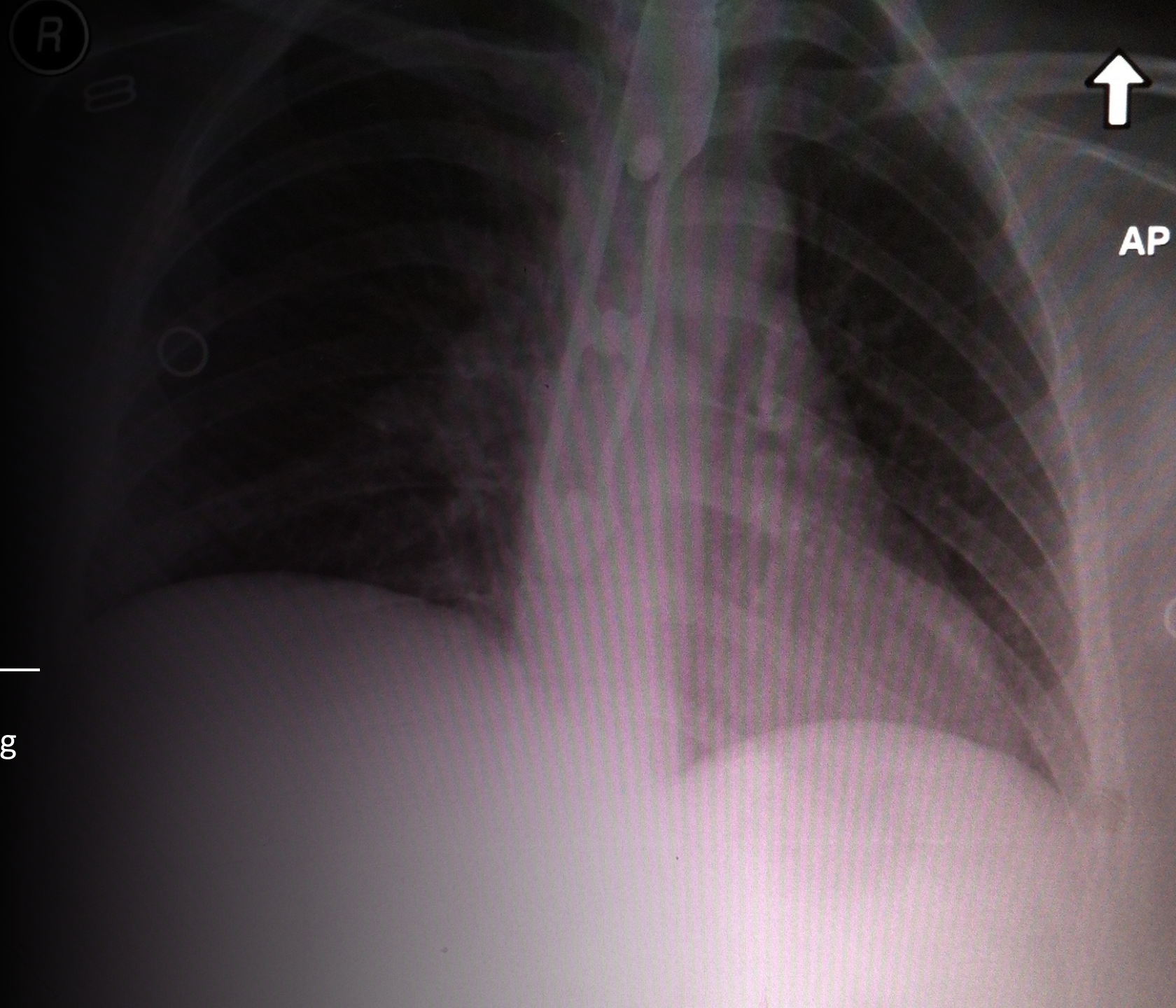
Pneumonias and Pneumothorax

Approaches in the acute care setting

Niran Argintaru



Objectives

1. Diagnosis, risk stratification and management of pneumonias of adult patients in the acute care setting

2. Focus on CXR interpretation for these indications

3. Be aware of the diagnosis and management of atypical pneumonias

4. Diagnosis and decision making of pneumothoraxes

Resources

- https://litfl.com/top-100/cxr/

- Waitemata DHB Respiratory Tract Infection – Empiric Antibiotic Treatment Guidelines

Case 1

43 year old man with syncope

Day 4

Features of Pneumonia on CXR

"Consolidation"

- Air bronchograms – dark bronchi made visible by white opacification of surrounding alveoli
- Usually focal, segmental in simple pneumonia
- Ill-defined borders

Complications

- Abscess, cavitating lesion
- Empyema
- Pleural effusion
- Pneumothorax (rarely)
- Atelectasis

Air Bronchograms

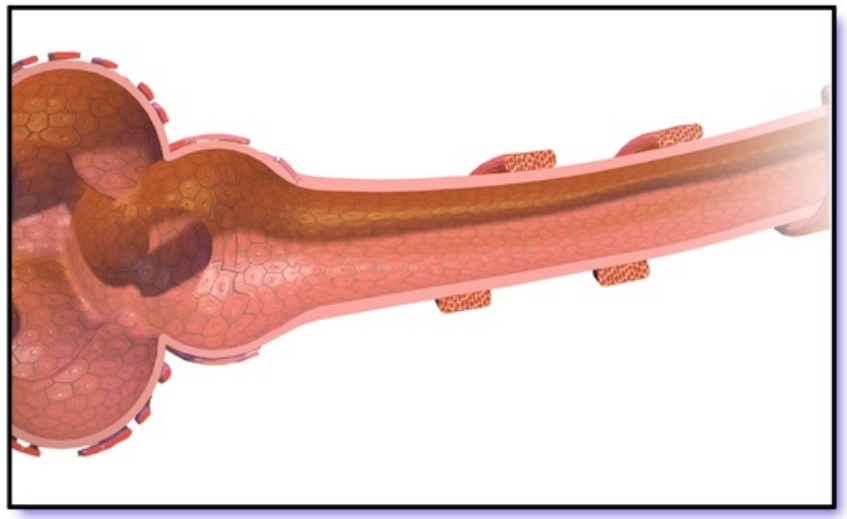
DDX:

1. Consolidation
2. Alveolar oedema
3. Atelectasis
4. Interstitial lung disease
5. Cancer
6. Pulmonary infarcts
7. Pulmonary haemorrhage

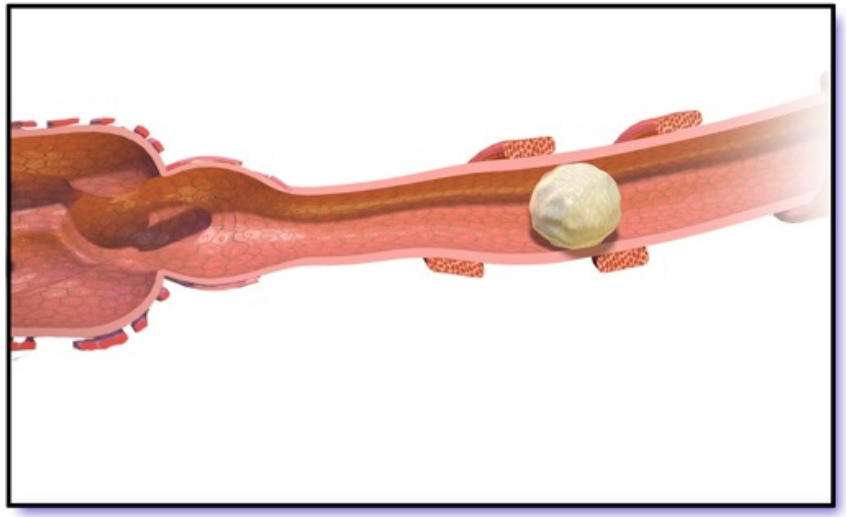
Can be seen during full expiration.

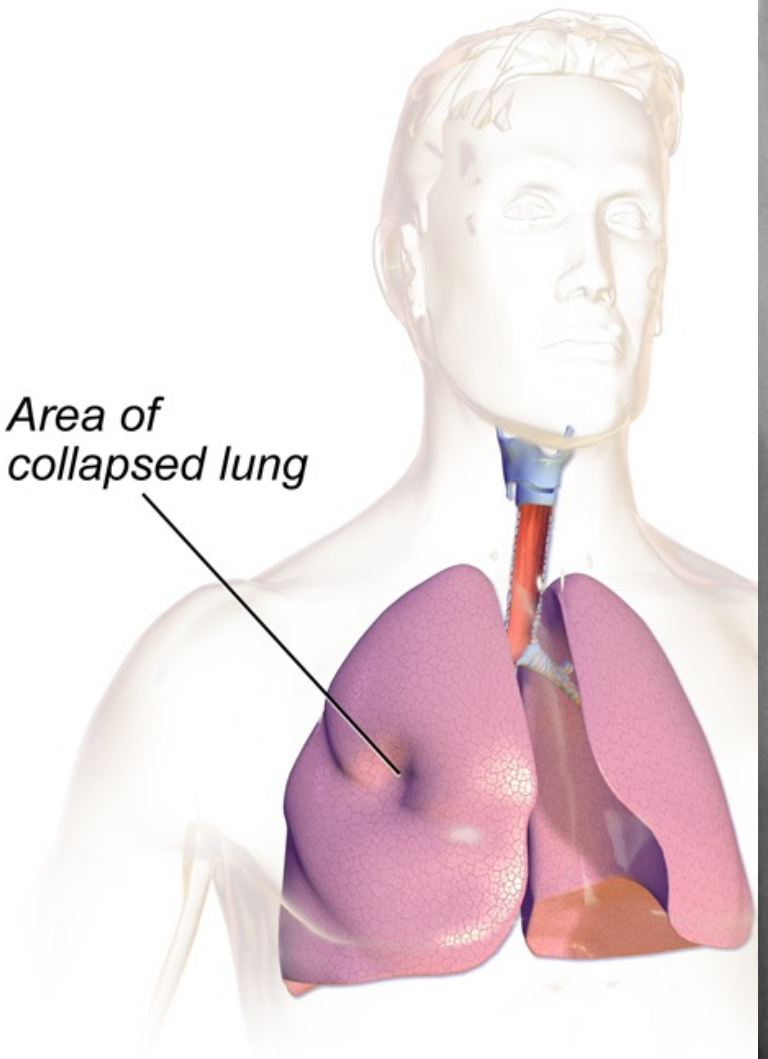
Atelectasis

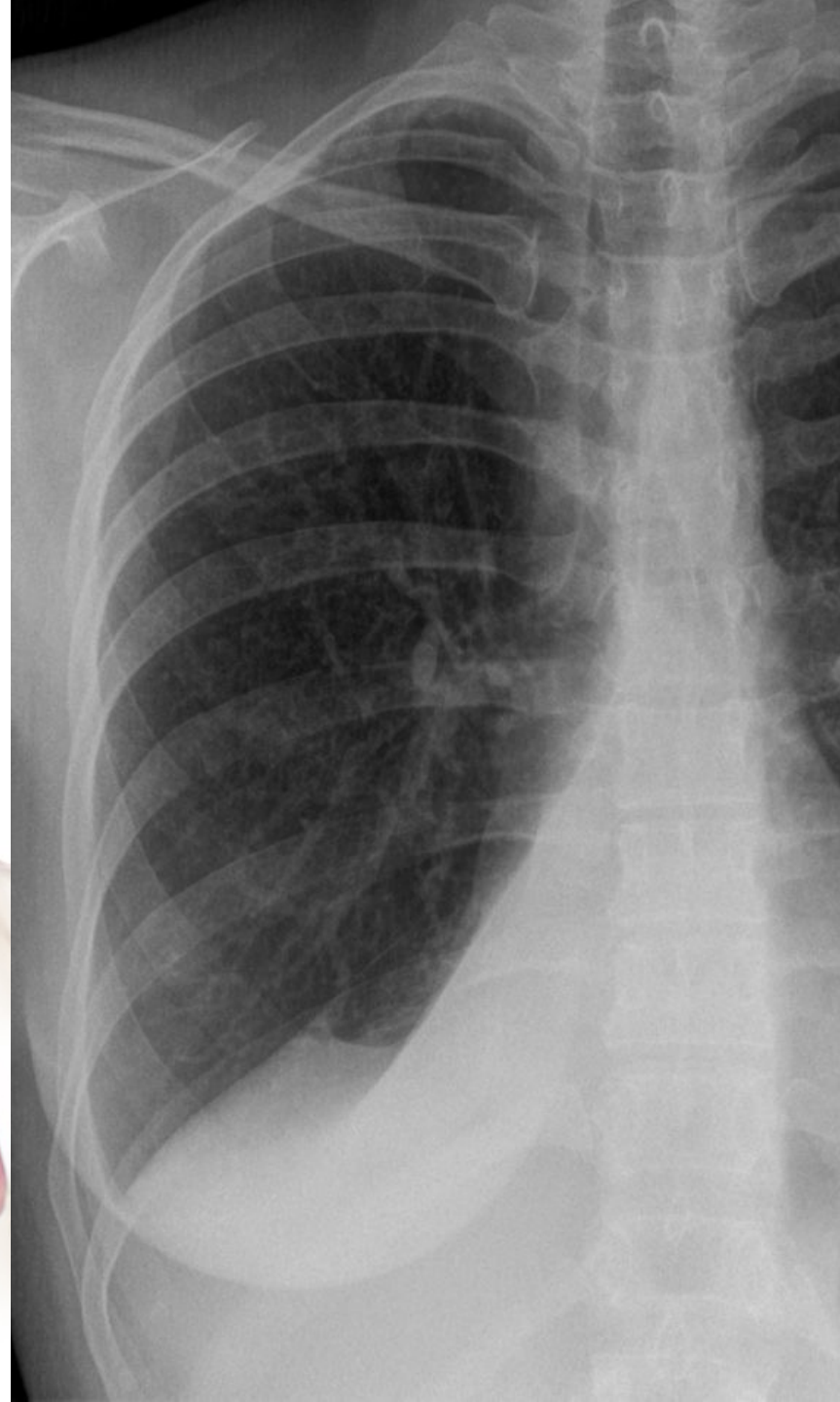
Normal Bronchiole

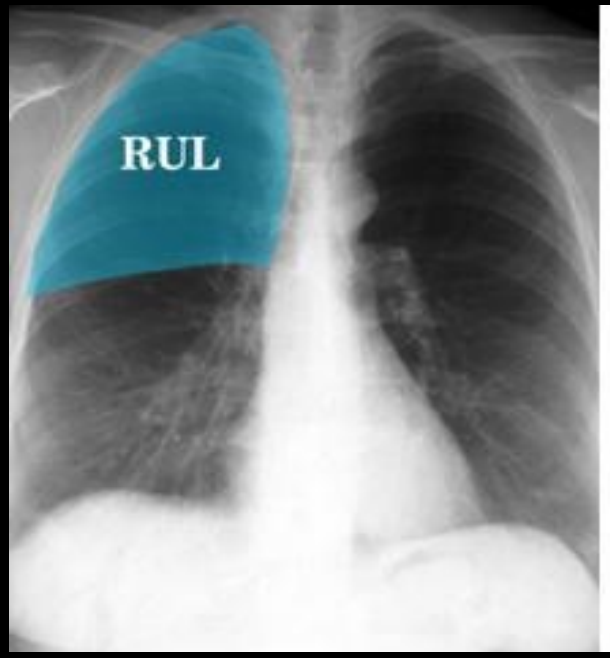


Blocked Bronchiole





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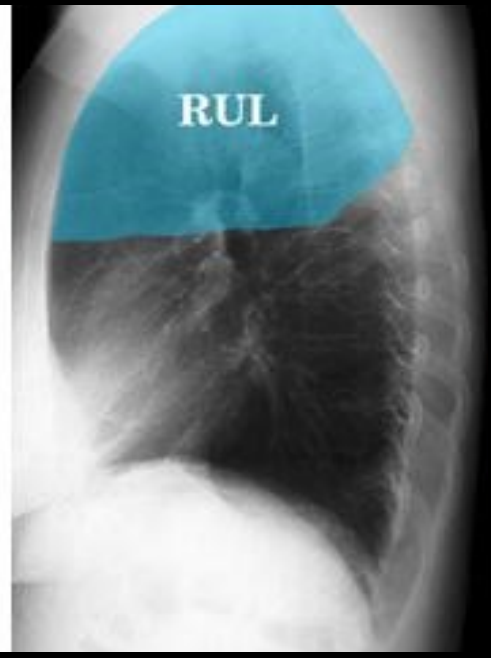
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RML


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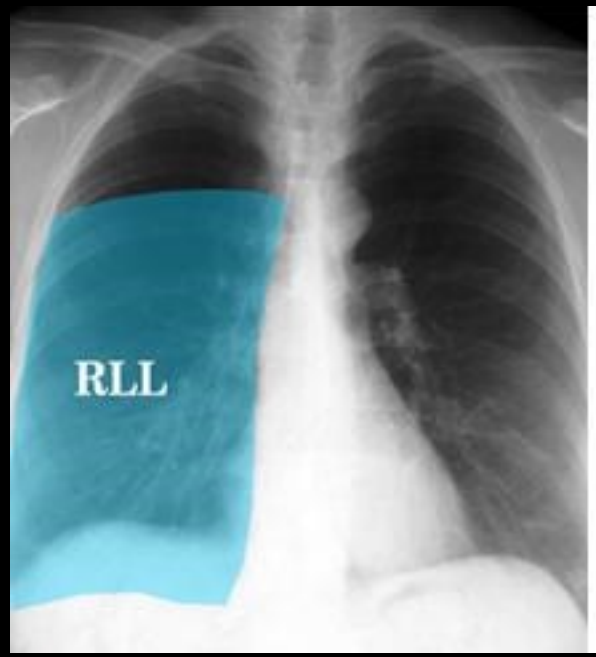
RLL


