

Chest X-Ray Interpretation for the CRNA

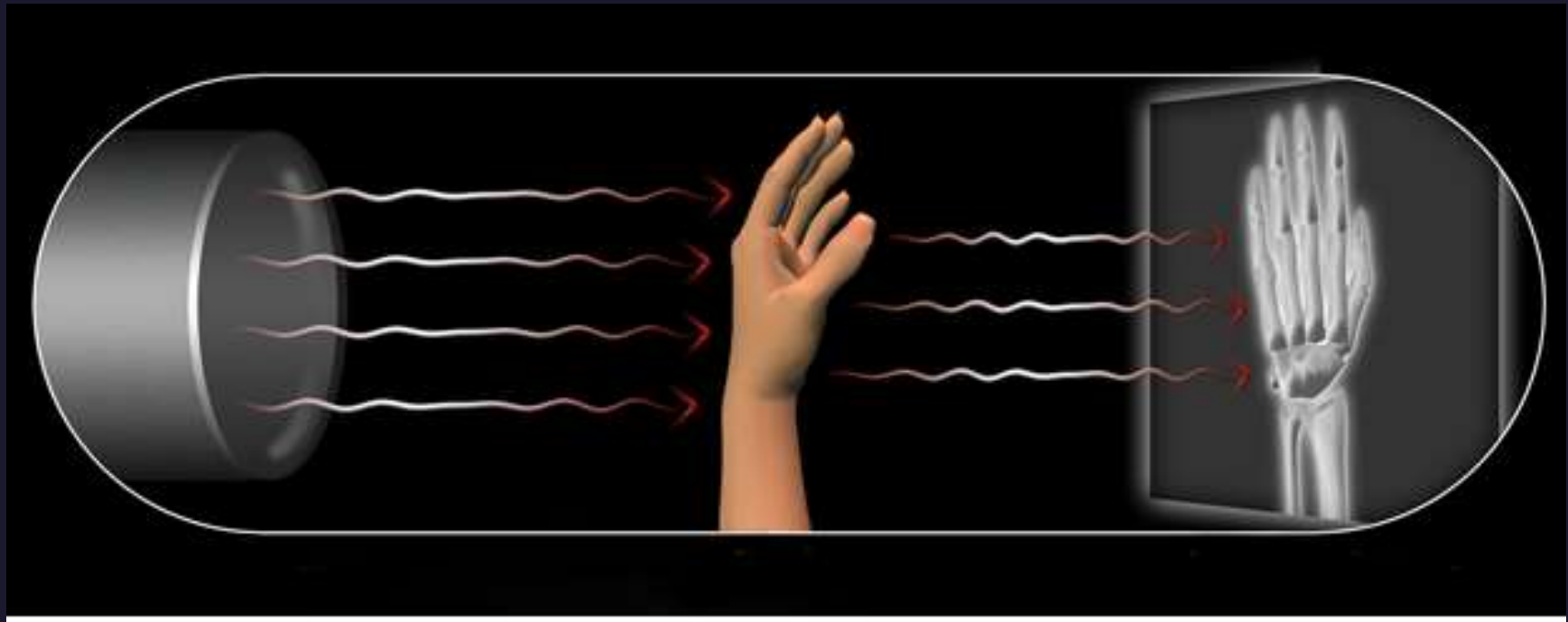
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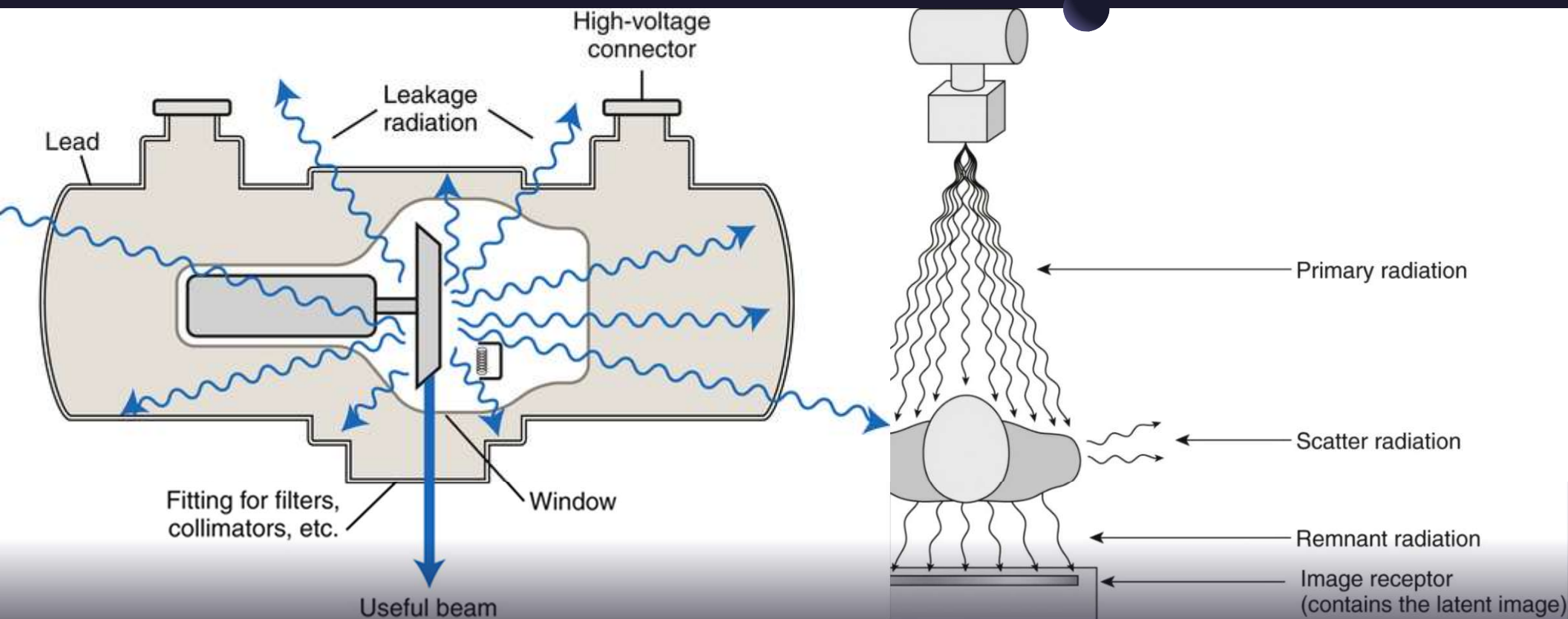
Objectives

- Review the basics principles of radiography including X-rays, image acquisition, and radiation safety.
- Discuss the basic principles of chest X-Ray interpretation.
- Review applicable disease processes that can be identified using plain chest radiographs.
- Review the use of chest radiography to aid in anesthetic procedures, and to confirm the placement of applicable tubes and lines.
- Discuss the use of chest radiography for the crashing patient.
- Discuss the future implications of chest radiography in changing the practice of anesthesia.

How does it work?







Direct vs Indirect Radiation








Naturally occurring "background" radiation

- “We are exposed to natural sources of radiation all the time. According to recent estimates, the average person in the U.S. receives an effective dose of about 3 mSv per year from natural radiation, which includes cosmic radiation from outer space. These natural "background doses" vary according to where you live. **People living at high altitudes such as Colorado or New Mexico receive about 1.5 mSv more per year than those living near sea level.** A coast-to-coast round-trip airline flight is about 0.03 mSv due to exposure to cosmic rays. The **largest source of background radiation comes from radon gas in our homes** (about 2 mSv per year). Like other sources of background radiation, the amount of radon exposure varies widely depending on where you live. To put it simply, the amount of radiation from one adult chest x-ray (0.1 mSv) is about the same as 10 days of natural background radiation that we are all exposed to as part of our daily living.”

Radiation Dose to Adults From Common Imaging Examinations

Procedure		Approximate effective radiation dose (mSv)	Approximate comparable time of natural background radiation exposure
 ABDOMINAL REGION	Computed Tomography (CT) — Abdomen and Pelvis	7.7 mSv	2.6 years
	Computed Tomography (CT) — Abdomen and Pelvis, repeated with and without contrast material	15.4 mSv	5.1 years
	Computed Tomography (CT) — Colonography	6 mSv	2 years
	Intravenous Urogram (IVU)	3 mSv	1 year
	Barium Enema (Lower GI X-ray)	6 mSv	2 years
	Upper GI Study With Barium	6 mSv	2 years
 BONE	Lumbar Spine	1.4 mSv	6 months
	Extremity (hand, foot, etc.) X-ray	< 0.001 mSv	< 3 hours
 CENTRAL NERVOUS SYSTEM	Computed Tomography (CT) — Brain	1.6 mSv	7 months
	Computed Tomography (CT) — Brain, repeated with and without contrast material	3.2 mSv	13 months
	Computed Tomography (CT) — Head and Neck	1.2 mSv	5 months
	Computed Tomography (CT) — Spine	8.8 mSv	3 years
 CHEST	Computed Tomography (CT) — Chest	6.1 mSv	2 years
	Computed Tomography (CT) — Lung Cancer Screening	1.5 mSv	6 months
	Chest X-ray	0.1 mSv	10 days

 DENTAL	Dental X-ray	0.005 mSv	1 day
	Panoramic X-Ray	0.025 mSv	3 days
	Cone Beam CT	0.18 mSv	22 days
 HEART	Coronary Computed Tomography Angiography (CTA)	8.7 mSv	3 years
	Cardiac CT for Calcium Scoring	1.7 mSv	6 months
	Non-Cardiac Computed Tomography Angiography (CTA)	5.1 mSv	< 2 years
 MEN'S IMAGING	Bone Densitometry (DEXA)	0.001 mSv	3 hours
 NUCLEAR MEDICINE	Positron Emission Tomography — Computed Tomography (PET/CT) Whole body protocol	22.7 mSv	7.6 years
 WOMEN'S IMAGING	Bone Densitometry (DEXA)	0.001 mSv	3 hours
	Screening Digital Mammography	0.21 mSv	26 days
	Screening Digital Breast Tomosynthesis (3D Mammogram)	0.27 mSv	33 days

