

Anesthesia Radiology

for 3rd Year Medical Students

Daniel Cook, MD

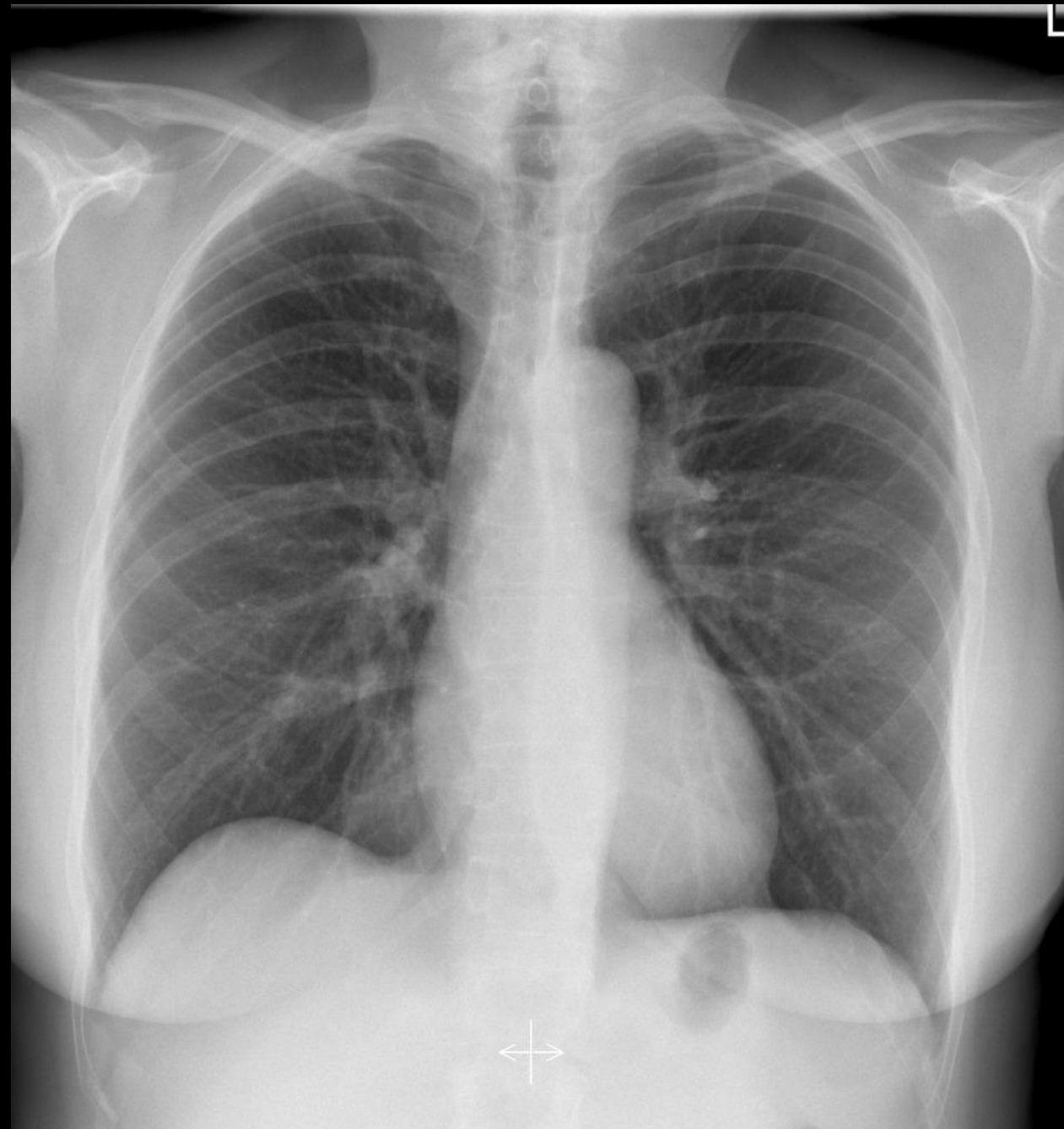
Evan Tyler, MD

Objectives

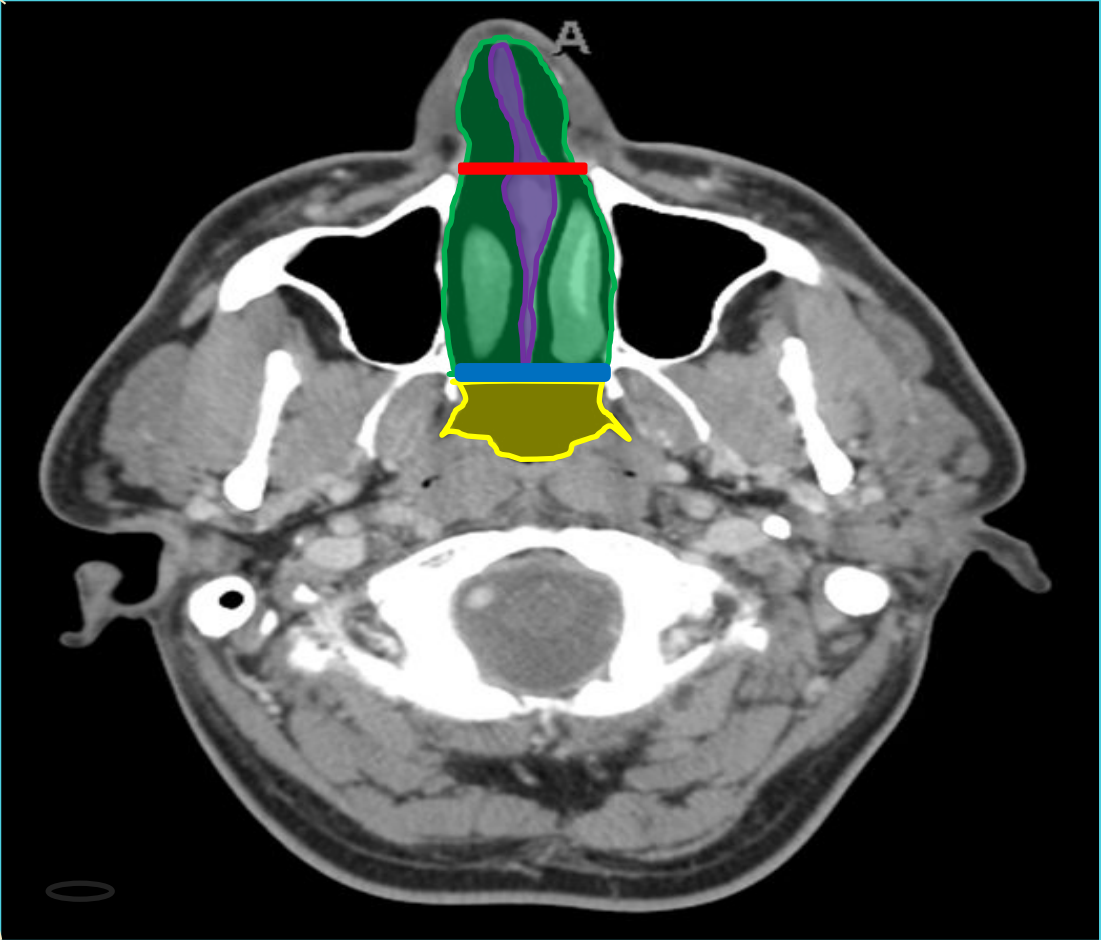
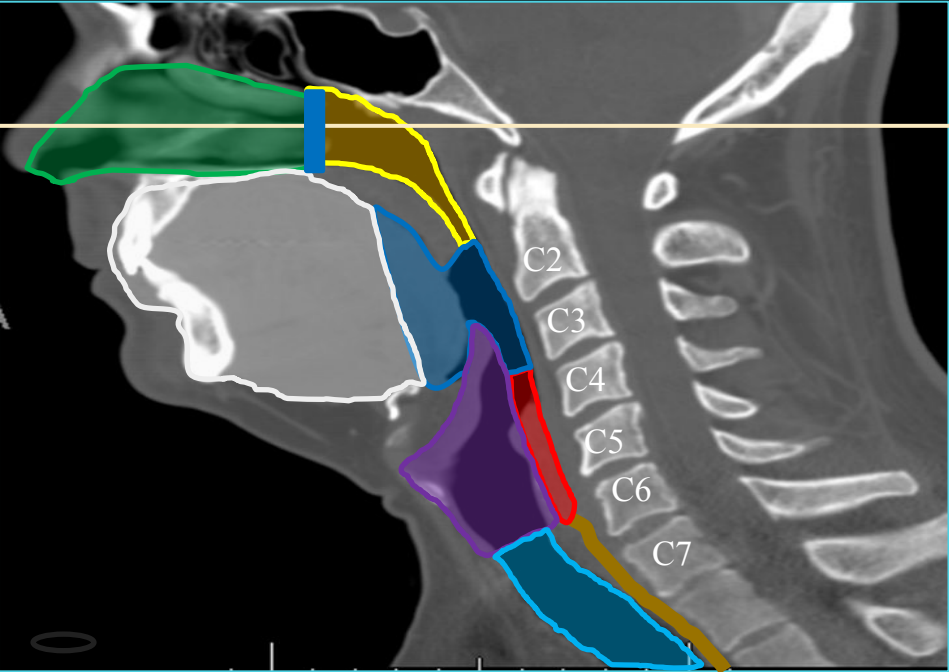
- Review chest radiograph search patterns
- Become familiar with relevant anatomy of the airway within the head, neck, and chest
- Review different types of airway support devices and their appropriate positioning on imaging
- Identify complications related to placement of airway support devices
- Learn when different imaging studies or views may be useful

First Things First...

- How do I make sense of a chest x-ray?
 - There are several techniques
 - ABCDEFGHI
 - 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
 - out to in
 - supportive devices, abdomen, borders, mediastinum, lungs, airway



Head and Neck Airway Anatomy



Hypopharynx

Trachea

Oral cavity

Oropharynx

Larynx

Esophagus

Nasal cavity

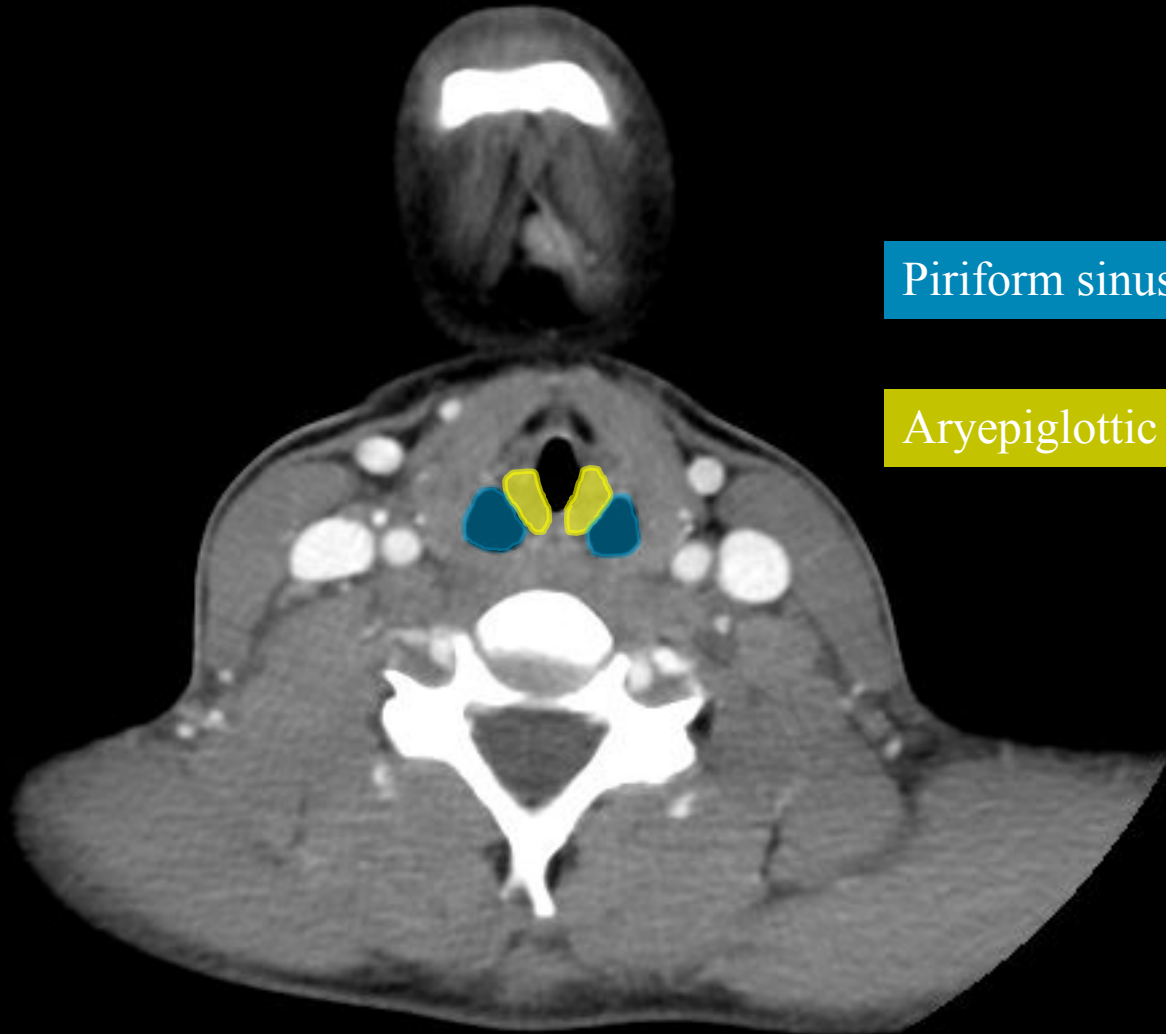
Pyriform aperture

Nasal choanae

Nasal septum

Nasopharynx

Hypopharynx-Piriform Sinus

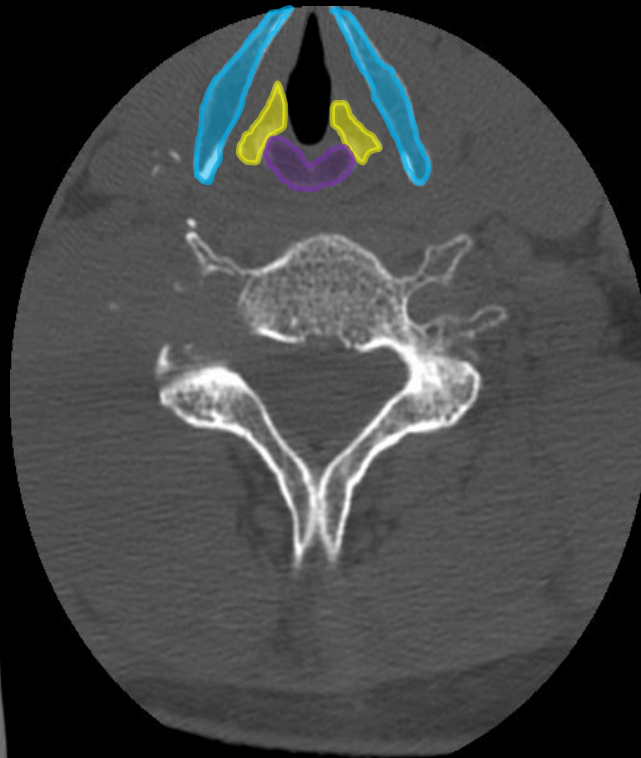
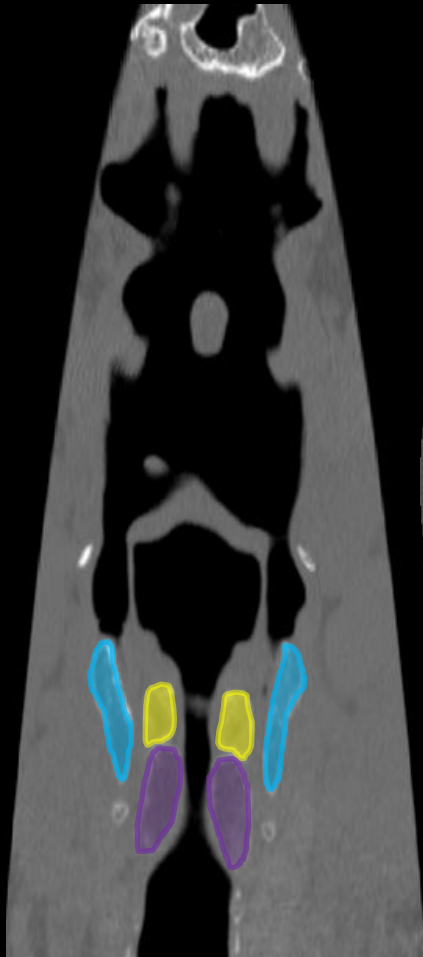


Piriform sinus

Aryepiglottic fold



Larynx

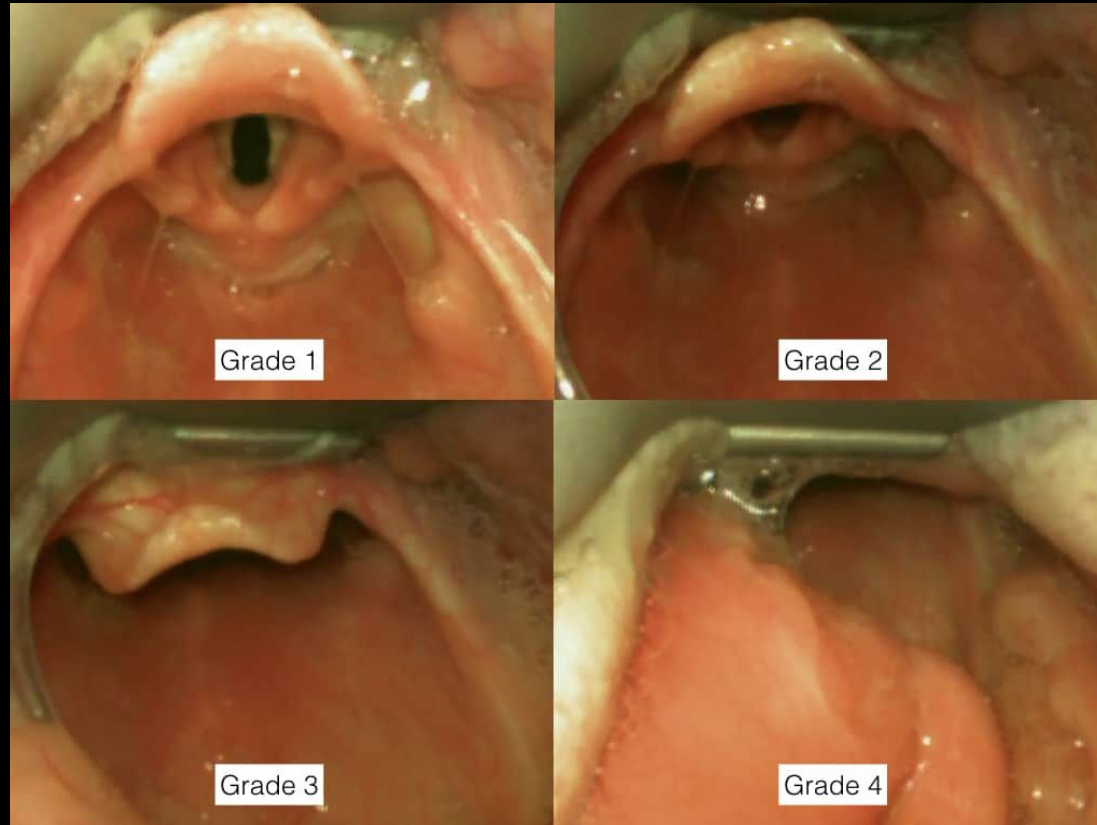
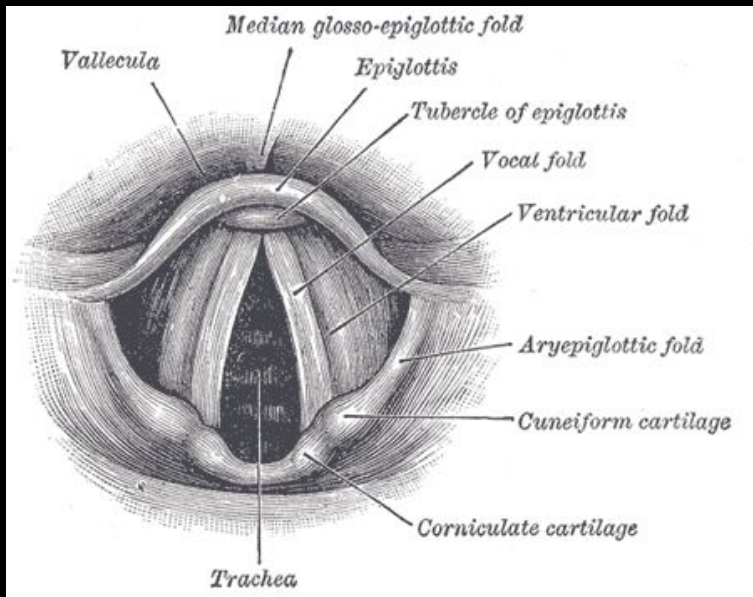