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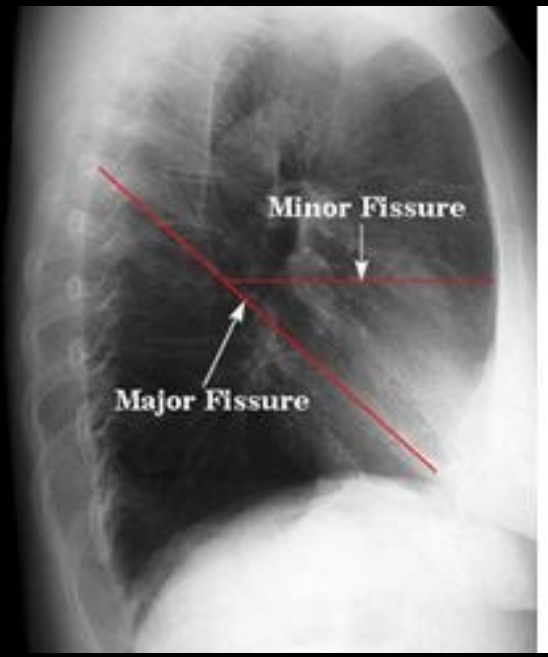
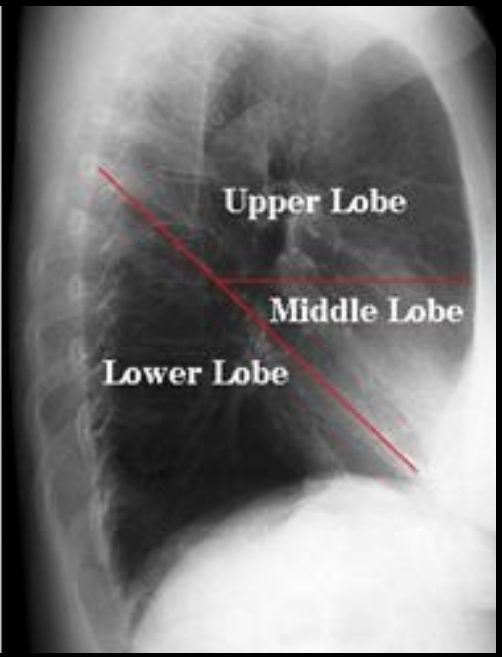
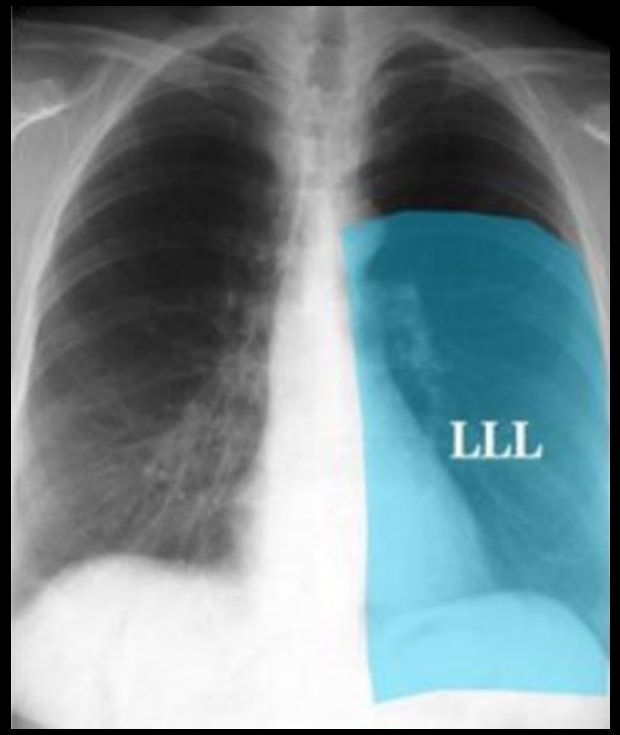

Minor Fissure
Major Fissure


Upper Lobe
Middle Lobe
Lower Lobe


LUL


LUL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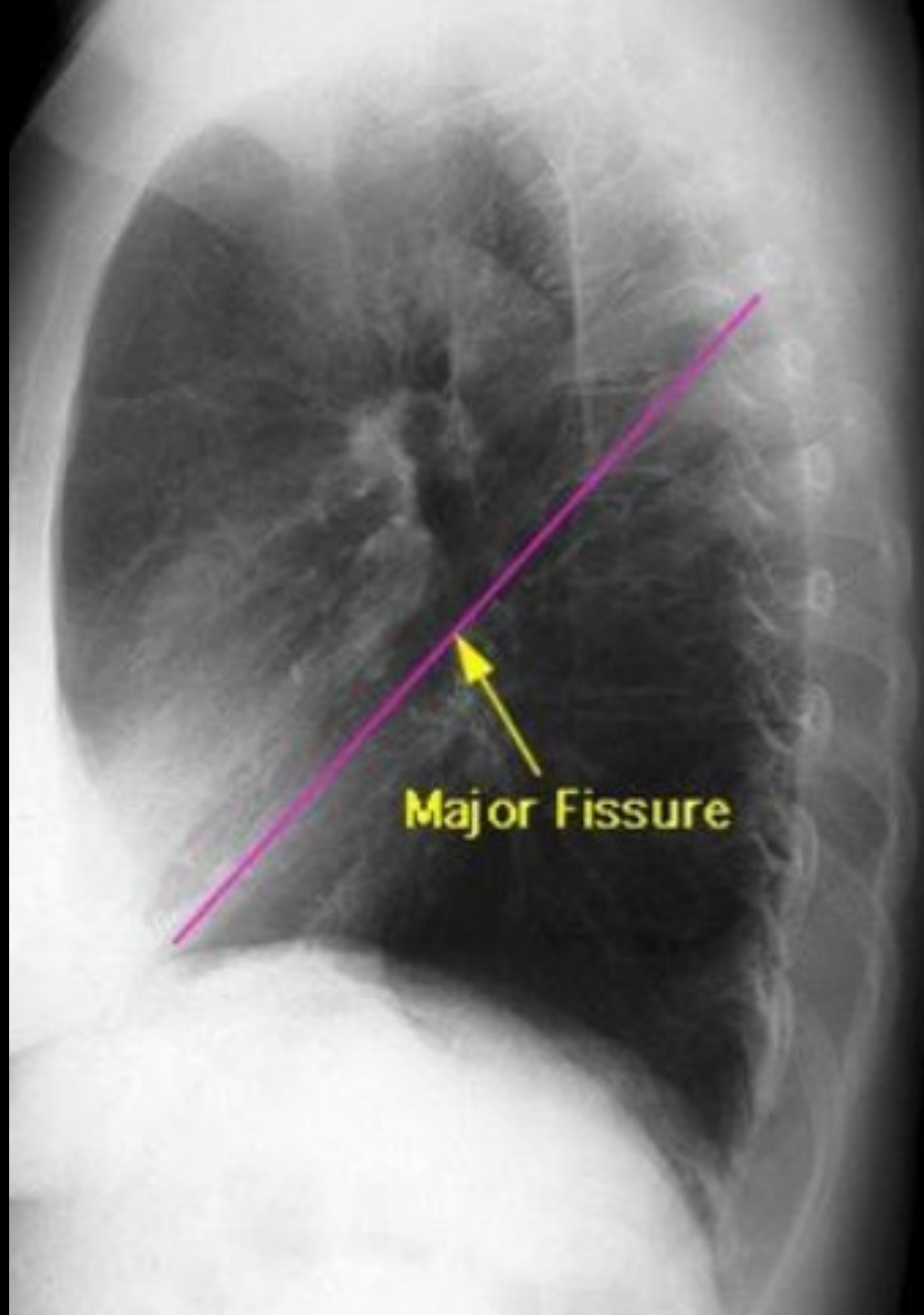

Major Fissure

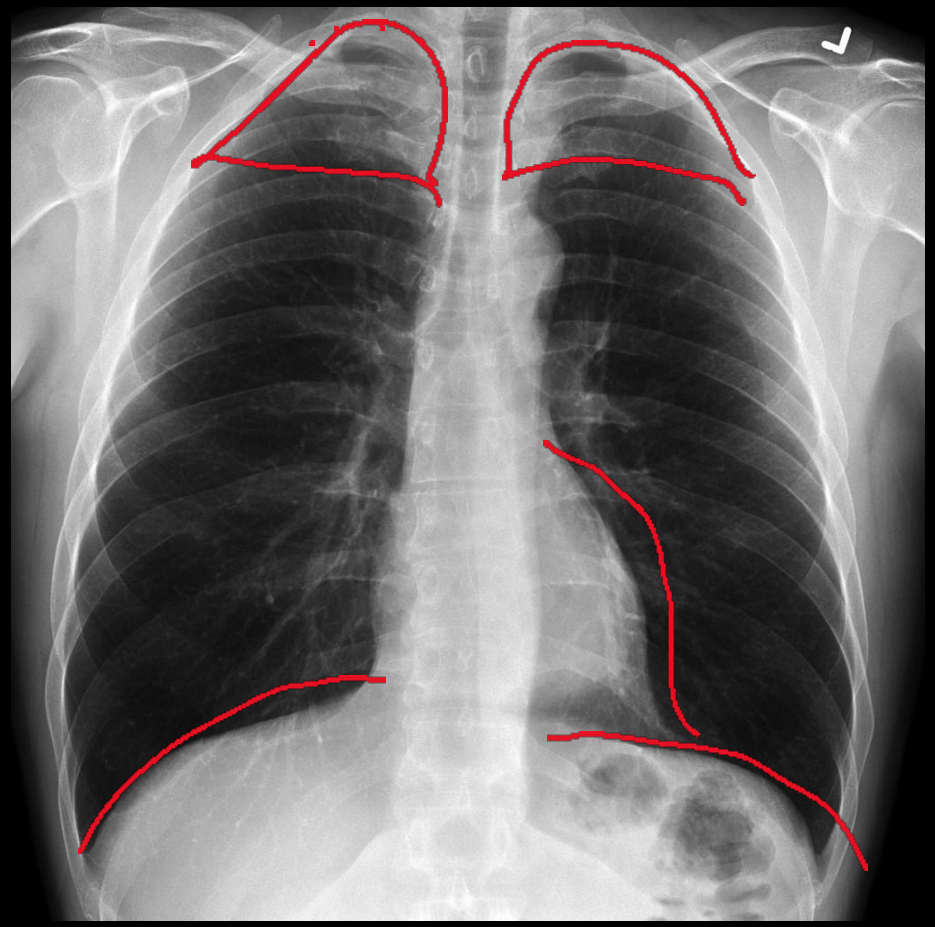
Clinical Features of Pneumonia vs. Viral

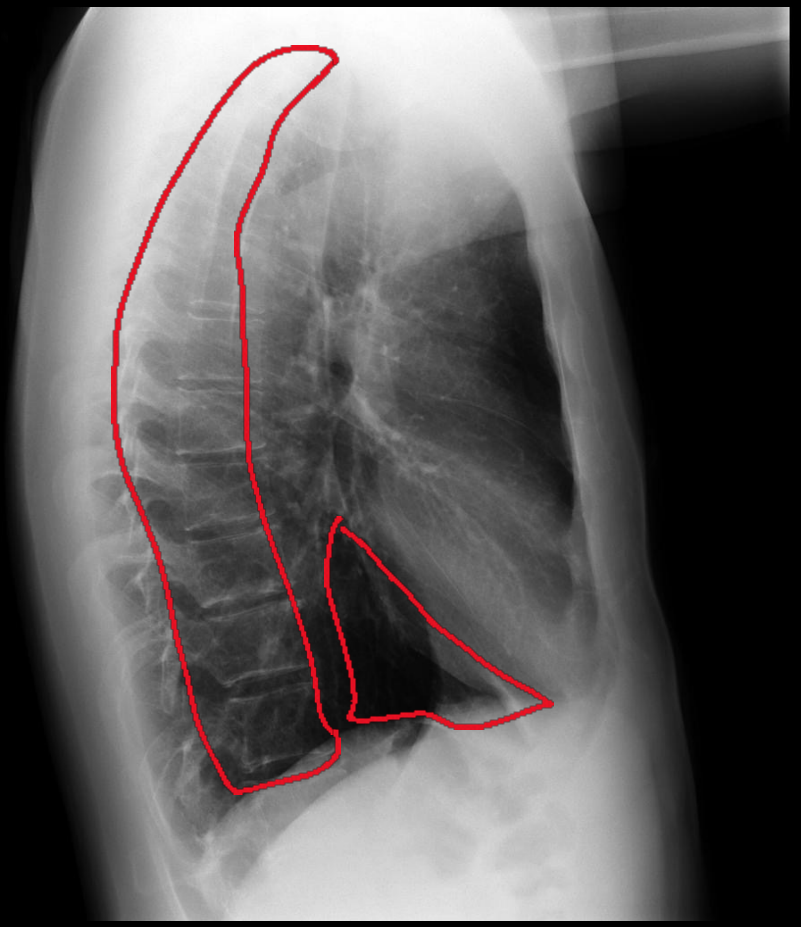
- Underlying chronic lung disease
- Fever (47% vs 32%)
- Pleurisy
- CRP elevation (103 vs 47)
- Tachypnoea (especially in children)

Do you need a chest x-ray to diagnose a pneumonia?

1. Px and Hx have limited predictive value
2. Atypical presentations can occur
3. Baseline x-rays are useful
4. WDHB guidelines state yes (CeDS)
5. Risk stratification requires X-ray
6. Need to assess for complications.

Pause and look twice.





Case 2

54 year old man with 6 weeks of worsening SOB and cough with right chest pain

Disposition?

Risk Stratification – CURB 65

C onfusion

U rea ≥ 7 mmol/L (often removed)

R R ≥30

B P < 90 systolic or < 60 diastolic

65 Age ≥ 65

>18 year old

AND

Acute respiratory tract illness

AND

Shadowing on CXR consistent with infection that is not pre-existing nor of any other known cause

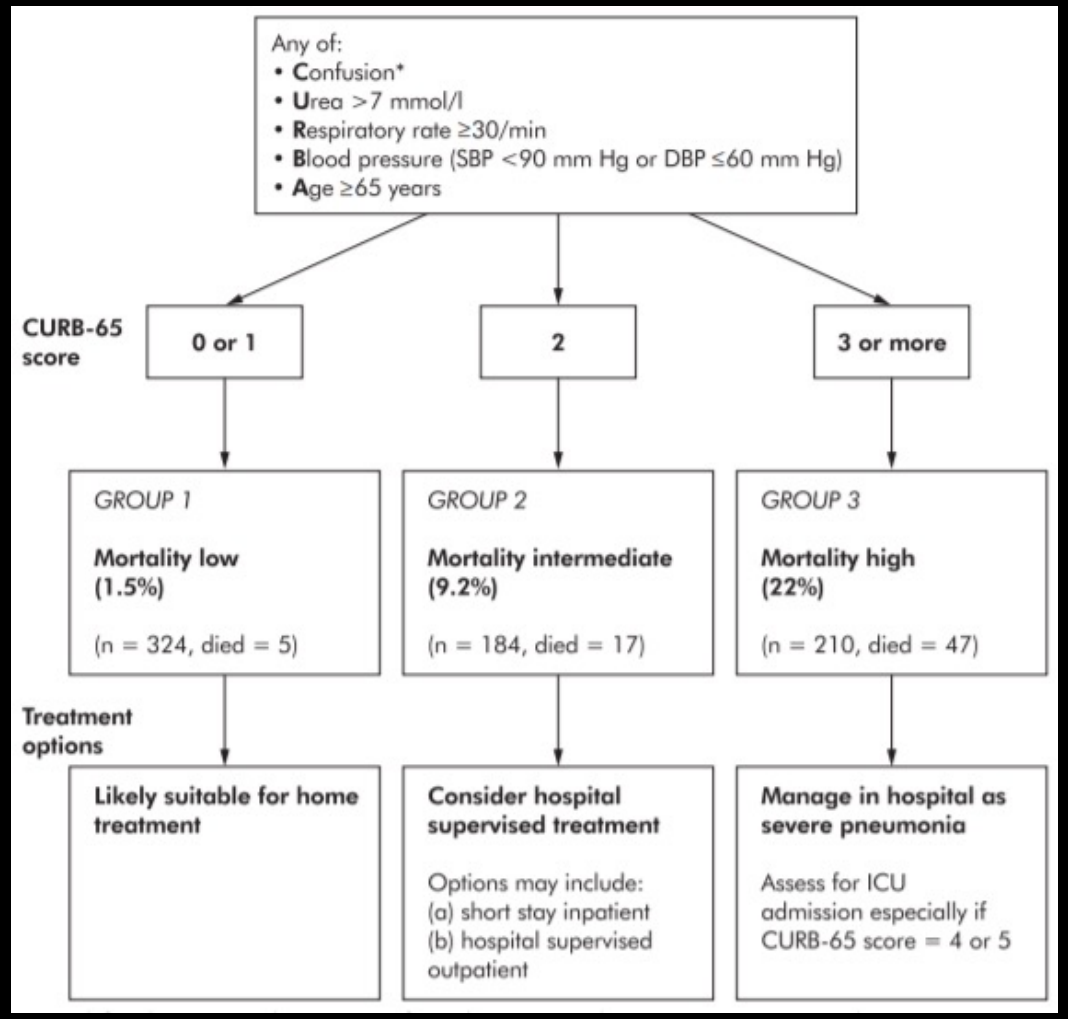
W Lim, M M van der Eerden, R Laing, W Boersma, N Karalus, G Town, S Lewis, and J Macfarlane. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. Thorax. 2003 May; 58(5): 377–382

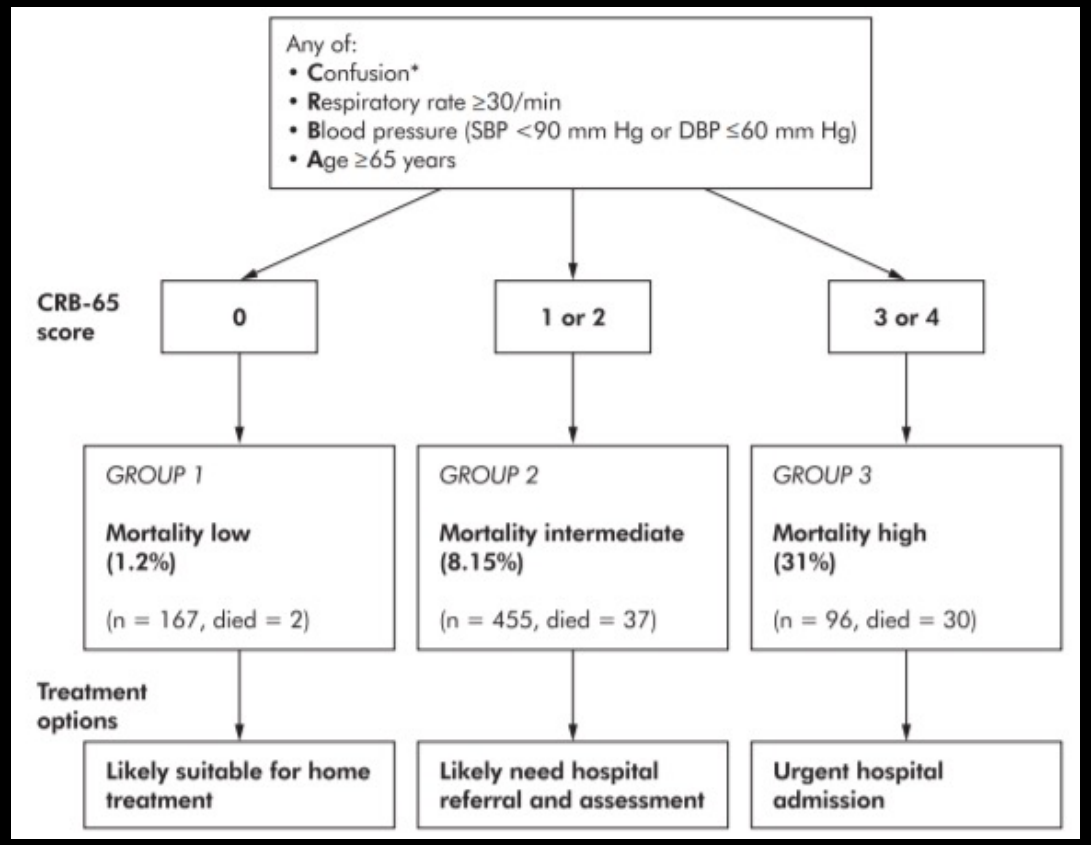
Risk Stratification – CURB 65 Exclusion Criteria

(1) Pneumonia was not the primary cause for hospital admission
(2) An expected terminal event
(3) Pneumonia was distal to bronchial obstruction
(4) Patients with TB, bronchiectasis, solid organ and haematological malignancies or HIV
(5) Admission within the previous 14 days
(6) Immunocompromised
(7) Nursing home residents.