OSHA Limits

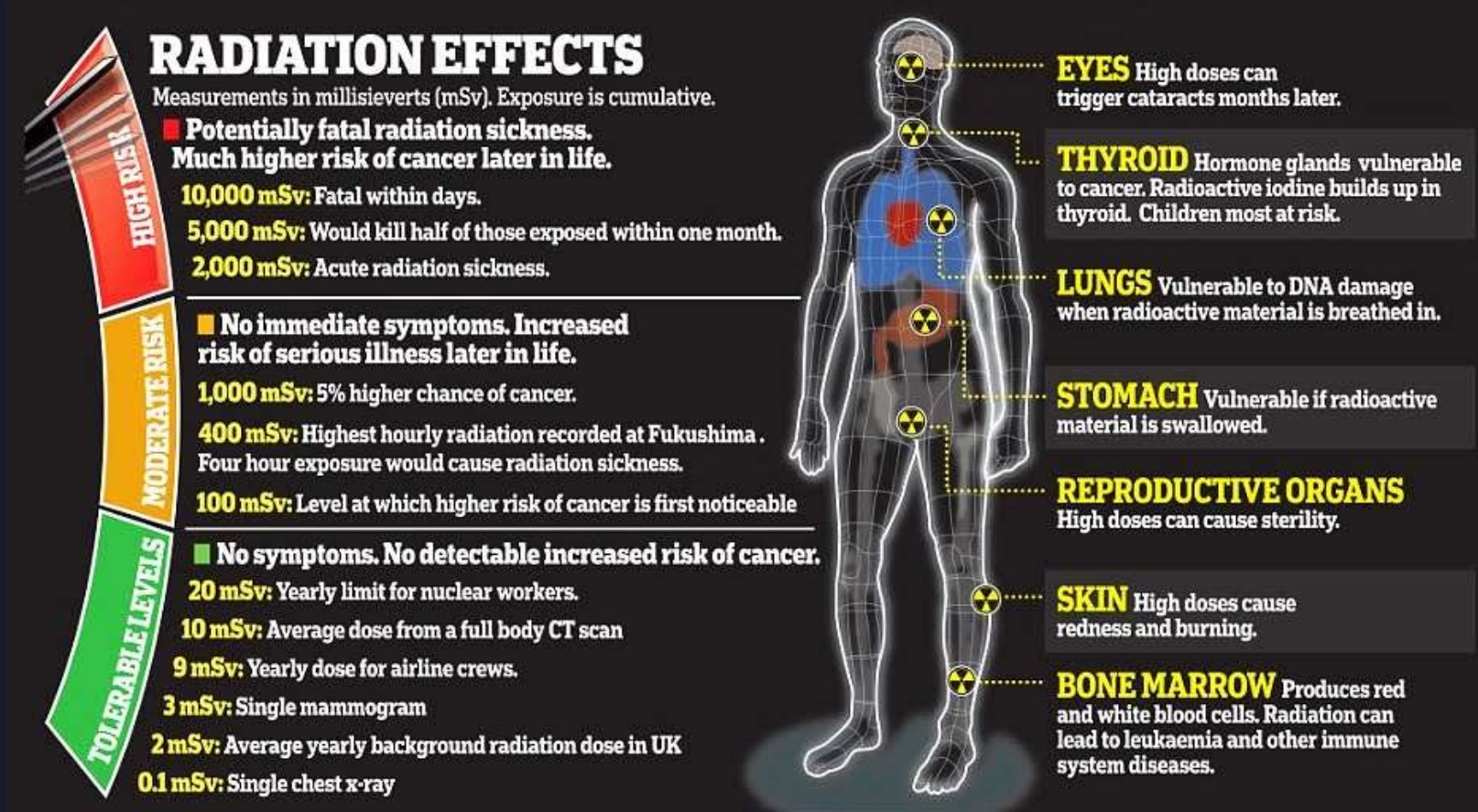
- 1 mSv = 0.1 rem
- No employer shall possess, use, or transfer sources of ionizing radiation in such a manner as to cause any individual in a restricted area to receive, in any period of one calendar quarter from sources in the employer's possession and control, a dose in excess of the following limits:
 - Whole body: head and trunk; active blood-forming organs; lens of eyes; or gonads: **1.25 rem per quarter**
 - Hands and forearms; feet and ankles: **18.75 rem per quarter**
 - Skin of whole body: **7.5 rem per quarter**

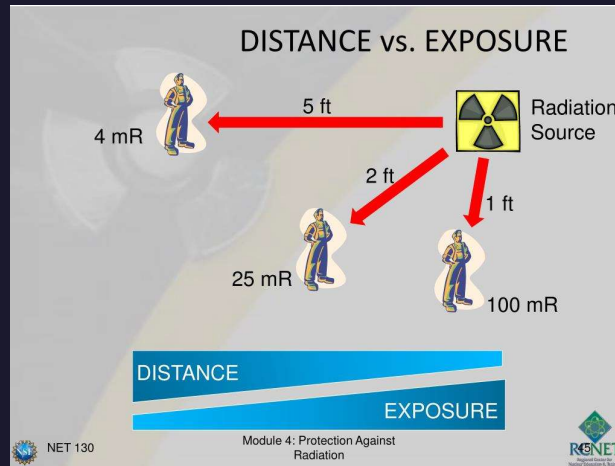
Federal Regulations

- Title 10, Part 20, of the *Code of Federal Regulations* ([10 CFR Part 20](#)), “Standards for Protection Against Radiation,” establishes the dose limits for radiation workers. The limits vary depending on the affected part of the body. The annual total for the whole body is 5,000 mrem.

Organ, tissue	Occupational Dose Limits		Non-occupational Dose Limits	
	mrem/year	mSv/year	mrem/year	mSv/year
Whole Body	5,000	50	100	1
Lense of the eye	15,000	150	NA	NA
Shallow dose (skin and extremities)	50,000	500	NA	NA

Effects on Organs





What can you
do?

Indications for Chest XRAY

Pneumonia

Pleural Effusions

Pneumothorax

Pulmonary
Contusions

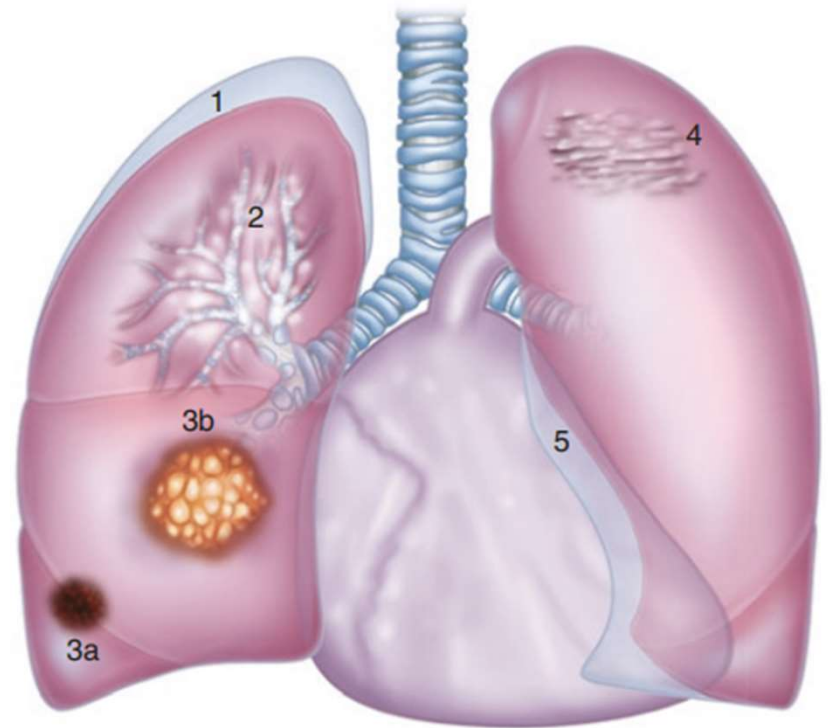
Rib Fractures

Thoracic/Mediastinal
Masses

Position of catheters,
tubes and thoracic
lines

Indications

Fig. 3.9 Schematic representation of parenchymal lung disease patterns on chest X-rays:
(1) Pneumothorax, (2) Consolidation, (3a) Nodule, (3b) Mass, (4) Interstitiopathy, (5) Atelectasis



Systematic Approach

**Assessment of
quality /
Airway**

**Bones and
soft tissues**

Cardiac

Diaphragm

**Effusions /
Extrathoracic
soft tissue**

**Fields, fissures
and foreign
bodies**

**Great vessels /
gastric bubble**

**Hila and
mediastinum**

Impression

Chest XRAY views



FIGURE 1.1. Patient position for PA CXR.

