

Re-expansion pulmonary edema

- what we need to know?

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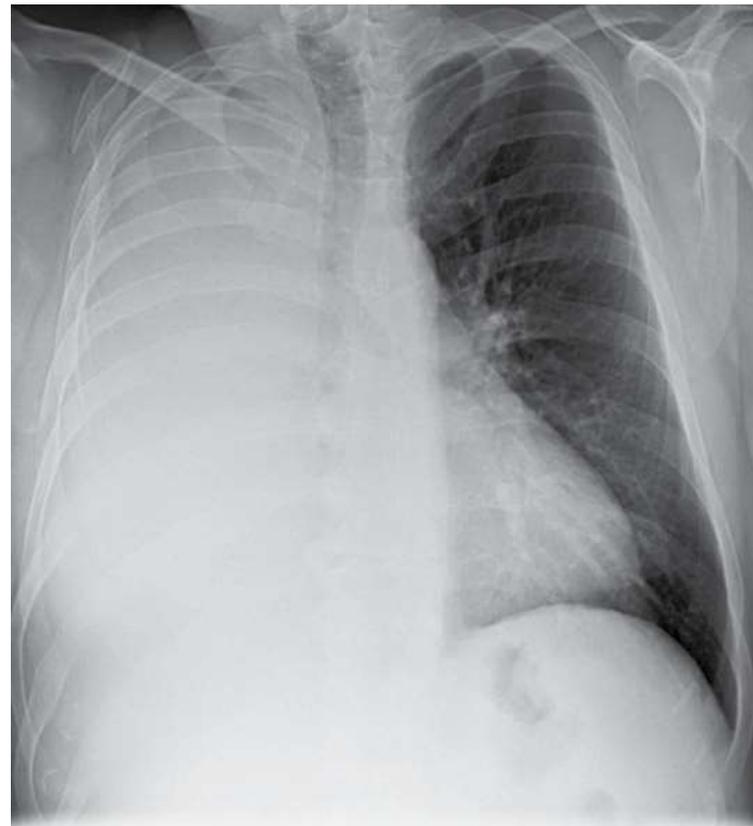
BIRDEM General Hospital

A 46-year-old man presented to the emergency department

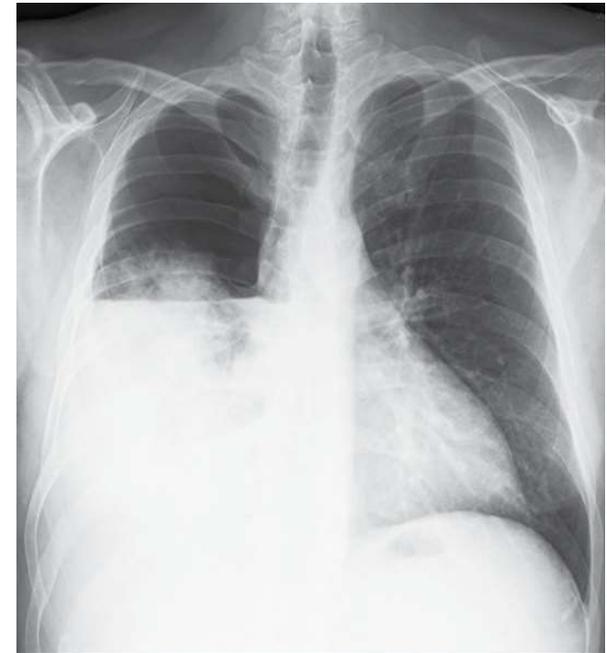
- Severe dyspnea
- 4-day history of cough

On admission, chest x-ray:

Complete white-out of the rt hemithorax with mediastinal deviation (massive pleural effusion)