W Lim, M M van der Eerden, R Laing, W Boersma, N Karalus, G Town, S Lewis, and J Macfarlane. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. Thorax. 2003 May; 58(5): 377–382

Risk Stratification – CURB 65 30 Day Mortality





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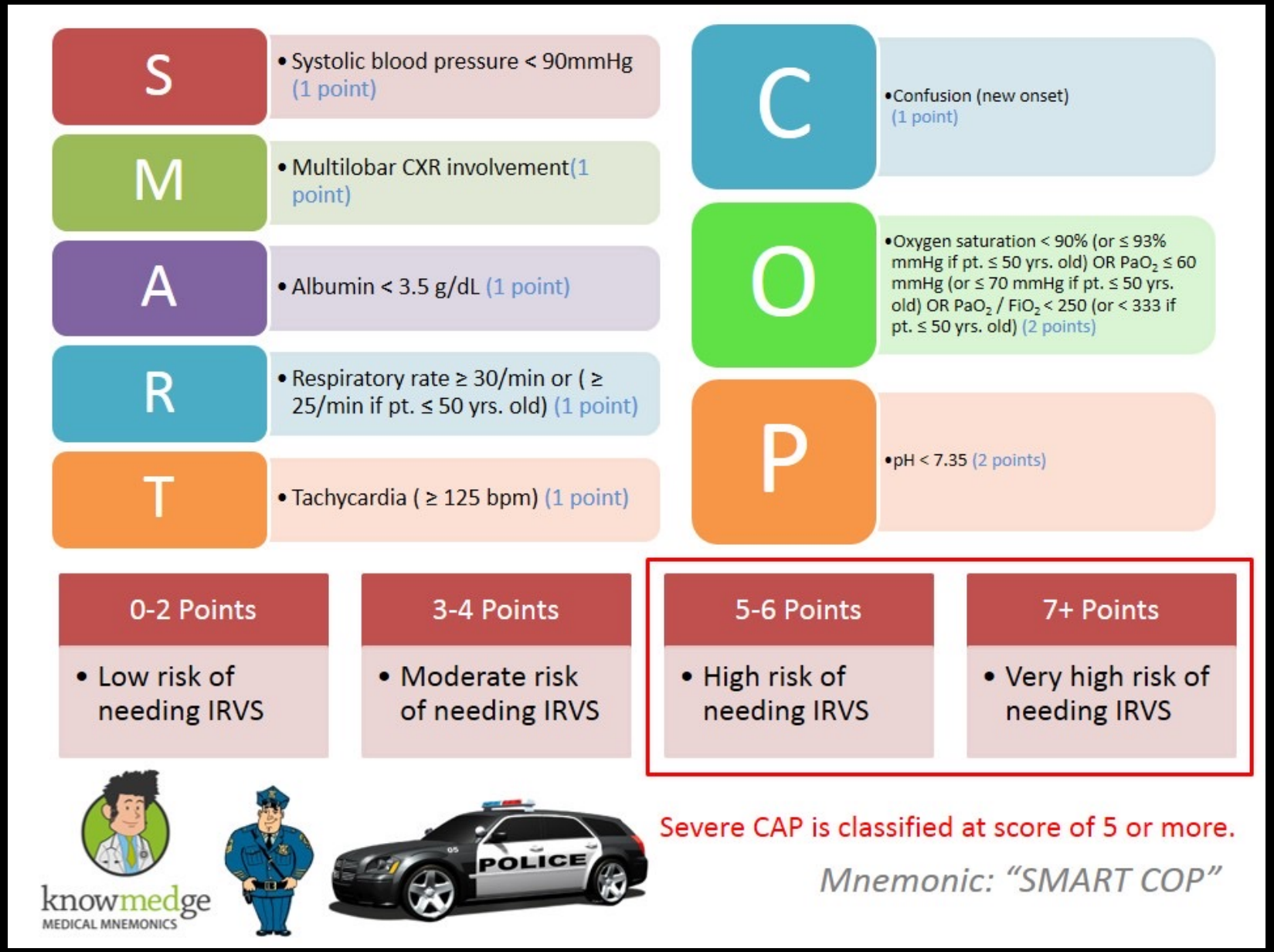
SMART COP

- Aimed to identify increased risk of needing:
  - Ventilatory support
  - Vasopressors
- Does not stratify mortality technically
- Does not include age

Patrick G. P. Charles, Rory Wolfe, Michael Whitby, et al. SMART-COP: A Tool for Predicting the Need for Intensive Respiratory or Vasopressor Support in Community-Acquired Pneumonia. *Clinical Infectious Diseases*, 47(3), Aug 2008, 375–384

SMART-COP



Patrick G. P. Charles, Rory Wolfe, Michael Whitby, et al. SMART-COP: A Tool for Predicting the Need for Intensive Respiratory or Vasopressor Support in Community-Acquired Pneumonia. *Clinical Infectious Diseases*, 47(3), Aug 2008, 375–384

SMART COP

92.3% sensitivity, 62.3% specificity

Uses worst results for each parameter

Inclusion criteria: ≥18 years with clinical and radiographic findings consistent with CAP.

Exclusion criteria: Pregnant women or Immunosuppression

Patrick G. P. Charles, Rory Wolfe, Michael Whitby, et al. SMART-COP: A Tool for Predicting the Need for Intensive Respiratory or Vasopressor Support in Community-Acquired Pneumonia. *Clinical Infectious Diseases*, 47(3), Aug 2008, 375–384

Pneumonia Severity Index (PSI)

Factor	Score
Patient age	
Male	Age
Female	Age - 10
Long-term care facility resident	+10
Accompanying disease[a]	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Chronic kidney disease	+10
Symptoms at diagnosis	
Acute psychosis[b]	+20
Breathing rate ≥30/min	+20
Systolic pressure <90 mmHg	+15
Body temperature <35°C or ≥ 40°C	+15
Heart rate ≥125/min	+10
Laboratory measurements	
Arterial blood pH <7.35	+30
BUN ≥30 mg/dL	+20
Serum sodium <130 mEq/L	+20
Serum glucose >250 mg/dL	+10
Hb <9 gm/dL (hematocrit <30%)	+10
Atmospheric arterial blood gas (PaO_2) <60 mmHg (SaO_2 <90%)	+10

Risk class (Points)	Mortality (%)	Recommended site of care
I (<50)	0.1	Outpatient
II (51–70)	0.6	Outpatient
III (71–90)	2.8	Outpatient or brief inpatient
IV (91–130)	8.2	Inpatient
V (>130)	29.2	Inpatient

QSOFA

RR >22

SBP <100

ALOC

Gestalt

- Co-morbidities
- Work of breathing
- Risk factors
- WCC <4 or >25 x 109/L
- Lactate >2.5
- Hb <90 g/L
- Complications of pneumonia

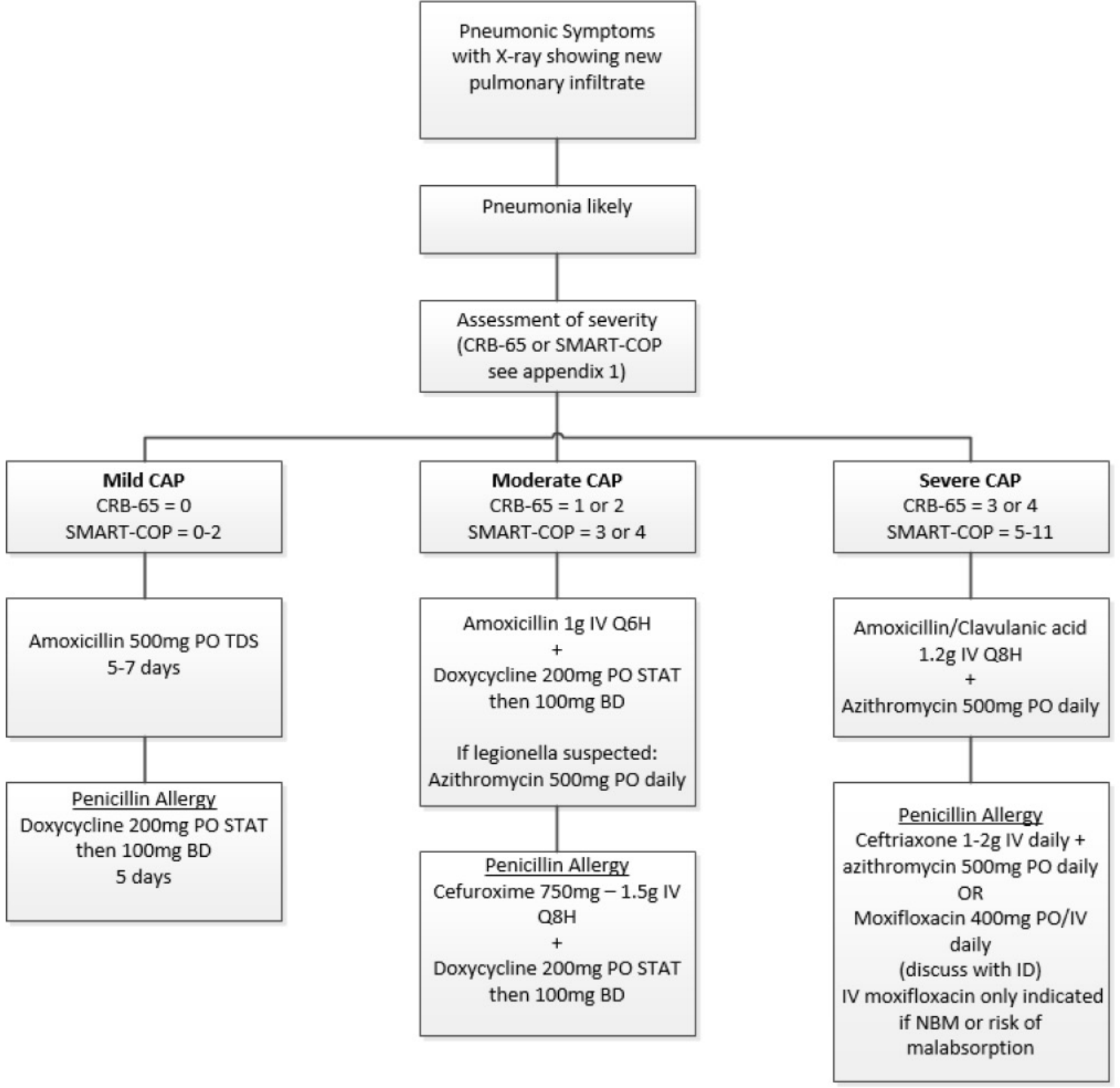
Laboratory tests in Pneumonia?

- Basic Chemistry including liver function, CRP
- CBC
- VBG – if tachypnoea, hypoxia, increased WOB, concern for sepsis

- Blood cultures – if meets sepsis criteria. No indication for routine blood cultures for all pneumonias.
  - Some society guidelines do suggest blood cultures for all admitted patients.

- NPS - For <u>all</u> admitted pneumonia patients

Empiric Management of Bacterial Pneumonia



Waitematā District Health Board

Best Care for Everyone

Follow up CXR?

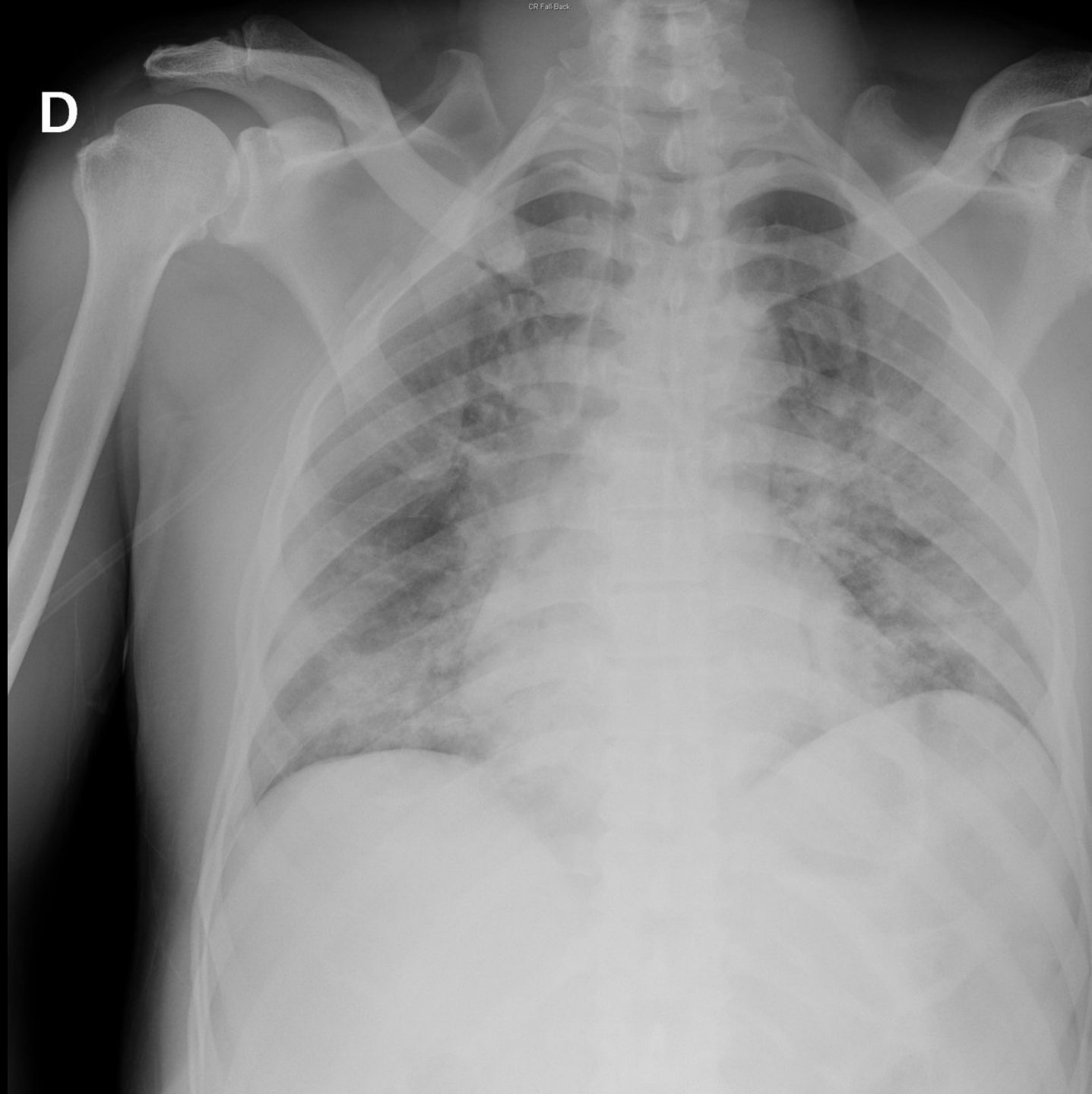
- In outpatients, consider recommending follow up CXR in 8 weeks if:
  - Very old +/- comorbid patients
  - Multifocal consolidation
  - Atypical chest x-ray findings.
  - Smoker or other cancer risk factors