Thyroid
cartilage

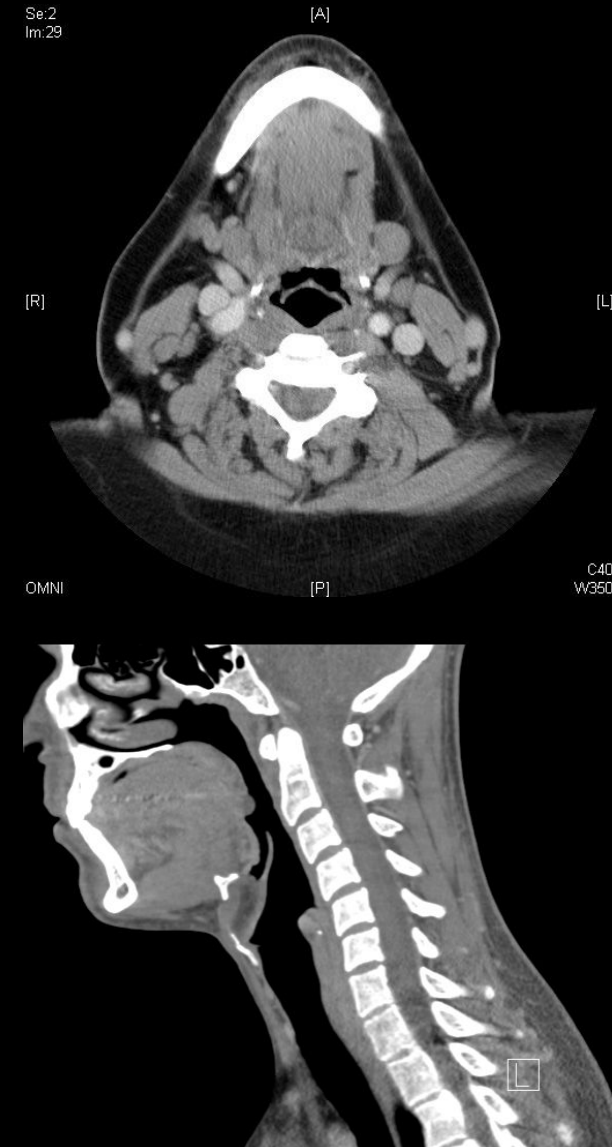
Arytenoid
cartilage

Cricoid
cartilage

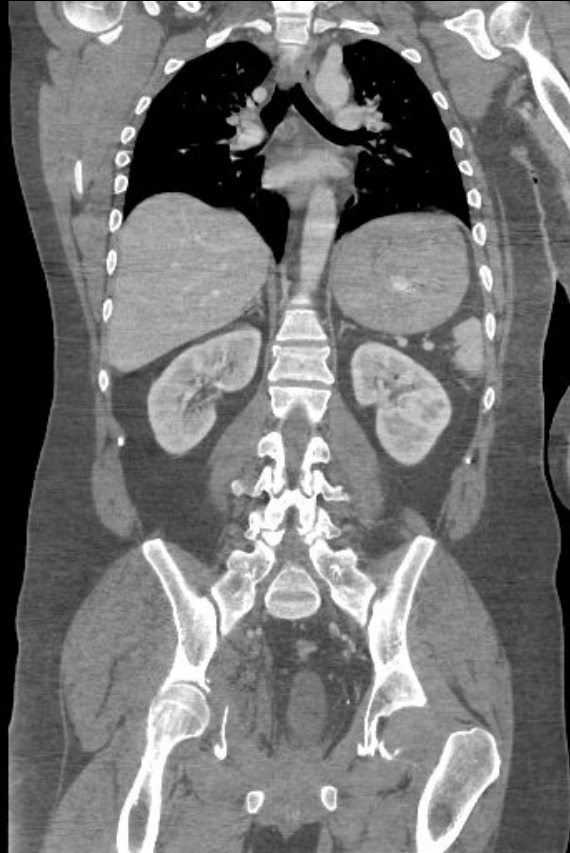
“Intubation View” of the Larynx



Cormack-Lehane classification of laryngeal view during direct laryngoscopy



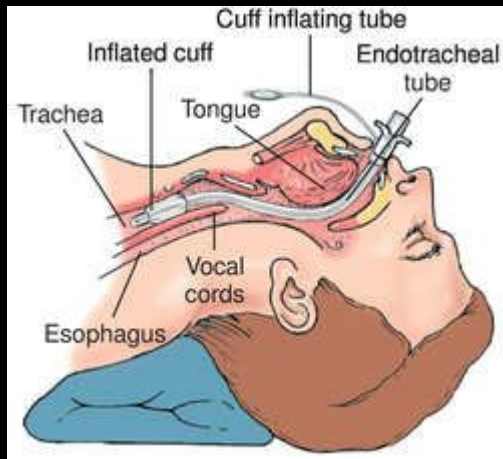
Airway Anatomy of the Chest



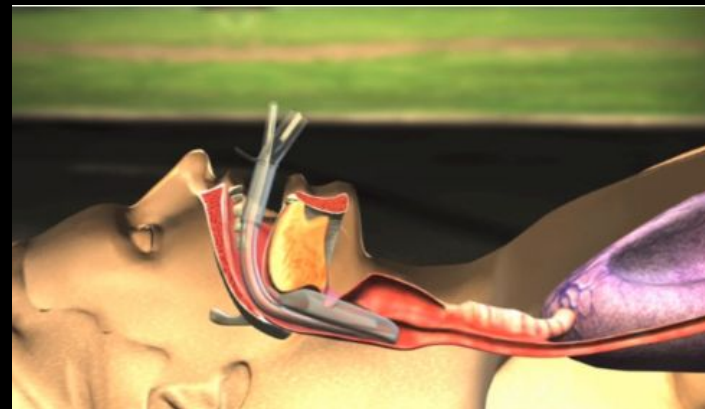
CT showing the carina
and bronchi

Airway Support Devices

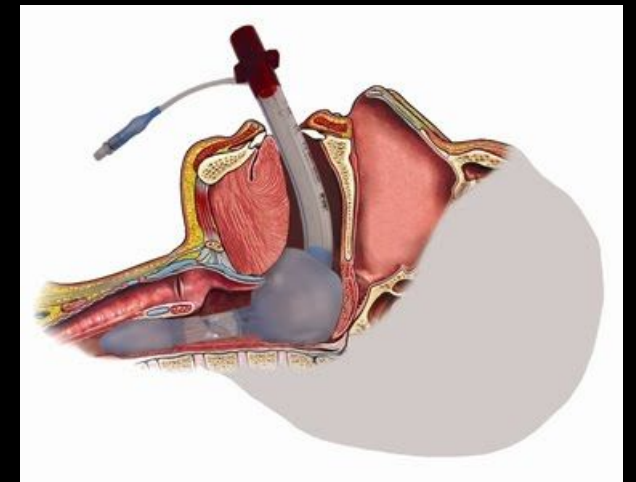
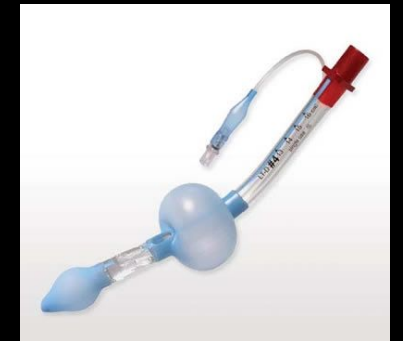
1. Endotracheal (ET) tube



2. Laryngeal mask airway (LMA)



3. King airway



What is the normal position for an endotracheal tube?

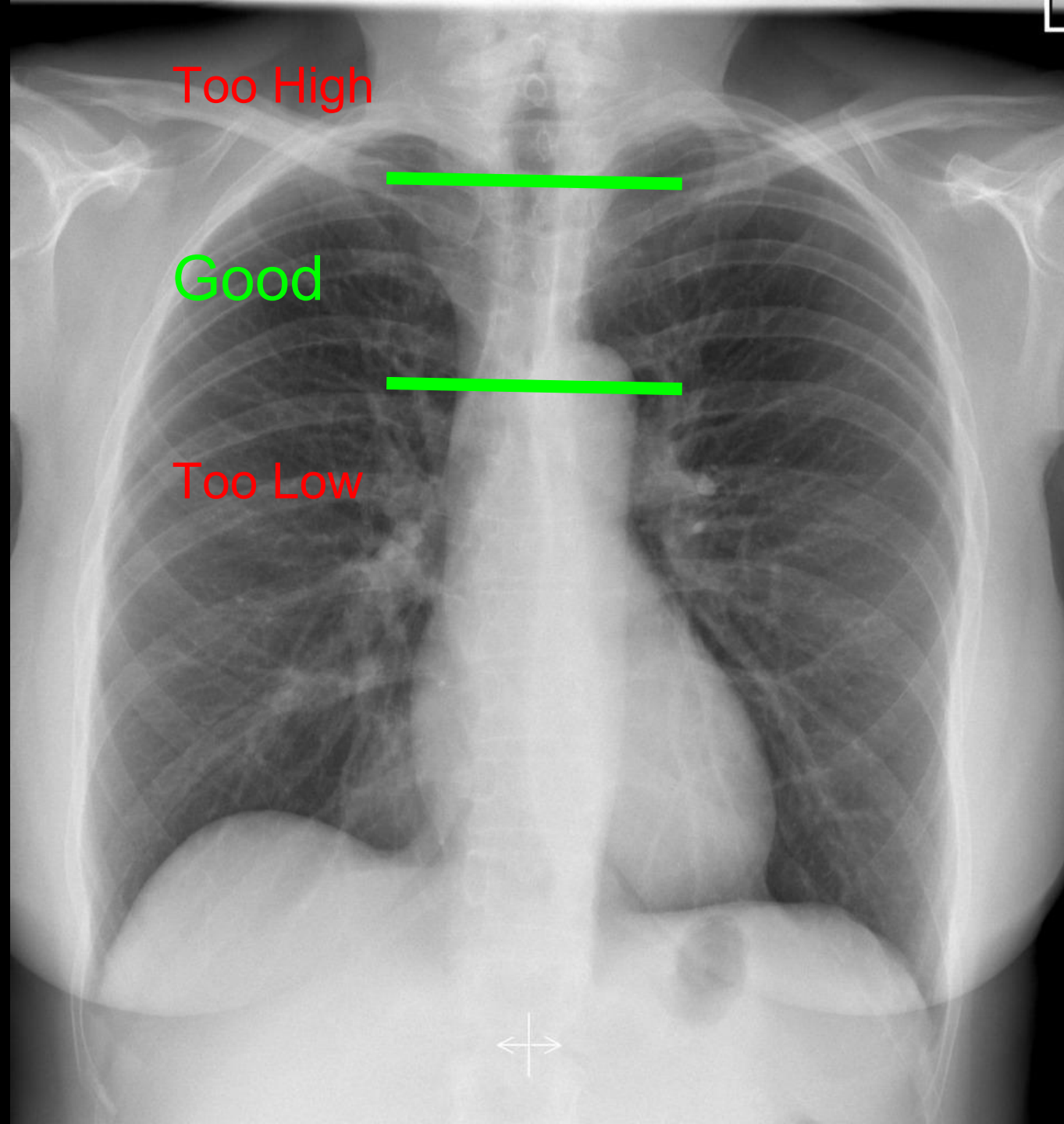
It depends...

- is the neck flexed, neutral, or extended?
- cm above carina...for adults
 - Flexed: 3 cm +/- 2
 - Neutral 5 cm +/- 2
 - Extended 7 cm +/- 2
- pediatric necks are shorter
 - 1-2 cm above carina is a good general rule

Where is the carina?

- should be near the sternal angle or overlie a level between T5-T7
- if you can't see the carina, you are probably safe if the ETT ends in the upper trachea near the clavicular heads (thoracic inlet)

Simplified, practical guide for ET tube placement



Endotracheal (ET) tube



CT showing the carina in an unintubated patient

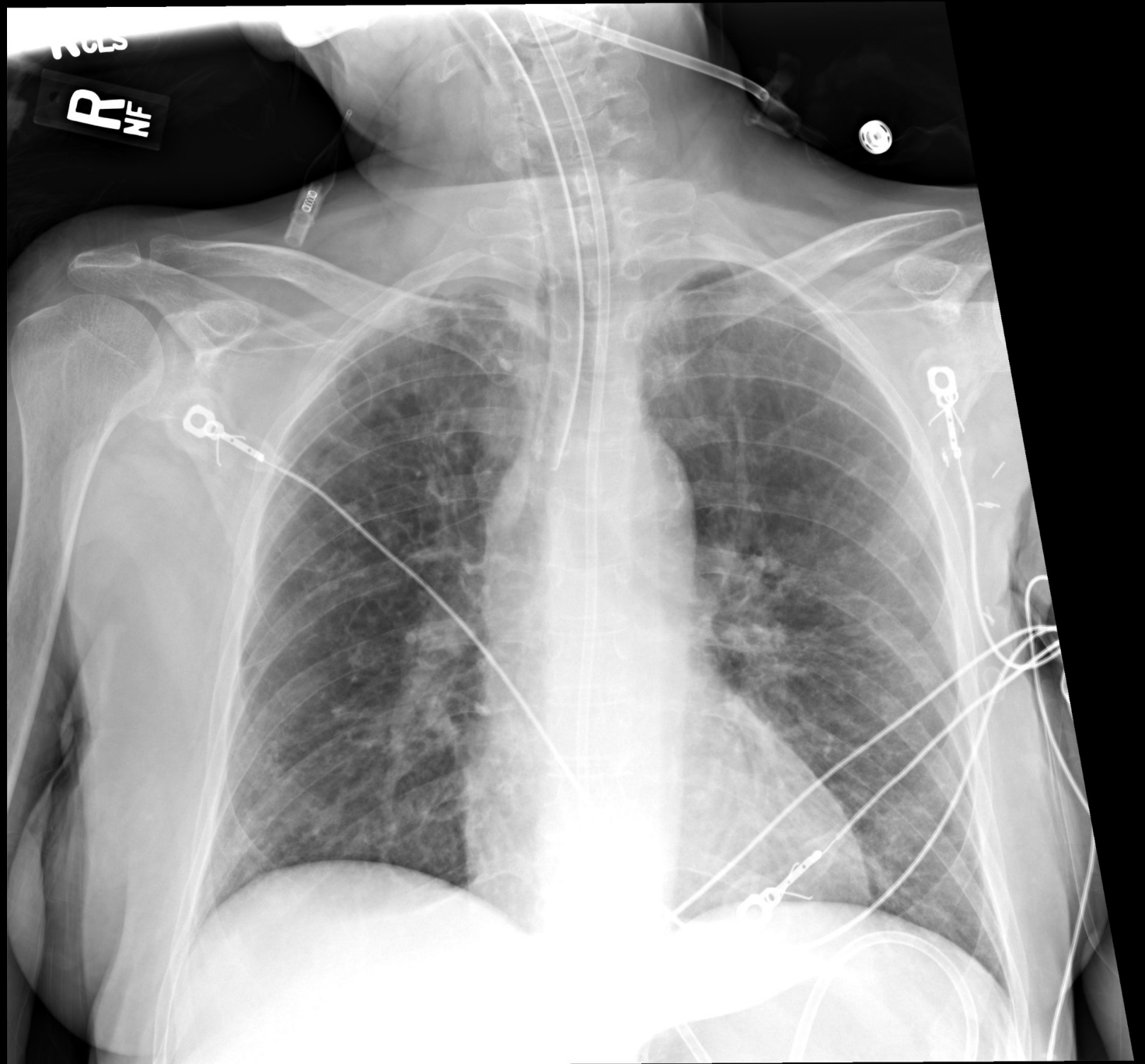


CT showing the tip of an endotracheal (ET) tube above the carina

Example Case

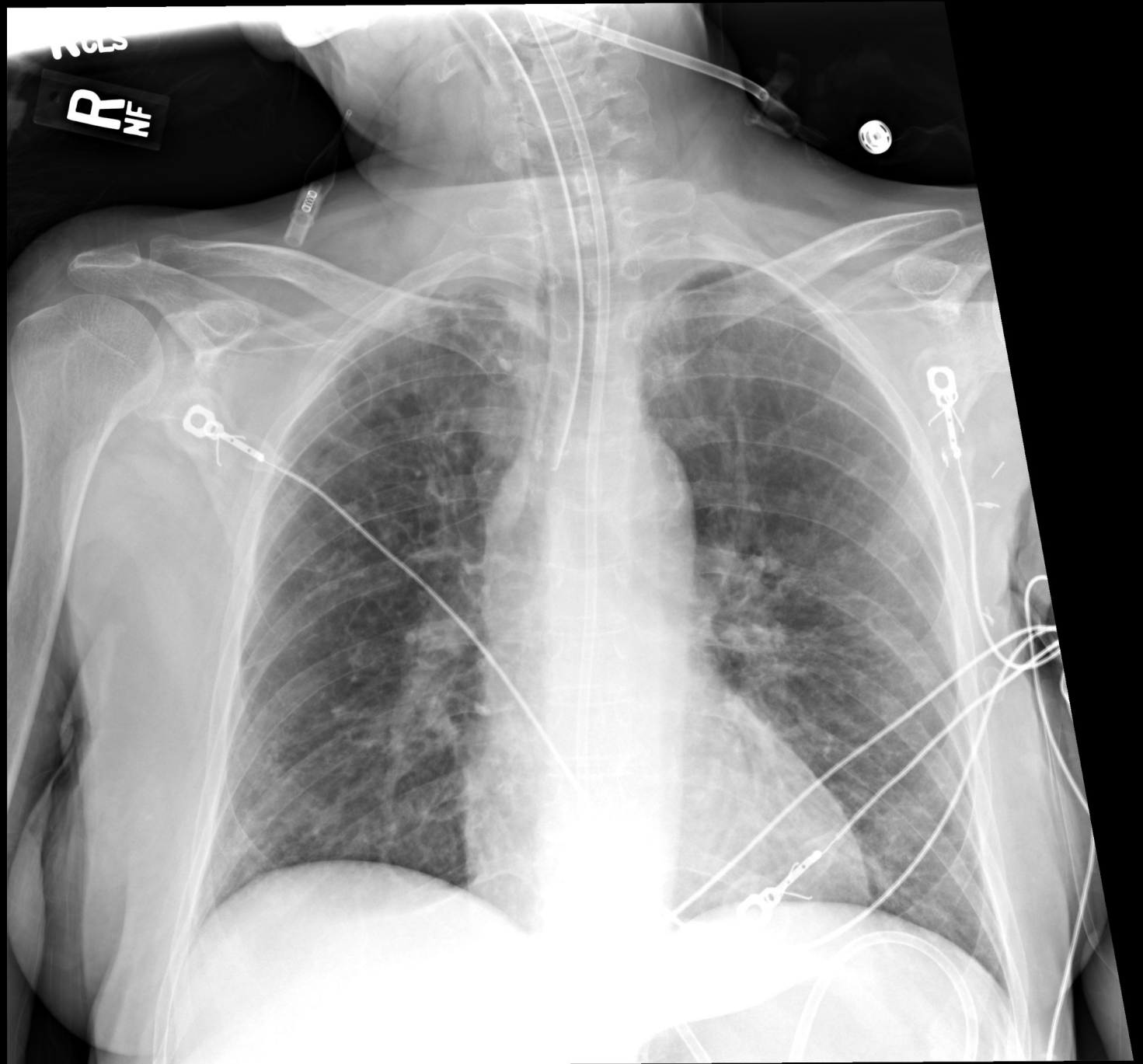
64 yo F

Indication: ET tube placement; inhalation injury



Impression:

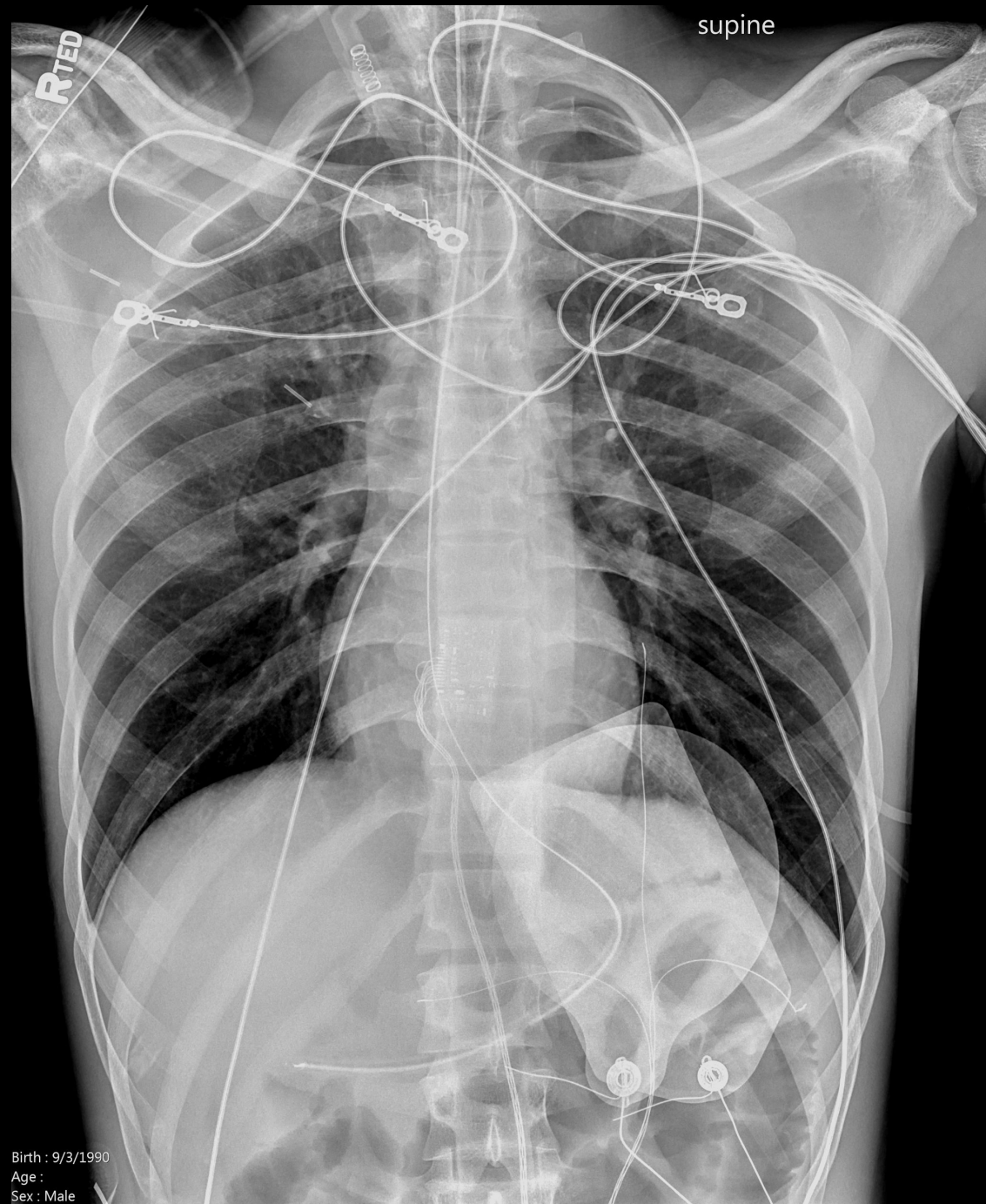
1. ET tube approximately 1.5 cm above the carina [too low]. Recommend retracting by 1-2cm.
2. Prominent interstitial markings likely from chronic changes related to emphysema.