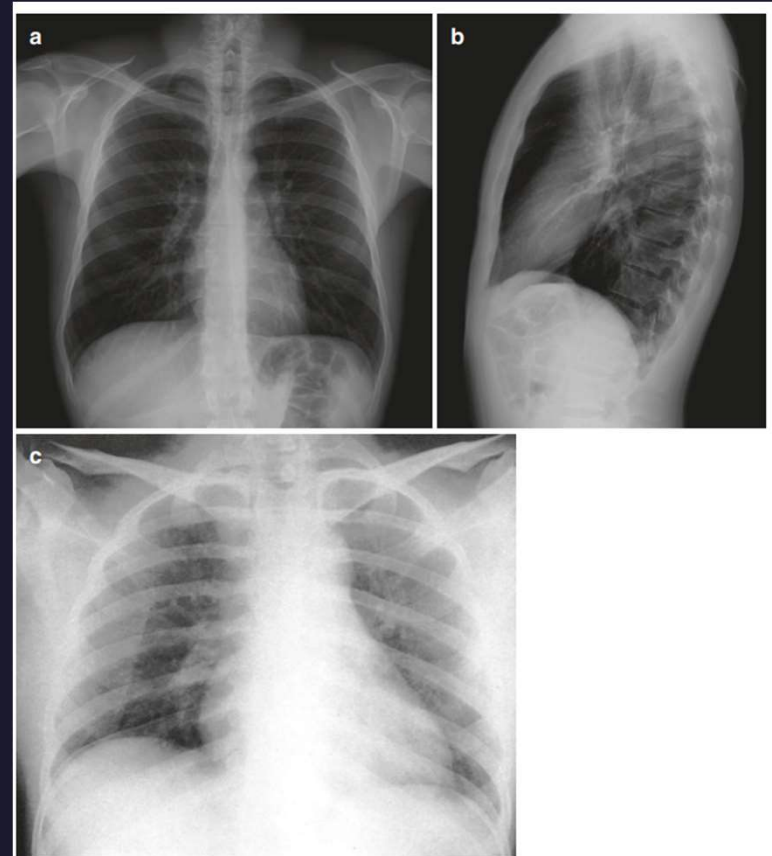
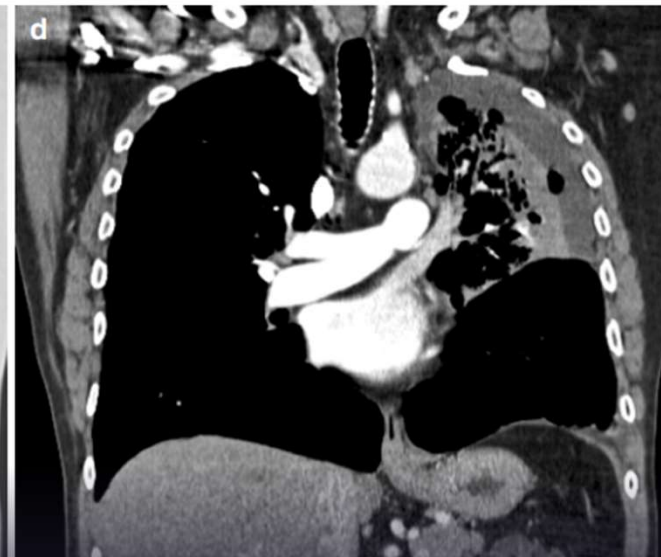
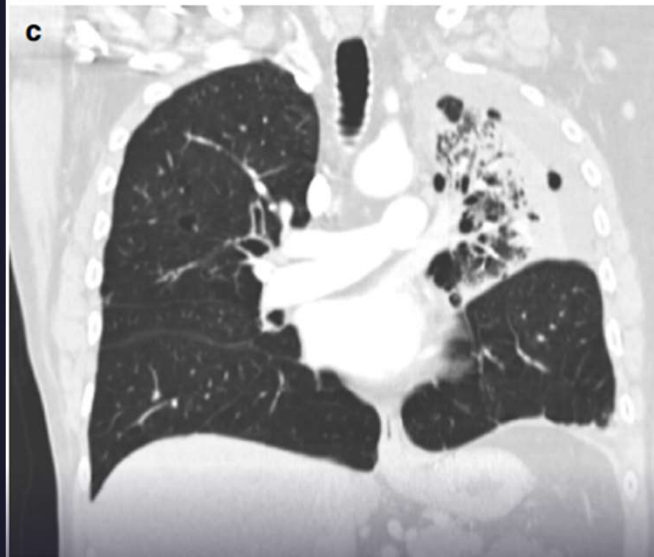
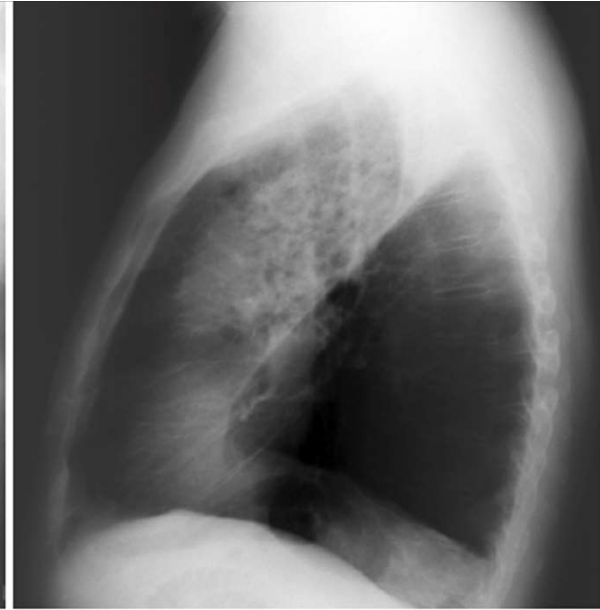


Fig.3.1 (a) Standard posteroanterior projection. (b) Standard lateral projection. (c) Anteroposterior projection obtained with a portable device at the patient's bed

Advanced Imaging Options



Tuesday, February 2, 20XX

Hilar/Mediastinal Anatomy

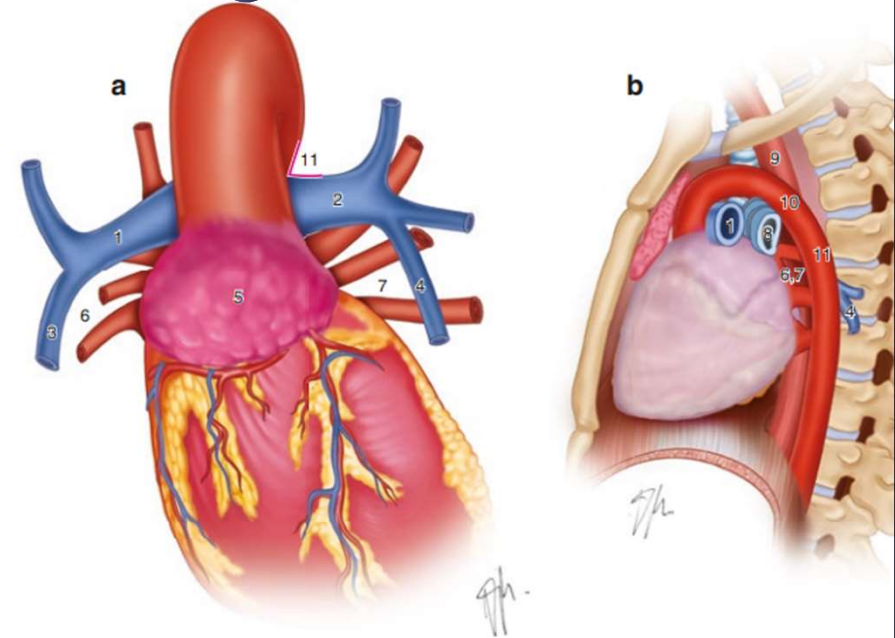
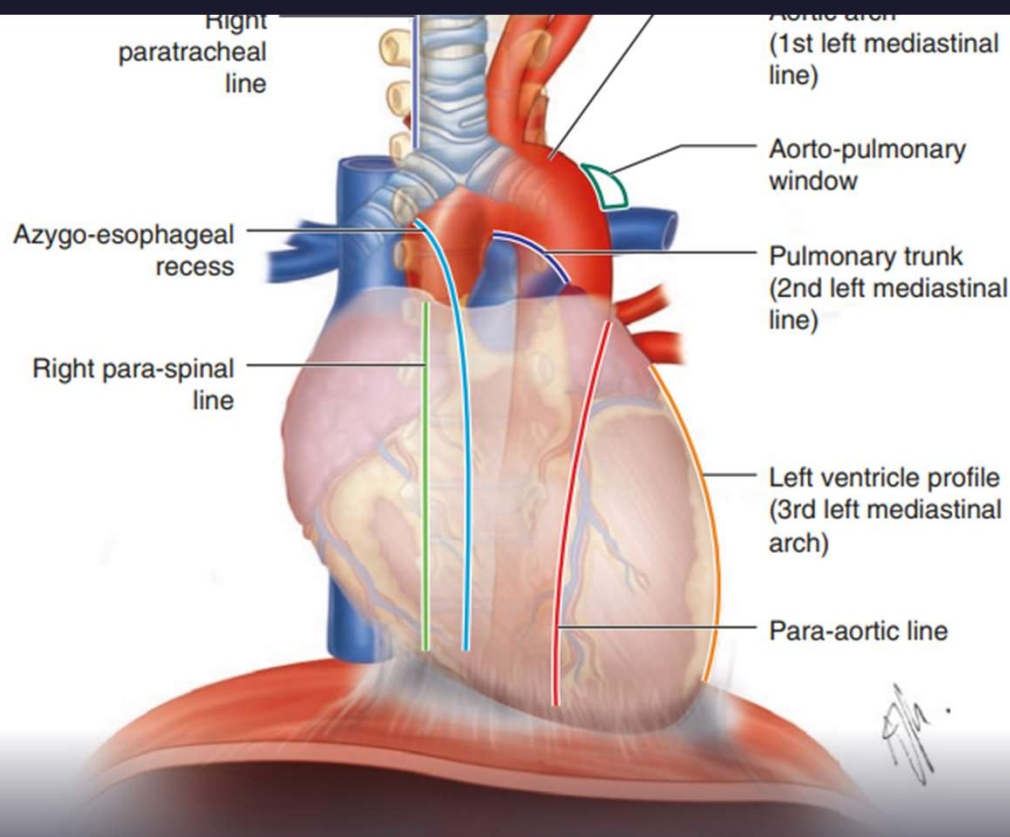
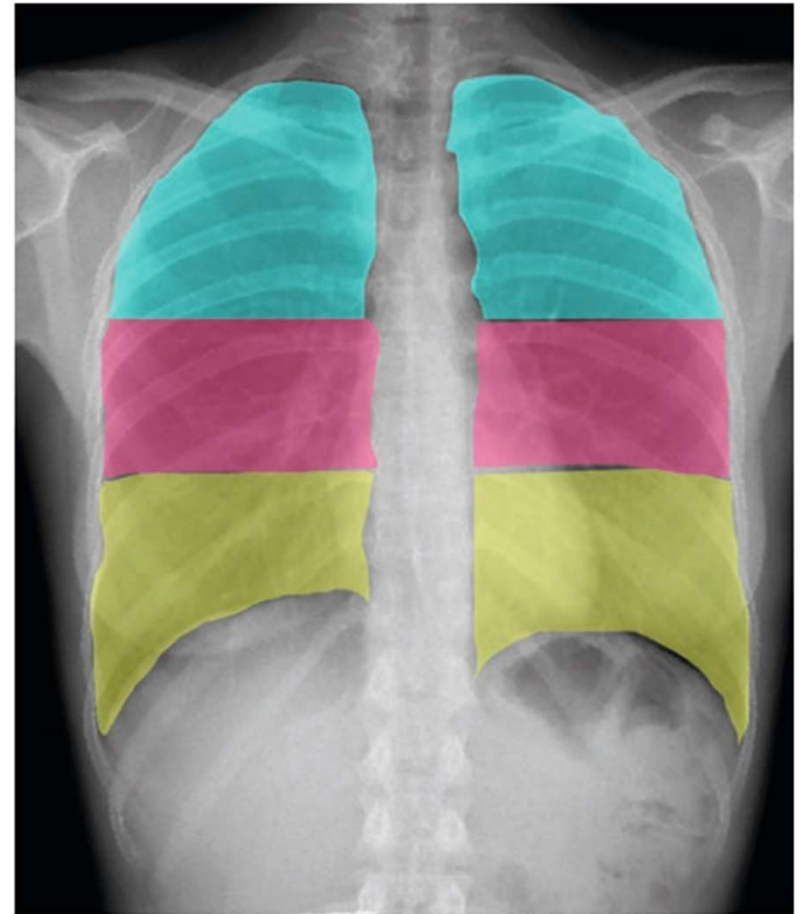