- Routine follow up Chest x-rays not needed for all pneumonias

Case 3

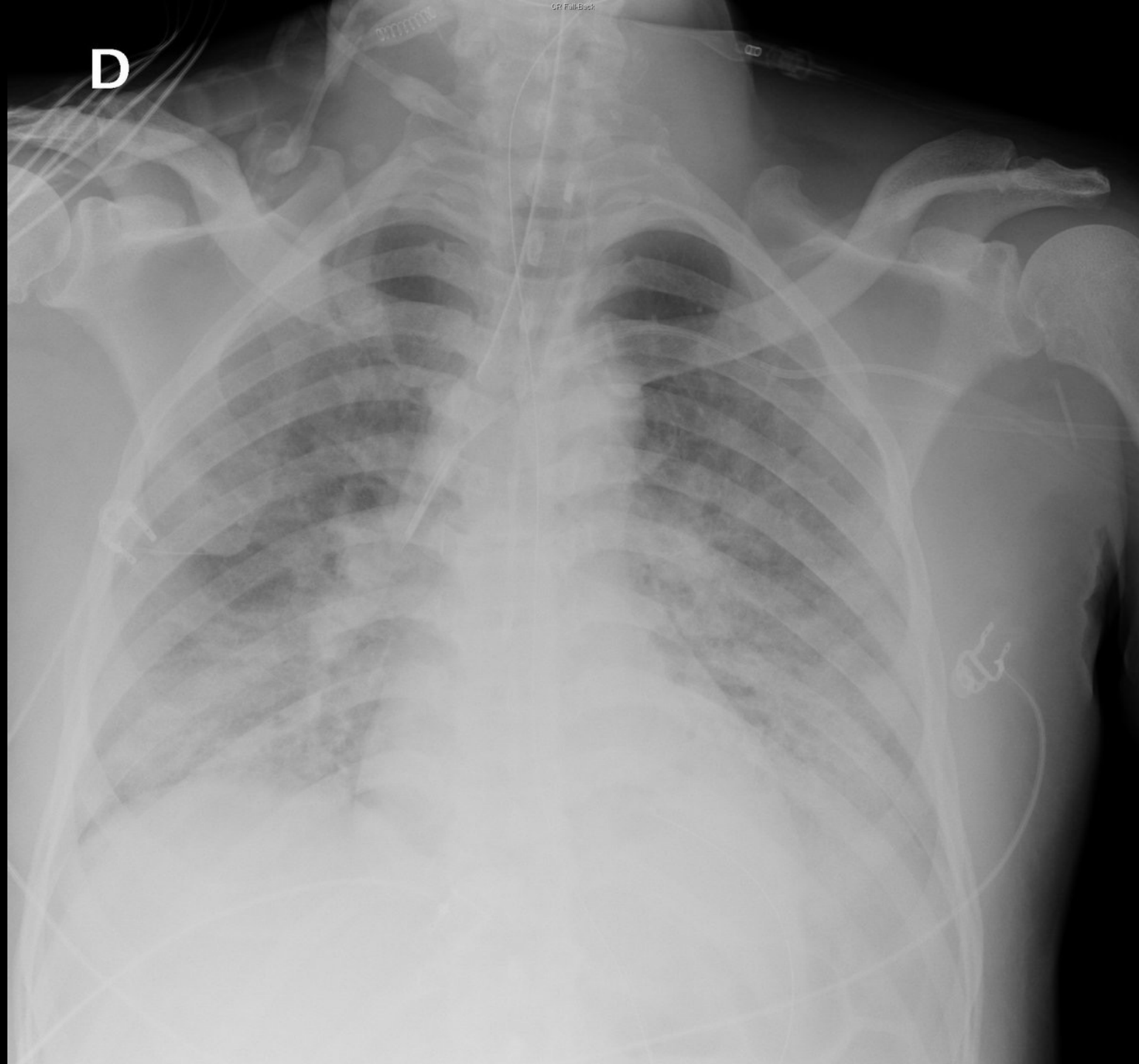
47 year old male presents with two days of fever and cough.

Day 5



Day 8

COVID-19



Viral Pneumonia on CXR

- Non-specific (CXR consolidation does not rule in bacterial infection)
- Usually Bilateral (Can be unilateral)
- Perihilar thickening and infiltrates
- COVID: distribution is most often bilateral, peripheral, and lower zone

Case 4

71 year old man with known previous COPD presents with 3 days of worsening cough, fevers and dyspnoea.

Pneumonia in “Special” Patients

- Acute exacerbation of COPD – no difference.
- Acute exacerbation of bronchiectasis – Amox/clav or cefuroxime

- Effusion or empyema– Amox/clav or cefuroxime + metronidazole
  - May need drainage – often need CT first
  - Consider ED drainage if severe (“white out”), resp distress, otherwise can be done as inpatient.

Waitematā District Health Board

Best Care for Everyone

- Immunocompromised – call a friend.

Pneumonia in “Special” Situations

- Hospital Acquired Pneumonia (HAP) or Aspiration pneumonia
  - Amox/clav 1.2g IV q8hrs
  - Cefuroxime 1.5g IV q8hr + Metronidazole 400mg PO/IV if aspiration

- Legionella or atypical concern – nursing home, older, co-morbid, very high CRP, unusual pattern on CXR, history on previous admissions
  - Add azithromycin 500mg PO

Waitematā District Health Board

Best Care for Everyone

Steroids in Pneumonia

Outcome	No. of Studies (No. of Participants)	Relative Risk (95% CI)	I^2, %
Mortality (adults with severe CAP)	9 (995)	0.58 (0.40–0.84)	12
Mortality (adults with nonsevere CAP)	4 (868)	0.95 (0.45–2.00)	0
Early clinical failure (adults with severe CAP)	5 (419)	0.32 (0.15–0.70)	74
Early clinical failure (adults with nonsevere CAP)	2 (905)	0.68 (0.56–0.83)	0
Early clinical failure (children)	2 (88)	0.41 (0.24–0.70)	25
Hyperglycemia	7 (1,578)	1.72 (1.38–2.14)	21

Steroids reduce time to cure, LOS (ward and ICU), risk of respiratory failure or shock and complication rate

Mortality reduction in severe pneumonias in adults

Seagraves T, Gottlieb M. Are Corticosteroids Beneficial in the Treatment of Community-Acquired Pneumonia? Annals of Emergency Medicine 74(1). 2019
Stern A, Skalsky K, Avni T, Carrara E, Leibovici L, Paul M. Corticosteroids for pneumonia. *Cochrane Database of Systematic Reviews* 2017, Issue 12. Art. No.: CD007720

Case 5

85 year old lady presents with worsening dyspnoea and chronic cough

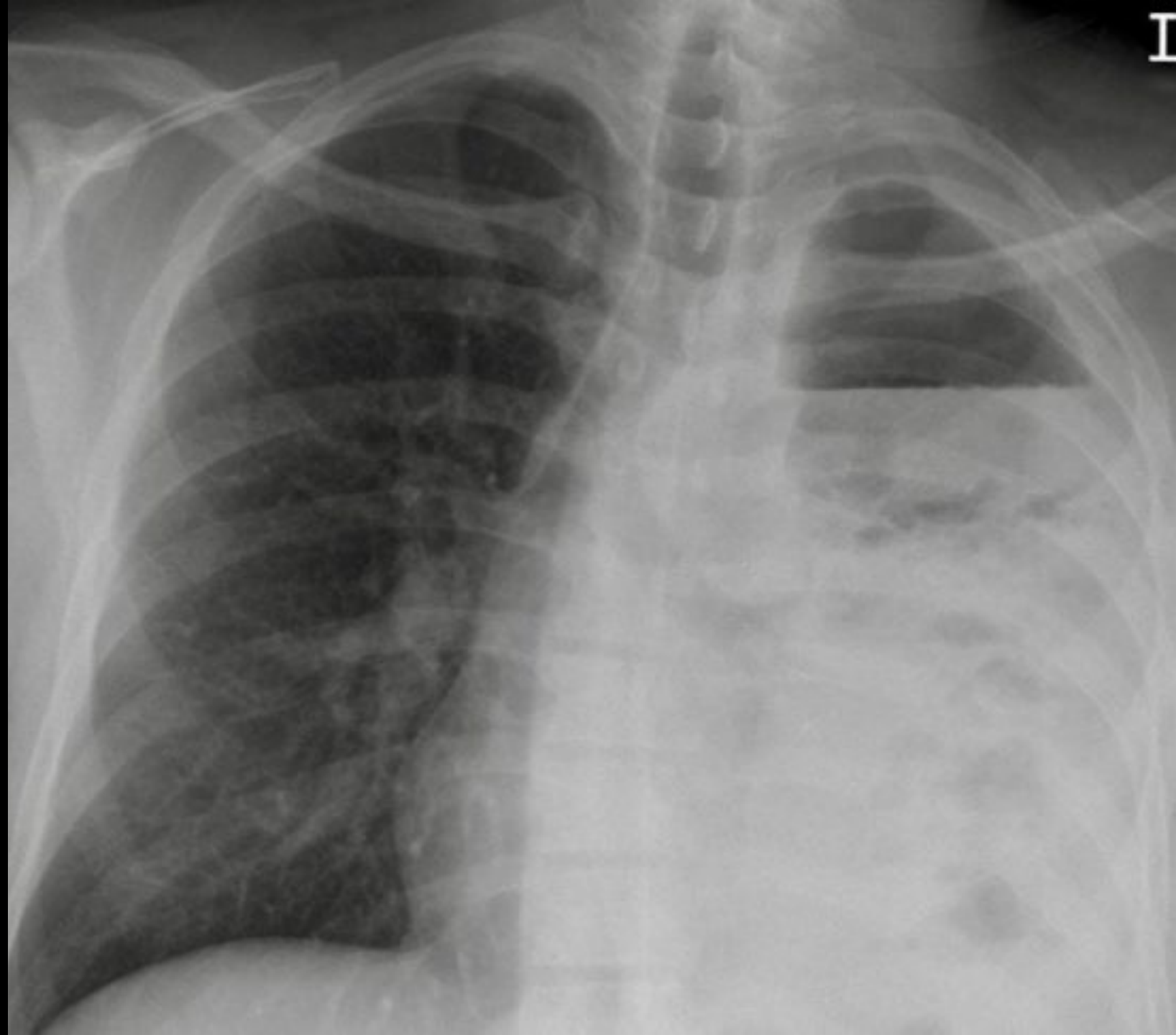
Atypical pneumonias

- Immunocompromised patients
- Recent Travel
- Immigrants from developing countries
- People living in crowded conditions
- People with underlying lung pathology

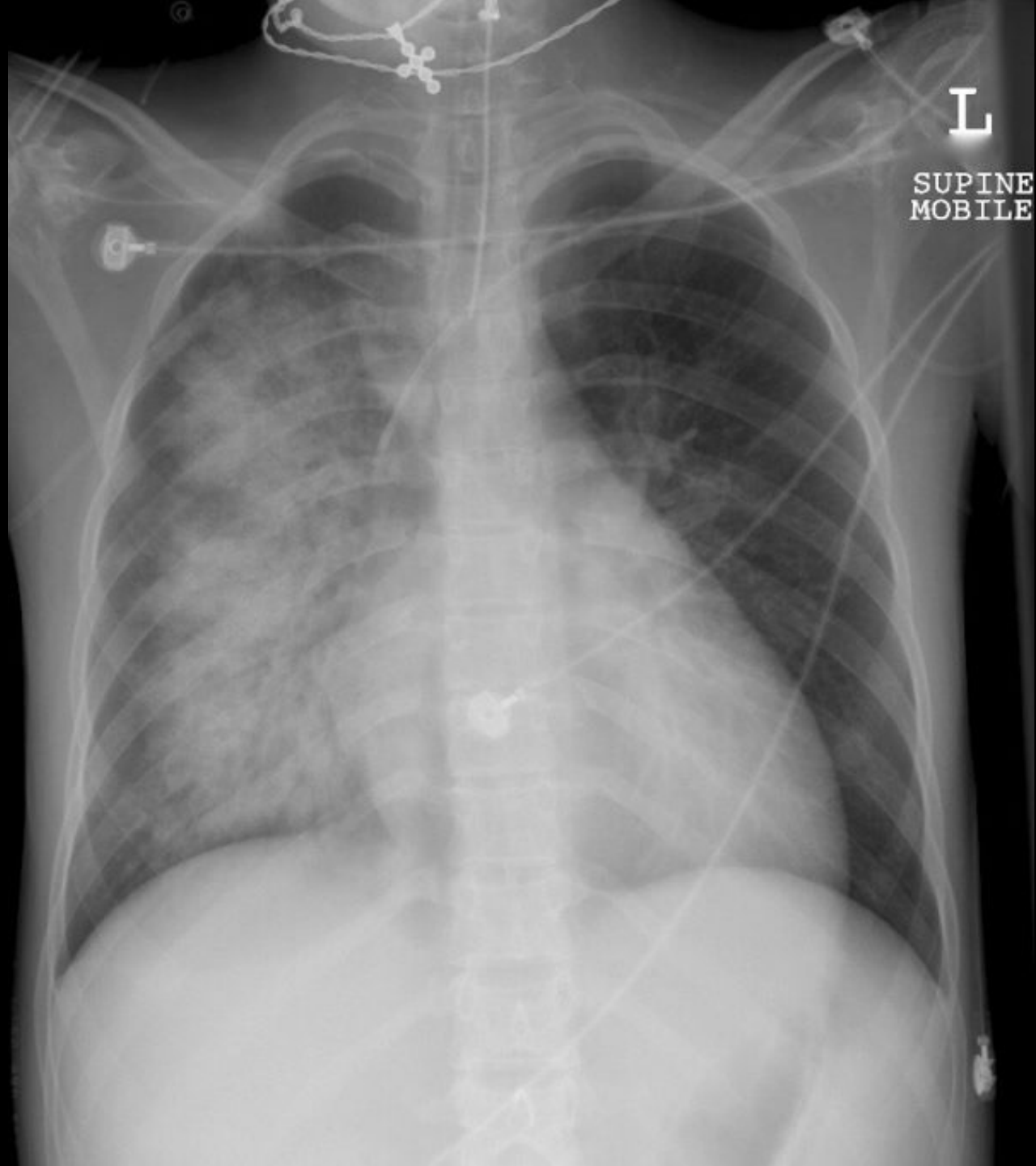
Atypical Pneumonia Hints

- Streptococcal pneumonia classically causes a '*rusty brown*' sputum which is commonly mistaken as haemoptysis.
- The sparing of the lung periphery is unusual but does not necessarily mean this is caused by an atypical organism. (20%)
- Gram negative pneumonia (legionella) more common in nursing homes, co-morbid patients or those exposed to antibiotics.
- Aspiration pneumonias tend to be gravity dependent
- TB is often bilateral though can be variable depending on presentation/stage of disease.

43 year old man was discharged from hospital 1 week ago having been treated for pneumonia



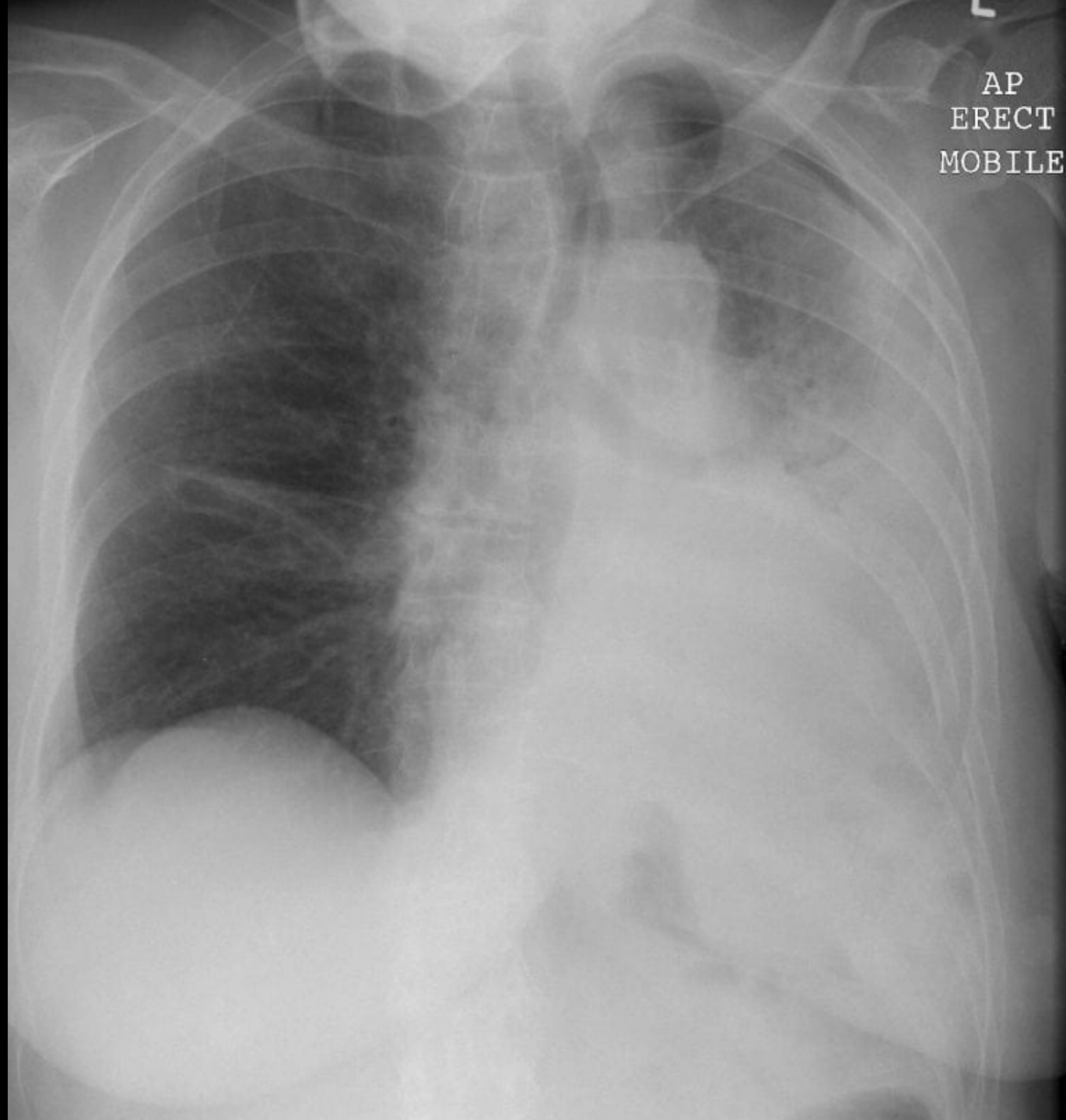
A 60 year old man is intubated in ED having presented by ambulance profoundly hypoxaemic in respiratory distress



Case 6

76 year old woman presents with fever and productive cough for 2 days.

