

MANAGEMENT OF PLEURAL DISEASES IN ICU

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Pleural diseases in ICU

➤ Pleural diseases itself are unusual causes for ICU admission.

BUT

➤ Pleural involvement secondary to diseases or procedures is frequently seen in ICU patients:

- *Pleural effusion and parapneumonic effusion.*
- *Pneumothorax.*
- *Hemothorax and chylothorax.*

Physiological Effects of Pleural diseases

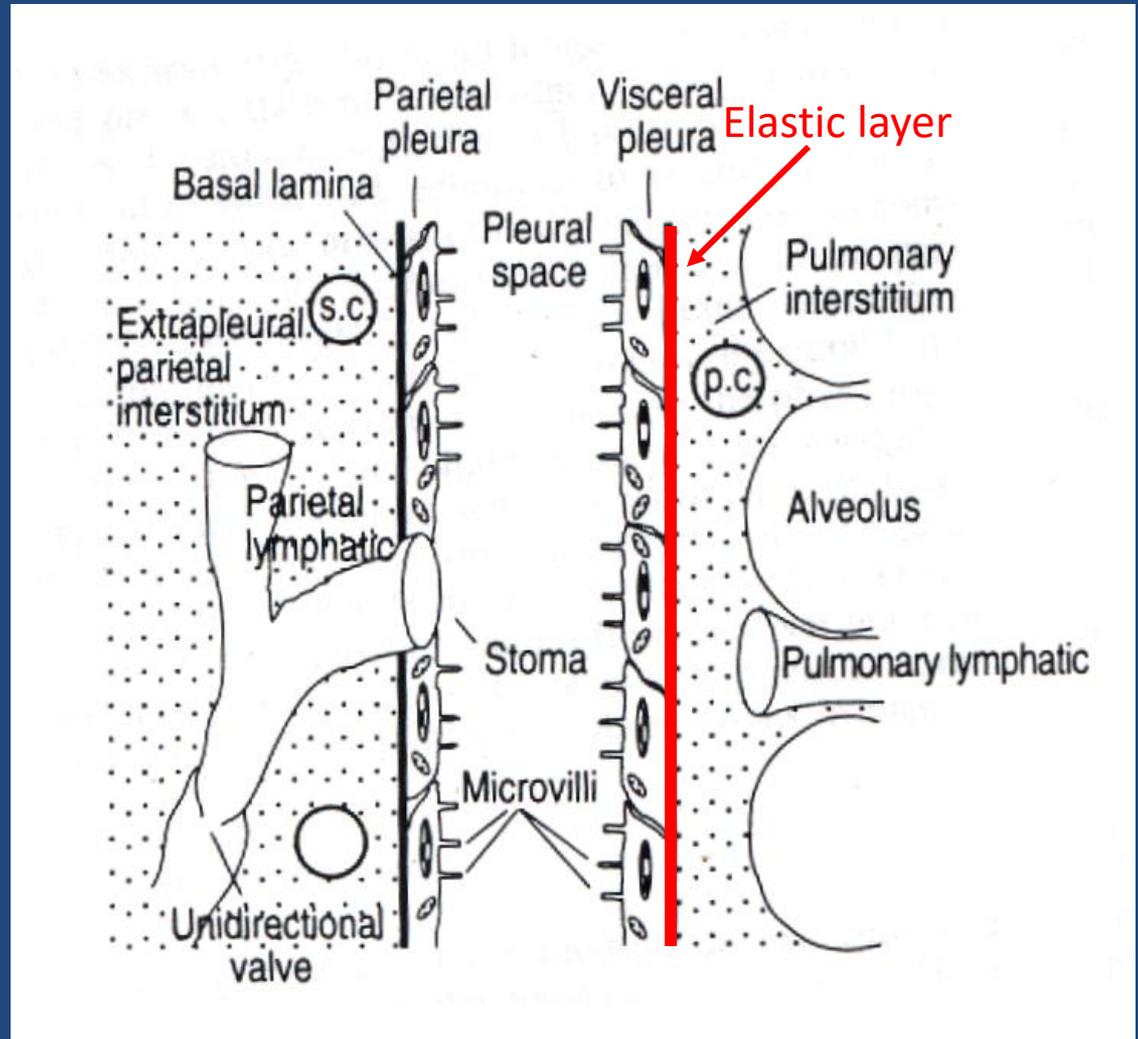
- Static properties of respiratory system
(restrictive ventilatory defect)
- Dynamic properties of respiratory system
(increase in respiratory resistance)
- Function of respiratory muscles
- Gas exchange properties
- Heart-lung interaction