Example Case

27yo M

Indication: s/p intubation;
altered mental status,
unspecified altered mental
status type



Birth : 9/3/1990
Age :
Sex : Male

AP: 0 BEST AP PORTABLE, 5/20/2014 4:13 PM
INDICATION: s/p intubation 04152 Altered mental status, unspecified altered mental status type
COMPARISON: none
FINDINGS:
Supportive devices: A gastric tube traverses anticipated esophageal course. An endotracheal tube is in place.
Cardiorespiratory/vascular: The cardiac mediastinal silhouette is unremarkable. Both lungs are well expanded and aerated. No pleural effusion.
Other: No evidence of pneumothorax.
CONCLUSION:
The tip of endotracheal tube is now clearly seen, however, it appears to be at the level of the clavicles, and it is free from being projecting over the mid trachea.

Impression:

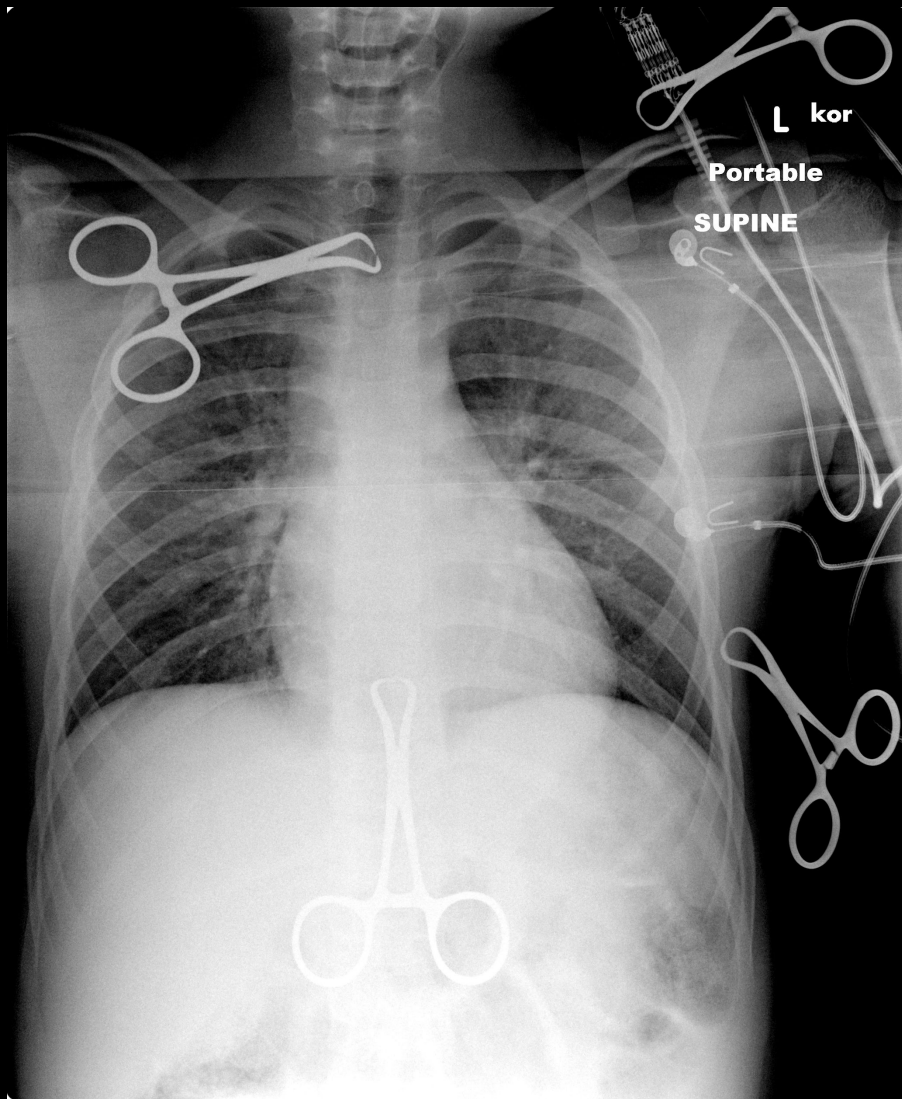
Tip of ET tube not clearly seen but likely at the level of the clavicles

Learning Points:

Sometimes the tip of the ET tube is not clearly visible

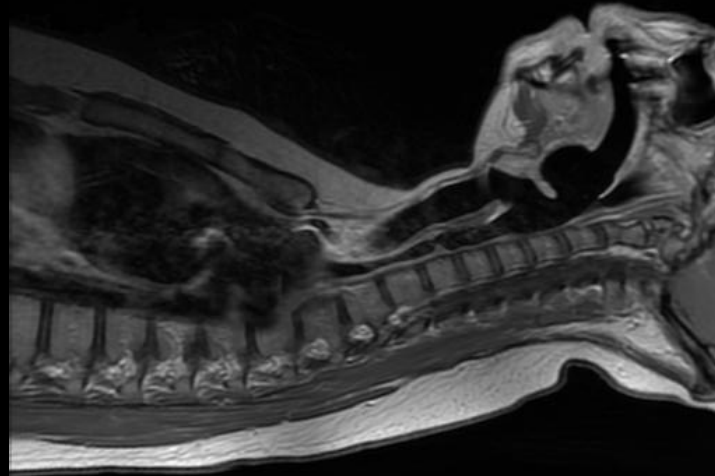


Laryngeal mask airway device

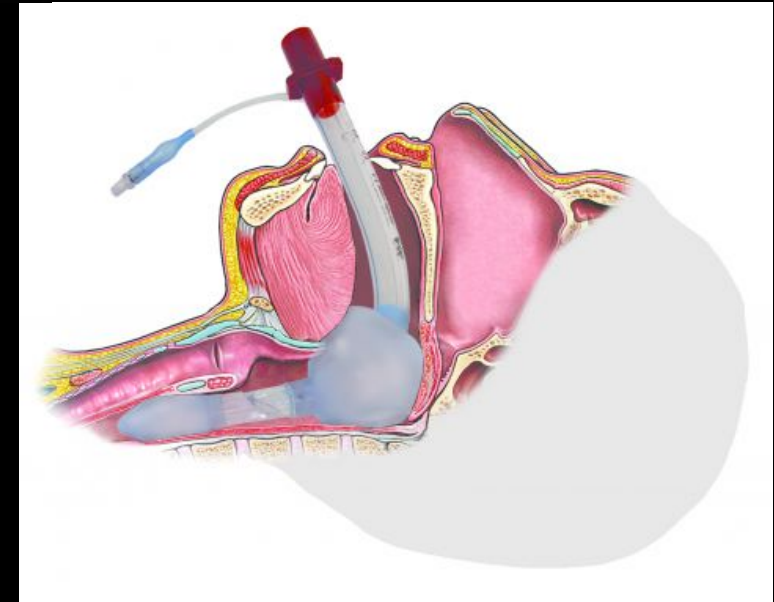


King airway- positioning

- through the mouth and into the hypopharynx/upper esophagus
- proximal balloon occludes oropharynx (oropharyngeal cuff)
- distal balloon occludes hypopharynx (esophageal cuff)
- openings between feed air into only escape path...the larynx



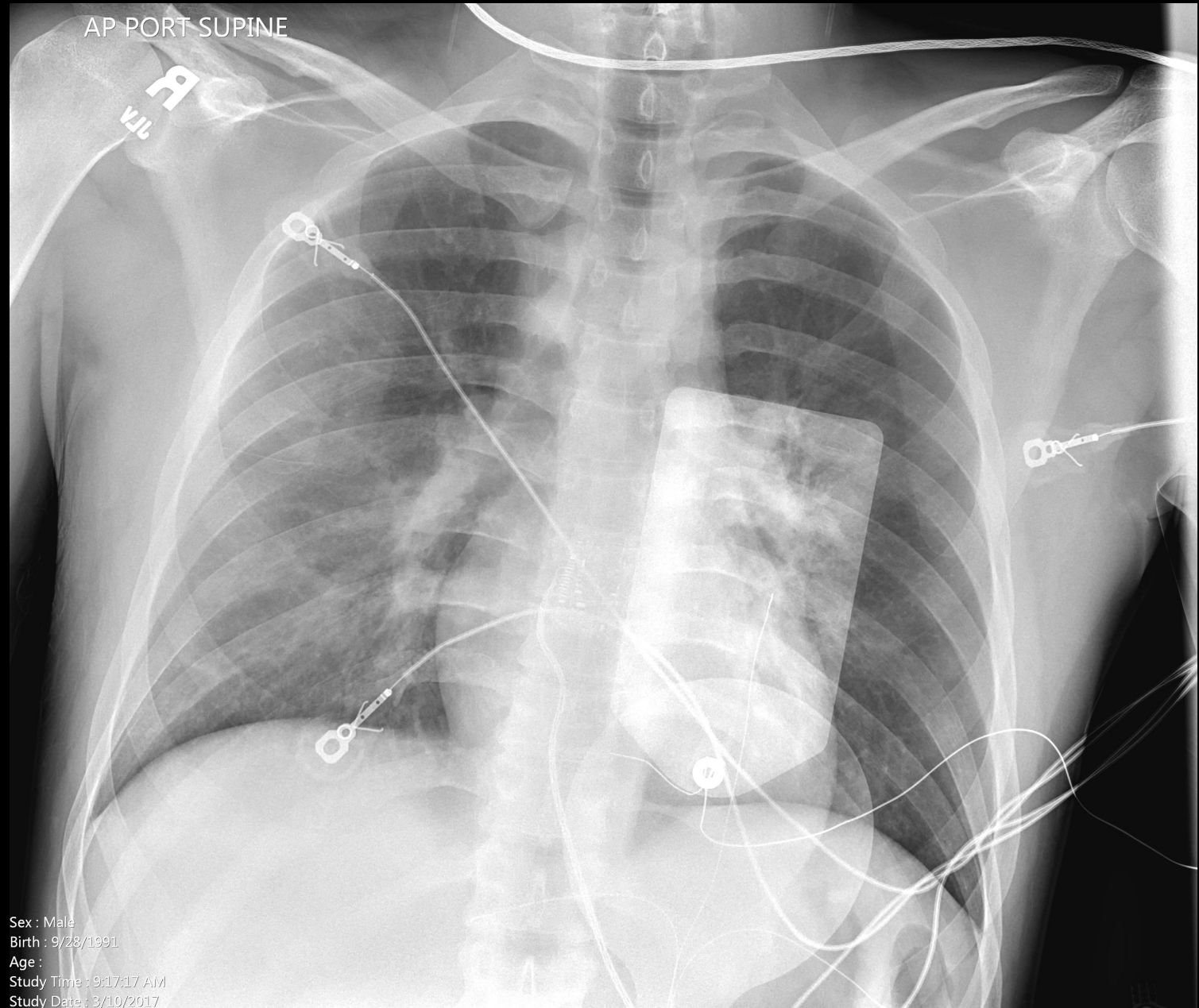
Courtesy of Dr. Thomas West



Example Case

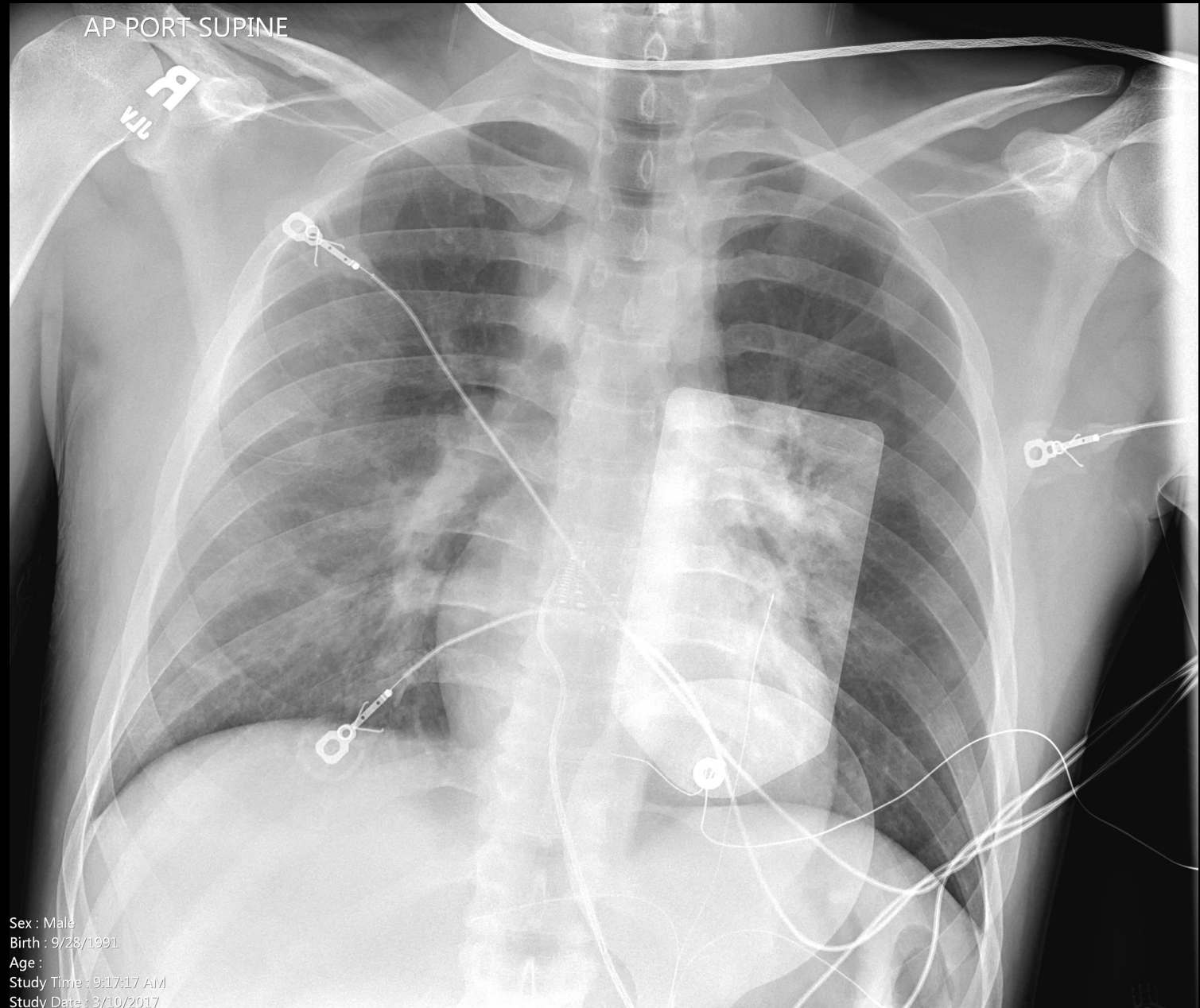
25yo M

Indication: King
airway in place, post
arrest, cardiac
arrest



Impression:

1. King airway present
2. Mild peribronchial cuffing without frank edema.
3. Low lung volumes with perihilar atelectasis.



Malpositioned King airway



Gastric
distention and
low lung
volumes are
clues



Cricothyroidotomy



Complications of airway support devices

- malpositioning
 - esophageal intubation
 - right bronchus intubation
 - too high or too low within the trachea
- kink in the airway tubing
- cuff leak (not discernable on imaging)
- pneumothorax

Ordering radiological studies

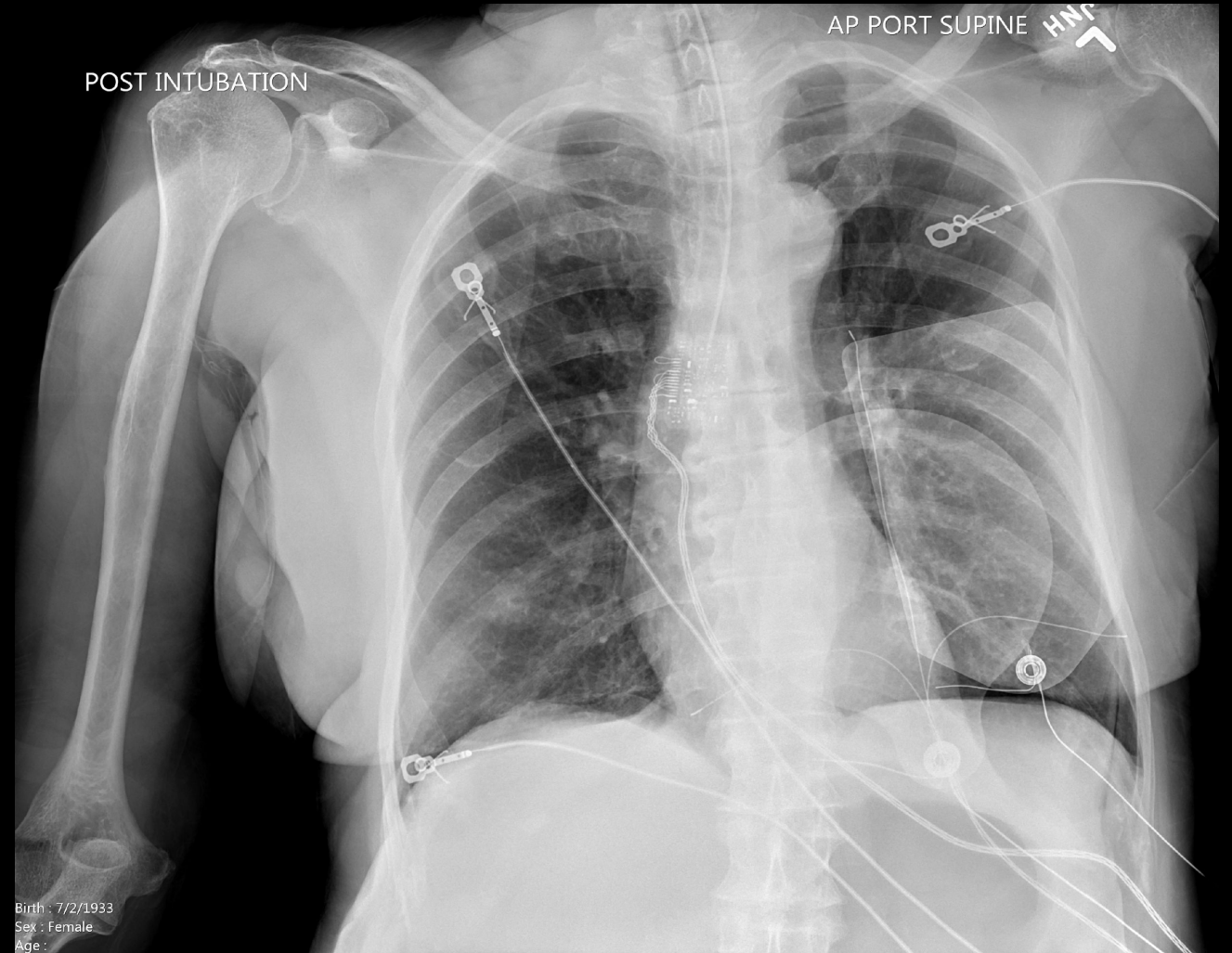
Most appropriate imaging studies for the following clinical indications:

- pneumothorax:
 - best initial: upright PA (and lateral) chest radiograph
 - most sensitive: chest CT without contrast
- ET tube placement:
 - AP chest radiograph with head in neutral position. Lateral cannot easily be obtained.
- pleural effusion:
 - best initial: upright PA and lateral chest radiographs
 - most sensitive: chest CT without contrast

Example Case

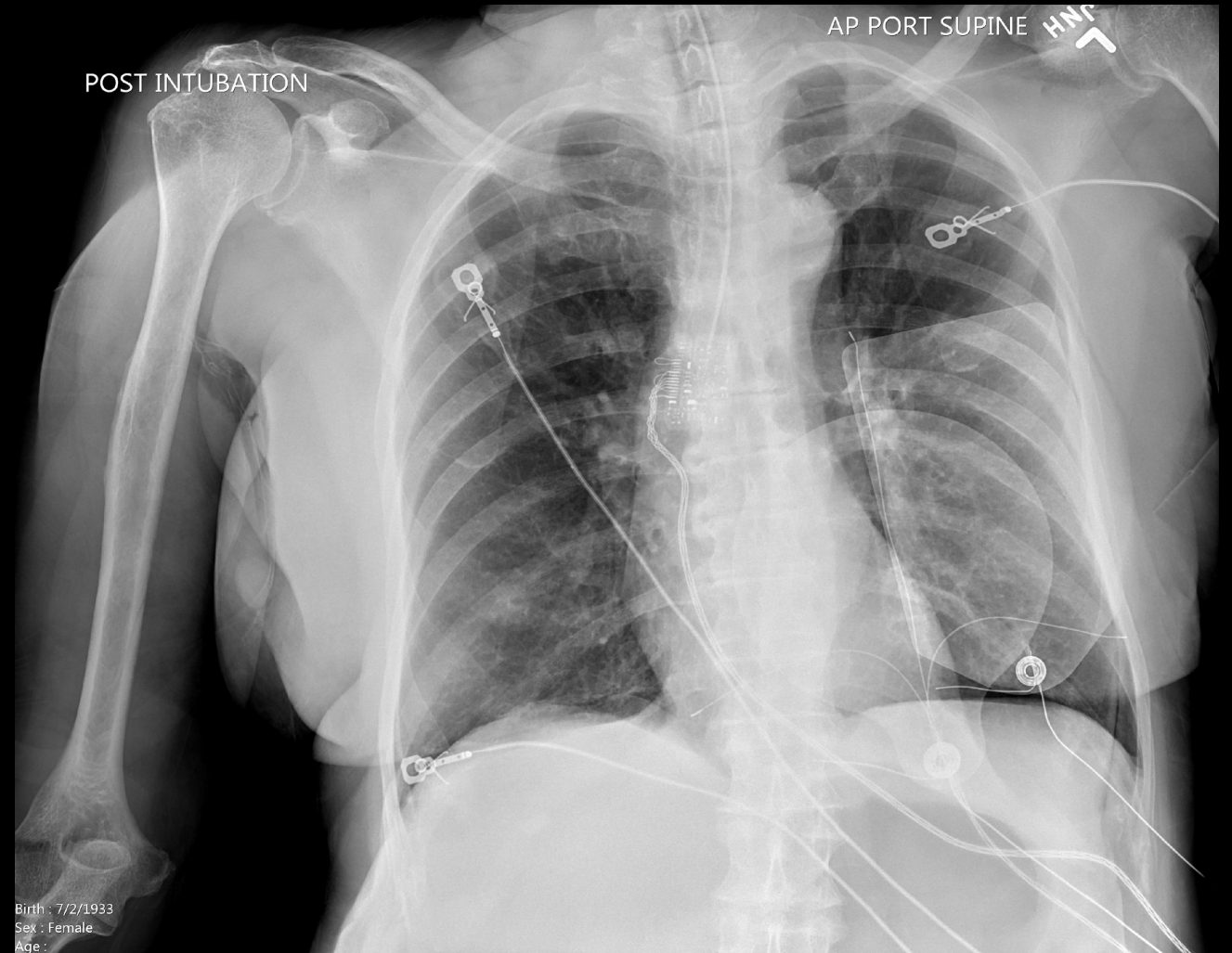
84 yo F

Indication: post
intubation,
Unresponsive



Impression:

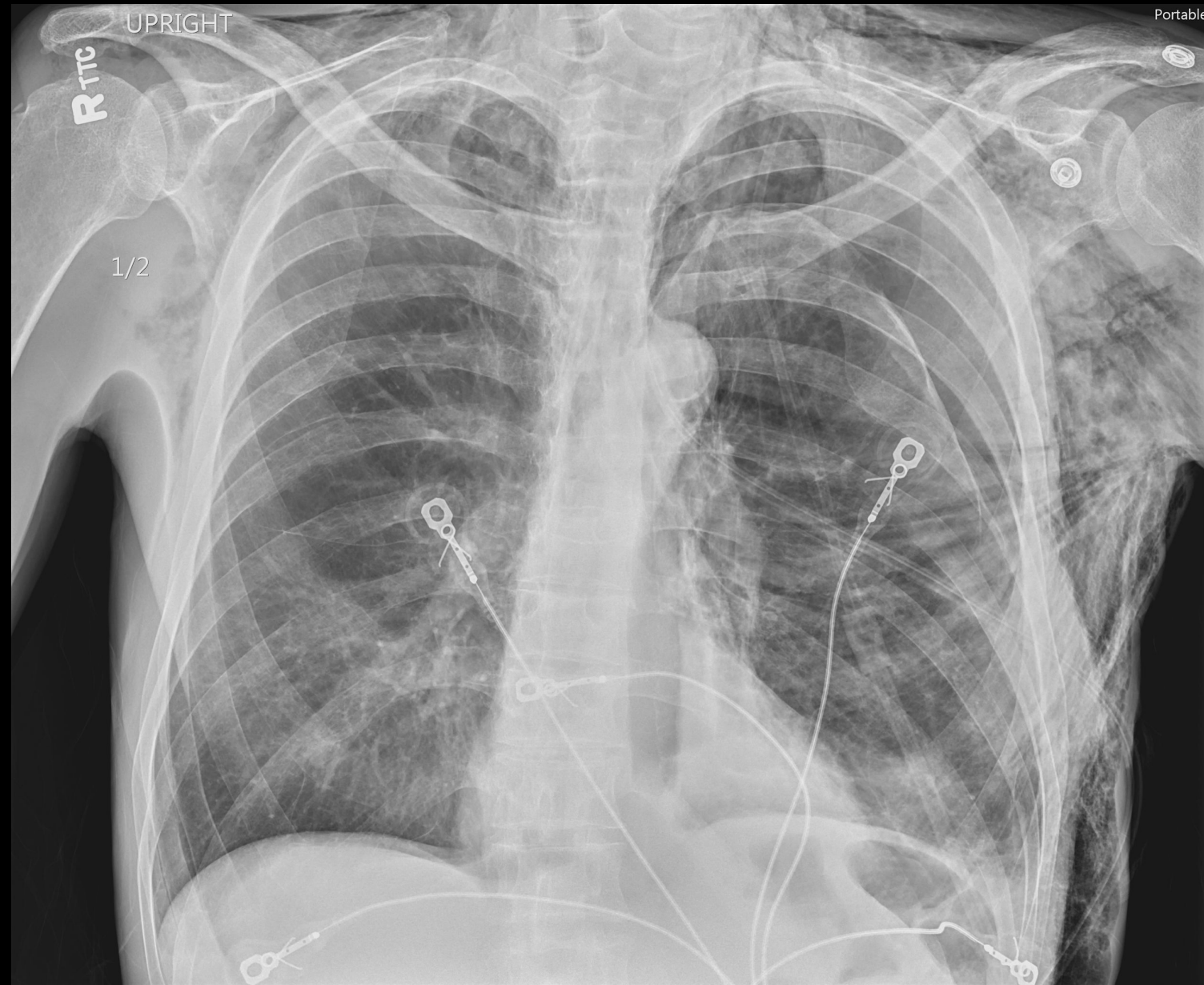
1. Right mainstem bronchus intubation, recommend withdrawal of the tube at least 4-5 cm.
2. Otherwise no acute cardiopulmonary process.
3. Small nodular opacity in the right middle lobe may represent overlapping shadows from a rib on end. PA and lateral chest x-ray is recommended for further evaluation to exclude underlying pulmonary nodule.



Example Case

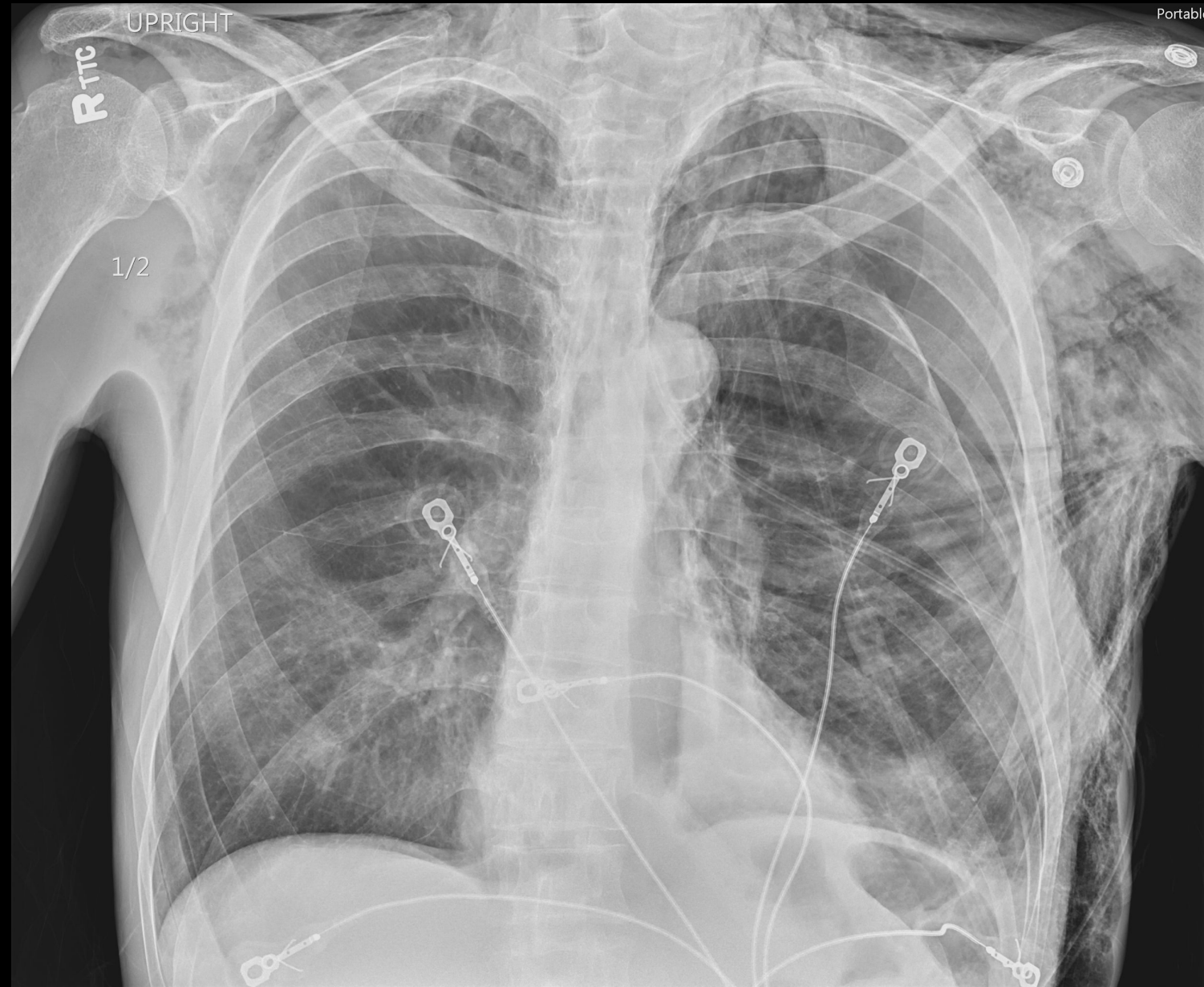
59 yo M

Indication: subQ
emphysema,
shortness of
breath, acute
respiratory failure



Impression:

1. Moderate left apical pneumothorax.
2. Left apical thoracostomy tube present along the posterior medial left apex.
3. Extensive left predominant subcutaneous emphysema.
3. Pneumomediastinum.
4. Bullous emphysematous changes.



Practice Cases

Practice Case

69 yo M

Hx: AMS, HTN

Indication:
tracheostomy tube
placed



Impression:

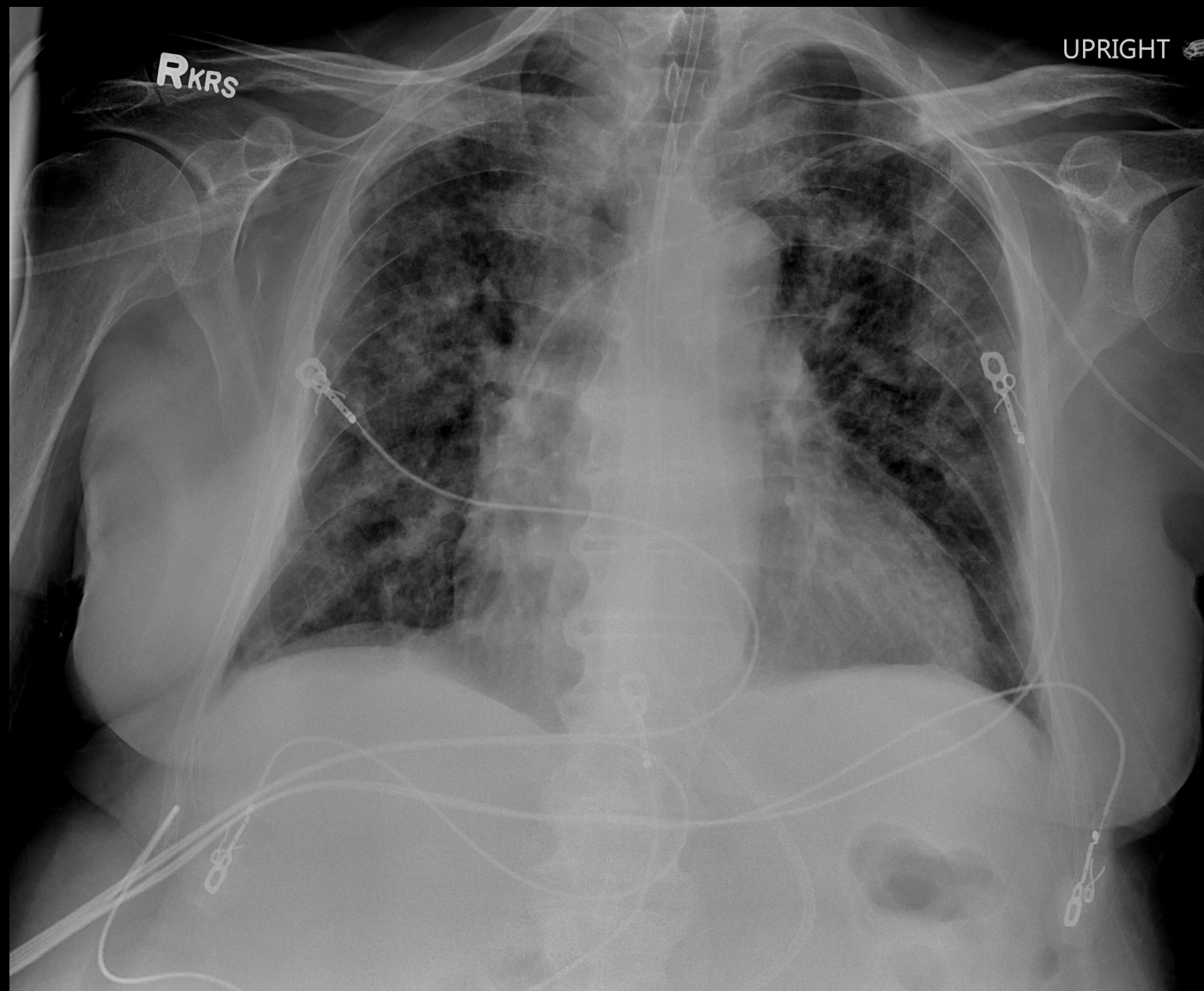
1. Low lung volumes with streaky bibasilar airspace opacities, which are favored to represent atelectasis.
2. Tracheostomy tube in appropriate position with distal tip projecting above the carina.



Practice Case

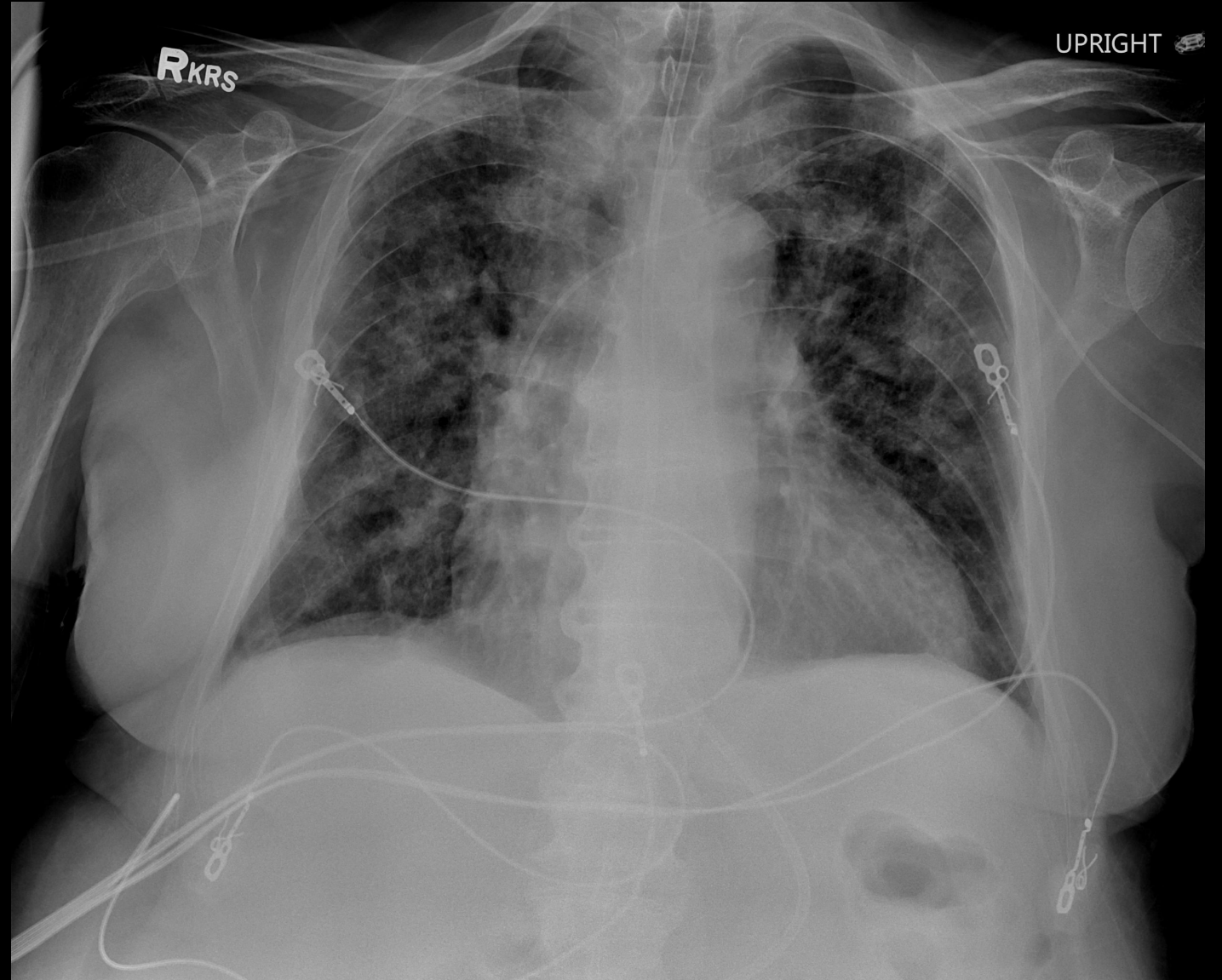
66yo F

Indication: fungal pneumonia



Impression:

1. Findings concerning for multifocal pneumonia, with atypical etiologies within the differential.
2. Left upper extremity PICC with tip projecting over the superior vena cava.

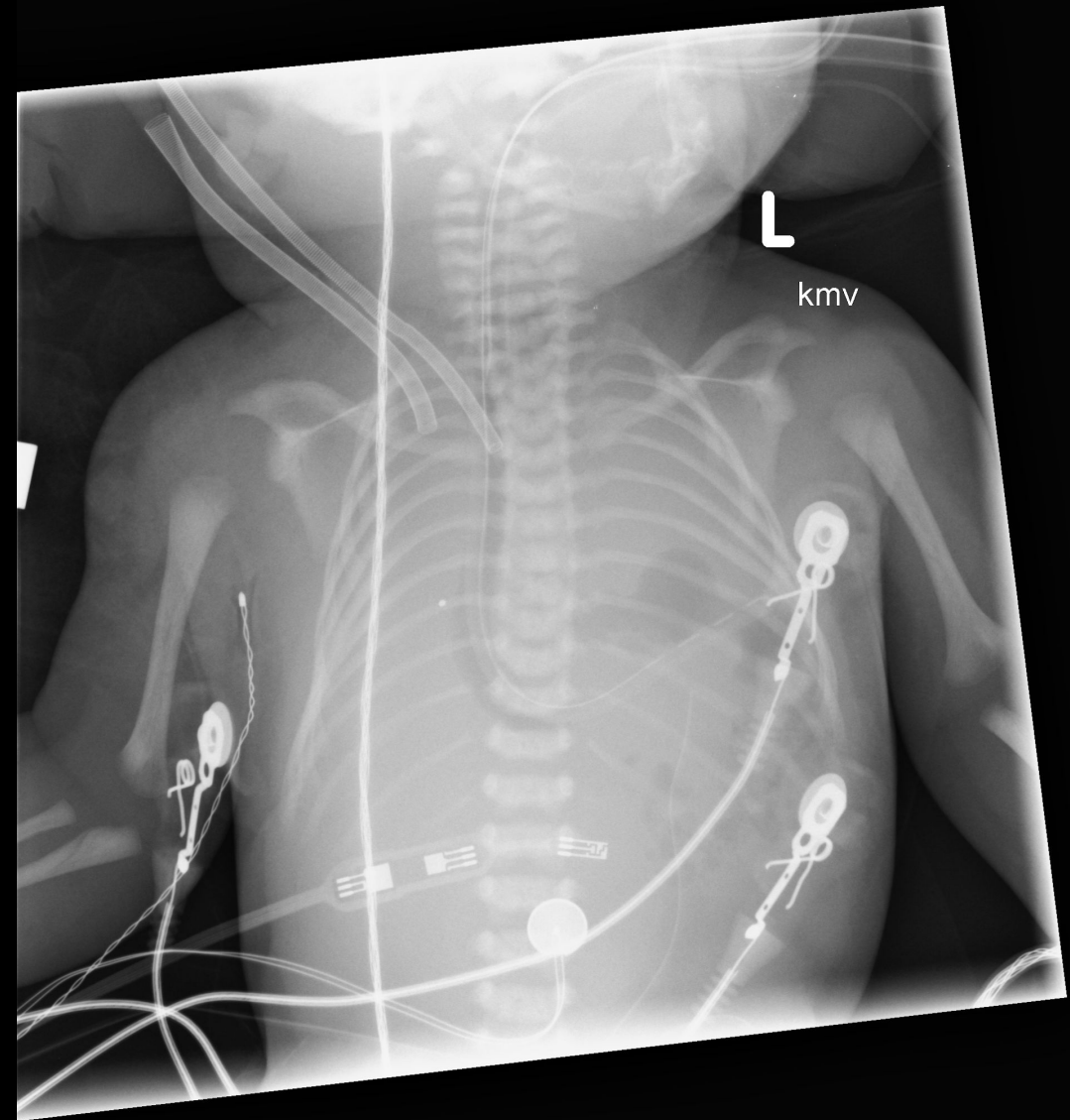


Practice Case

9D F

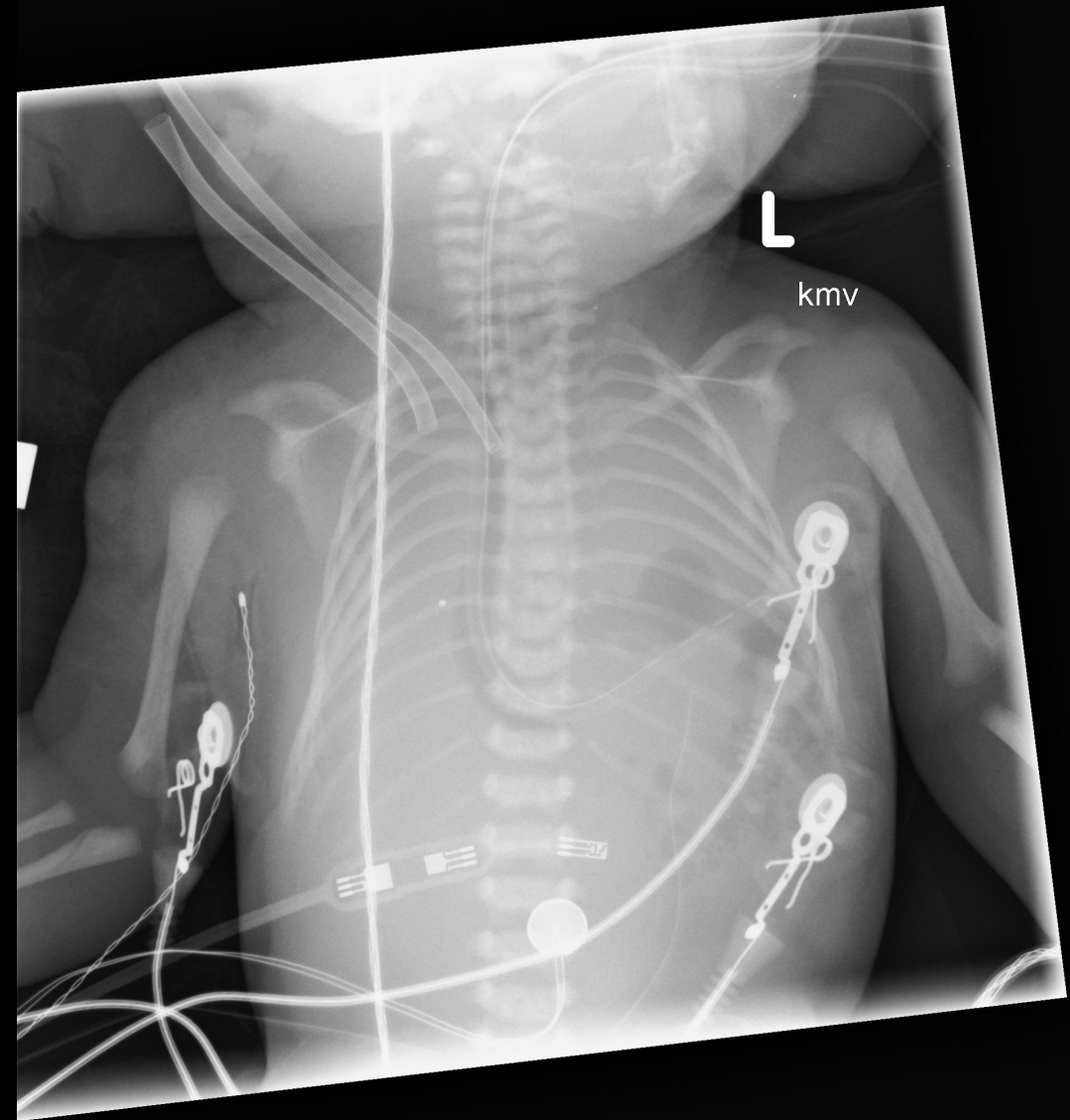
Hx: congenital
diaphragmatic
hernia

Indication: Check
ETT placement



Impression:

1. Similarly positioned ETT with distal tip projecting over the right pedicle line at the level of T2 and superimposed over the enteric tube. Gaseous distention of the stomach and esophagus are concerning for esophageal intubation. This tube is been repositioned on subsequent examination.
2. Similar position of ECMO catheters, gastric tube, and UVC (which still projects over the left hemithorax in an indeterminate location).
3. Similar near complete opacification of the thorax with obscured cardiomeastinal silhouette.
4. Stomach bubble and bowel gas overlie the left hemithorax, compatible with known congenital diaphragmatic hernia.
5. Diffuse body wall edema.