From care home, hx of dementia



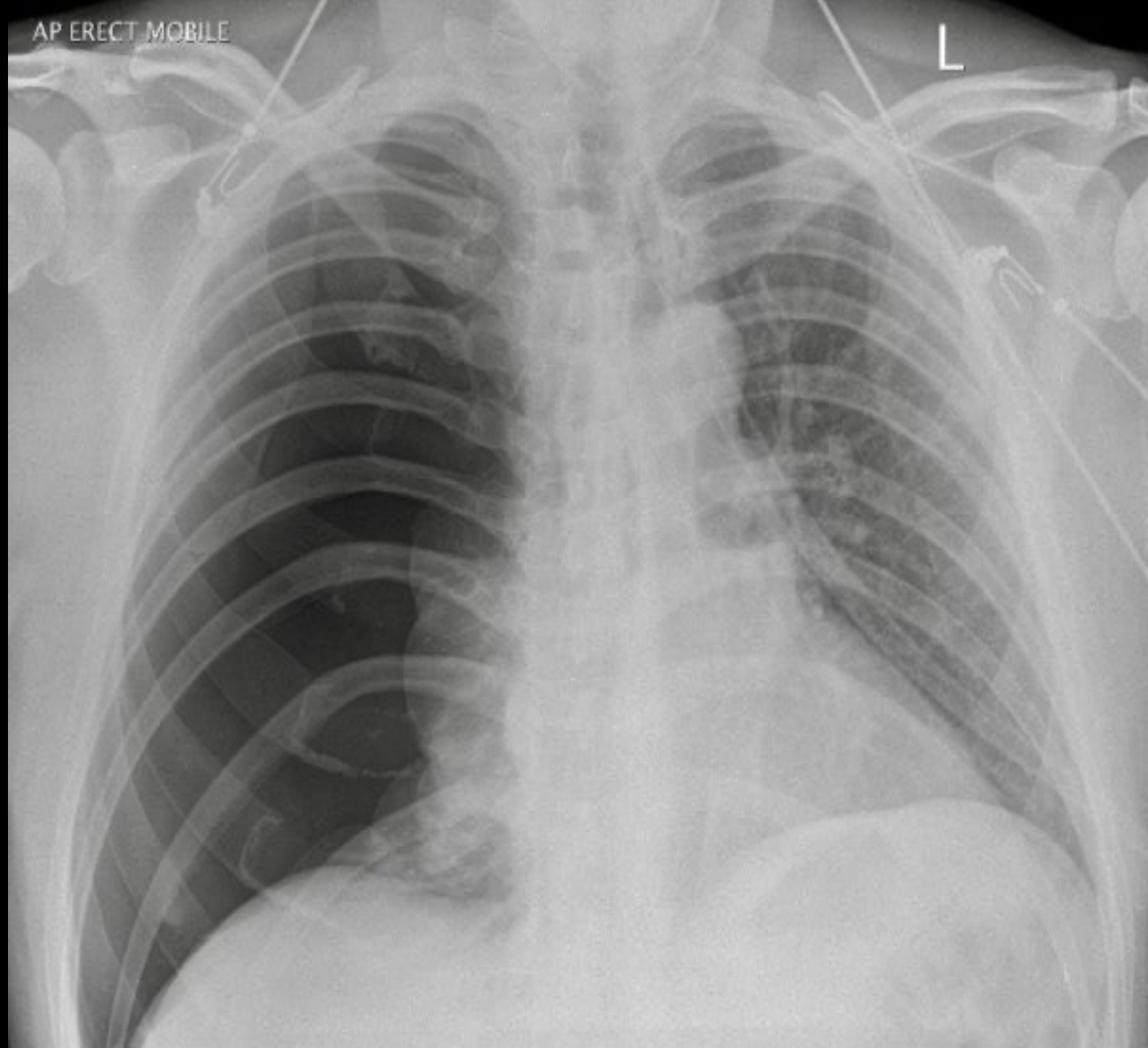
PNEUMOTHORAX

Case 7

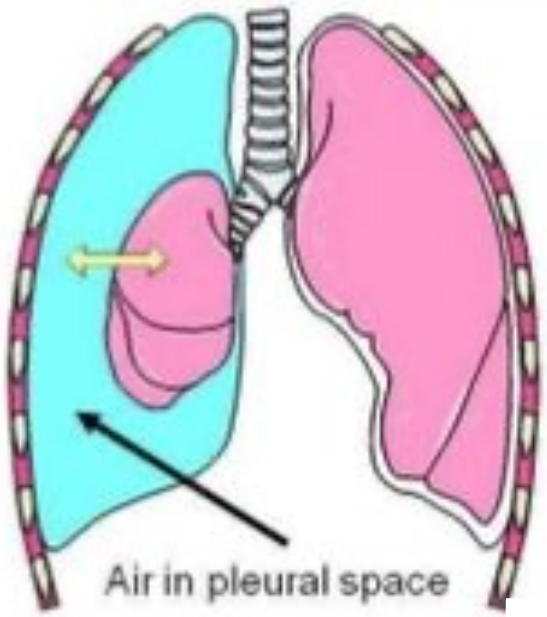
A 39 year old man presents with sudden onset right sided pleuritic pain.

Smokes marijuana

SpO2 on air 96%

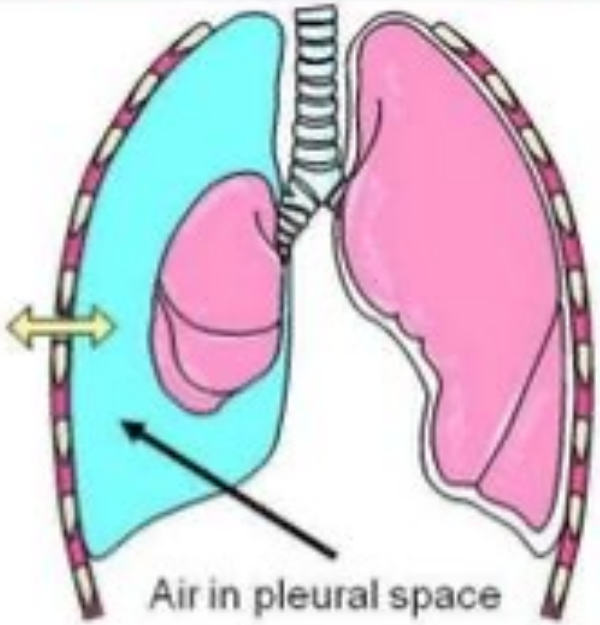


Spontaneous Pneumothorax



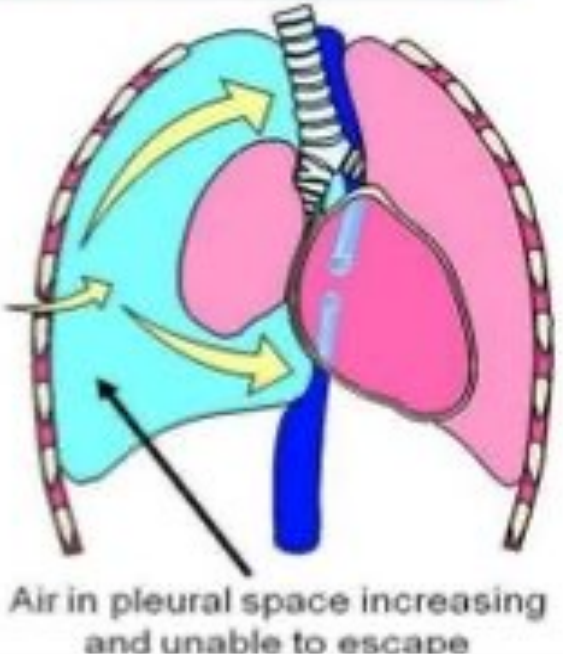
The pleural cavity pressure is < the atmospheric pressure

Traumatic Pneumothorax



The pleural cavity pressure is = the atmospheric pressure

Tension Pneumothorax



The pleural cavity pressure is > the atmospheric pressure

https://medicinespecifics.com/spontaneous-vs-tension-pneumothorax/

“Types” of pneumothoraces

- Spontaneous Pneumothorax (SPT)
  - **Primary** (no disease)
  - **Secondary** (underlying lung disease)
- Traumatic Pneumothorax
  - **Iatrogenic** (barotrauma and procedure related)
- Tension Pneumothorax – intrapleural air under positive pressure for the entire respiratory cycle
  - Spontaneous (rarely)
  - Usually Traumatic
- Occult Pneumothorax – seen on CT (or US) but not on CXR

Primary Spontaneous Pneumothorax

- No obvious underlying pathology
- **Risk factors:**
  - Young
  - Male (15 vs. 5 per 100,000)
  - Tall
  - Smoking
  - Change in air pressure (diving)
  - Marfan's syndrome
  - Cocaine use
  - Mitral valve prolapse

Rosen's Emergency Medicine (9th ed)

Secondary Spontaneous Pneumothorax

Airway disease

- COPD - 70% of secondary PTX. Often due to bullae development.
- Asthma
- Cystic fibrosis (CF)

Infections

- Lung abscess or necrotising lung infections
- PCP
- Tuberculosis

Interstitial lung disease

- Sarcoidosis
- Pulmonary fibrosis
- Lymphangiomyomatosis - abnormal smooth muscle proliferation
- Tuberous sclerosis
- Pneumoconiosis - fibrosis due to dust inhalation

Other

- Neoplasm - Primary lung CA vs. Pleural/pulmonary metastatic disease
- Connective tissue disease
- Pulmonary infarct
- Catamenial (endometrial) PTX - Rare. within 72hrs of onset of menses

Pneumothorax Presentation

- Shortness of breath
- Pleuritic Chest pain
- Subcutaneous emphysema
- Tachypnoea, tachycardia, hypoxia

Tension PTX = clinical obstructive shock

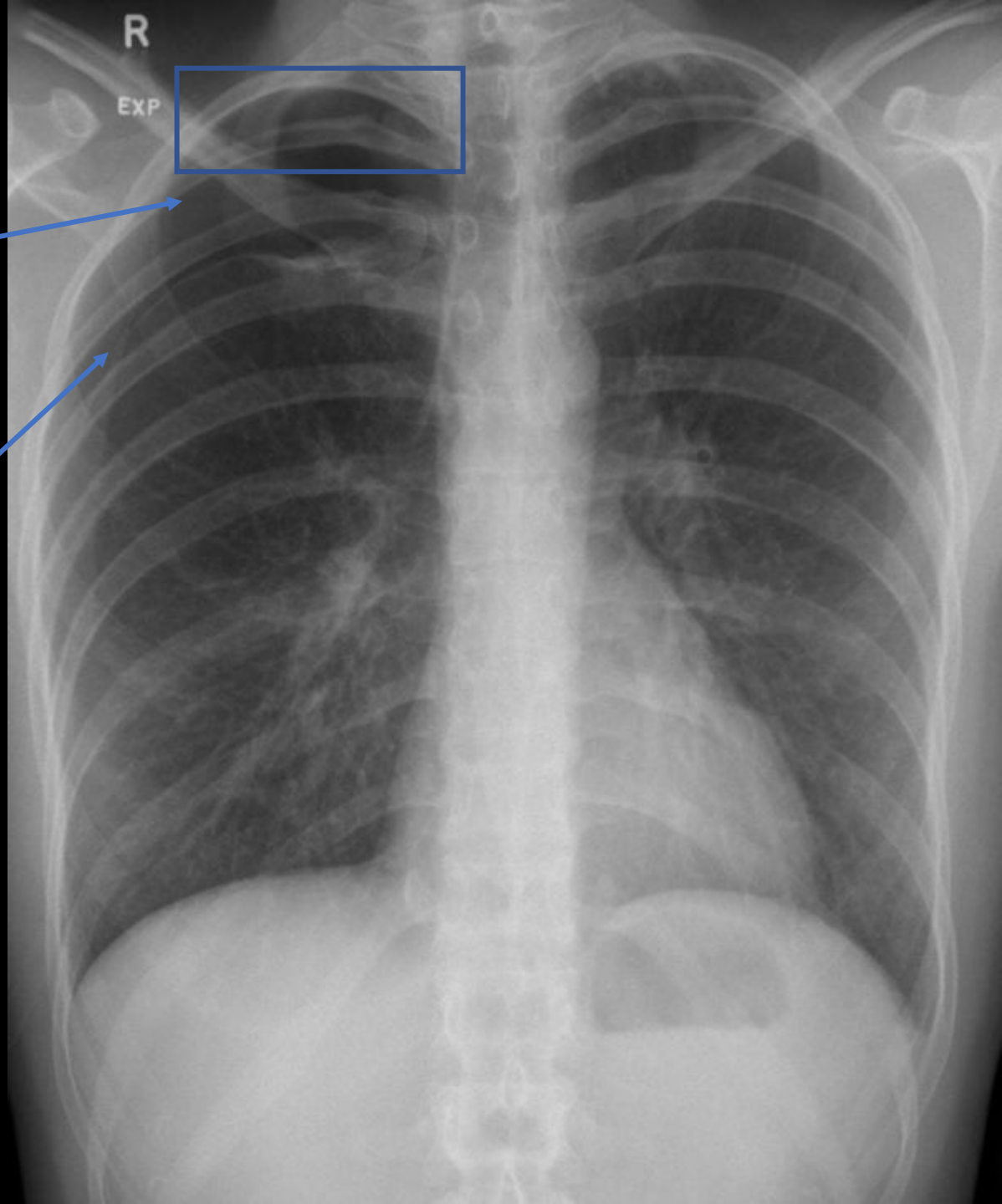
- Rapidly deteriorating patient with respiratory distress, hypotension, severe tachycardia and loss of breath sounds/ chest rise on one side

- Textbook: Distended neck veins, tracheal deviation, displaced apex beat.