PLEURAL EFFUSION IN ICU PATIENTS

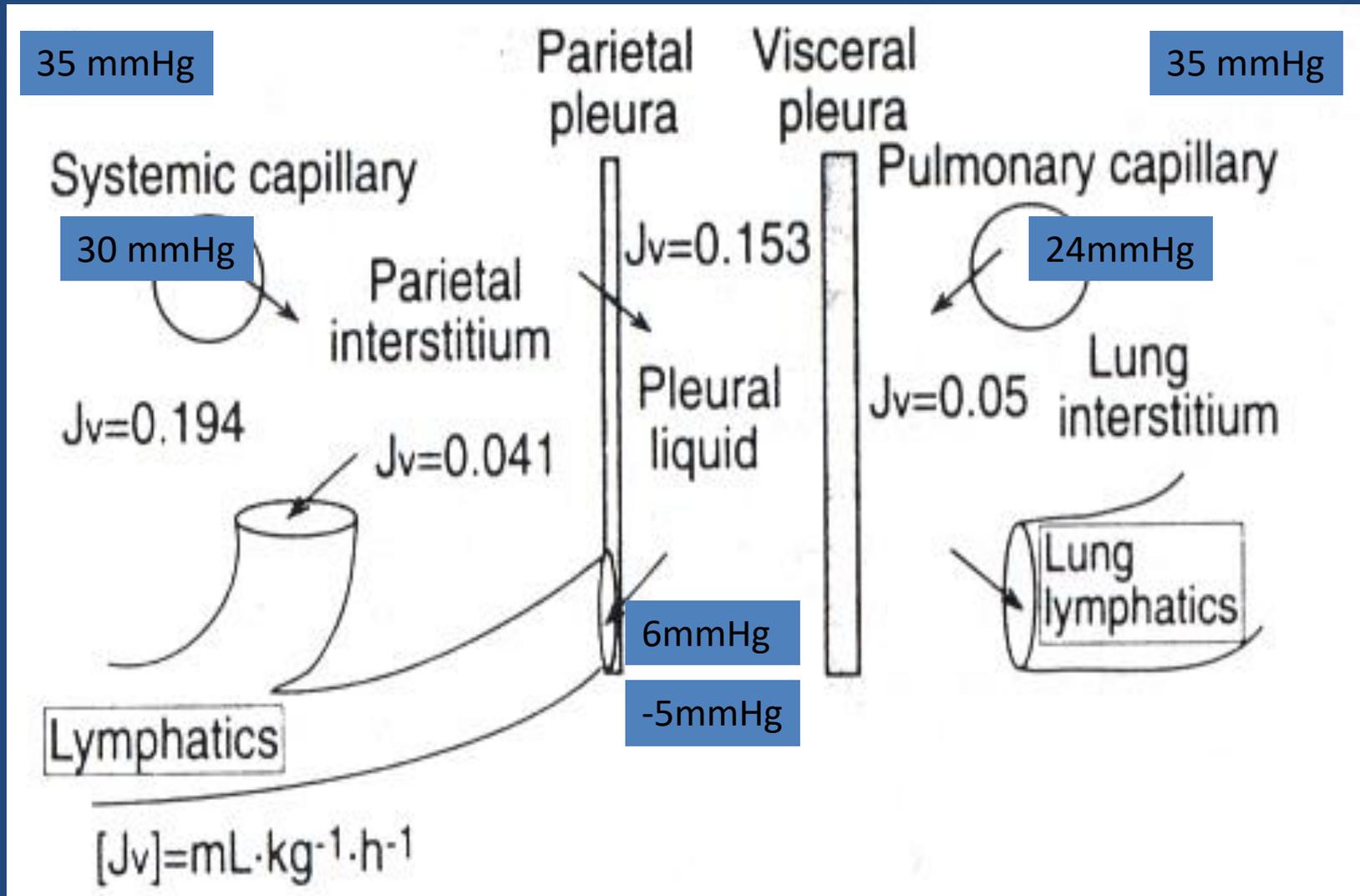
- Frequency and causes?
- How to detect?
- How to manage?

Pleural fluid turnover

- Pleural fluid production:
~ 0.01 ml/kg/h or ~15 ml/day
- Pleural fluid absorption:
~ 0.01 ml/kg/h or ~15 ml/day
- Drainage is achieved by the
“Lymphatic pump”
- Pressure generated by the
lymphatic pump: ~ -10 cm H₂O
- Max Fluid drainage capacity:
~ 0.20 ml/kg/h or ~300 ml/day.



Pathway of pleural fluid



PATHOGENESIS OF PLEURAL EFFUSION

Pleural effusion develops when there is interference with the mechanisms that maintain the balance between production and drainage of pleural fluid.

PATHOGENESIS OF PLEURAL EFFUSION

Increased pleural fluid production

- **Increased Hydrostatic Pressure Gradient in pleura**
 - Increased intravascular pressure (e.g. left sided heart failure)
 - Decreased pleural pressure (e.g. atelectasis)
- **Increased Capillary Permeability (kf)** (e.g. pleura inflammation)
- **Decreased Oncotic Pressure Gradient** (e.g. hypoproteinemia)
- **Influx from free peritoneal fluid**
- **Disruption of the thoracic duct**

Decreased pleural fluid drainage capacity

- **Obstruction of lymphatics**
- **Elevation of Systemic Venous Pressure**

Pleural effusion in critically ill patient?

- Due to a primary disease.
- Due to supportive or therapeutic interventions:
 - MV, sedation, paralysis  atelectasis or VAP.
 - Aggressive IV fluid due to hemodynamic instability  imbalance between hydrostatic and oncotic pressures  pleural transudation.