Practice Case
69 yo M

Indication: Trauma



Impression:

1. Kinked King airway
2. R clavicle fracture



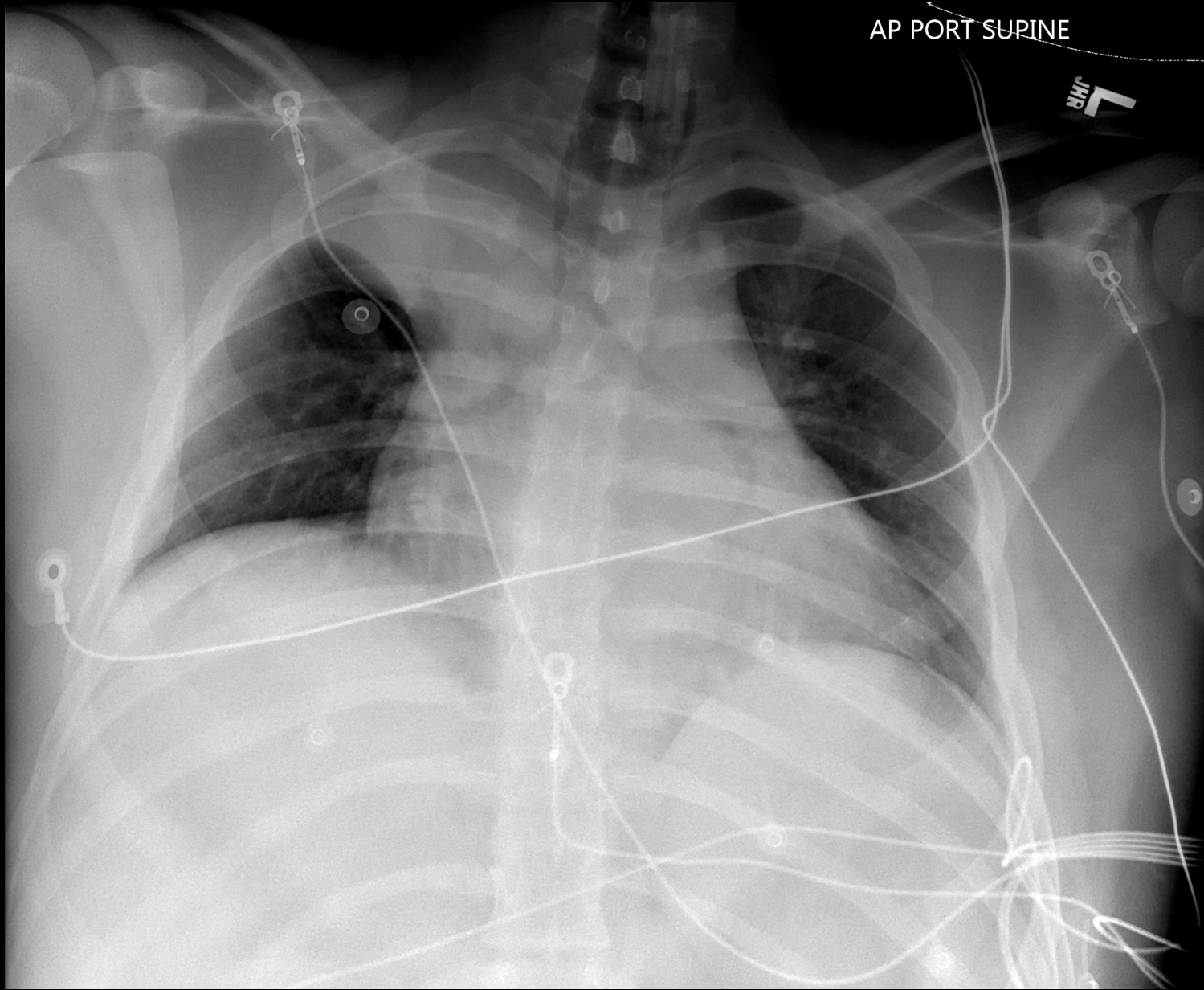
AP PORT SUPINE



Practice Case

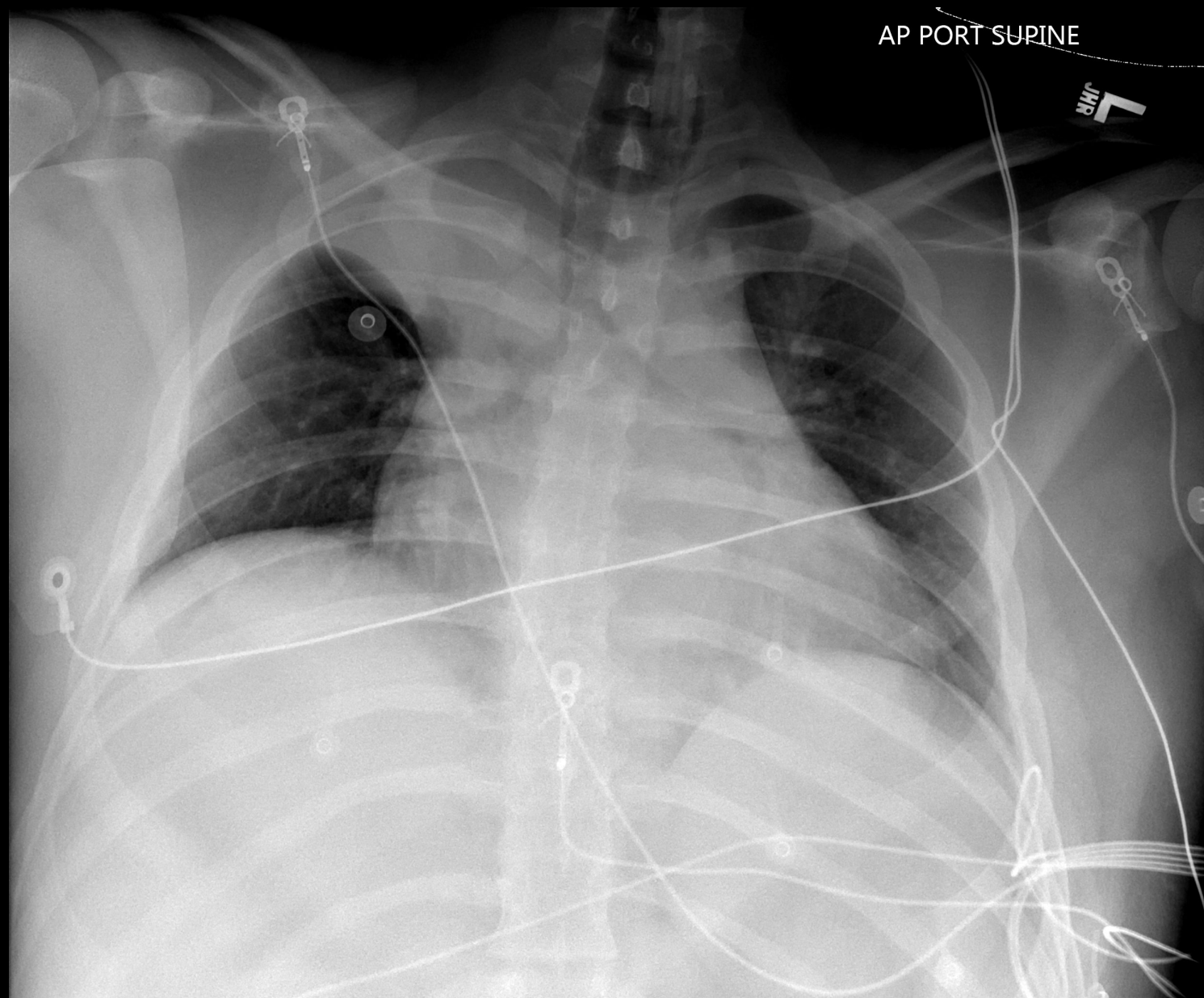
16 yo M

Indication: Multiple trauma



Impression:

Right upper lobe
collapse with king
airway in place.

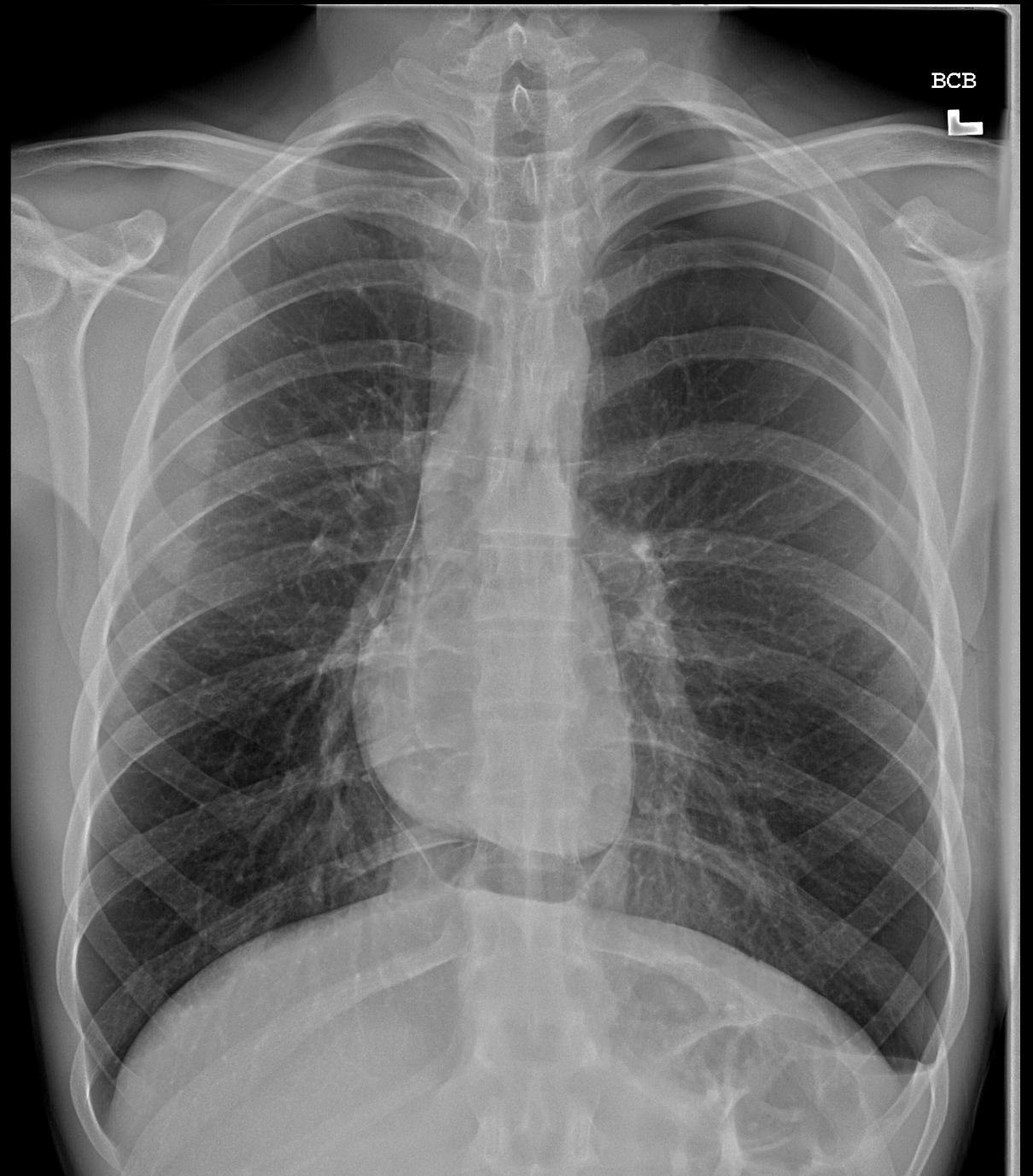


Practice Case

18 yo M

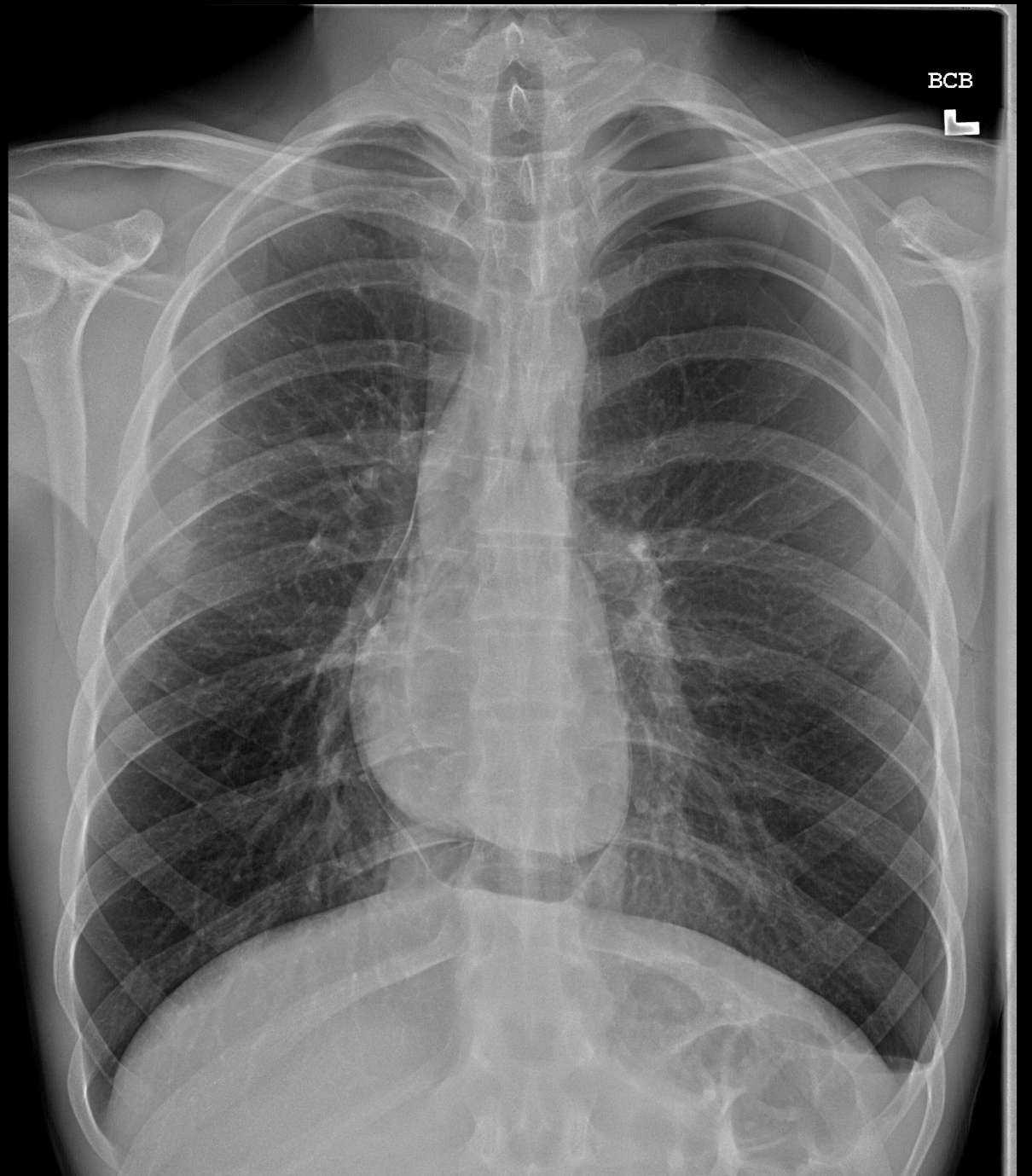
Indication: dyspnea

Hint: several findings, think intubated pts with high tidal volume setting



Impression:

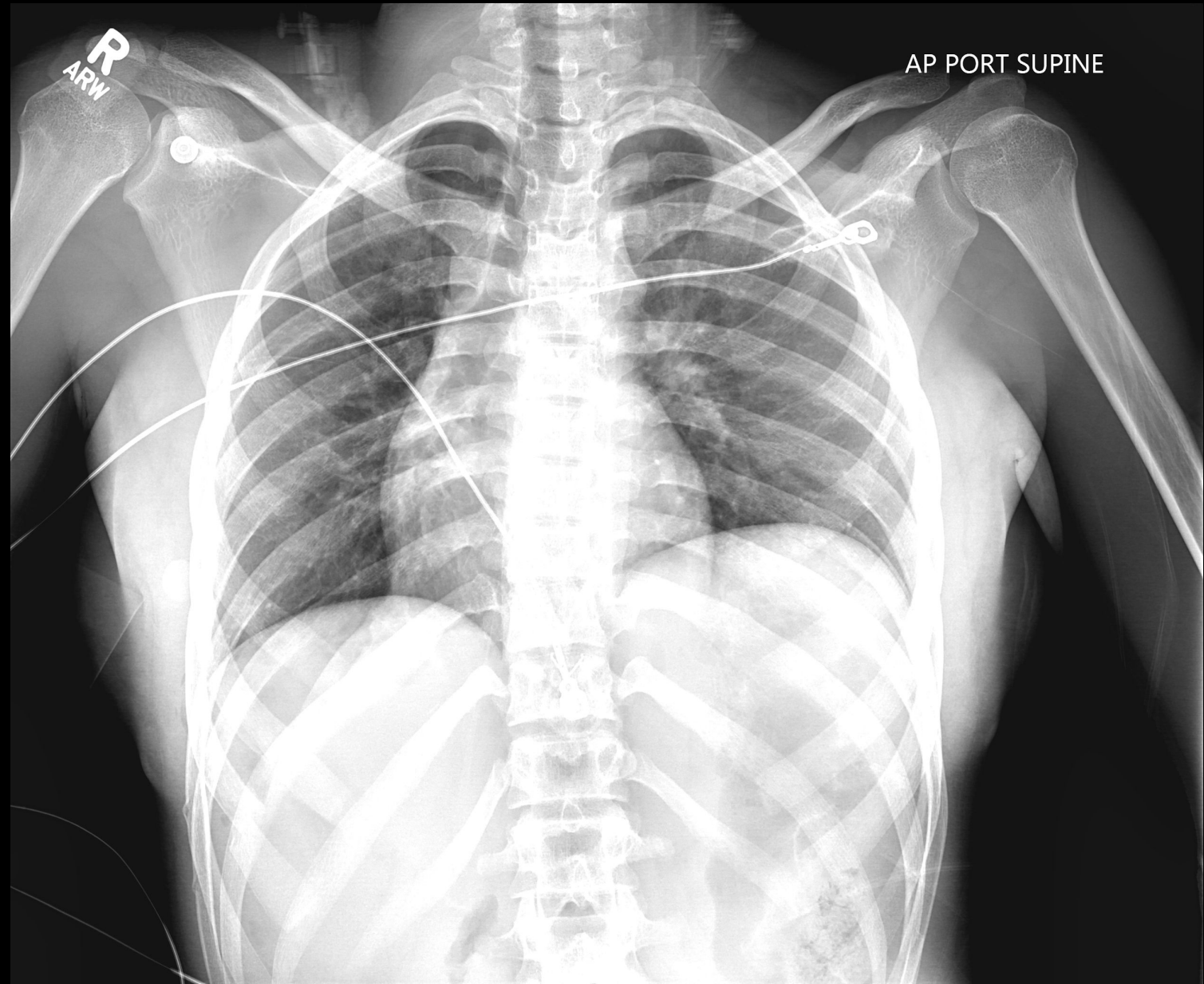
1. Moderate-sized left-sided pneumothorax.
2. Moderate volume pneumopericardium.