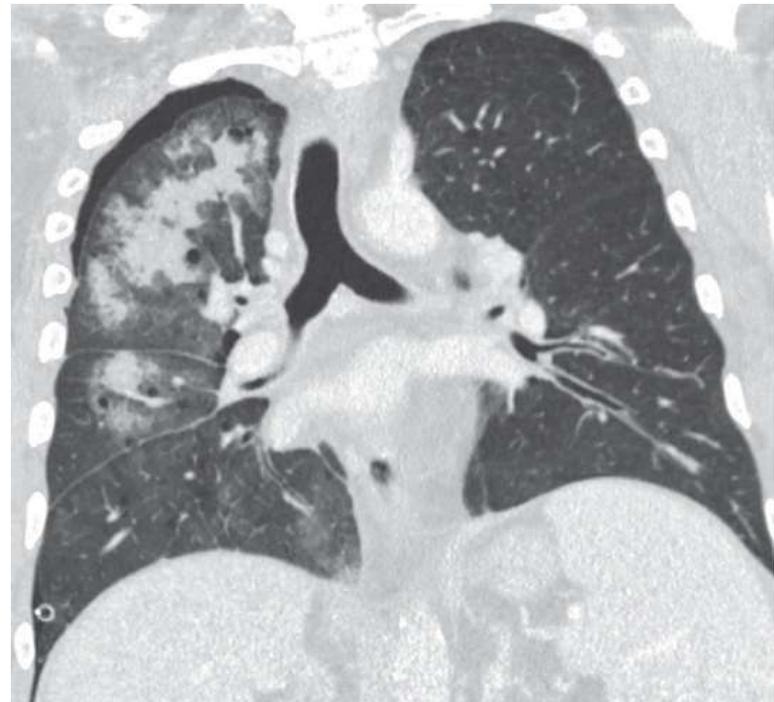


- Pleural fluid aspiration was done immediately
- Dyspnea didn't relief to any extent
- A further CXR taken, now a large rt hydro-pneumothorax



- A large chest drain was inserted to ensure adequate drainage.
- Dyspnea worsened progressively rather than being improved.
- A chest CT scan was done to rule out any underlying lung disease.

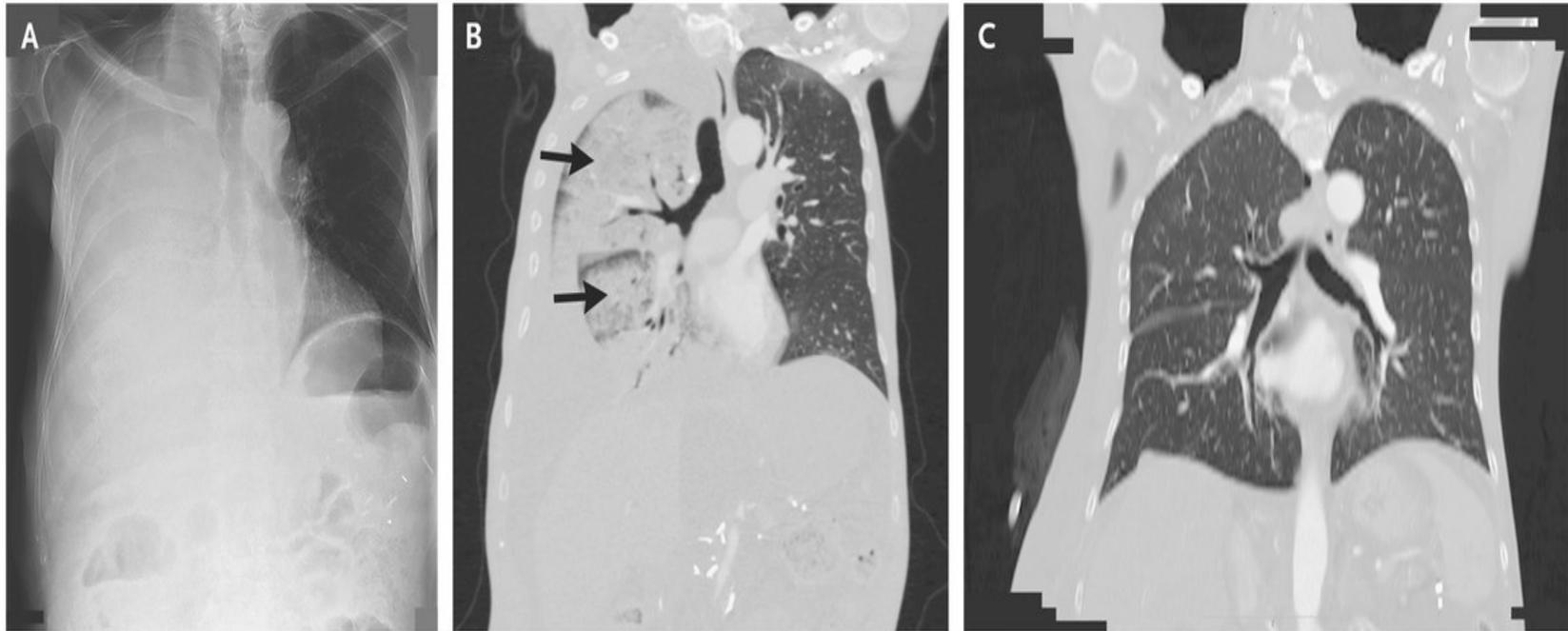
(Near-complete resolution of rt hydro-pneumothorax and patchy consolidation, ground glass opacities, and septal thickening throughout the rt lung)