Pleural Effusions in the Medical ICU*

Prevalence, Causes, and Clinical Implications

Lalaine E. Mattison, MD; Lynn Coppage, MD; Daniel F. Alderman, MD; John O. Herlong, MD; and Steven A. Sahn, MD, FCCP

- 100 consecutive patients admitted to MICU.
- PE in 62%, 41% on admission (2/3 were non infectious).
- When compared with patients who never had PE during their MICU stay, patients with PE had statistically significantly
 - Lower serum albumin concentration.
 - Higher APACHE II scores.
 - Longer MICU stays, and
 - Longer mechanical ventilation.
- No patient died as a direct result of his or her PE.

(CHEST 1997; 111:1018-23)



clinical investigations in critical care

Clinically Documented Pleural Effusions in Medical ICU Patients*

How Useful Is Routine Thoracentesis?

*Muriel Fartoukh, MD; Elie Azoulay, MD; Richard Galliot, MD;
Jean-Roger Le Gall, MD; Frederic Baud, MD; Sylvie Chevret, MD; and
Benoît Schlemmer, MD*

- The incidence of PE in all patients admitted to 3 MICUs in 1 year was 8.4% (113/1,351).
- Infectious exudates was (42.7%), non infectious exudates (32.9%) and transudates (24.4%).
- Routine thoracentesis proved a simple and safe means of improving the diagnosis and treatment.

(CHEST 2002; 121:178–184)

Pleural Effusions in Febrile Medical ICU Patients*

Chest Ultrasound Study

Chih-Yen Tu, MD; Wu-Huei Hsu, MD, FCCP; Te-Chun Hsia, MD; Hung-Jen Chen, MD; Kuen-Daw Tsai, MD; Chung-Wen Hung, MD; and Chuen-Ming Shih, MD

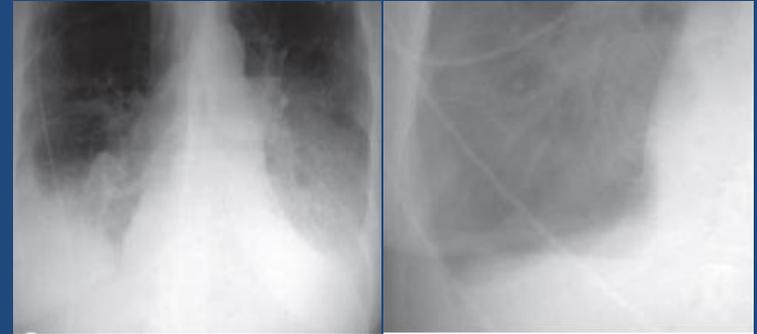
- During 1 year, 1,640 patients were screened for evidence of PE with fever more than 38 ° C.
- 94 (5.7%) febrile patients had PE, proven by CXR and LUS.
- Routine thoracentesis + pleural fluid cultures in all patients.
- 58 patients (62%) had infectious exudates.
- 28 patients (30%) had transudates.
- 8 patients (8%) had non infectious exudates.
- The prevalence of empyema was 16% (15 of 94 patients).

How to detect pleural effusion in critically ill patient?

Imaging:

- Portable chest Xray:

Limitations: variable quality, obese patients, bad cooperation, and supine position.



- Lung ultrasound: Highly sensitive, proper assessment of the amount of fluid, the complexity of the pleural space, and provides a safe entry point for drainage.

- CT scan



Management of pleural effusion in critically ill patient?