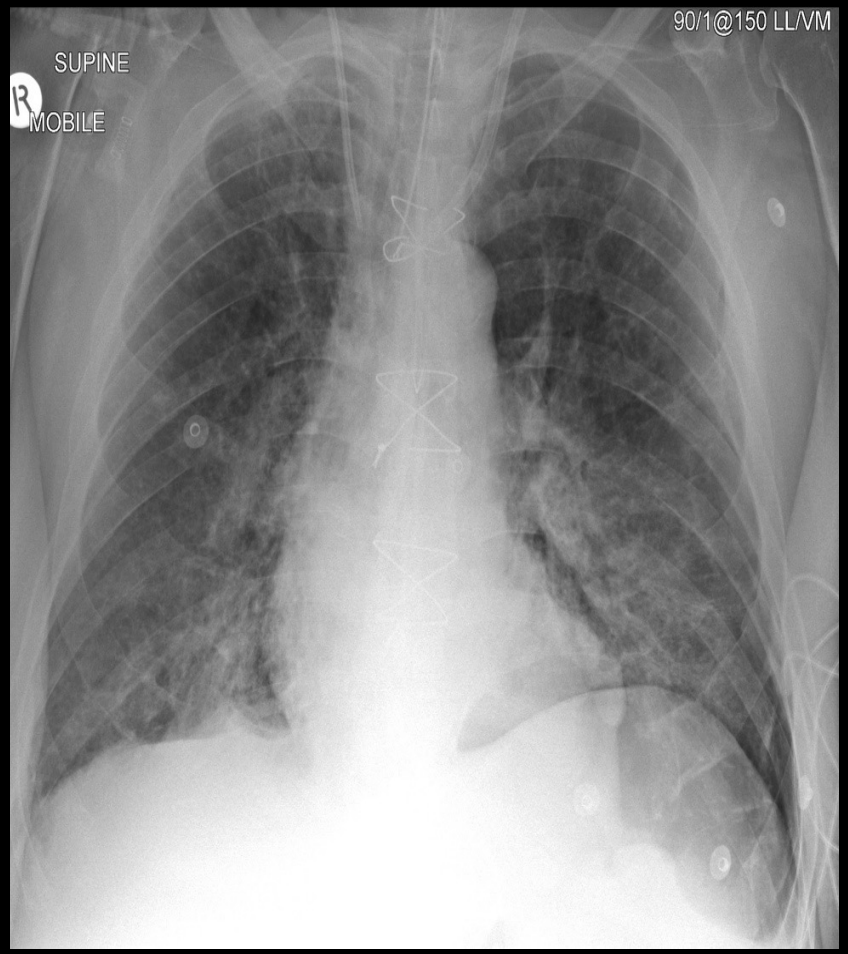
Finding a Pneumothorax on X-ray

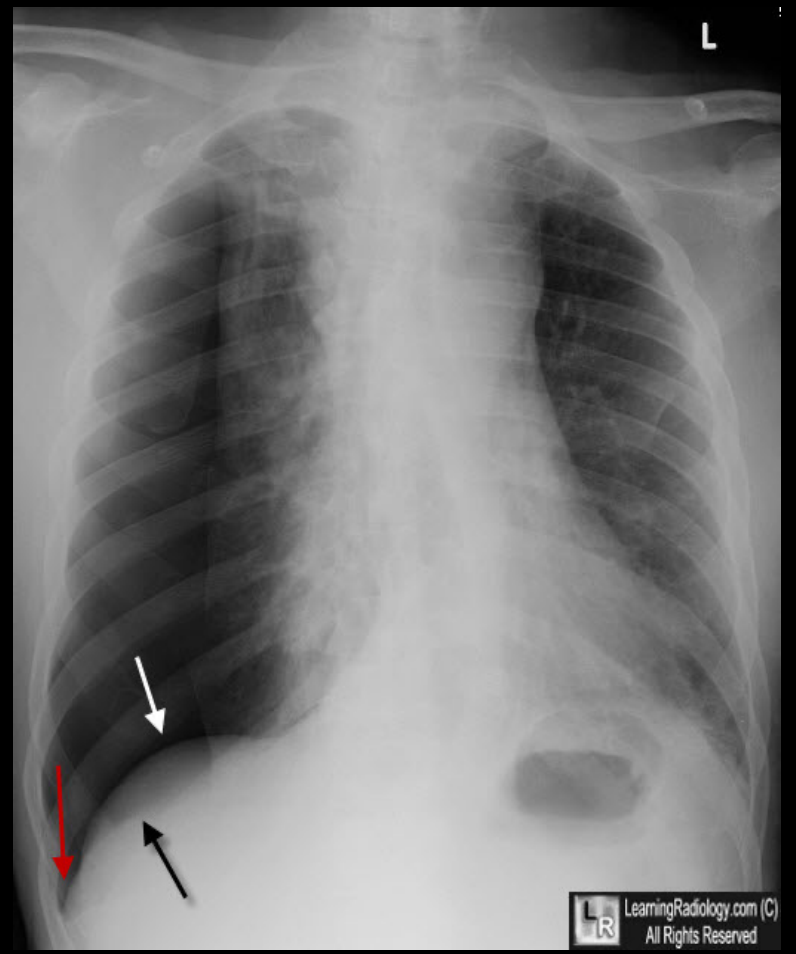
Hyperlucency

Visualisation of visceral pleural



Deep Sulcus Sign on supine X-ray





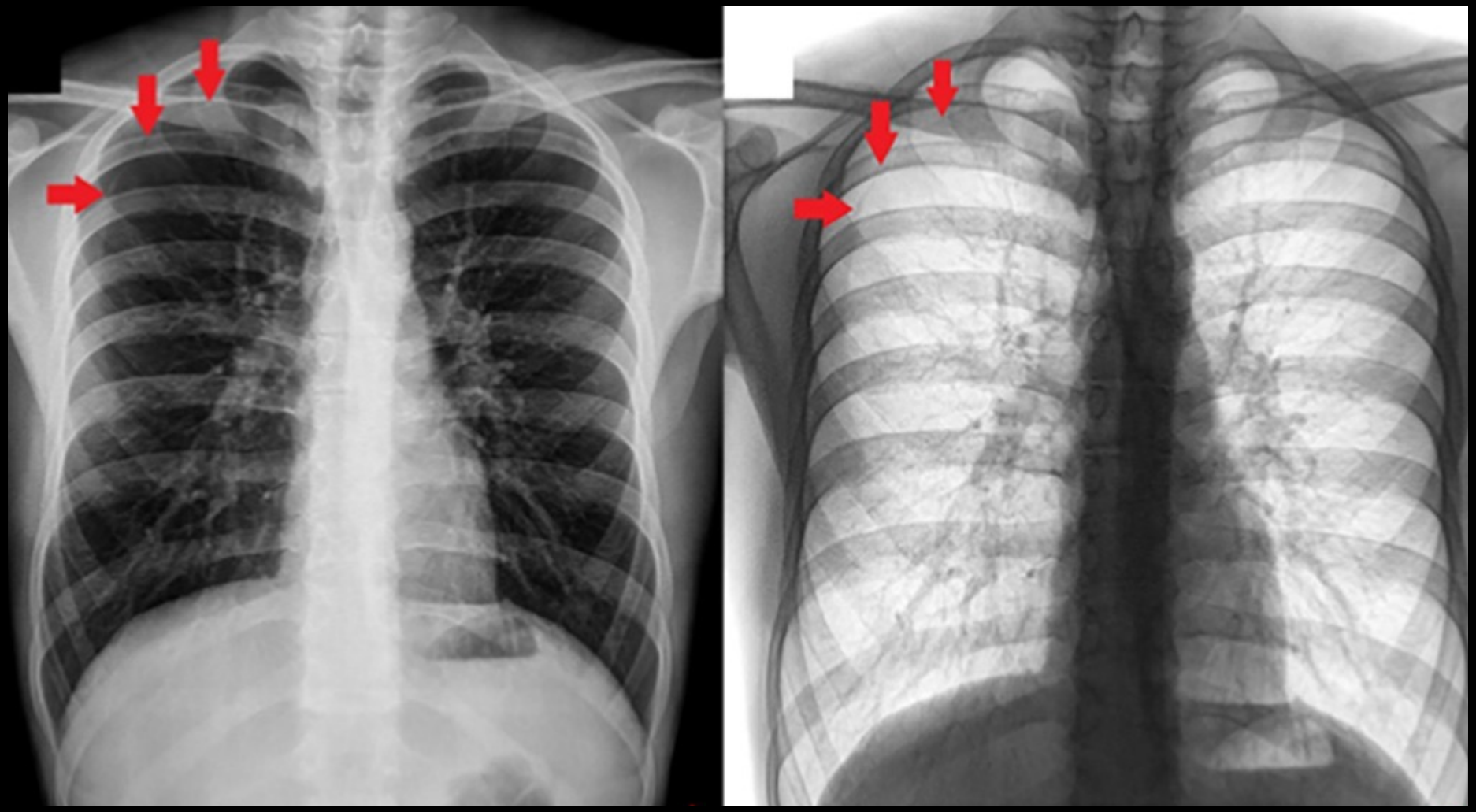
Inverting the X-ray

106 PTX CXRs

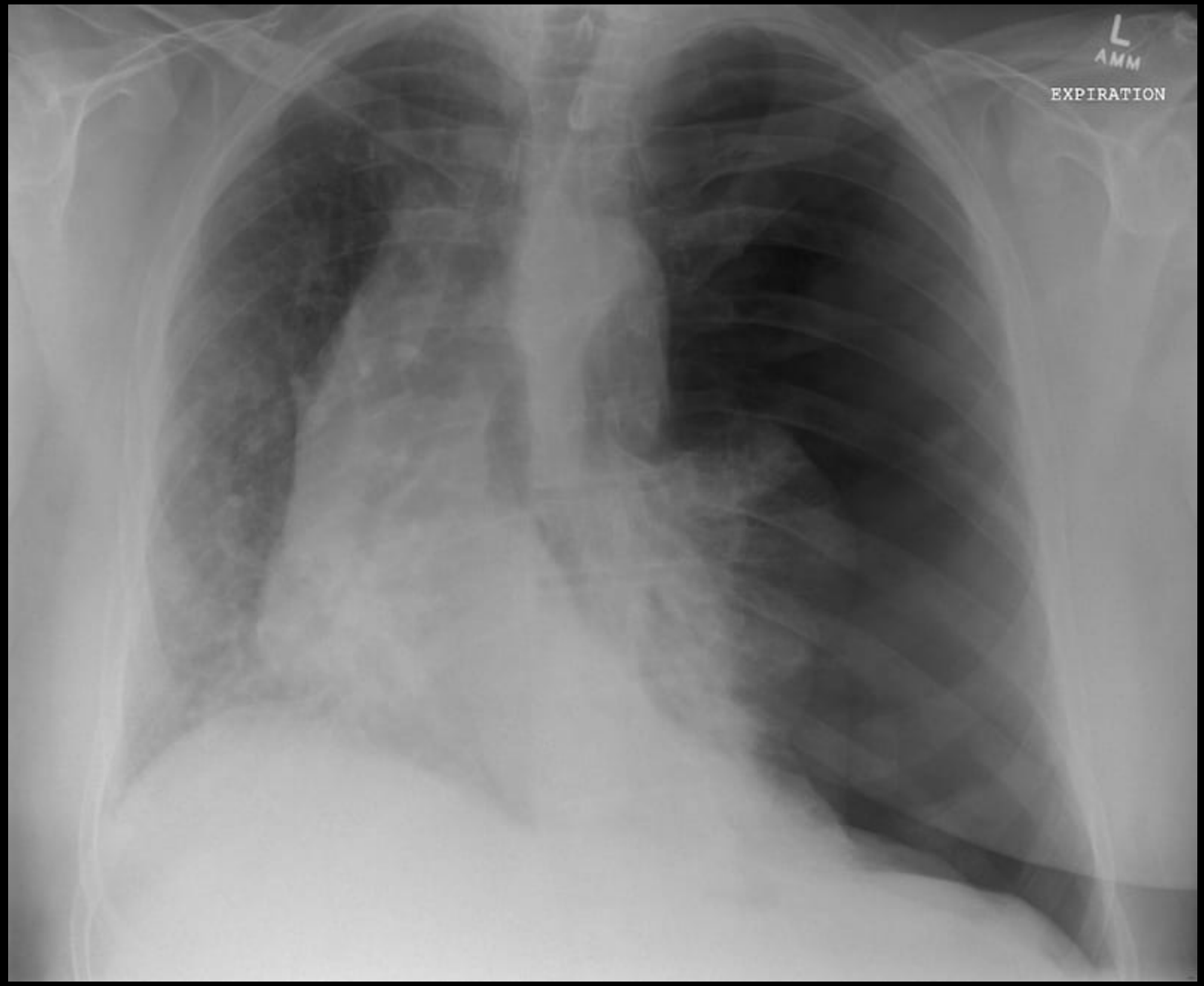
162 normal CXRs

Sensitivity of conventional CXR higher than inverted gray-scale images

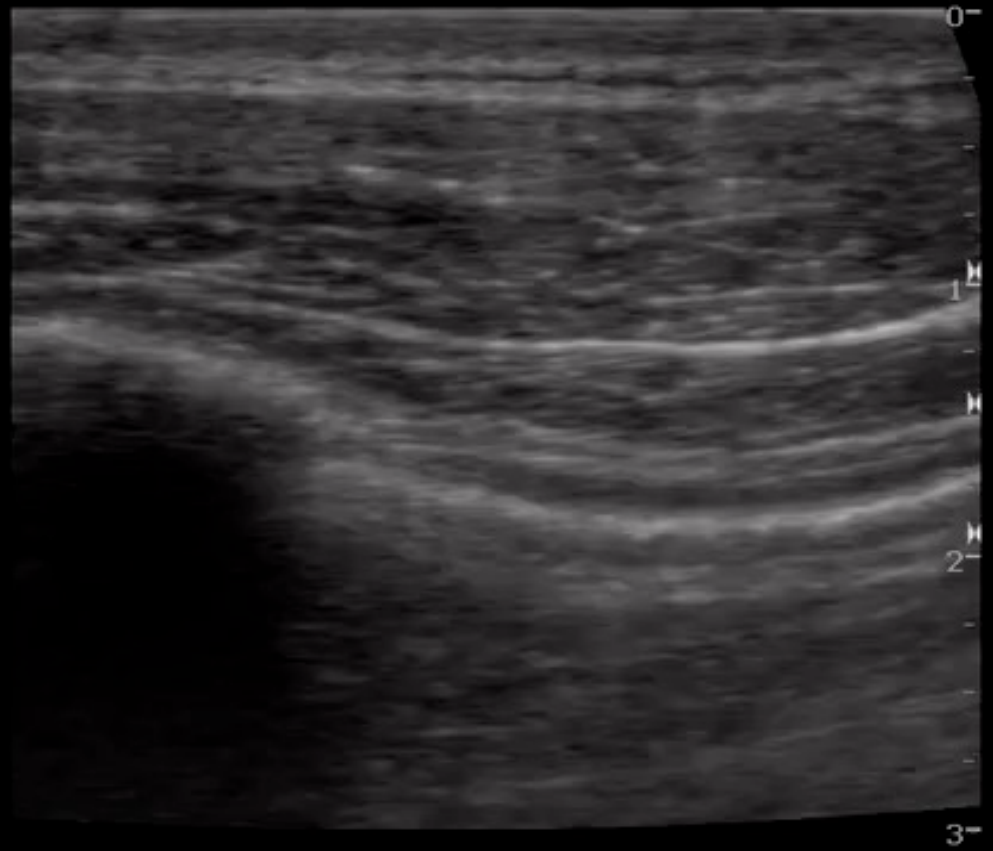
(95% CI (2,08–5,04), $p < 0,01$)

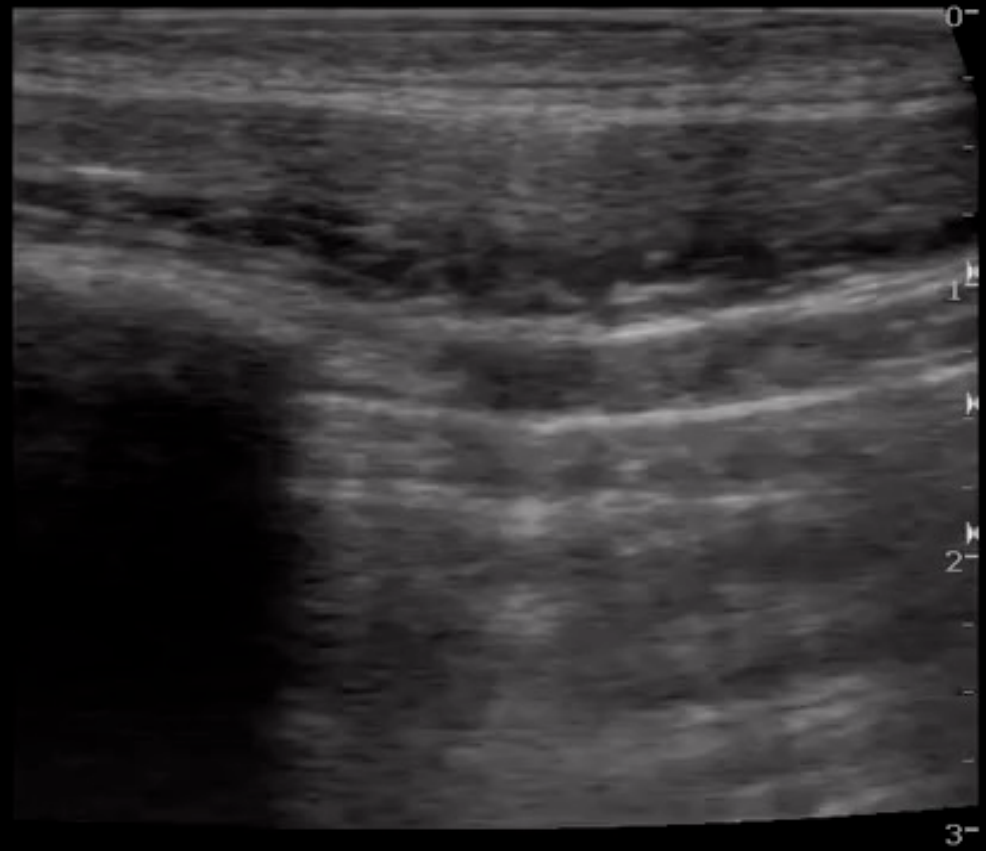


Musalar et al. Conventional vs invert-grayscale X-ray for diagnosis of pneumothorax in the emergency setting. American J. Of EM Volume 35, Issue 9, September 2017, Pages 1217-1221