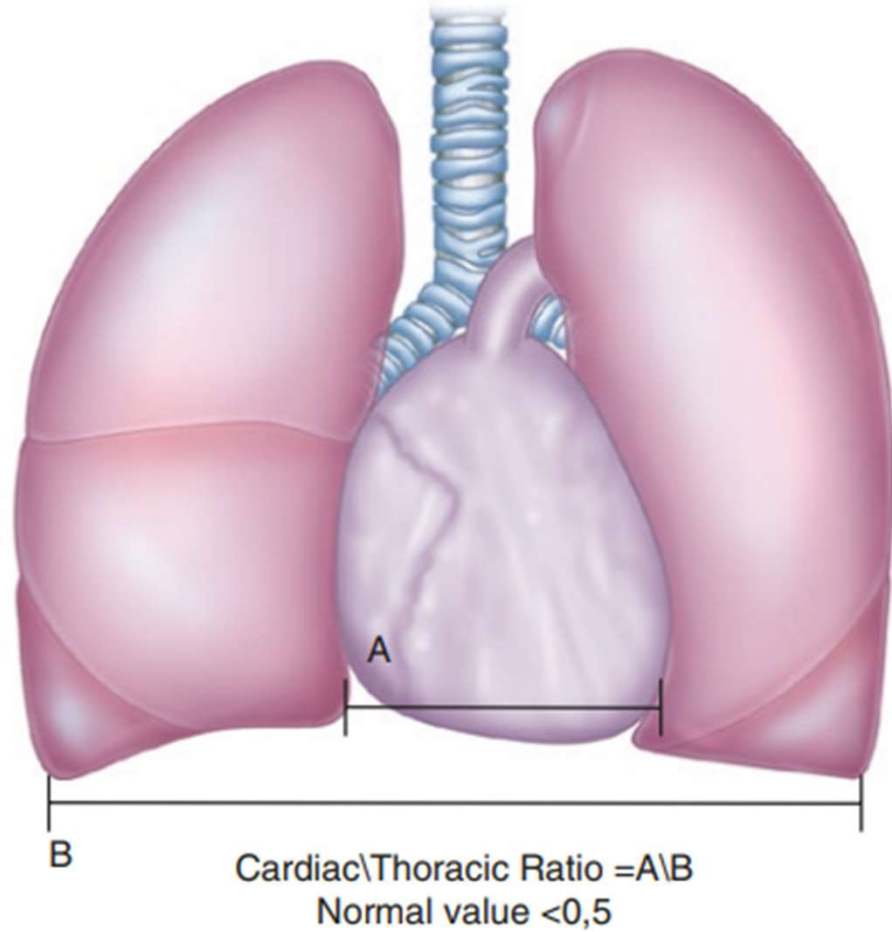
Fig. 3.3 Diagram of the main hilar structures in the PA (a) and LL (b) projections: (1) Right main bronchus, (2) Left pulmonary artery, (3) Right lower lobar pulmonary artery, (4) Left lower lobar pulmonary artery, (5) Right atrium, (6) Right pulmonary veins, (7) Left pulmonary vein, (8) Right main bronchus, (9) Trachea, (10) Aortic arch, (11) Aortopulmonary window

Lung Parenchyma

Fig. 3.5 Schematic representation of the division of the lung parenchyma in three regions. When assessing the lung parenchyma, the density of each region should be compared