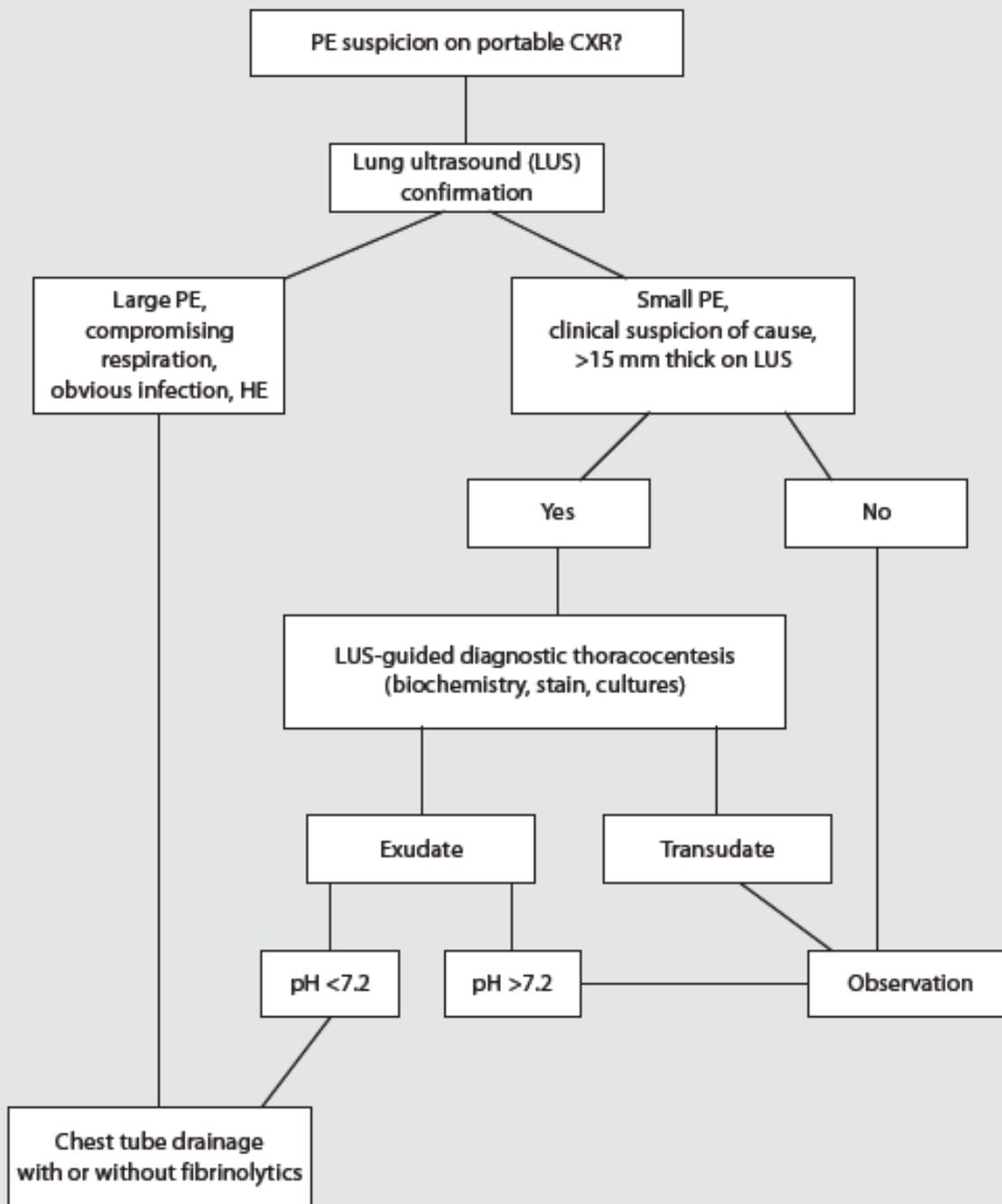
- When a pleural effusion is recognized in a critically ill patient, 3 questions have to be asked:
 - *Is it a transudate or an exudate?*
 - *What is the likely cause?*
 - *Is it necessary to perform thoracentesis to confirm a definite diagnosis?*

➤ Transudate or exudate?

Light's criteria (for exudate: sensitivity 98%, specificity 83%):

- (a) the ratio of pleural fluid protein to serum protein is $.0.5$;
- (b) the ratio of pleural fluid (LDH) and serum LDH is $.0.6$;
- (c) pleural fluid LDH is more than $2/3$ normal upper limit for serum.

➤ Pleural fluid characteristics remain the most reliable diagnostic test to guide the management.



Flow chart for the management of Pleural Effusion in critically ill patients.

➤ Which Drain?

- The use of small-bore pig-tail (Fuhrman) catheters (8–14 Fr) placed under radiographic guidance offers a reliable treatment, safe, less invasive and better tolerated alternative to Large bore Chest tubes.



PNEUMOTHORAX

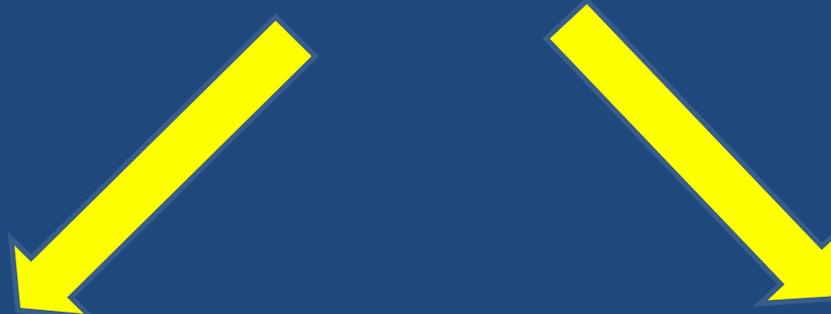
- Air in the pleural space...
- Spontaneous: primary or secondary
- Traumatic / Iatrogenic
- Open/Closed
- **Tension Pneumothorax**

➤ Iatrogenic pneumothorax in ICU:

- Mechanical Ventilation
- Invasive Procedures (CVC, thoracentesis, bronchoscopy and TBLB, pericardiocentesis, tracheostomy).
- Certain diseases may increase the incidence (e.g. ARDS....).

How can Mechanical Ventilation be responsible for Pneumothorax?

