of the spirogram (B). The spirometer will continue to accumulate the volume and will draw a straight vertical line upwards at the end of the graph. The top of that line allows measurement of the patient's FVC. One can, of course, also measure the FEV₁ from this tracing (1.0 L).

INTERPRETING THE RESULTS



INTERPRETING THE RESULTS





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