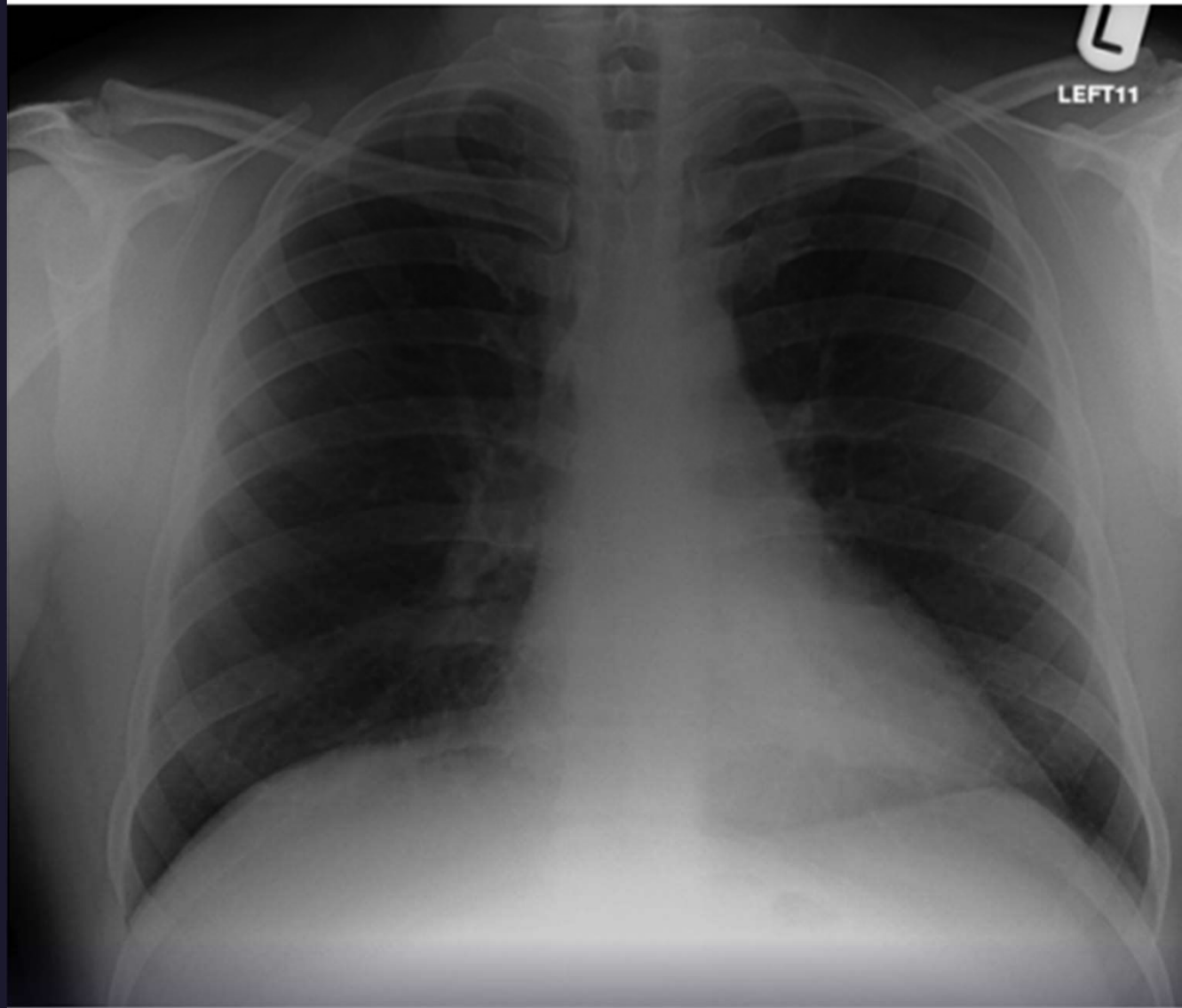


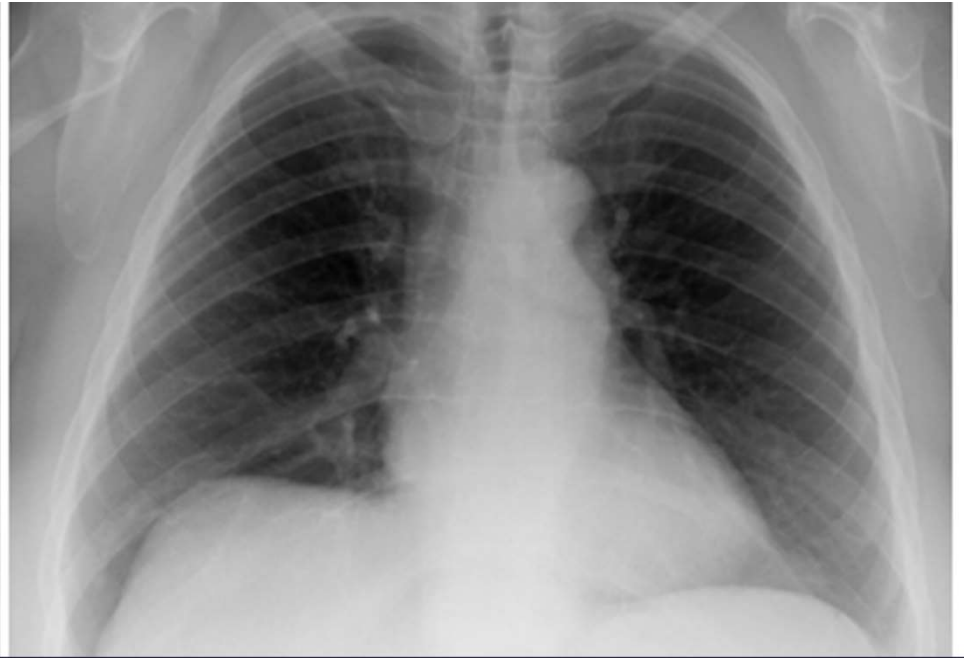
Mediastinal Silhouette



Evaluation

- 1) The medial ends of the clavicles should be equidistant from the vertebral column
- 2) The trachea should be in the midline
- 3) The scapulae should be off the lung fields
- 4) There should be 10 posterior ribs visible above the diaphragm
- 5) Five centimeter of lung apices should be above the clavicles
- 6) Both costophrenic angles should be included on the film