BIOTRAUMA



Volutrauma
and Barotrauma

Atelectatrauma

Large distending force



Extreme stress/strain
Volutrauma, Barotrauma

Rupture

Moderate distending force



Moderate stress/strain
Atelectrauma

Signalling

Epithelial & endothelial cells
accommodate their surfaces

Mechanical signalling via integrins,
cytoskeleton, ion channels

Inflammatory cascade

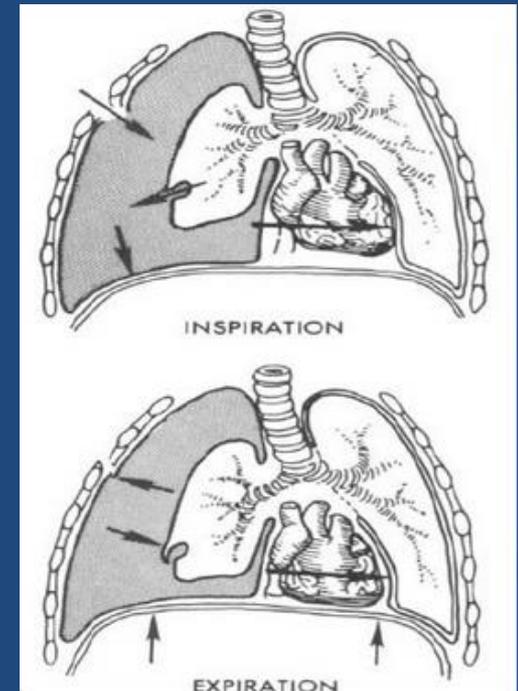
Cellular infiltration and full-blown inflammation

Biotrauma

How to diagnose?

Clinical assessment:

- Sharp stabbing chest pain, dry cough....Local Chest examination.
- Tension pneumothorax: Positive pleural pressure throughout the respiratory cycle (check-valve mechanism)
 - Distress
 - Hypoxemia, cyanosis
 - Hemodynamic instability



Radiological assessment:

- Portable CXR: Sometimes difficult to make a definite diagnosis in supine films taken in ICU.
- Lung Ultrasound: Highly sensitive in detection of pneumothorax.
- CT chest:

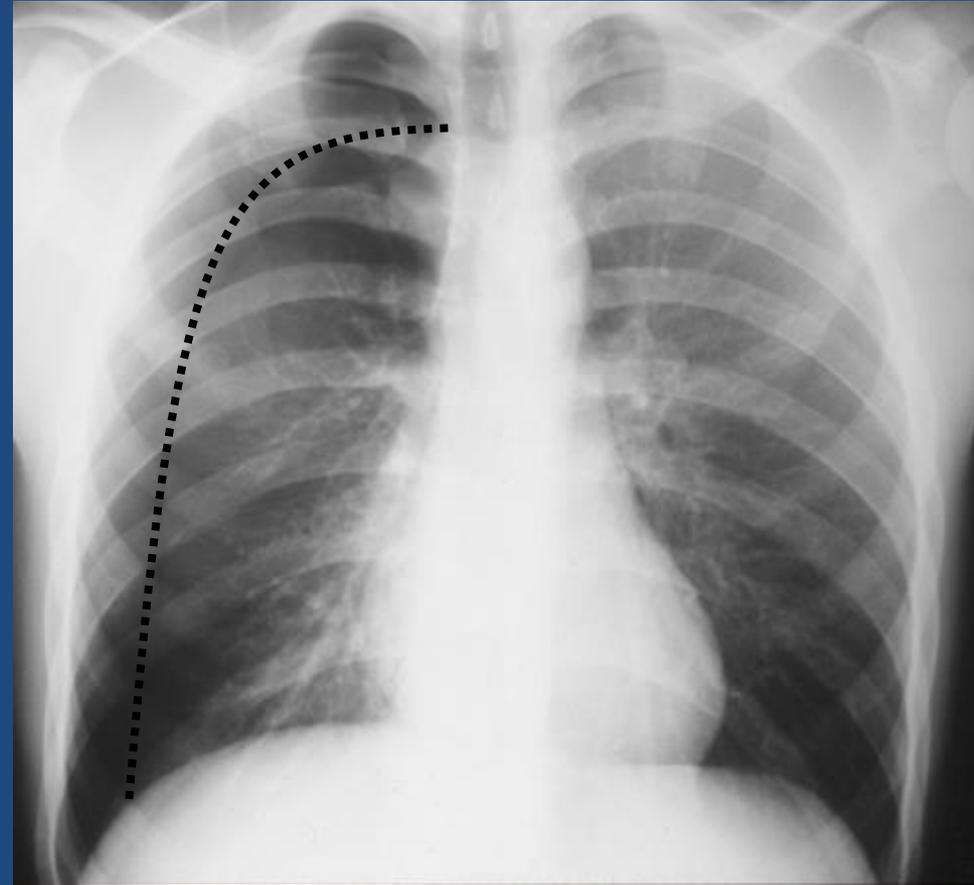
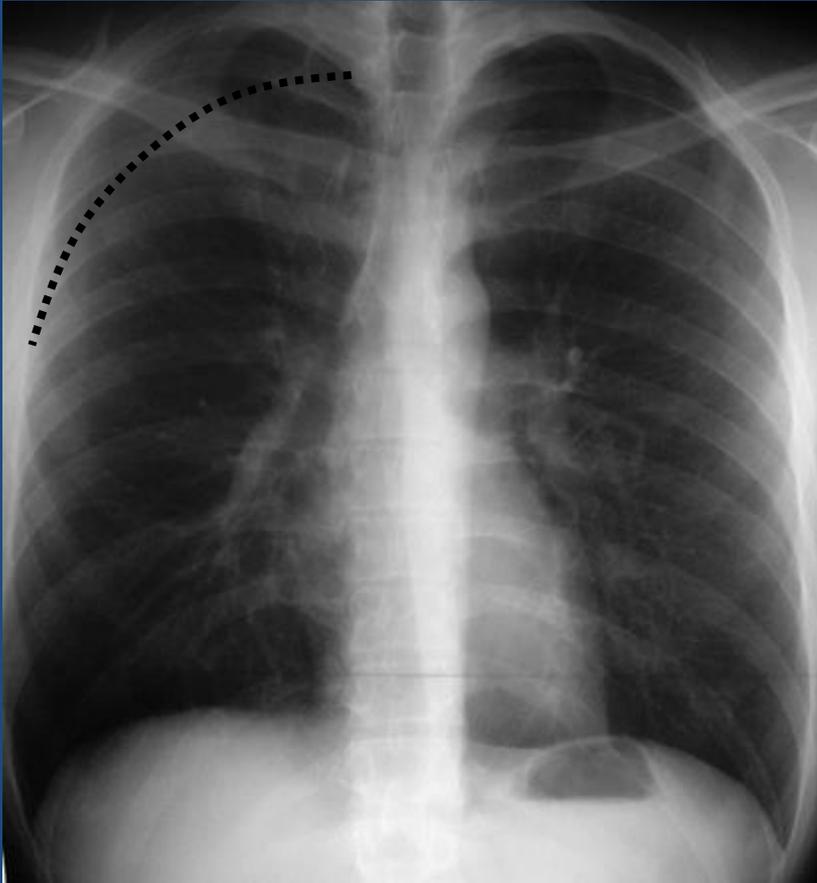
How to Prevent?