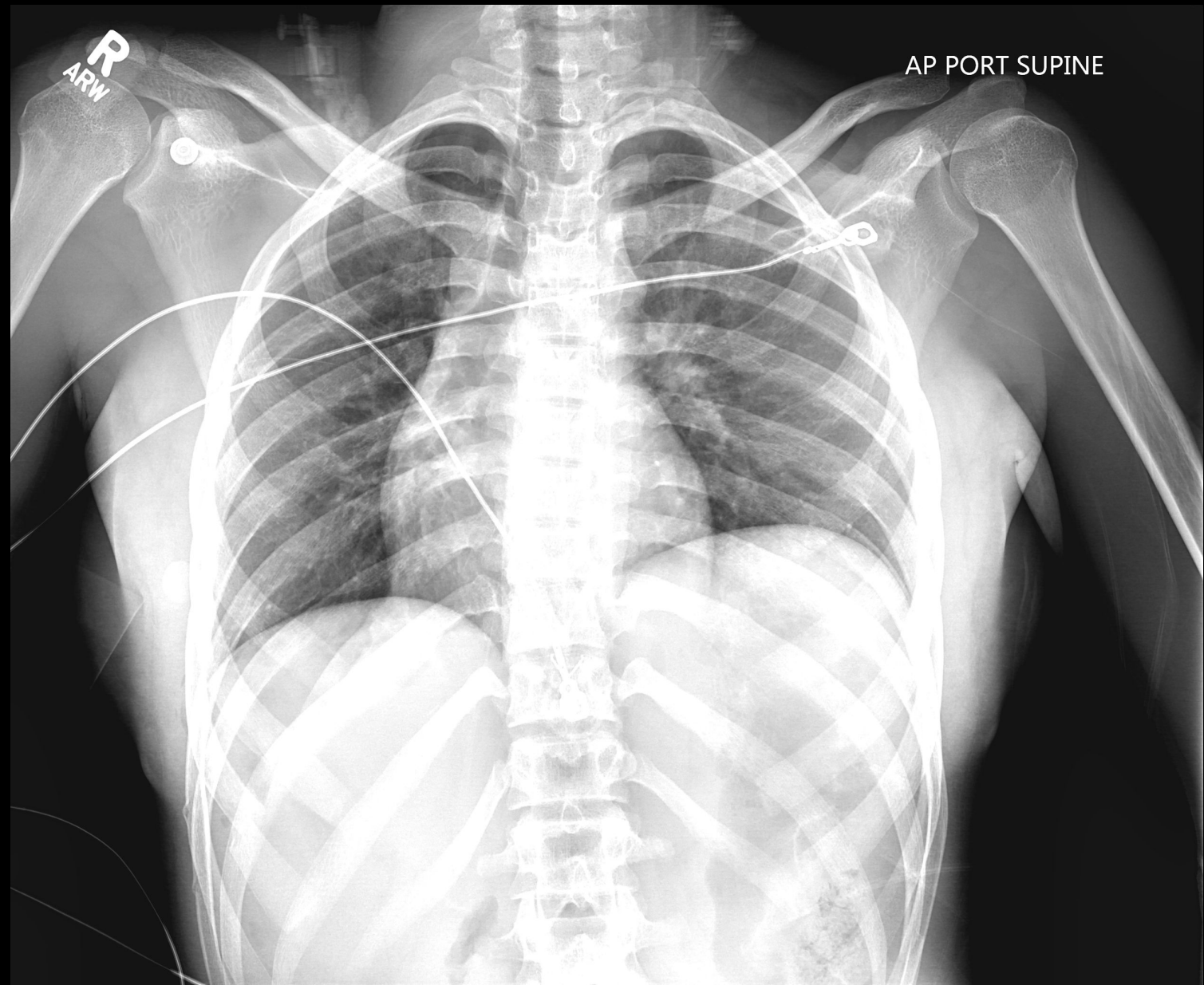
Practice Case

19 yo F

INDICATION:
Multiple trauma,
MVC



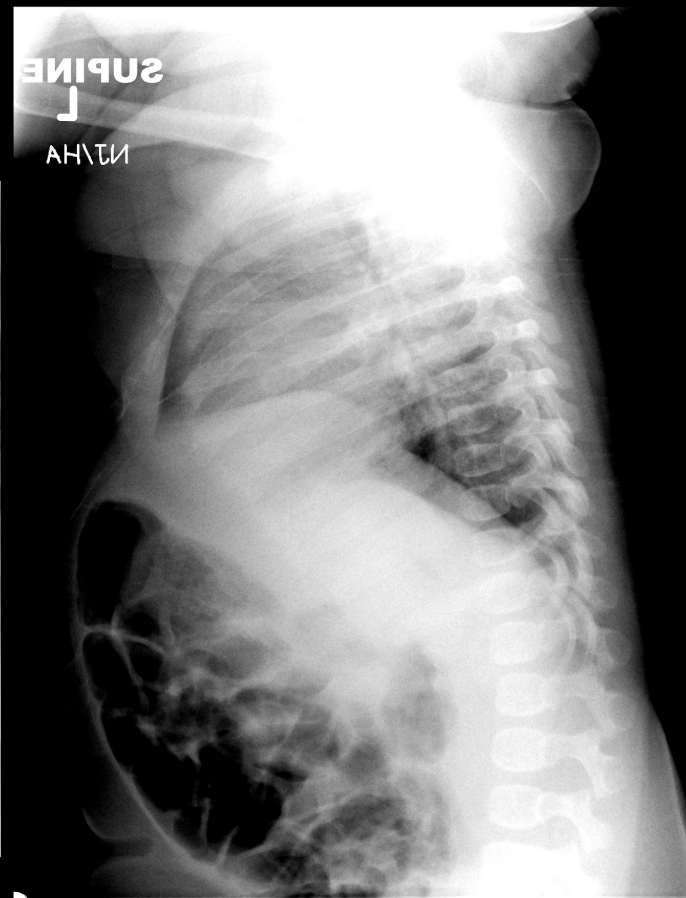
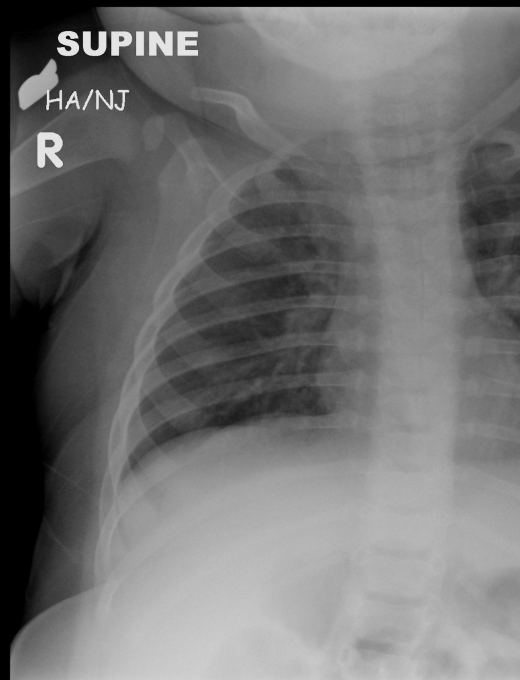
Impression:
Acute mildly
displaced lower
right rib fractures
with small right
pneumothorax.



Practice Case

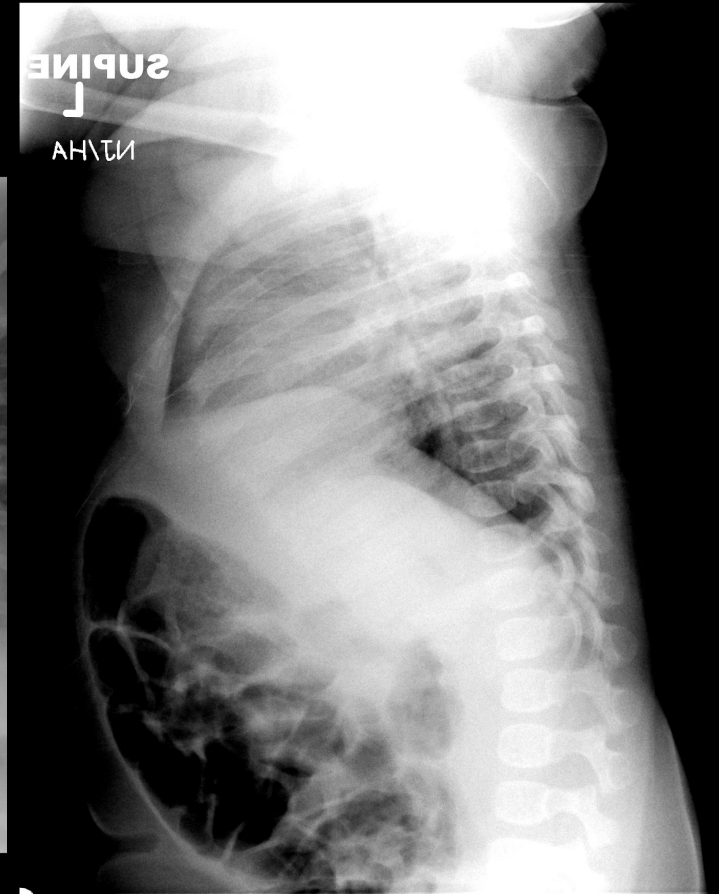
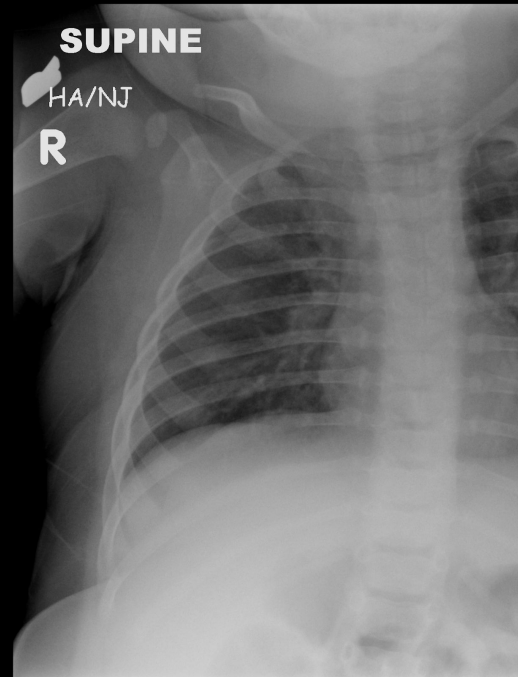
6 mo M

INDICATION: frequent desats, worsening respiratory status



Impression:

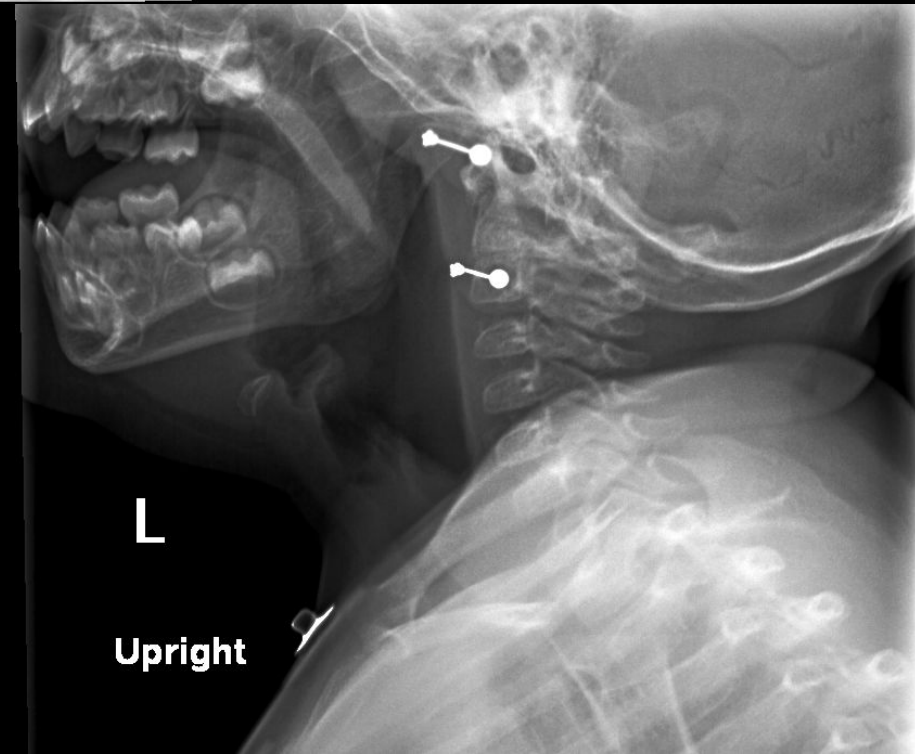
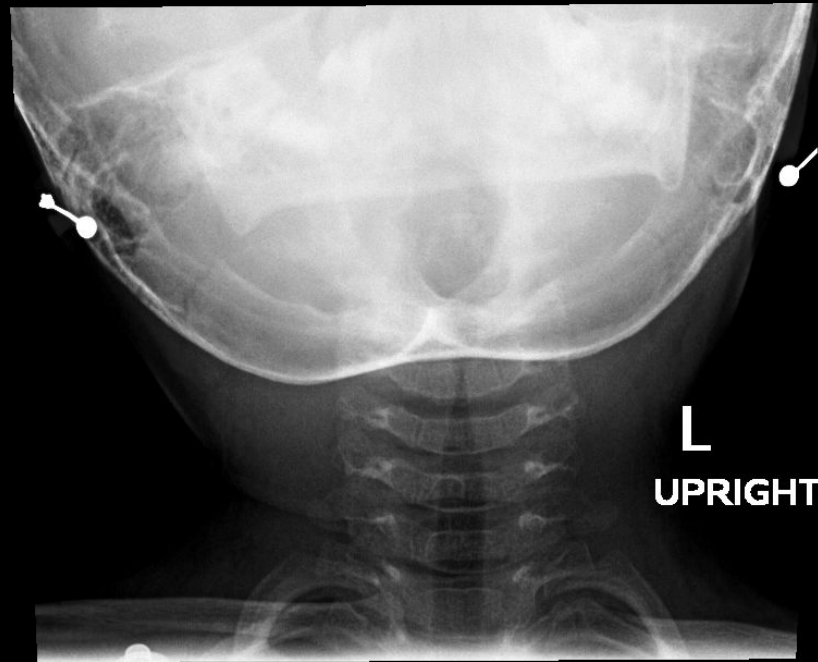
1. Lucency at the periphery of the upper right hemithorax represents a skin fold rather than a pneumothorax.
2. Right upper lung opacity which may reflect atelectasis. Pneumonia is difficult to entirely exclude but is not favored.
3. Nonspecific peribronchial thickening and perihilar atelectasis.
4. Pulmonary hyperexpansion.



Practice Case:

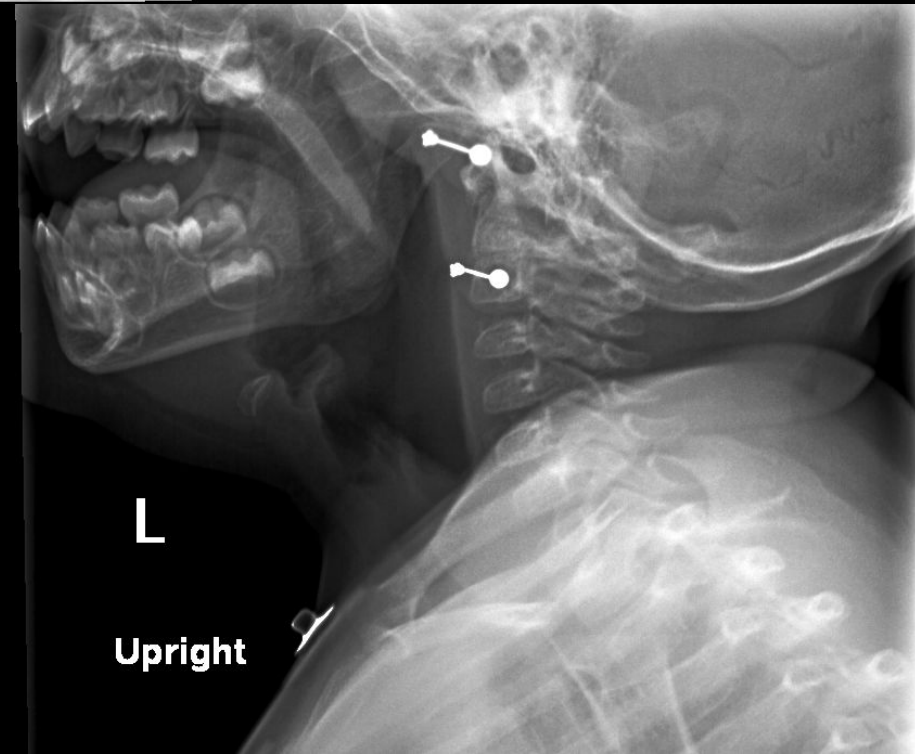
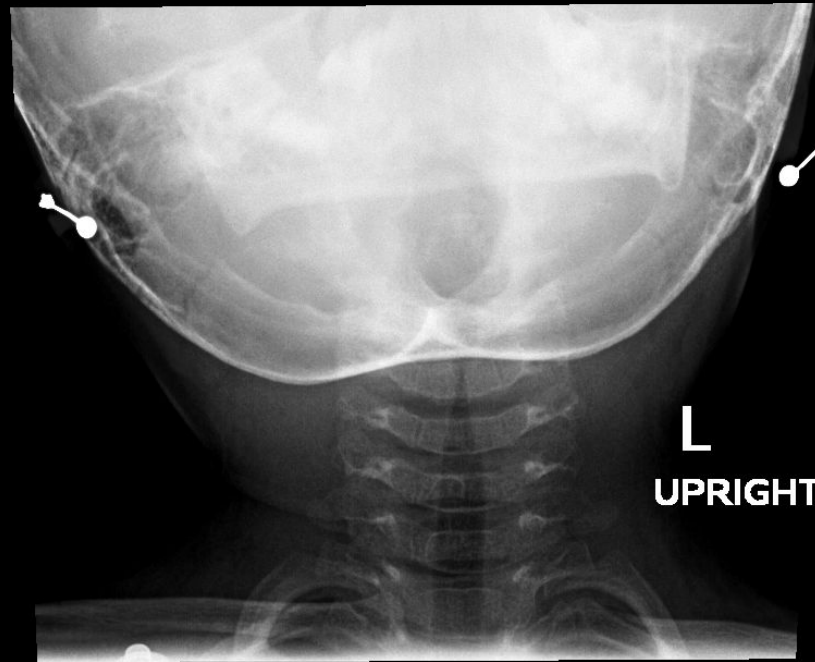
2 yo F

INDICATION: stridor,
dyspnea



Impression:

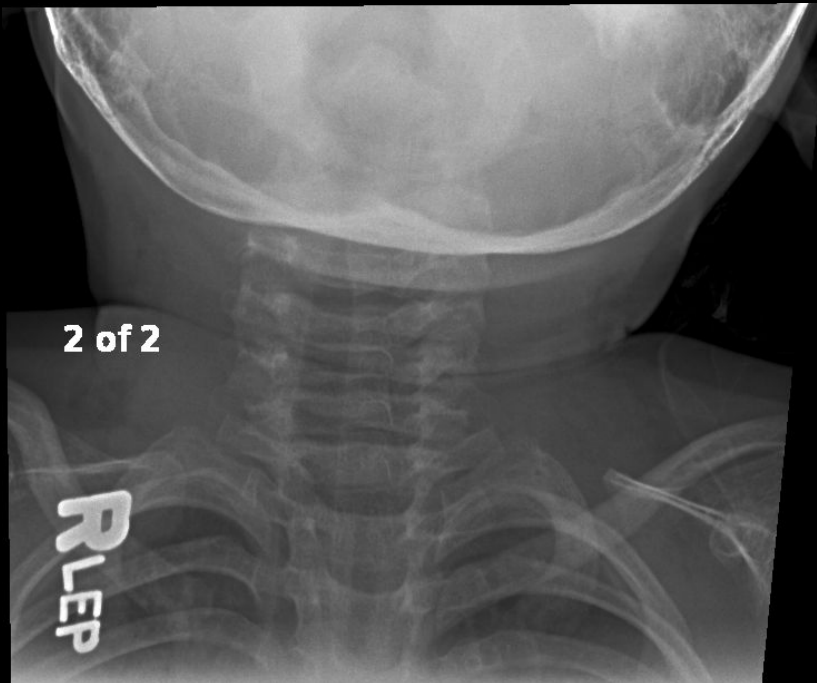
1. There is subglottic narrowing of the trachea with ballooning of the hypopharynx superior to this, consistent with croup.
2. The epiglottis and prevertebral soft tissues appear normal.



Practice Case

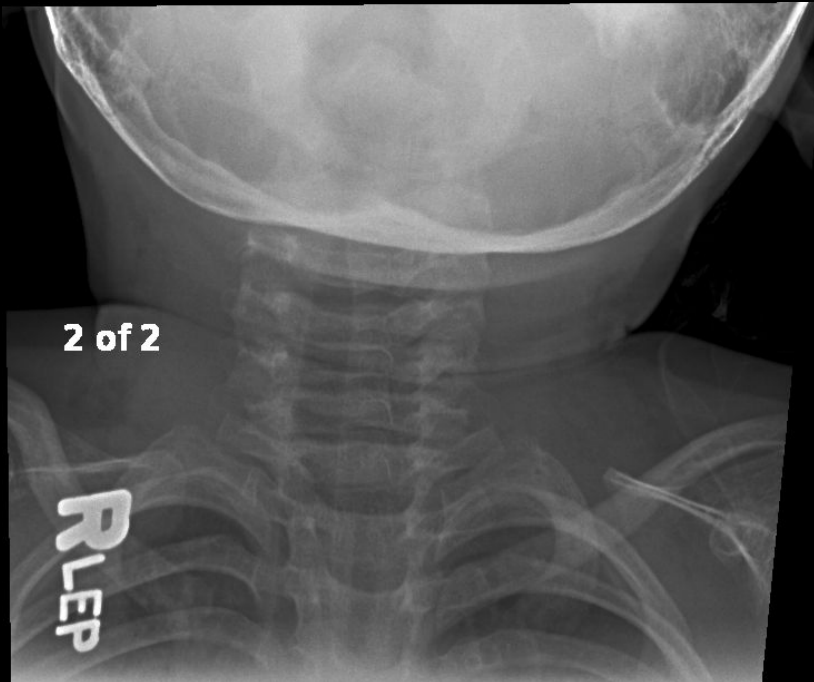
2 yo M

Indication: Stridor



Impression:

1. The airway is patent.
2. Normal radiographic appearance of the epiglottis.
3. Prevertebral soft tissues are within normal limits.
4. No evidence of osseous findings.