Effects of Breathing and Positioning

Pleural Effusion

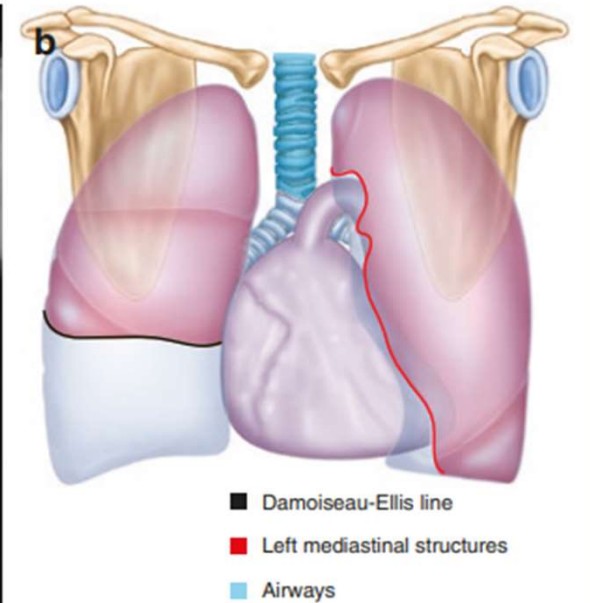
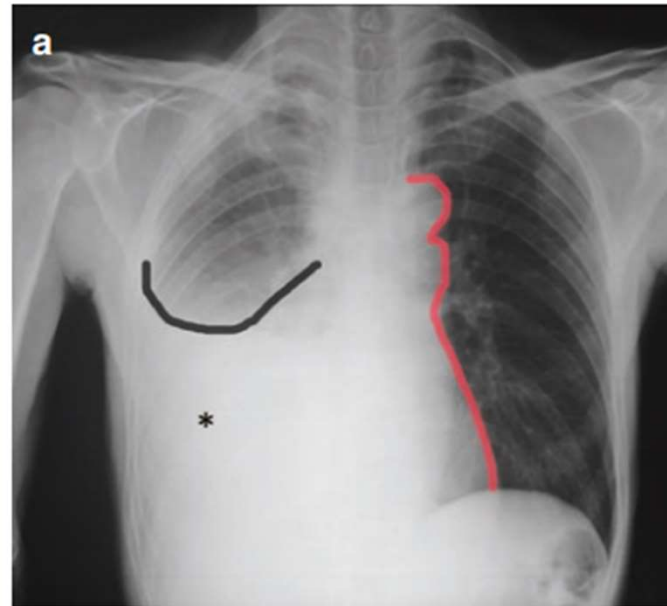
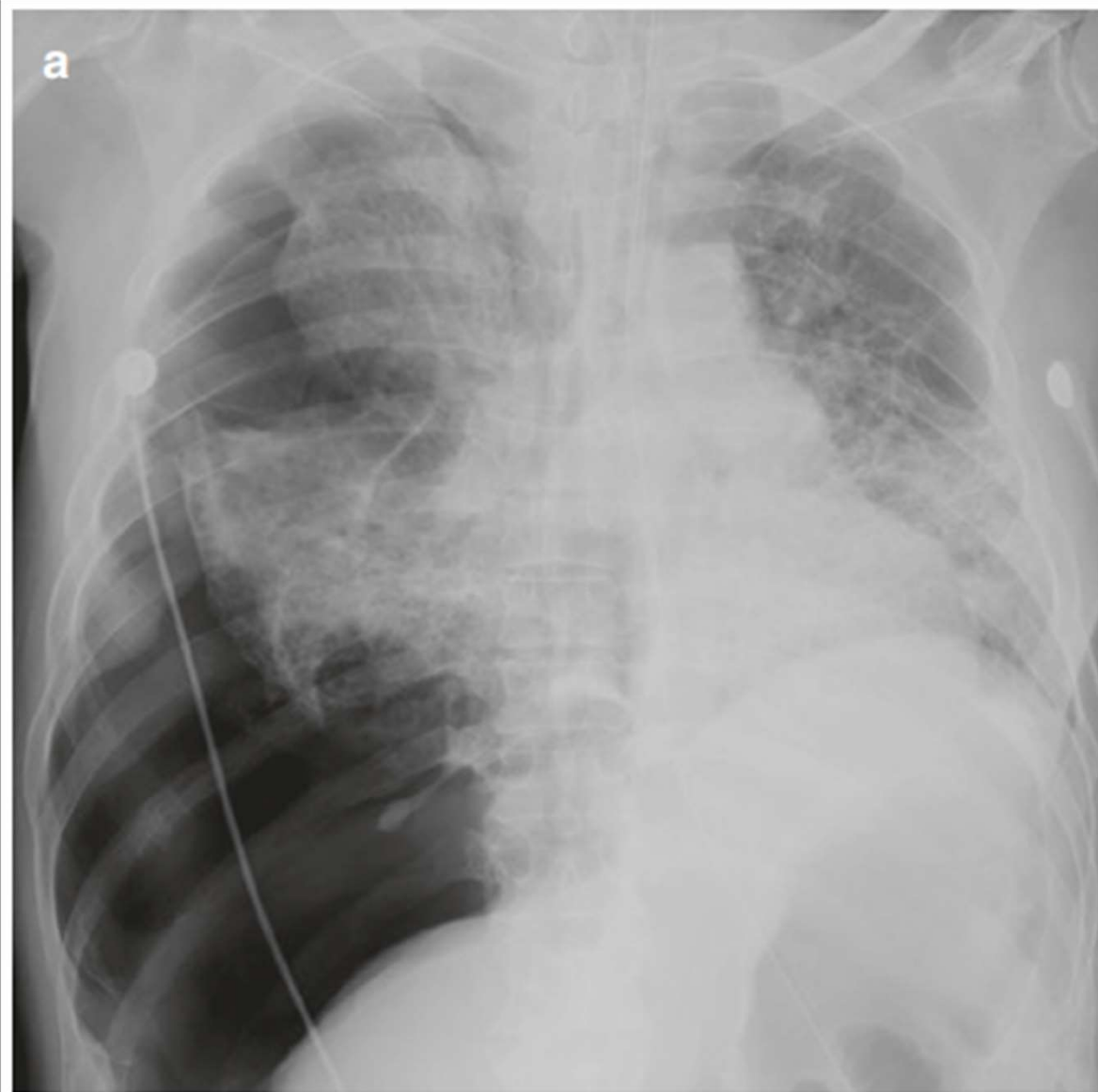
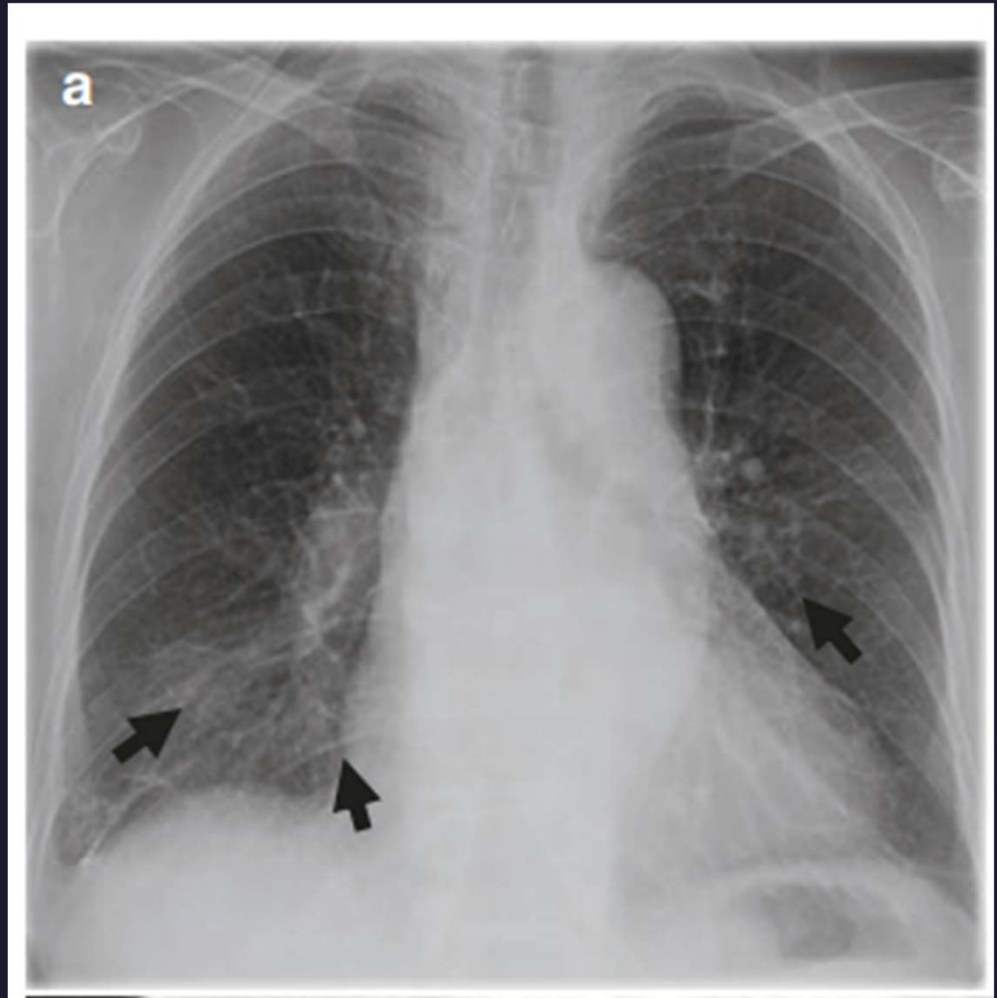
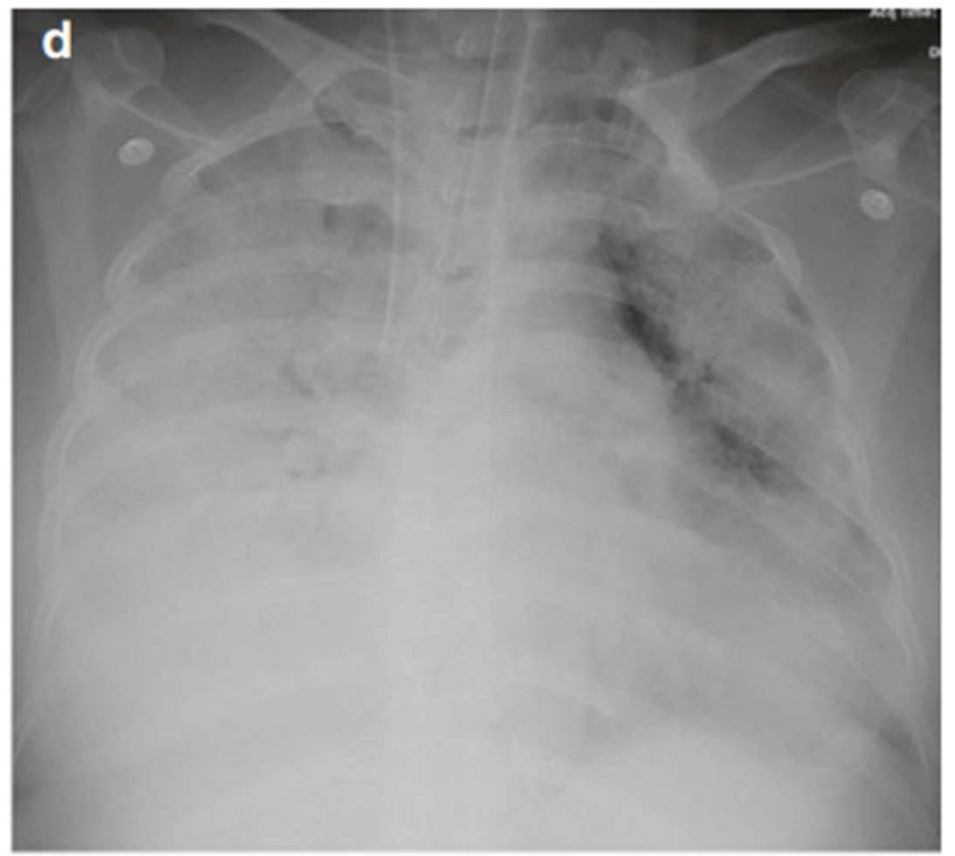
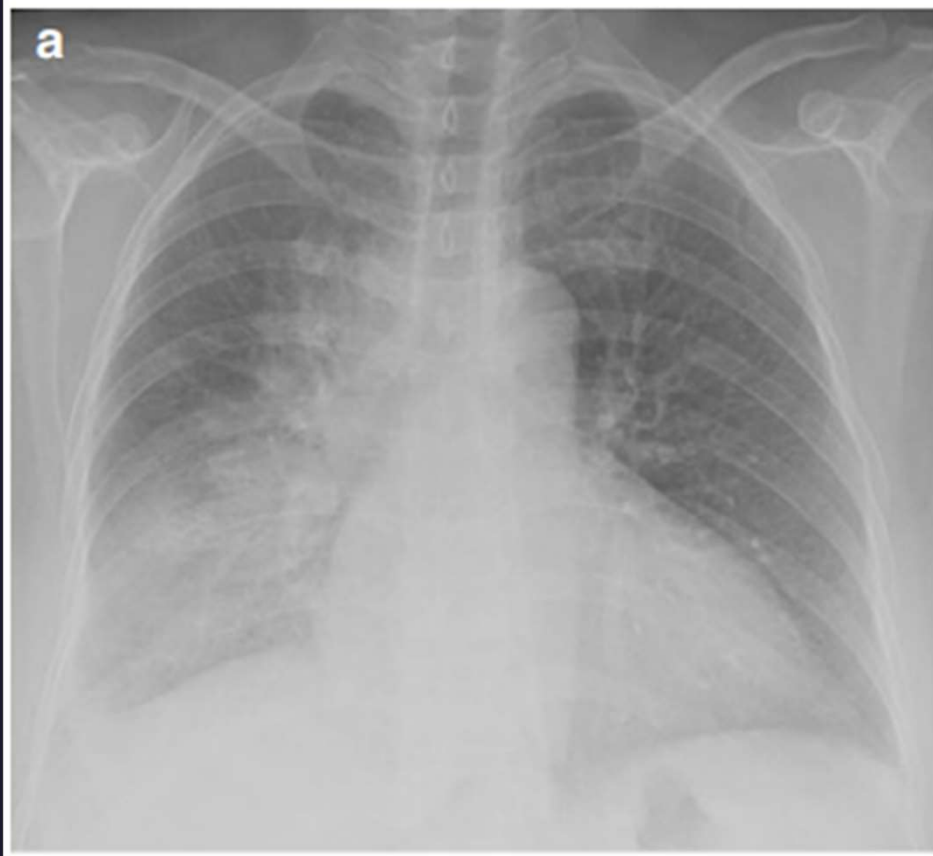
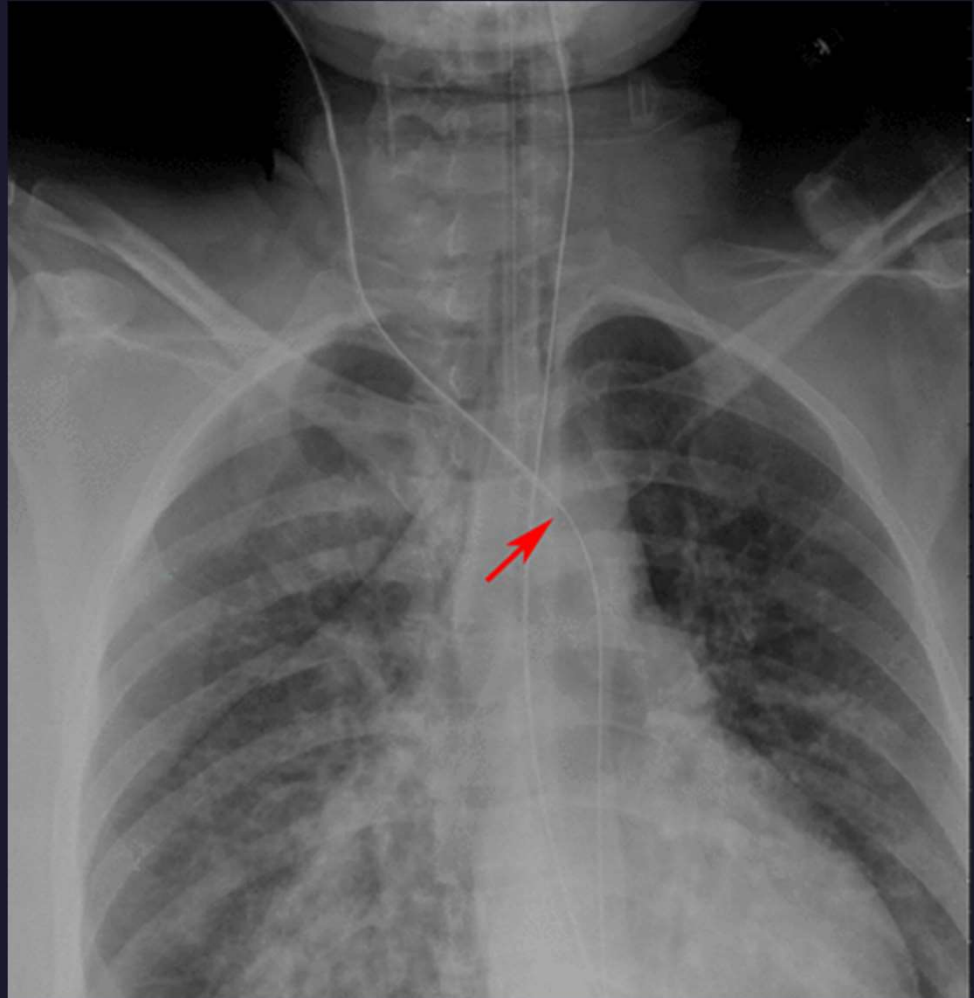