- Mind the plateau pressure in MV patients (< 30 cmH₂O).
- During CVC insertion:
 - Stop ventilation at the moment of needle advancement.
 - Avoid multiple attempts.
 - Post-procedure chest Xray is mandatory.
 - Use ultrasound guidance when possible.
- Invasive pleural procedures.....Ultrasound guidance.

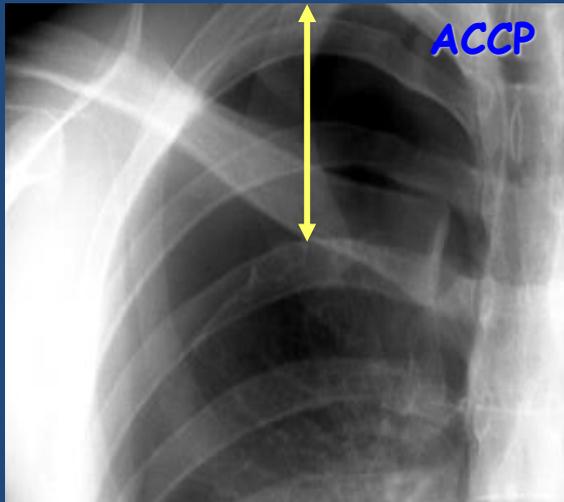
Treatment

1. Should *every* patient presenting with a Pneumothorax in ICU
BE TREATED????
2. When just to observe?
3. Is there a role for manual ~~aspiration~~?
4. WHEN and HOW to drain?
5. WHEN to remove the drain?
6. Is there a FOLLOW UP needed?

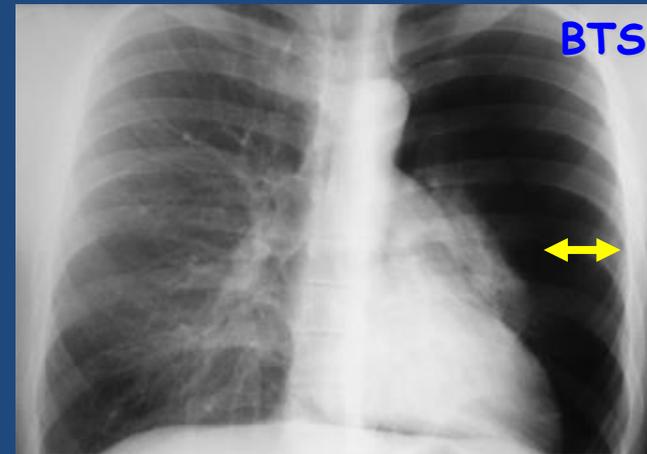
Evacuate air in large or symptomatic pneumothorax



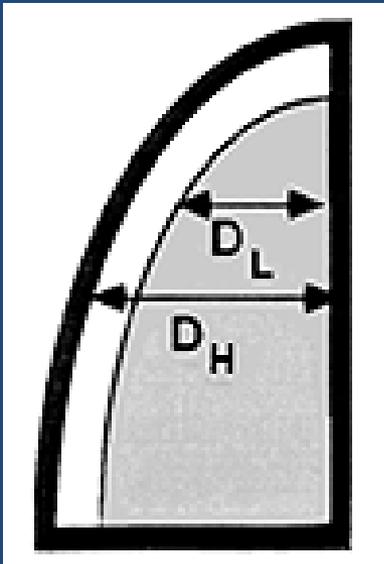
Definition of a “large” pneumothorax?