L
AMM
EXPIRATION

Pneumothorax on Ultrasound

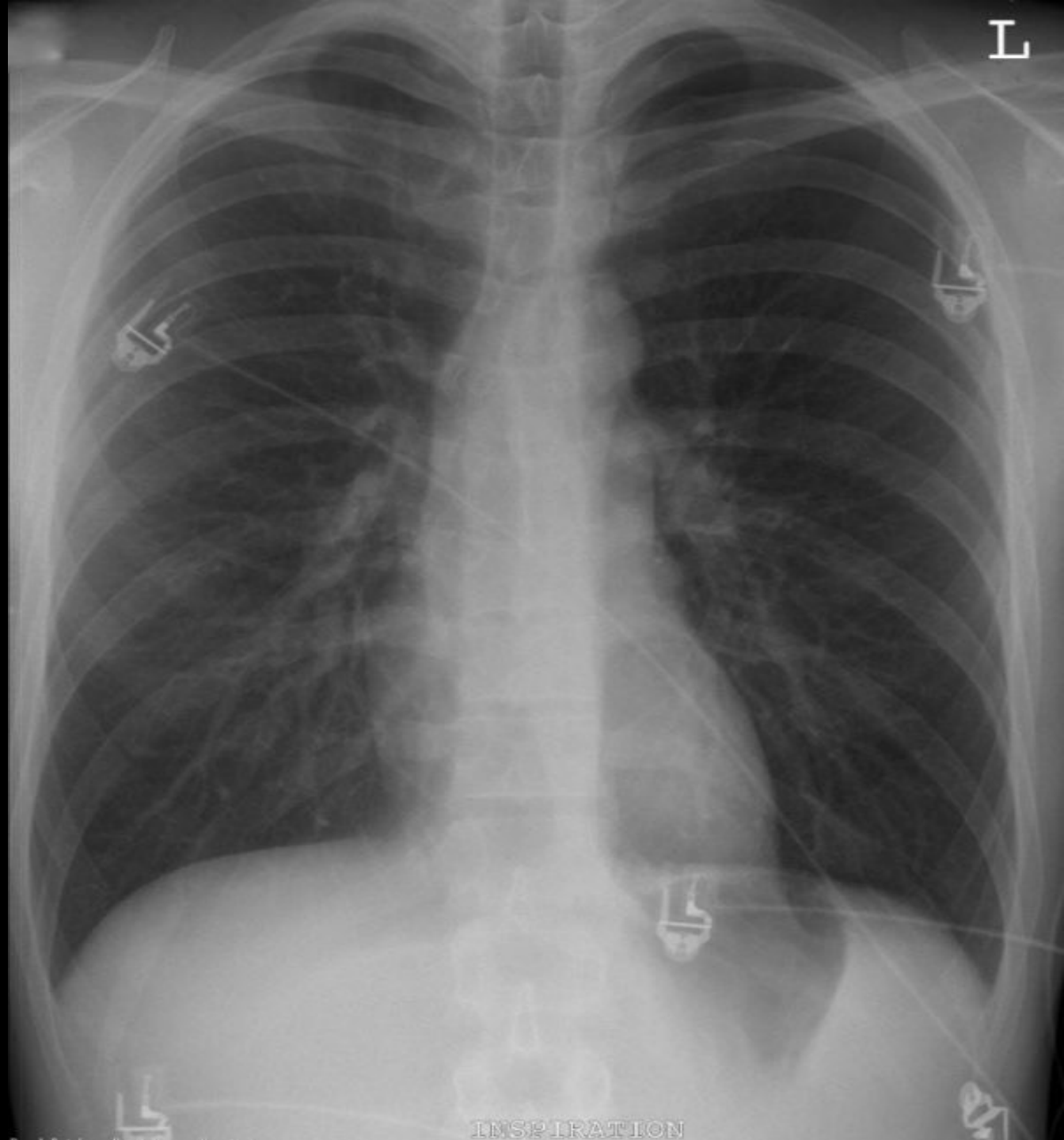




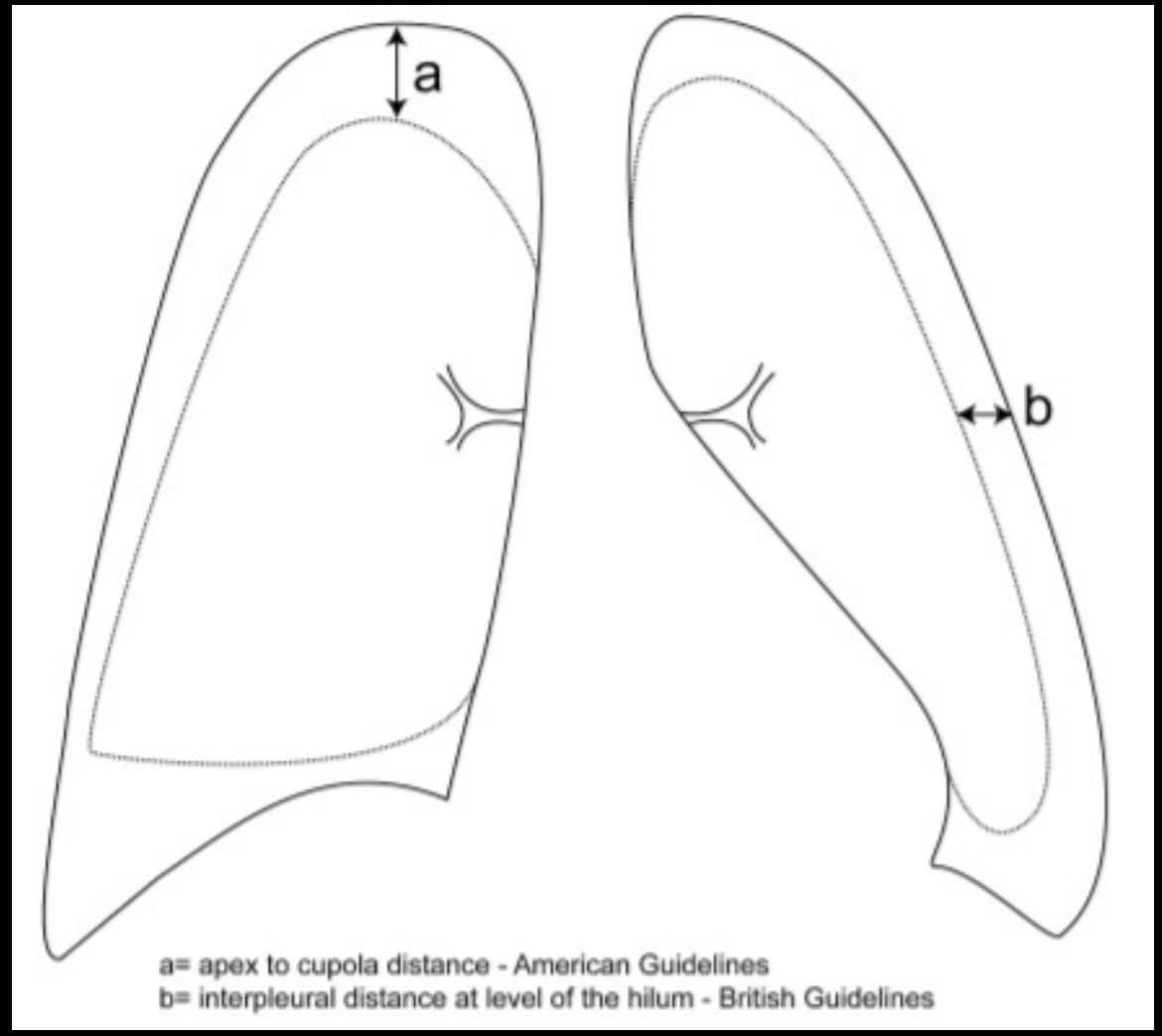
Case 8

A 28 yo man presents with sudden onset left sided sharp chest pain.

P 85, RR 14, SpO2 on air 98%



How big is this pneumothorax?



- Large pneumothorax if:
  - a >3cm
  - b >2cm
- Size matters less than presentation
- CT > CXR

Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010 A MacDuff, A Arnold, J Harvey, on behalf of the BTS Pleural Disease Guideline Group

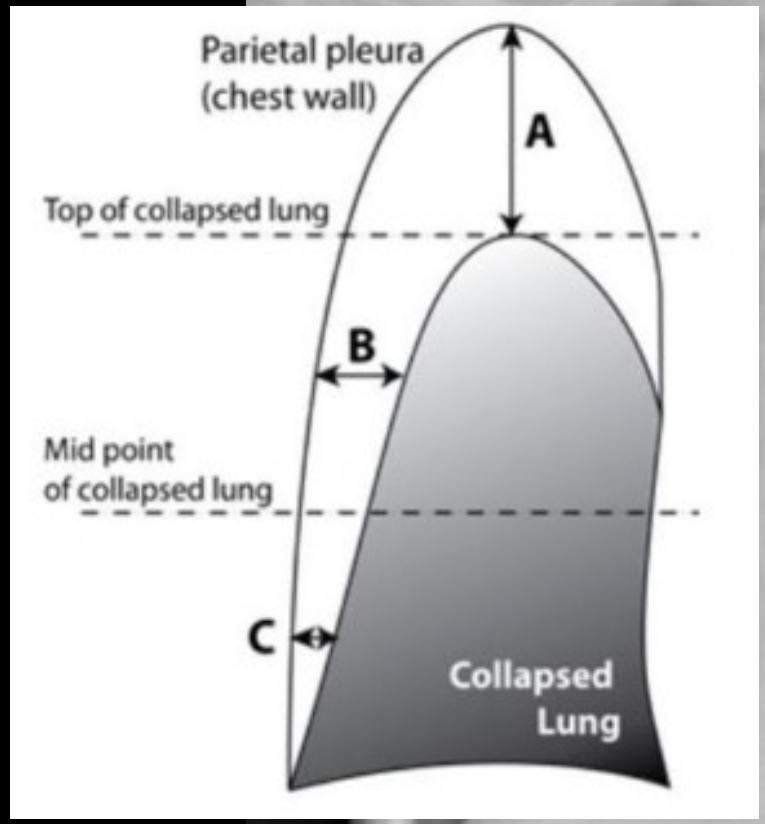
How big is this pneumothorax?

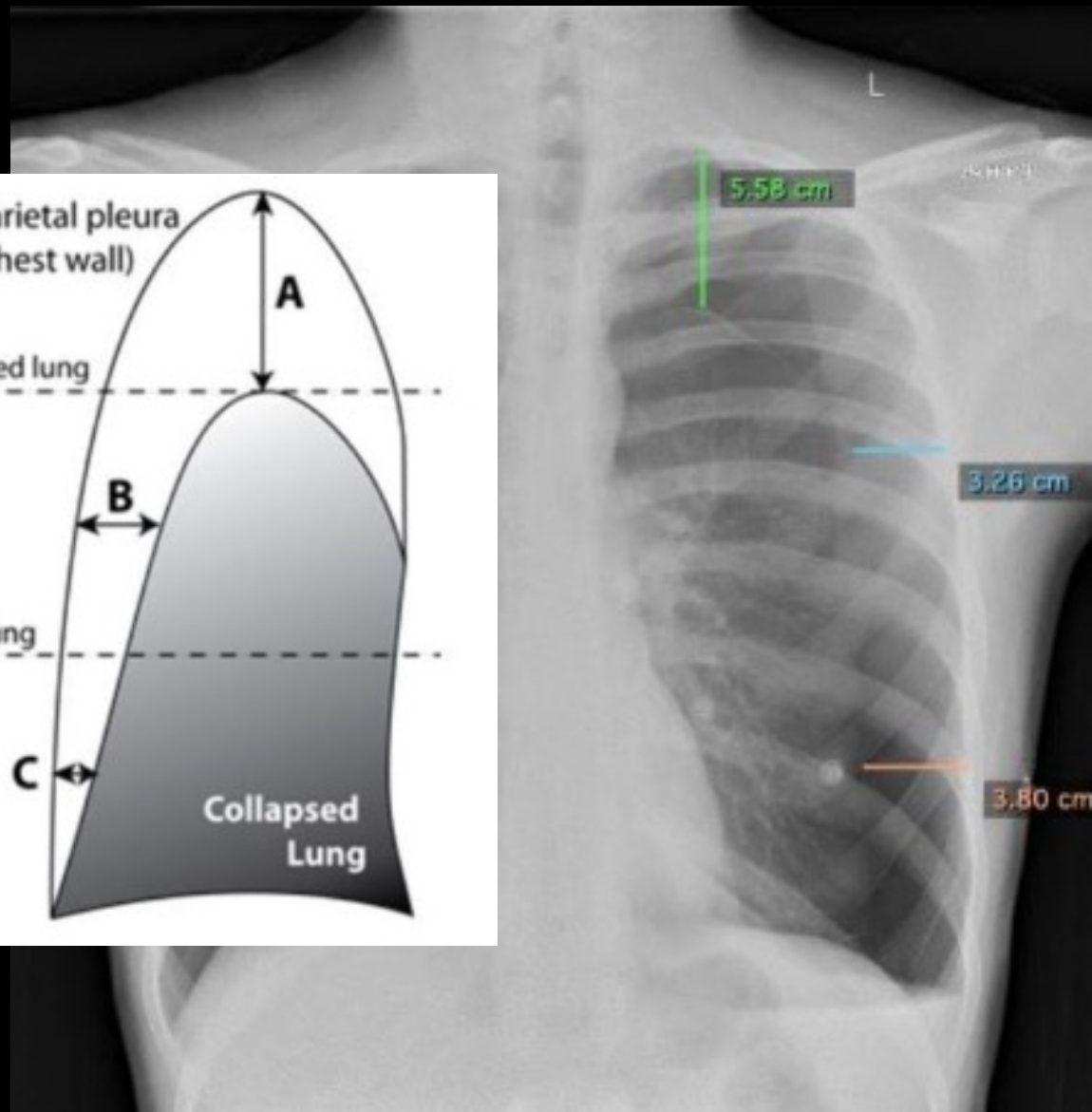
Collins method

% = 4.2 + 4.7 (A + B + C)

- A = maximum apical interpleural distance
- B = interpleural distance at midpoint of upper lung half
- C = interpleural distance at midpoint of lower lung half

>32% = not small





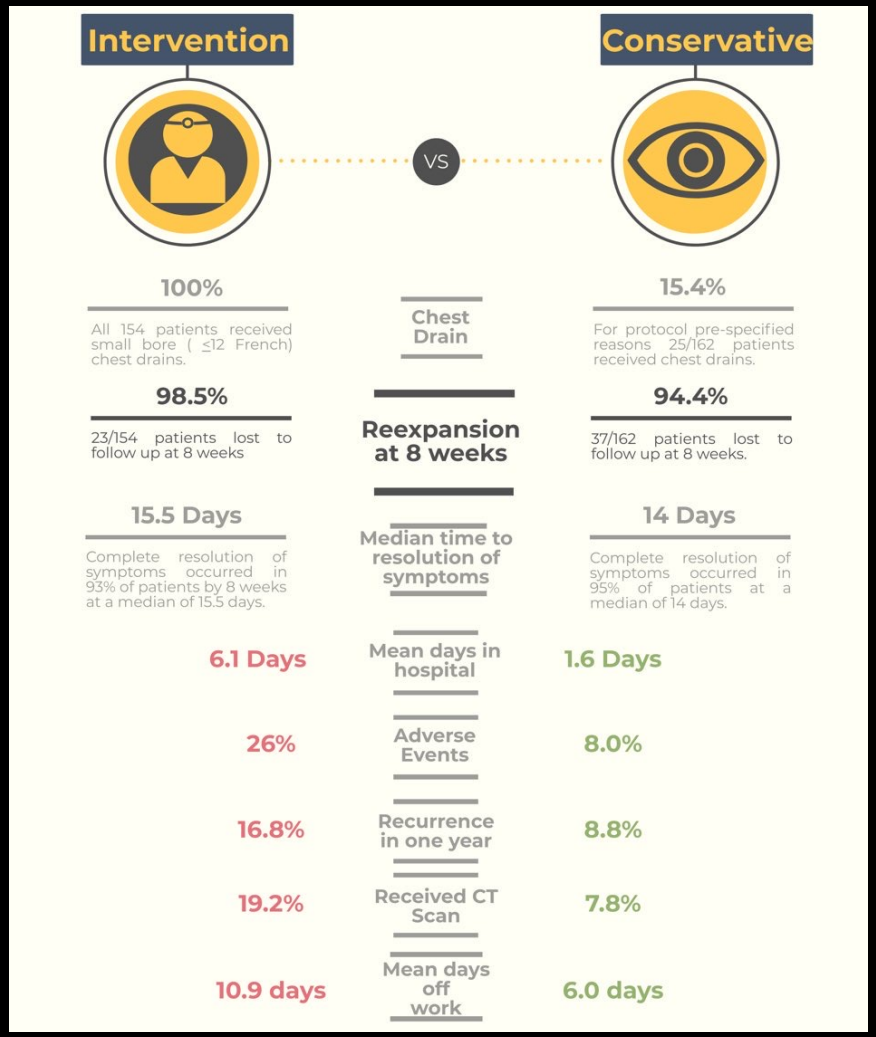
Indications for drainage of a pneumothorax

1. Respiratory distress, hypoxia or any evidence of tensioning
2. Recurrent primary pneumothoraces
3. Pneumothorax associated with effusion (or haemothorax)
4. Failed conservative therapy or aspiration
5. Expectation of positive pressure ventilation or transport
6. Recurrent pneumothorax after chest tube removal
7. …Traumatic Pneumothorax (debatable)
8. …Large pneumothorax (debatable) – 2010 guidelines

Do large pneumothoraxes need drainage?

RCT **Non-inferiority design**

316 patients aged 14-50 with first **MODERATE** to **LARGE** spontaneous pneumothorax were randomized to immediate interventional management or conservative (watch and wait) approach.



BOTTOM LINE

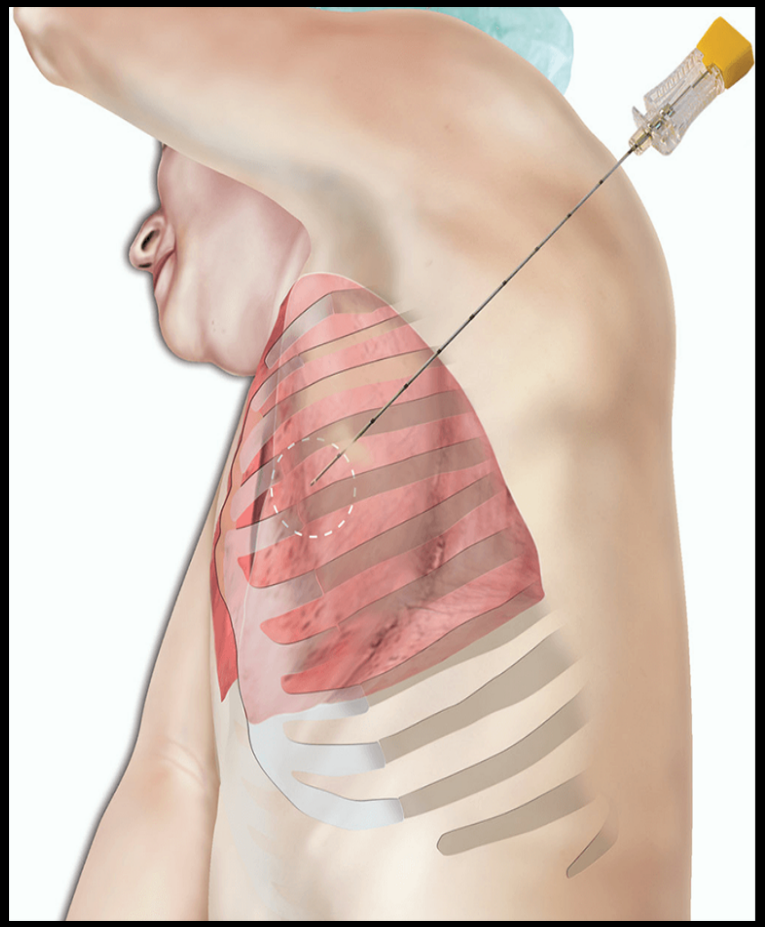
This study provides modest evidence that **conservative management is non-inferior to chest tube placement** for moderate-large spontaneous pneumothoraces and favours all patient-centred outcomes.

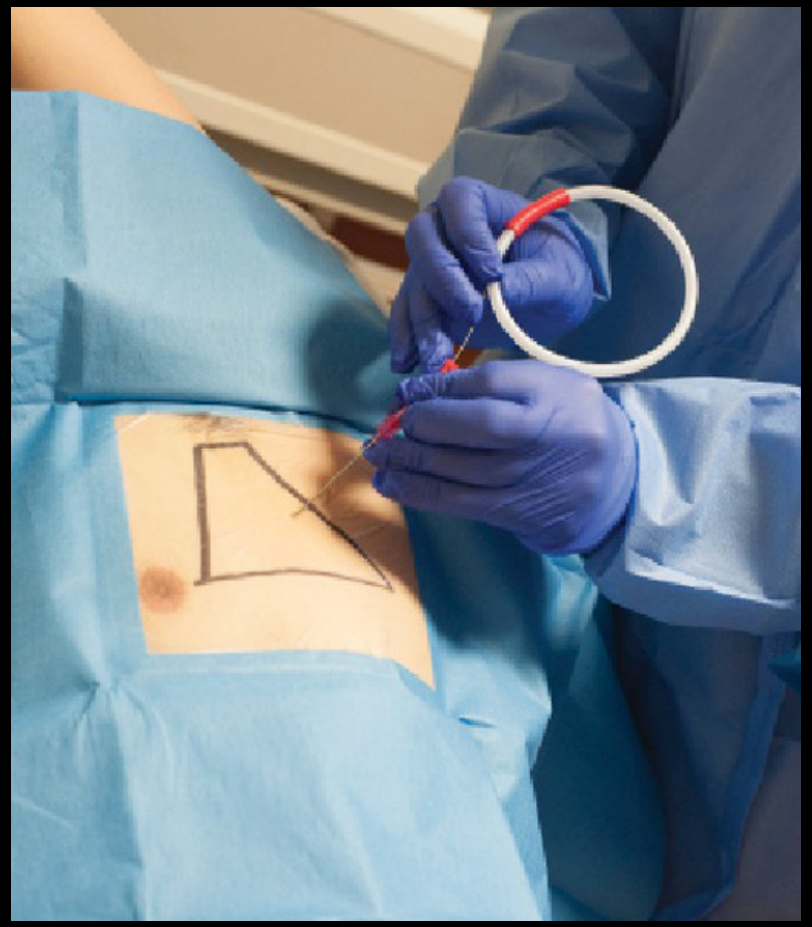
Brown SGA, Ball EL, Perrin K, et al, for the PSP Investigators. Conservative versus interventional trea
spontaneous pneumothorax. N Engl J Med 2020;382(5):405-415.