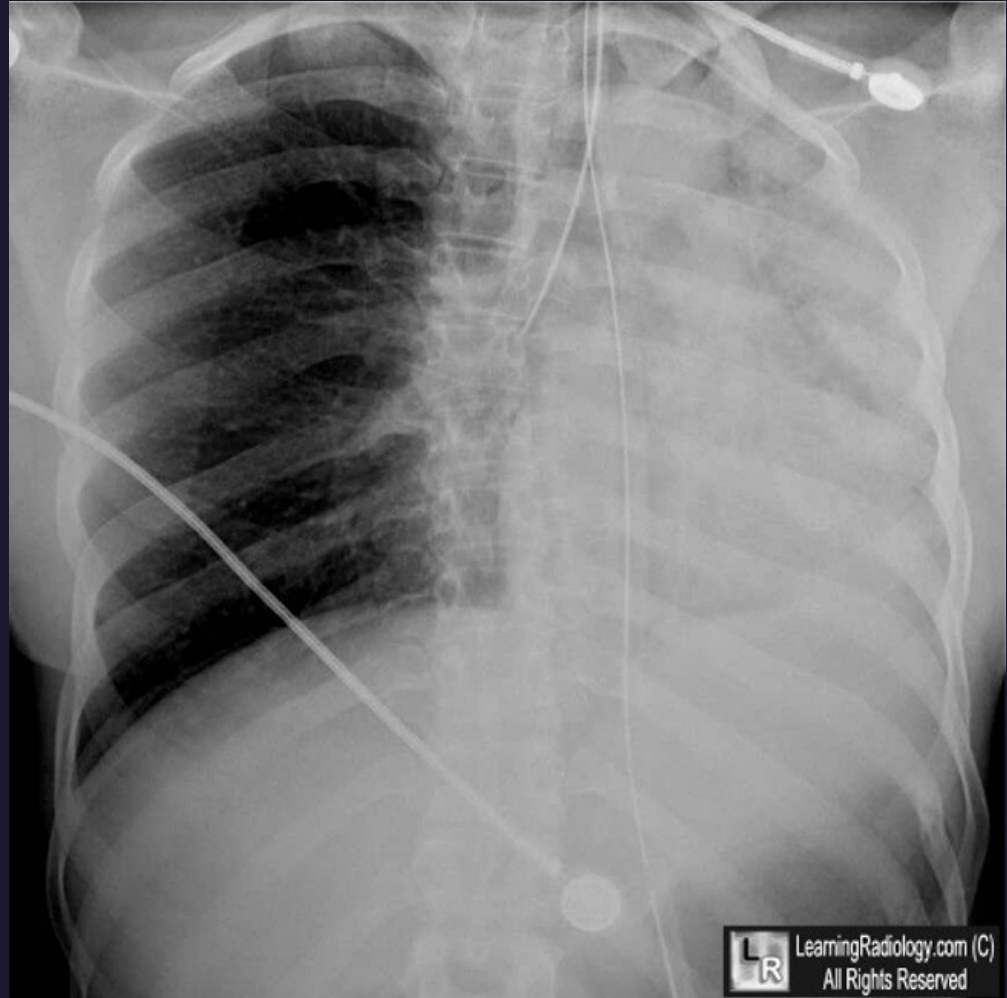
Fig. 3.8 Significant pleural effusion (*) with the typical Damoiseau-Ellis line (*black line*) (a, b). Note that the left mediastinal structures (*red line*) are essentially not shifted because of associated atelectasis (a, b)

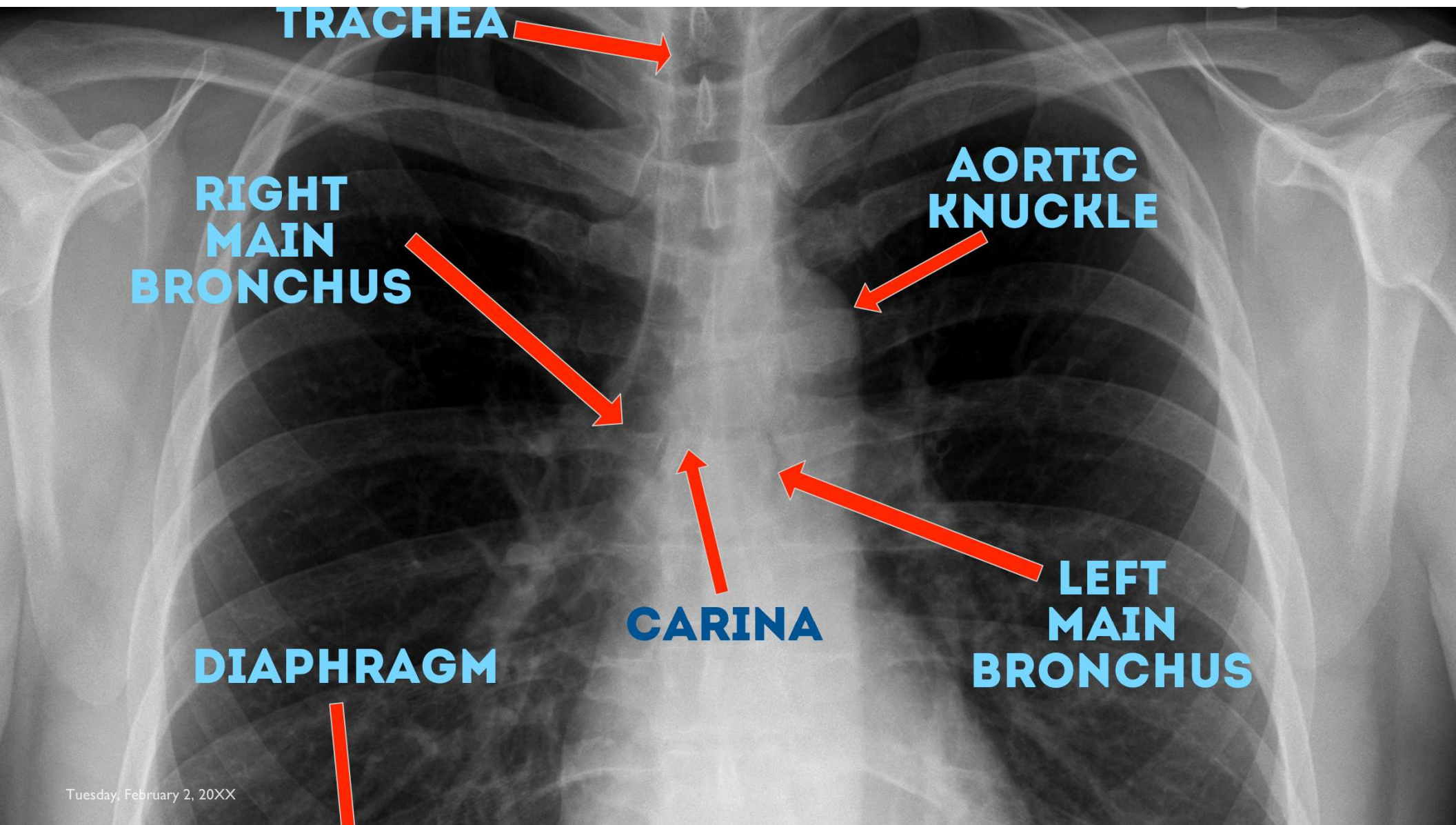


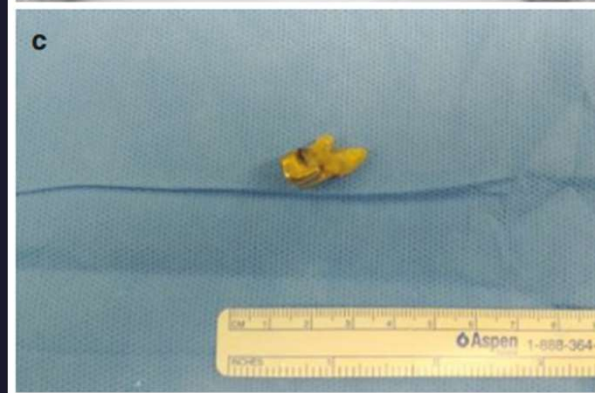
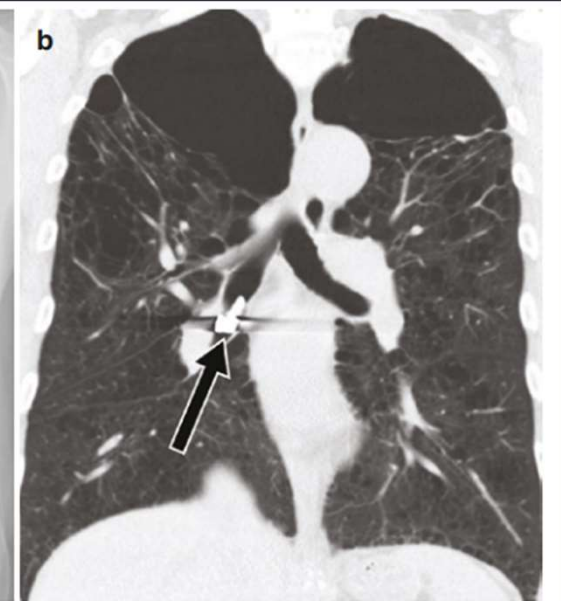
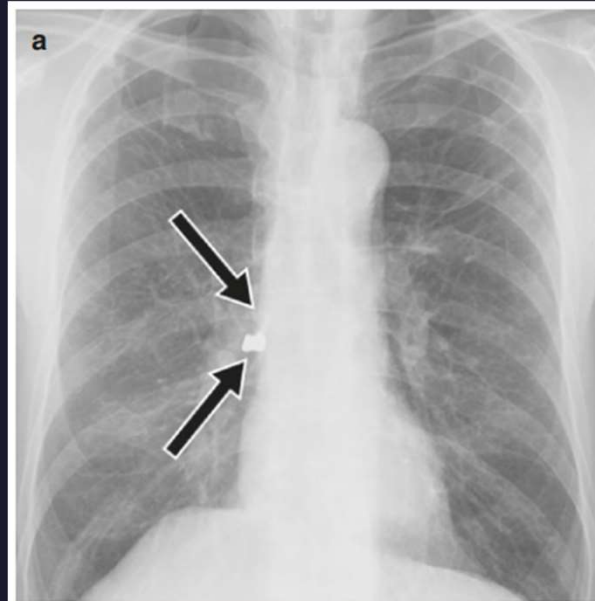