Practice Case:

2 yo M

Indication: earring in
nose, aspiration of
foreign body



Impression:

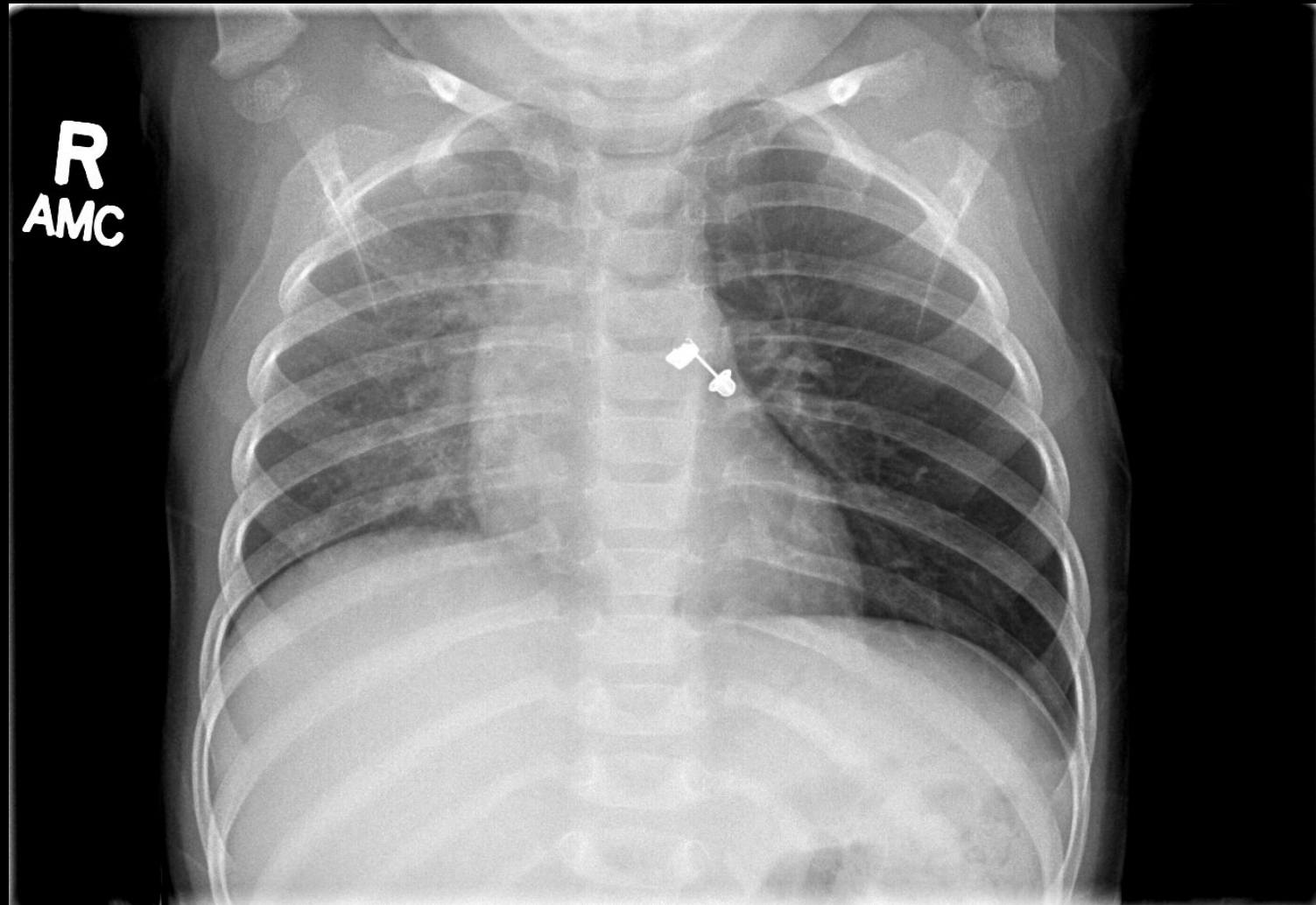
1. Redemonstrated radiopaque foreign body projecting over the maxillary alveolar ridge, likely within the inferior left nasal cavity with correlating with the comparison chest radiograph.
2. No acute facial fractures are evident.



Practice Case

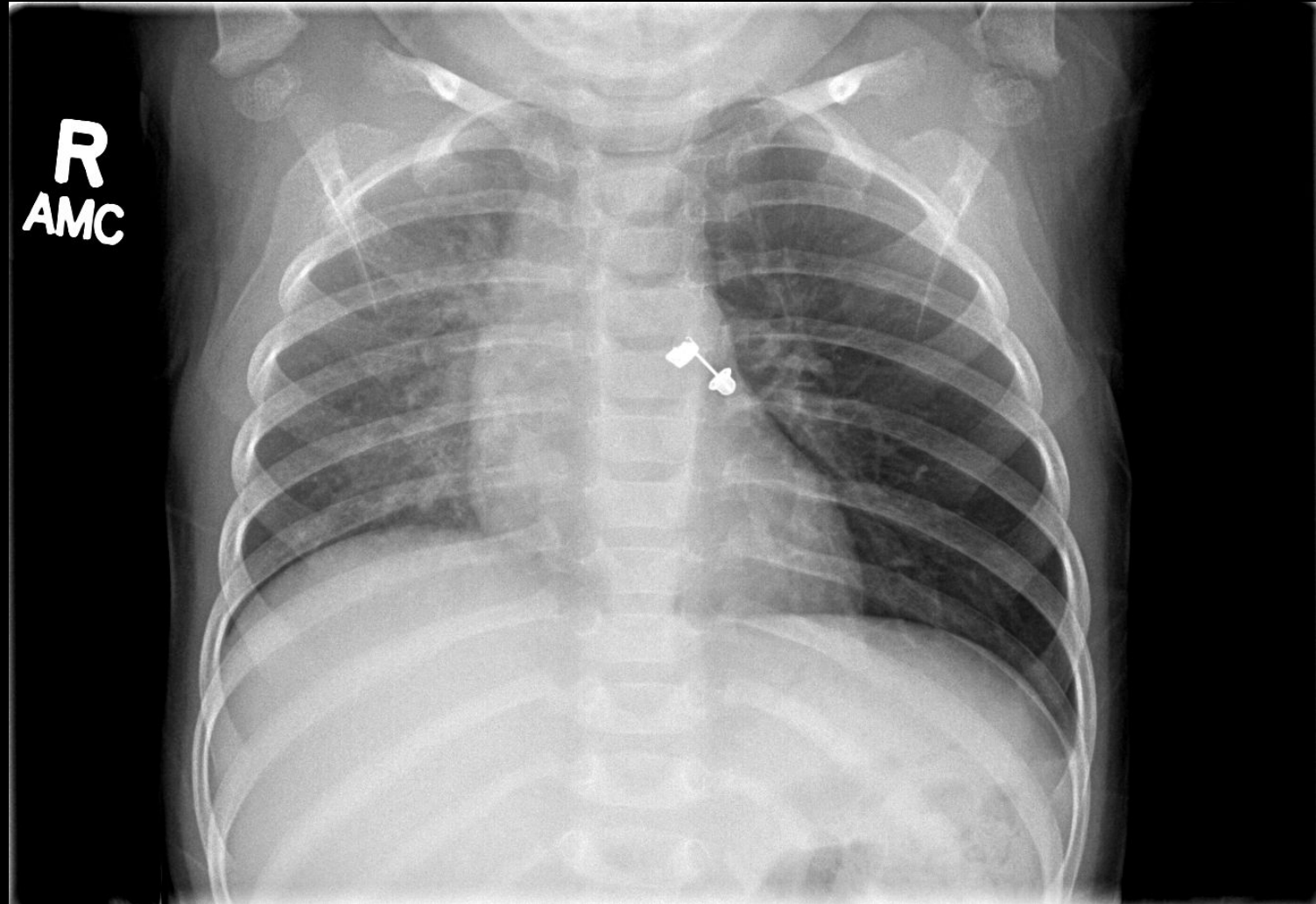
1 yo F

Indication: foreign
body



Impression:

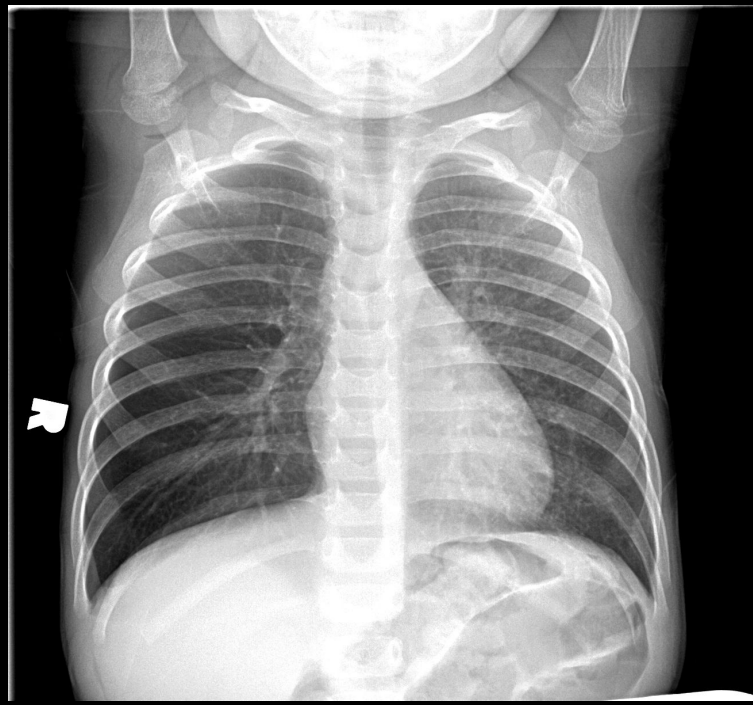
1. Metallic earring-like object in the left mainstem bronchus measuring about 1.2 cm in length. This results in ball valve obstruction with hyperinflation of the left lung and volume loss on the right.
2. No pleural effusion or pneumothorax.
3. Normal cardiopericardial size and configuration. Rightward mediastinal shift.
4. No acute osseous findings.
5. Unremarkable appearance of the upper abdomen.



Practice Case:

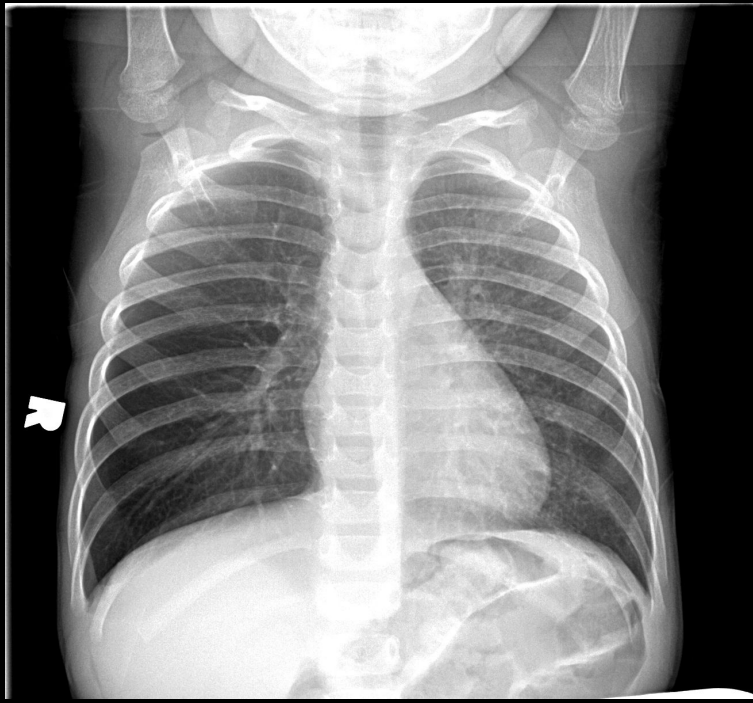
1 yo M

Indication: concern
for foreign body, RLL
(outside xray showed
RLL air trapping)



Impression:

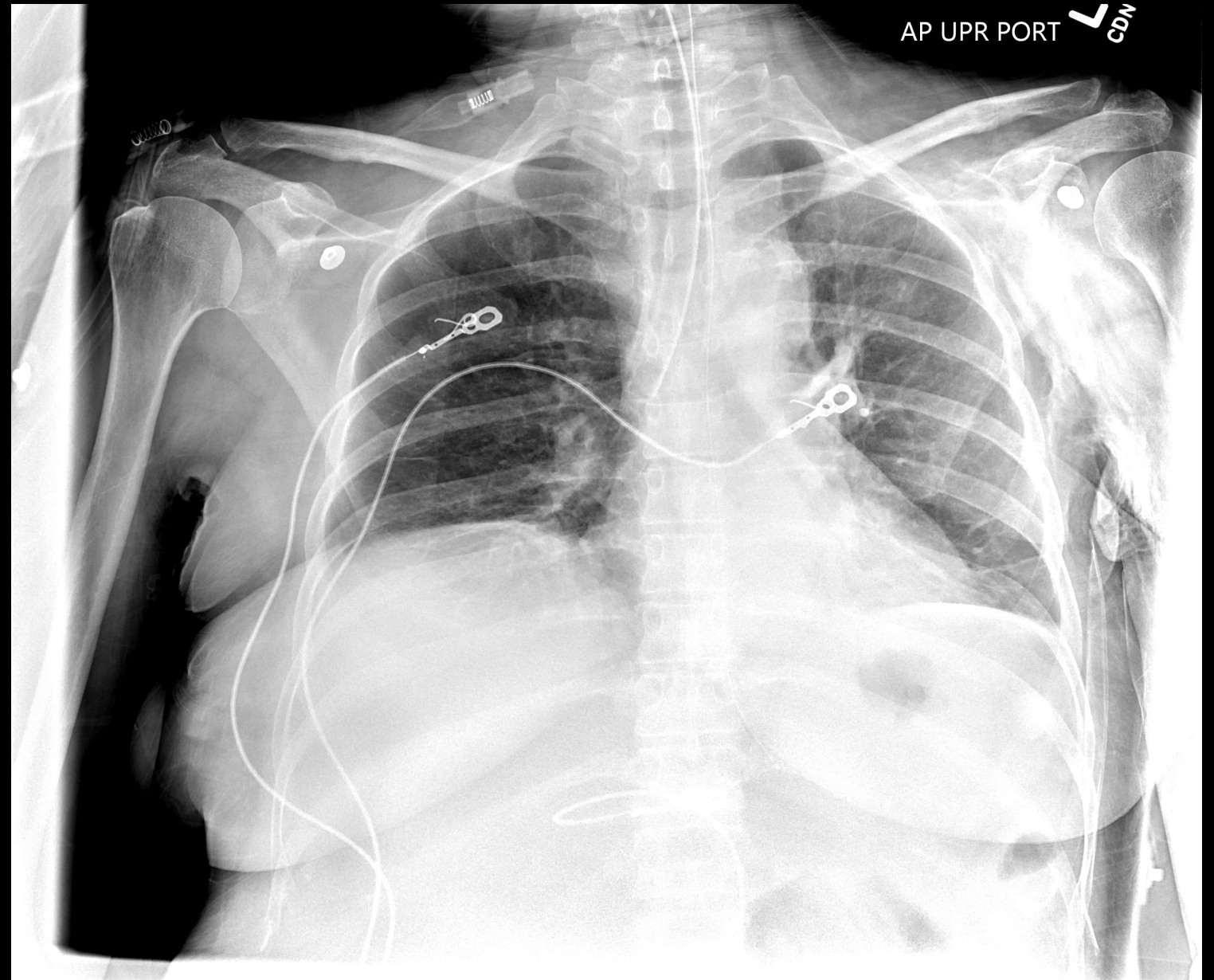
Asymmetric hyperinflation of the right lung, particularly at the base. Hyperlucency persists on the right lateral decubitus view. These findings are compatible with air-trapping in the right lung, possibly due to a nonradiopaque foreign body. No radiopaque foreign body is seen.



Practice Case

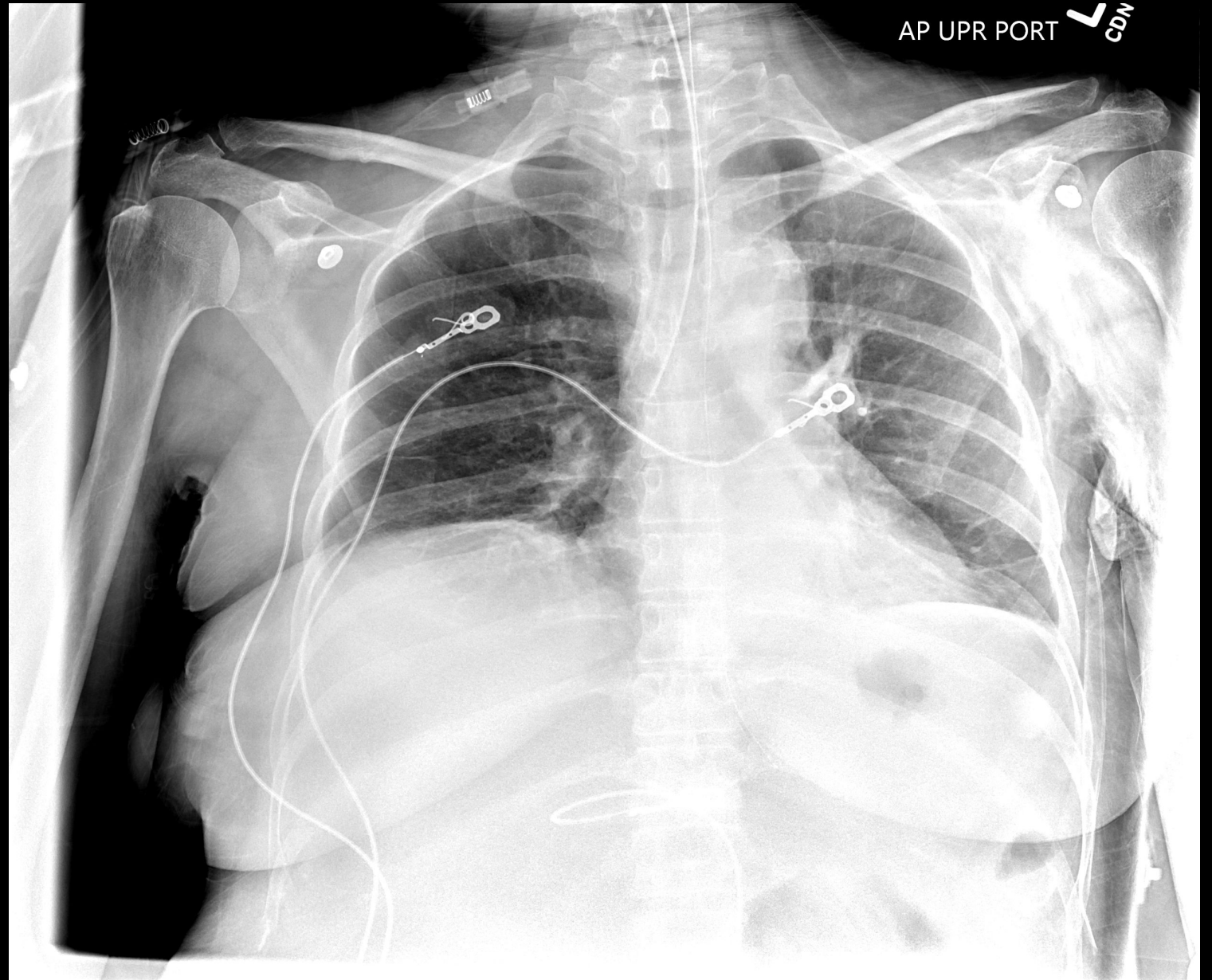
41yo F

Indication: sob I63.9
Cerebrovascular
accident (CVA),
unspecified
mechanism



Impression:

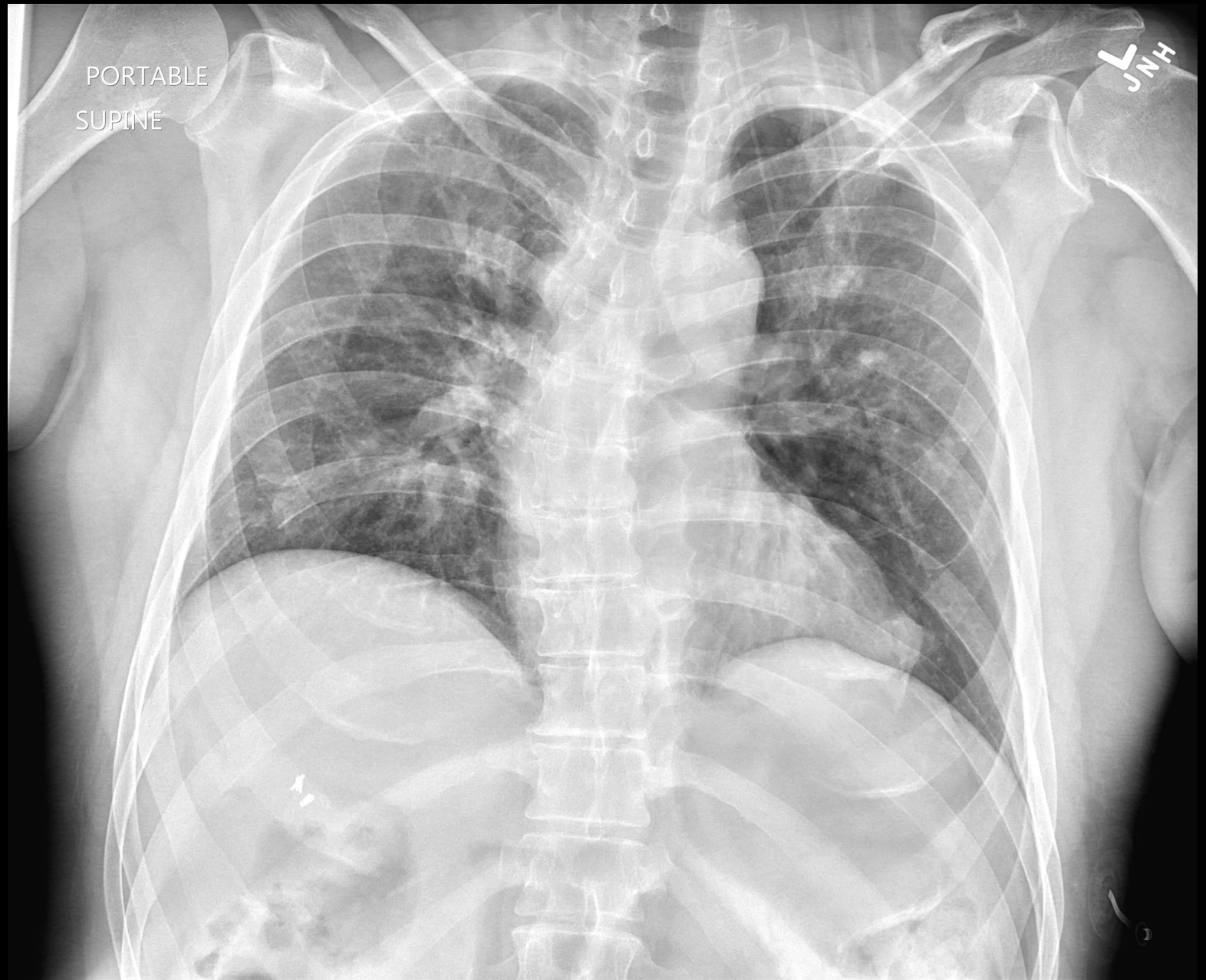
Right mainstem
intubation which on
subsequent
radiograph is
retracted.