apex-copula ≥ 3 cm



complete dehiscence
distance > 2 cm



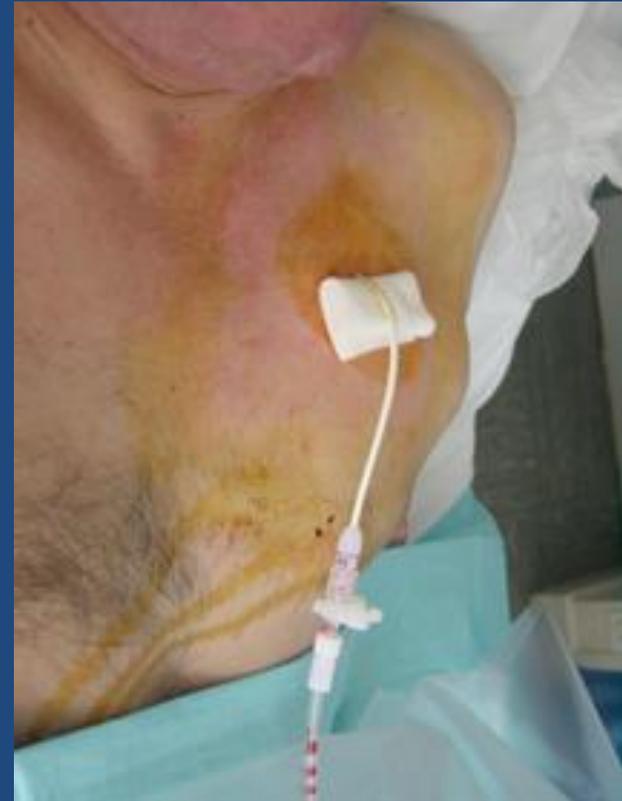
>15-20% (Light index)