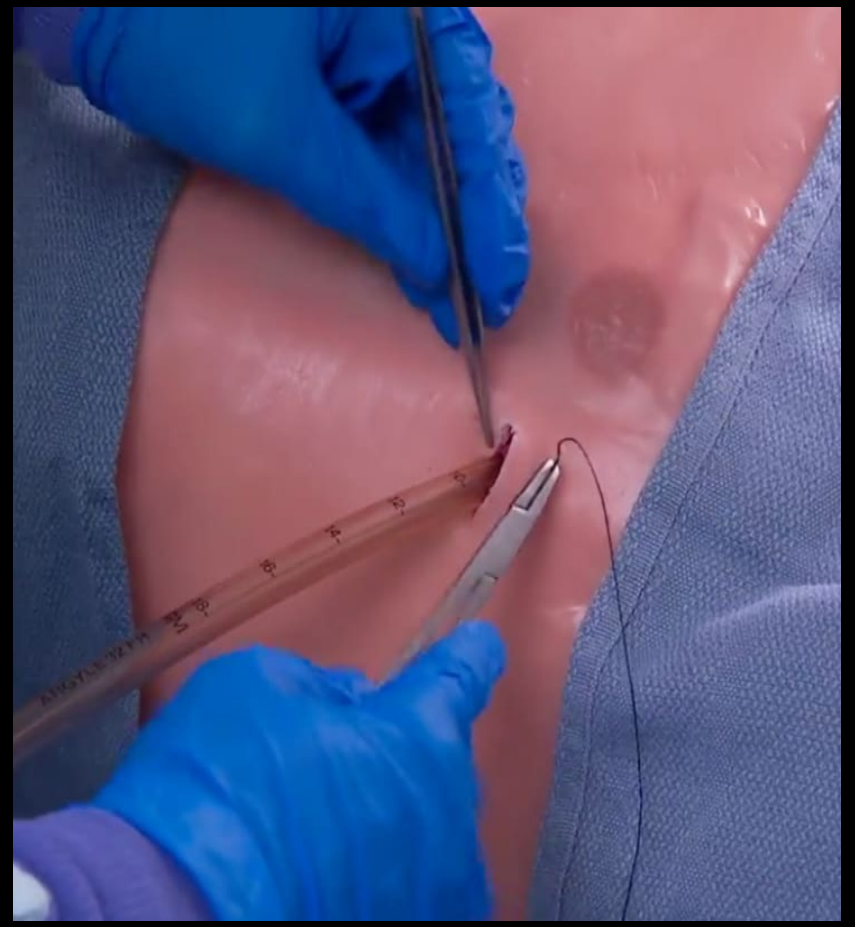
Presentation >>> Size

- Does this patient need a chest drain?
- Could this be a mimic?
- Does this patient need more imaging before a chest drain?

Pneumothorax Drainage







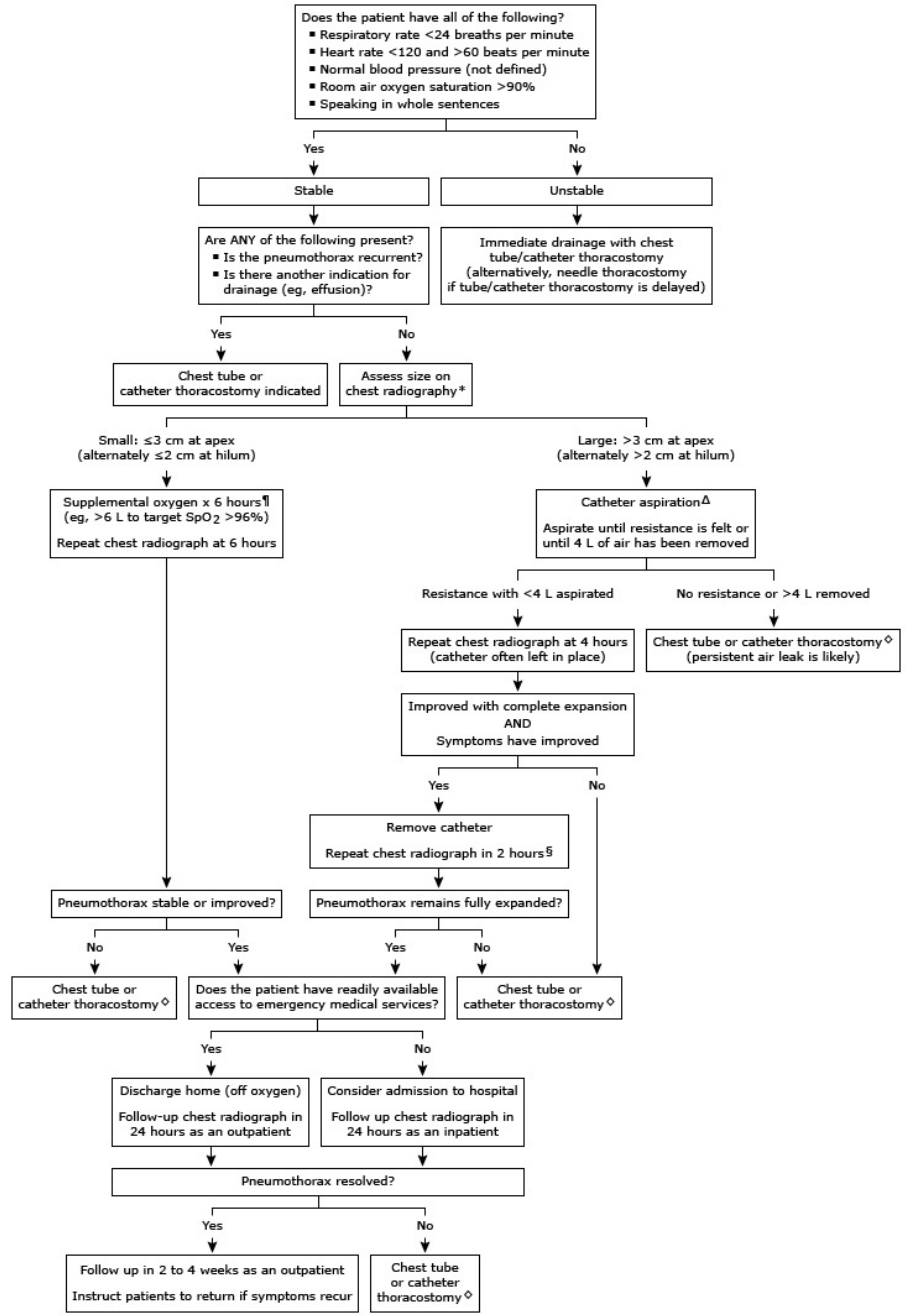
Pneumothorax Drainage

- Needle (14-16 G) aspiration is as effective as large-bore (>20 F) chest drains and may be associated with reduced hospitalisation and length of stay

- Needle aspiration was also not inferior to seldinger technique chest drainage

A. Thelle, M. Gjerdevik, M. SueChu, O. M. Hagen, P. Bakke Randomised comparison of needle aspiration and chest tube drainage in spontaneous pneumothorax European Respiratory Journal 2017 49

Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010 A MacDuff, A Arnold, J Harvey, on behalf of the BTS Pleural Disease Guideline Group

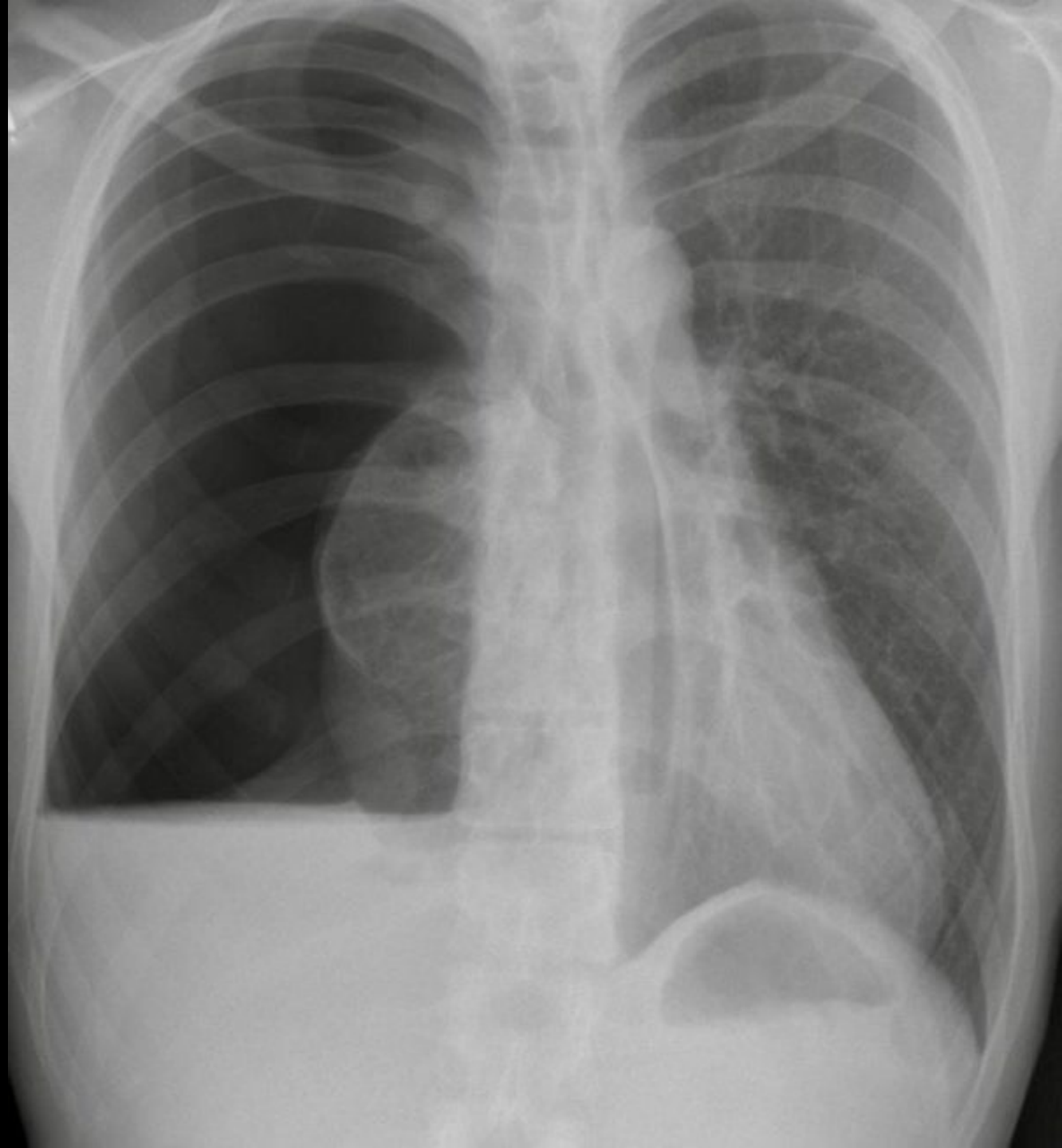

Does the patient have all of the following?
Respiratory rate <24 breaths per minute
Heart rate <120 and >60 beats per minute
Normal blood pressure (not defined)
Room air oxygen saturation >90%
Speaking in whole sentences
Yes
No
Stable
Unstable
Are ANY of the following present?
Is the pneumothorax recurrent?
Is there another indication for drainage (eg, effusion)?
Immediate drainage with chest tube/catheter thoracostomy (alternatively, needle thoracostomy if tube/catheter thoracostomy is delayed)
Yes
No
Chest tube or catheter thoracostomy indicated
Assess size on chest radiography*
Small: ≤3 cm at apex (alternately ≤2 cm at hilum)
Large: >3 cm at apex (alternately >2 cm at hilum)
Supplemental oxygen x 6 hours¶ (eg, >6 L to target SpO2 >96%)
Repeat chest radiograph at 6 hours
Catheter aspirationΔ
Aspirate until resistance is felt or until 4 L of air has been removed
Resistance with <4 L aspirated
No resistance or >4 L removed
Repeat chest radiograph at 4 hours (catheter often left in place)
Chest tube or catheter thoracostomy◇ (persistent air leak is likely)
Improved with complete expansion AND Symptoms have improved
Yes
No
Remove catheter
Repeat chest radiograph in 2 hours§
Pneumothorax stable or improved?
Pneumothorax remains fully expanded?
No
Yes
Yes
No
Chest tube or catheter thoracostomy◇
Does the patient have readily available access to emergency medical services?
Chest tube or catheter thoracostomy◇
Yes
No
Discharge home (off oxygen)
Follow-up chest radiograph in 24 hours as an outpatient
Consider admission to hospital
Follow up chest radiograph in 24 hours as an inpatient
Pneumothorax resolved?
Yes
No
Follow up in 2 to 4 weeks as an outpatient
Instruct patients to return if symptoms recur
Chest tube or catheter thoracostomy◇

Outpatient Management of Pneumothoraxes

1. Observation in ED – 4-6hrs – depends on situation.
2. Repeat chest x-ray in 24-48hrs
3. Pain management – if pain is controlled, no distress, normal obs.
4. Good return to ED instructions

26 year old man RTC.

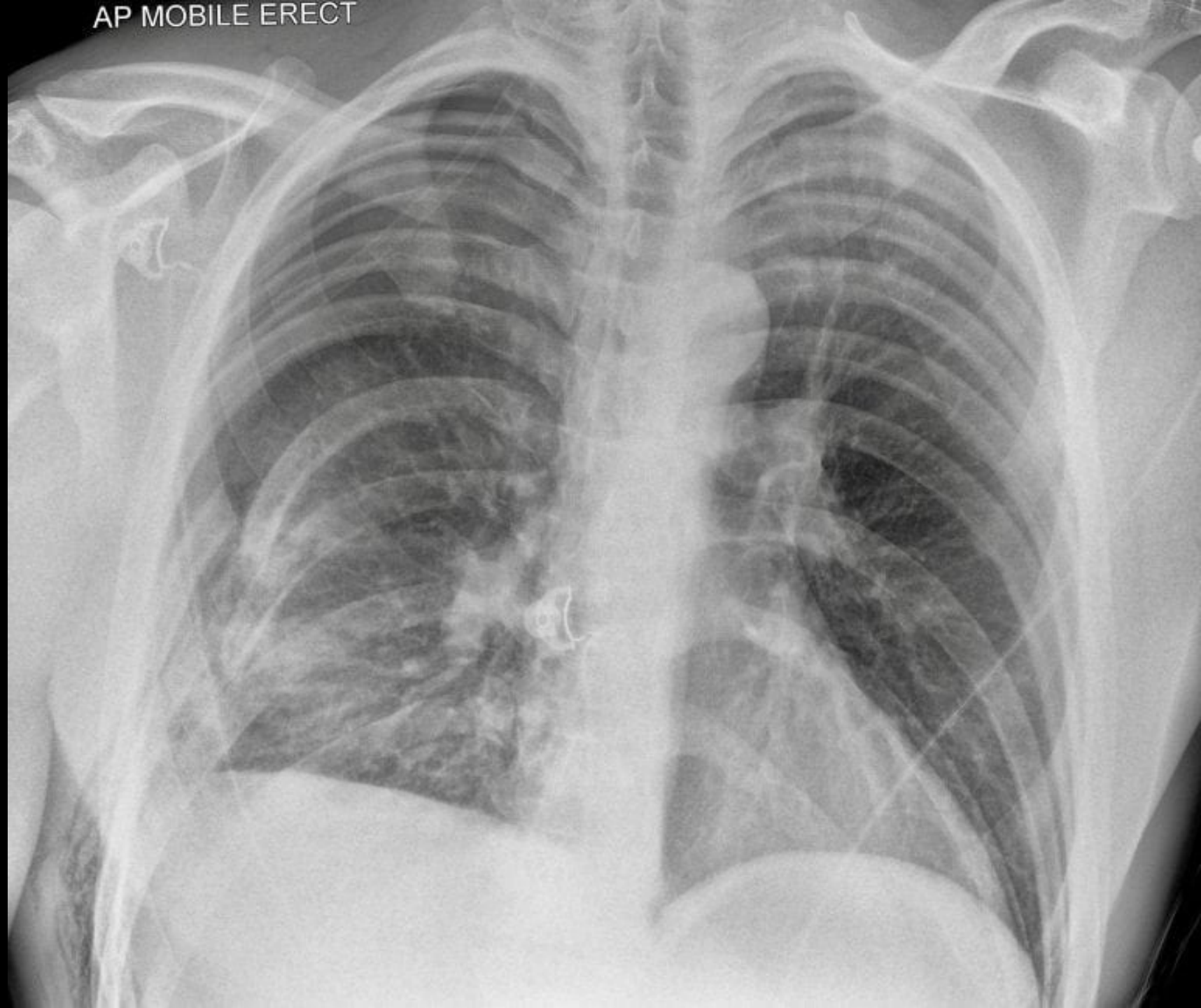
Now increasingly agitated with falling BP.



Case 9

31 year old builder falls 2m onto a concrete block.

He’s complaining of severe right sided chest pain.



Trauma Considerations

- Small bore vs. large bore chest tubes in trauma
- Who needs CT chest?
- Chest drain before or after CT?

Questions?


25¢
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Search ID: awhn655
"We've had budget cutbacks since your last session of flight simulation."