Practice Case:

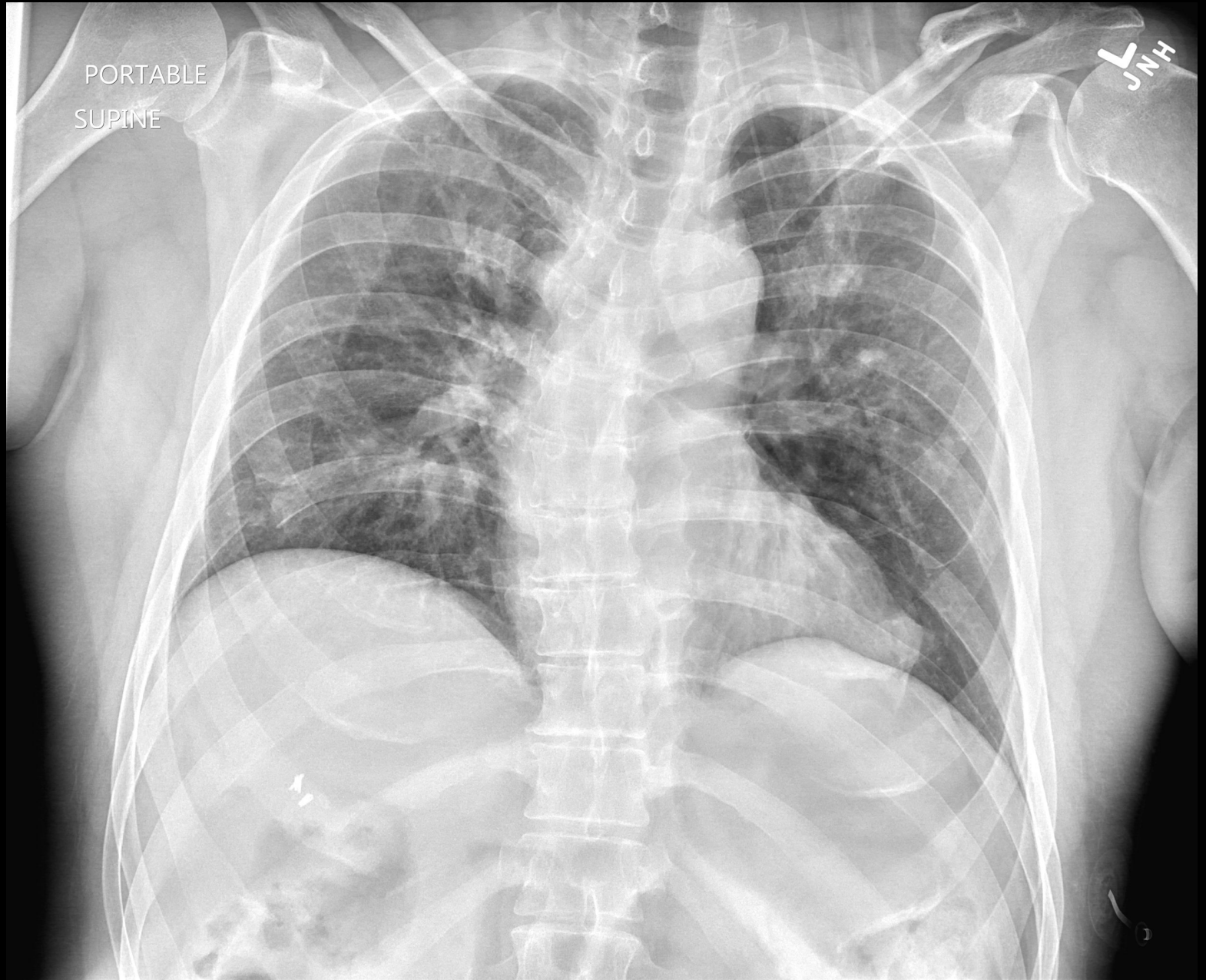
45yo M

Indication: Multiple
trauma, MVC



Impression:

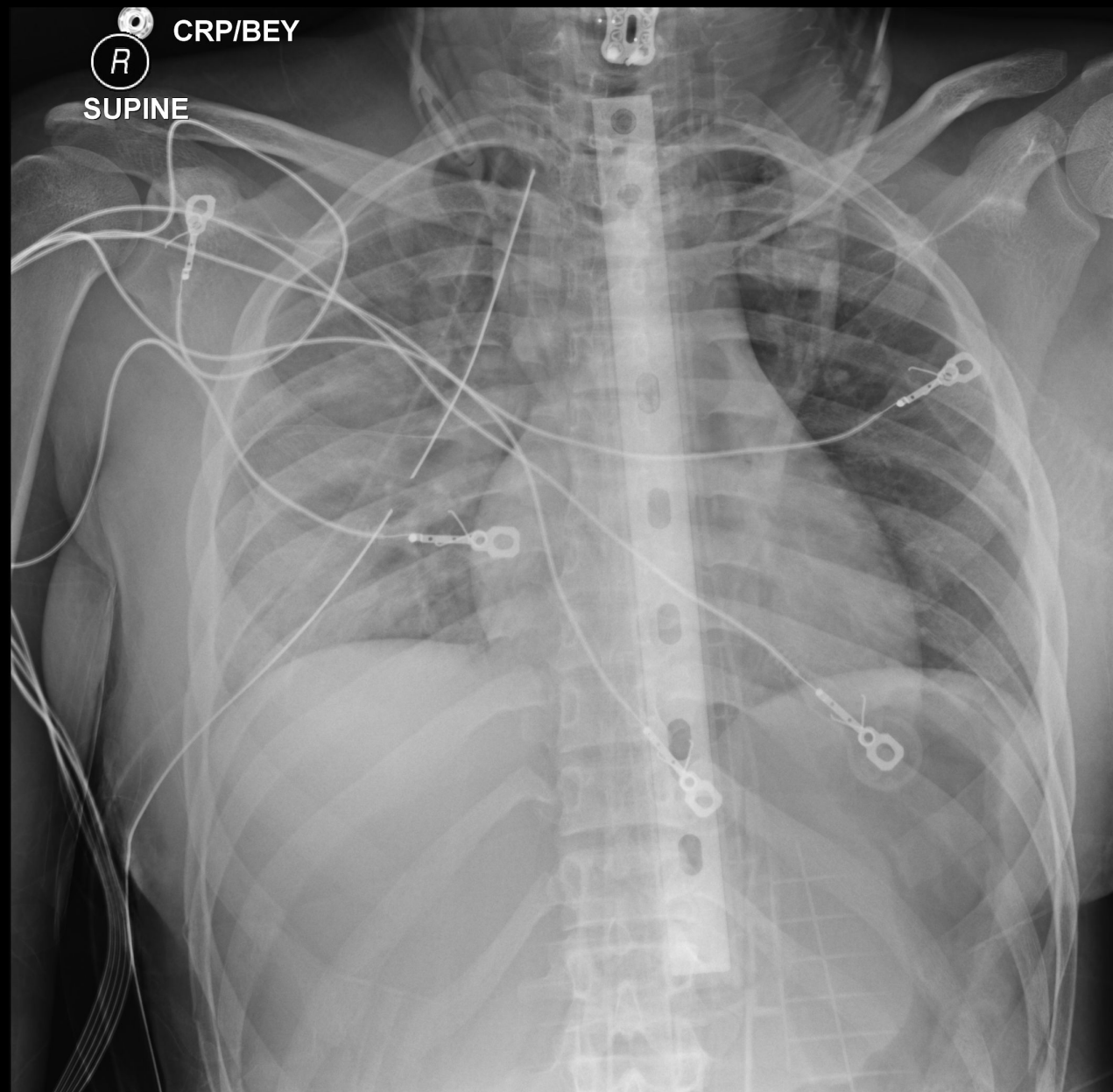
1. Left pneumothorax.
2. Scattered airspace opacities in the bilateral lungs likely representing contusion in the setting of trauma.
3. Displaced fracture of the distal left clavicle. Displaced rib fractures of the right lower ribs. Additional bilateral nondisplaced rib fractures are better demonstrated on contemporaneous CT of the chest, abdomen, and pelvis.



Practice Case:

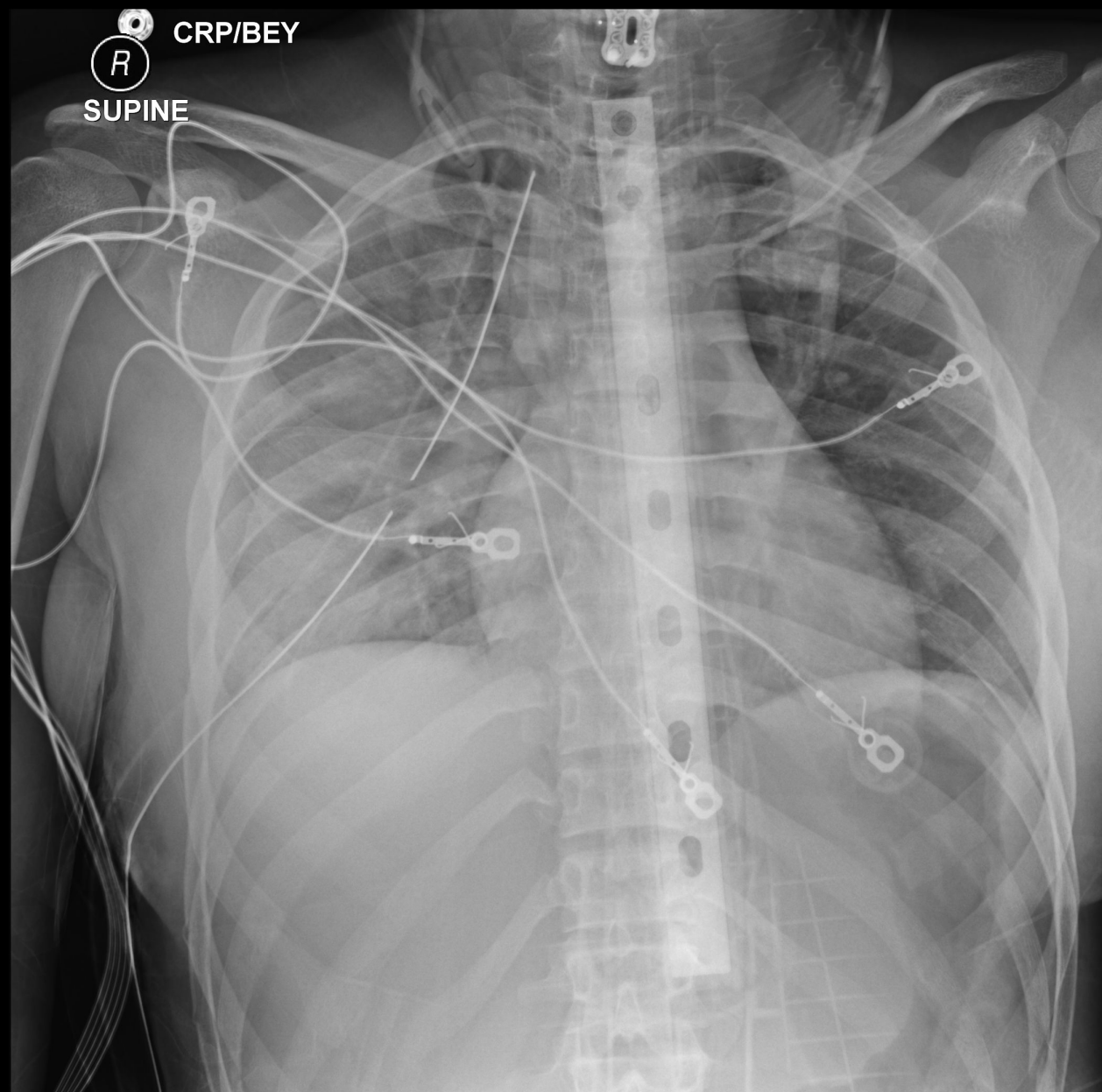
19yo F

Indication: chest
tube, ptx, MVC
(motor vehicle
collision),
Pneumothorax on
right



Impression:

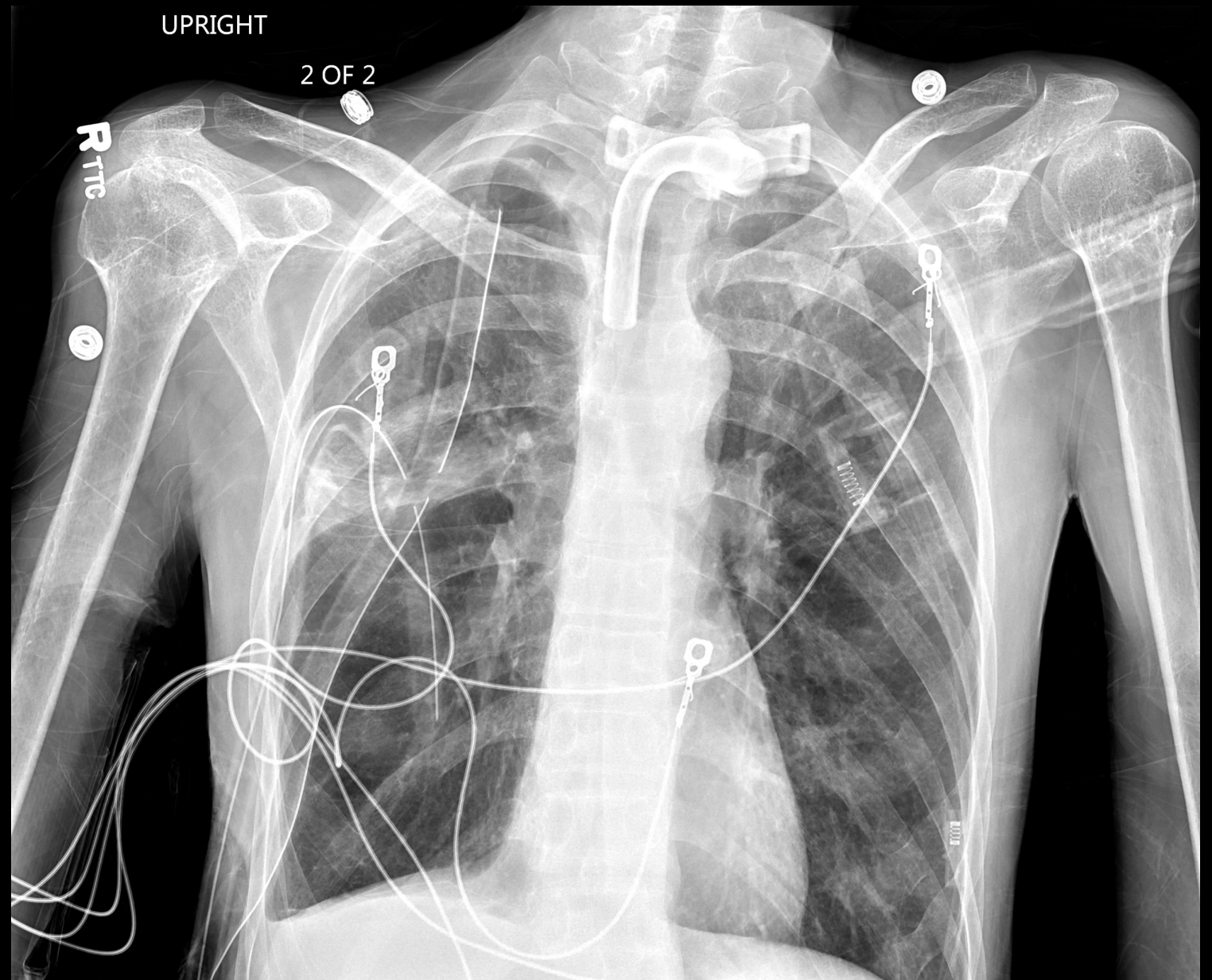
1. Right thoracostomy tube present.
2. Subtle lucency along the right heart border suggests possible small pneumothorax. Skin fold overlies the right mid and lower chest.
3. Hazy opacity over the right mid and lower chest, likely representing pulmonary contusion. Atelectasis and/or aspiration could also be present. Interval improvement in aeration of the left lower lobe left lung is now clear.
4. Known fractures of the right lower ribs.



Practice Case:

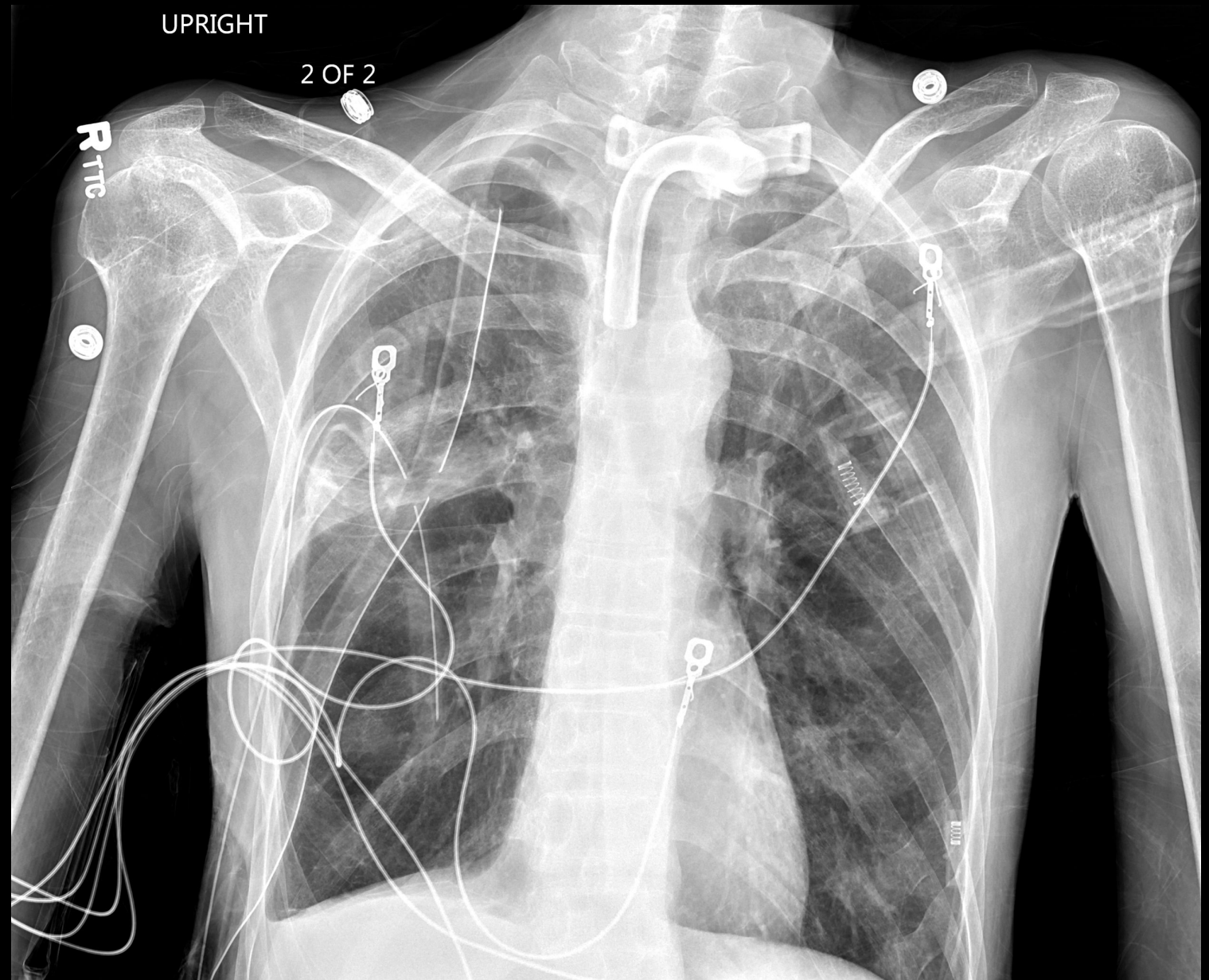
52yo M

Indication:
pneumothorax



Impression:

1. No pneumothorax. Two right chest tubes.
2. Opacity in the lower portion of the right upper lobe which may reflect atelectasis or pneumonia.
3. Tiny right pleural effusion.
4. Background of emphysematous changes.



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