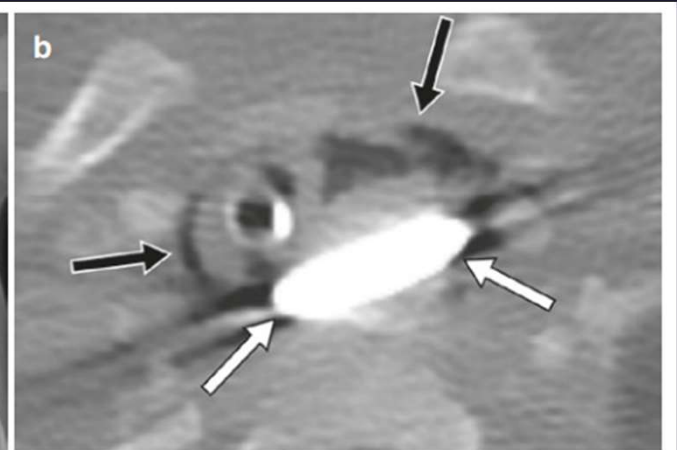
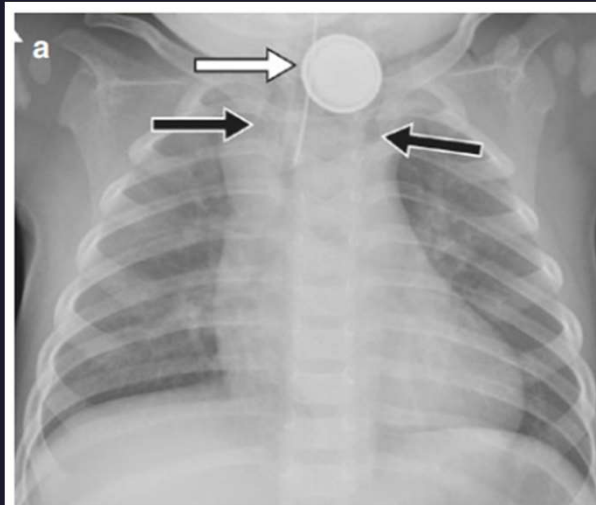






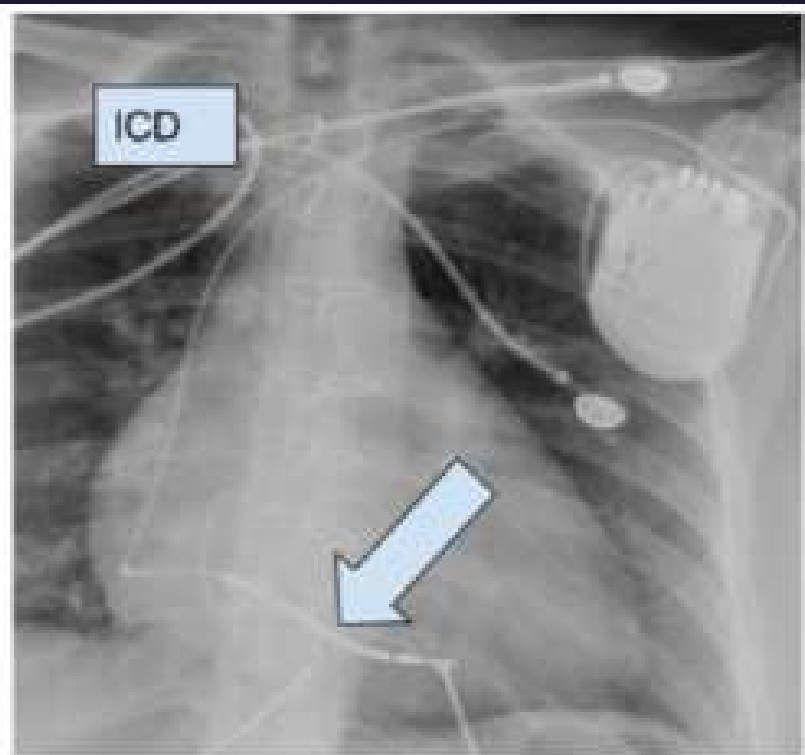




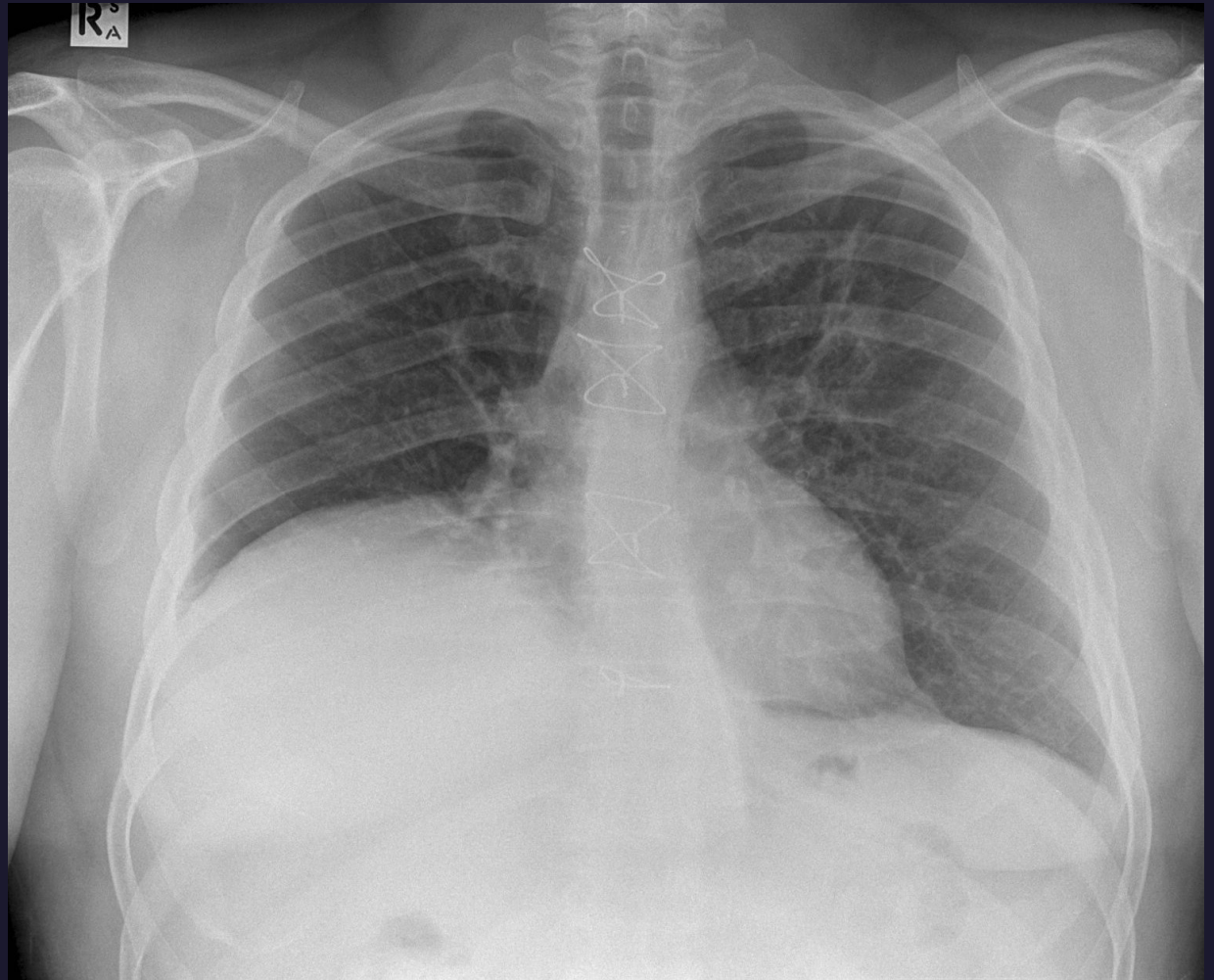




A



B



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[Radiation Dose from X-Ray and CT Exams \(radiologyinfo.org\)](https://radiologyinfo.org)

[Radiation Protection Guidance For Hospital Staff – Stanford Environmental Health & Safety](#)

[Radiation Safety | American College of Radiology \(acr.org\)](https://www.acr.org/quality-safety/radiation-safety)