$$\text{Size PTX (\%)} = \left(1 - \frac{D_L^3}{D_H^3} \right) \times 100$$

Tube drainage

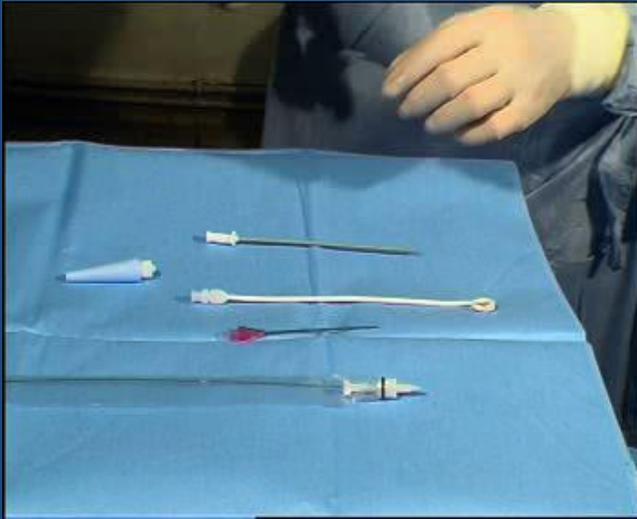


Simplify the life of your patients

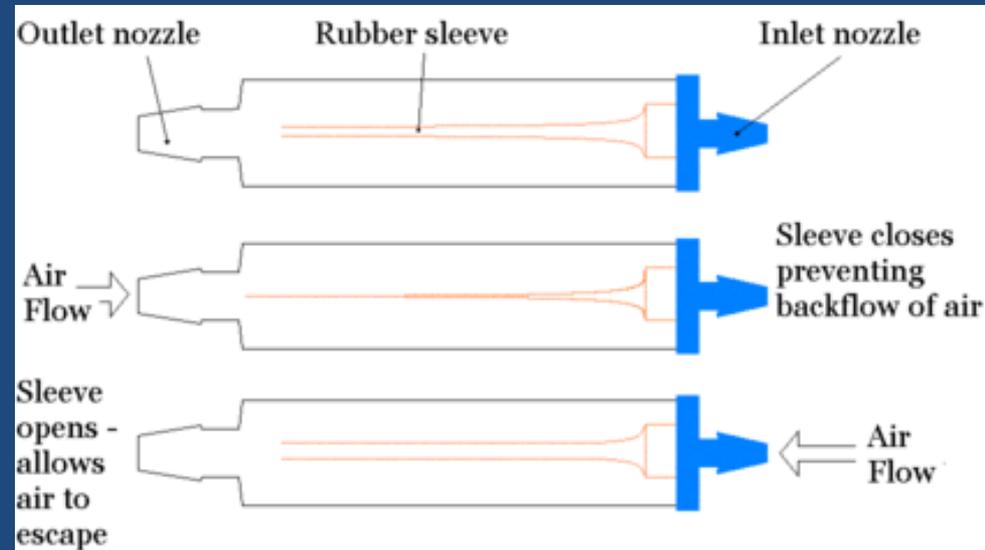


Forget the large tubes

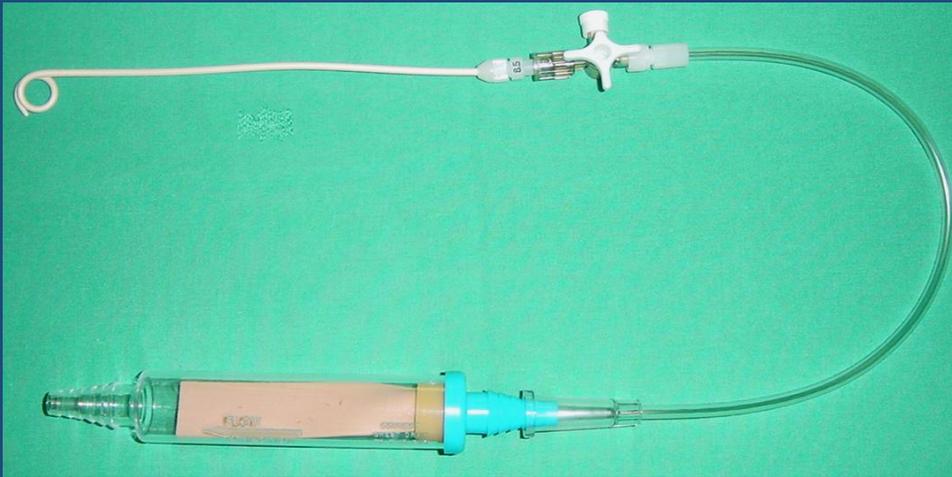
The pig-tail (Fuhrman) catheter = Seldinger technique



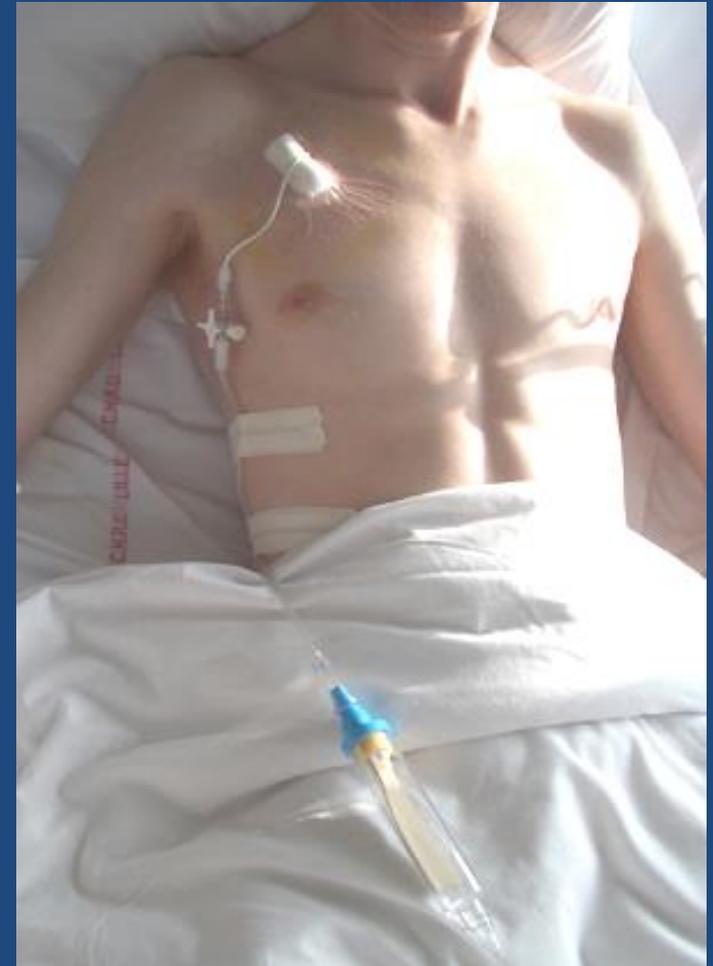
Heimlich valve



Pig-tail catheter placed via the anterior route connected to a Heimlich valve



Ensure the patency of the tube every 8 hours



HEMOTHORAX

- Thoracic injury (the most common cause).
- Other causes in ICU patients include:
(Ruptured aortic aneurysm, pulmonary infarction, malignancy or several invasive procedures (CVC, thoracentesis, percutaneous aspiration or biopsy). Rarely as a complication of anticoagulation).
- Hematocrit of the fluid should be measured.
- Chest tube drainage.
- Exploratory thoracotomy is strongly considered if :
 - more than 2 liters of blood are evacuated initially from the chest
 - or if bleeding continues at a rate exceeding 200 ml/h.

CHYLOTHORAX

(i.e. accumulation of chyle in the pleural cavity).

- Infrequent in critically ill patients.
- Mostly traumatic, iatrogenic causes (thoracic surgery)
- Chest tube drainage if large causing respiratory distress.
+/- TPN.
- Surgical or thoracoscopic interventions are recommended for posttraumatic or postsurgical chylothorax.



THANK YOU