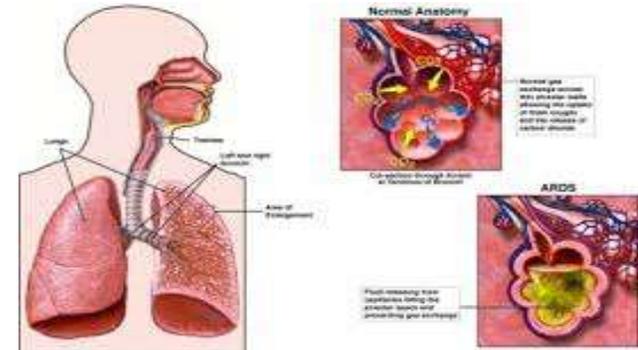


- Based on the clinical and radiological findings, a diagnosis of **re-expansion pulmonary edema** was made.
- The patient recovered completely after 2 days of supportive treatment and a further CXR showed clear lung fields bilaterally.



Re-expansion pulmonary edema

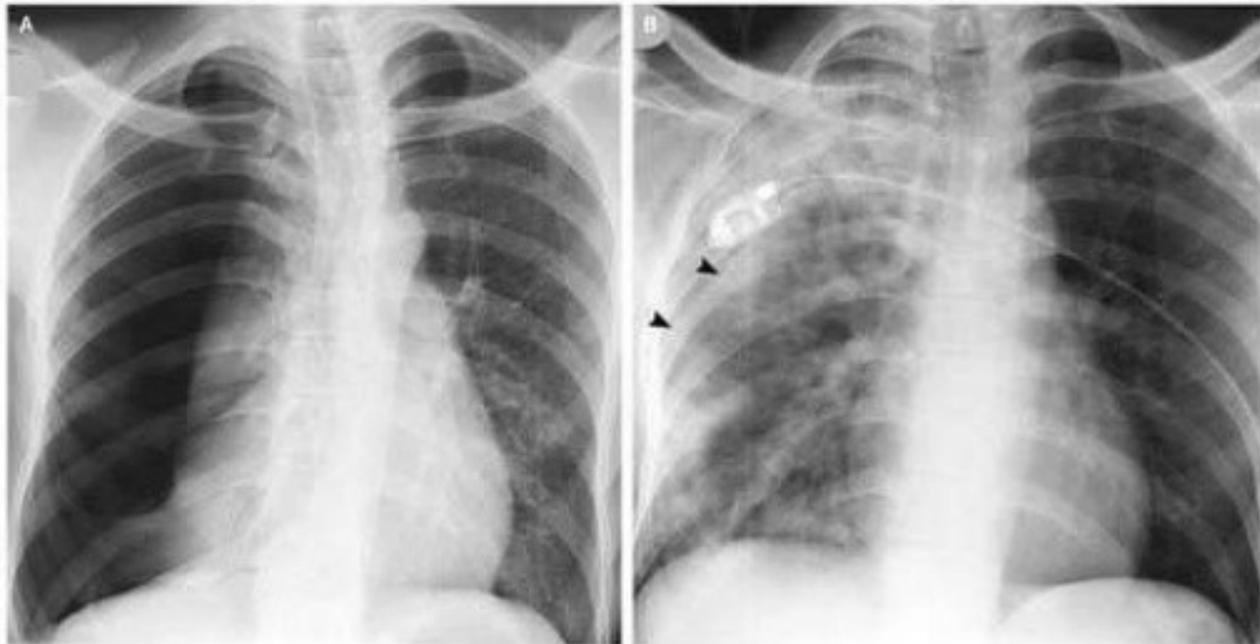




- Re-expansion pulmonary edema is an unilateral pulmonary edema which occurs rarely as a complication in <1% of cases where a lung has been rapidly re-expanded after being collapsed.
- The mortality can reach up to 20%

- The first reference to respiratory failure after pleurocentesis, was made by [Pinault, in 1853, following the removal 3 liters of pleural liquid](#). From this finding, a new clinical condition was defined, called re-expansion pulmonary edema (RPE).
- The first well-documented report was presented by [Foucart in 1875](#)
- [In 1958, Carlson and colleagues](#) described the first RPE case following pneumothorax drainage.

RPE AFTER ICD INSERTION FOR SPONTANEOUS PNEUMOTHORAX



Re-expansion pulmonary edema was also reported after

- Atelectasis
- Excision of giant hepatic cyst or mediastinal tumor

Sautter RD et al: Fatal pulmonary edema and pneumonitis after re-expansion of chronic pneumothorax. Chest 60:399, 1971

Patho-physiology

Root cause - Increased permeability of the pulmonary capillaries as a result of inflammation.

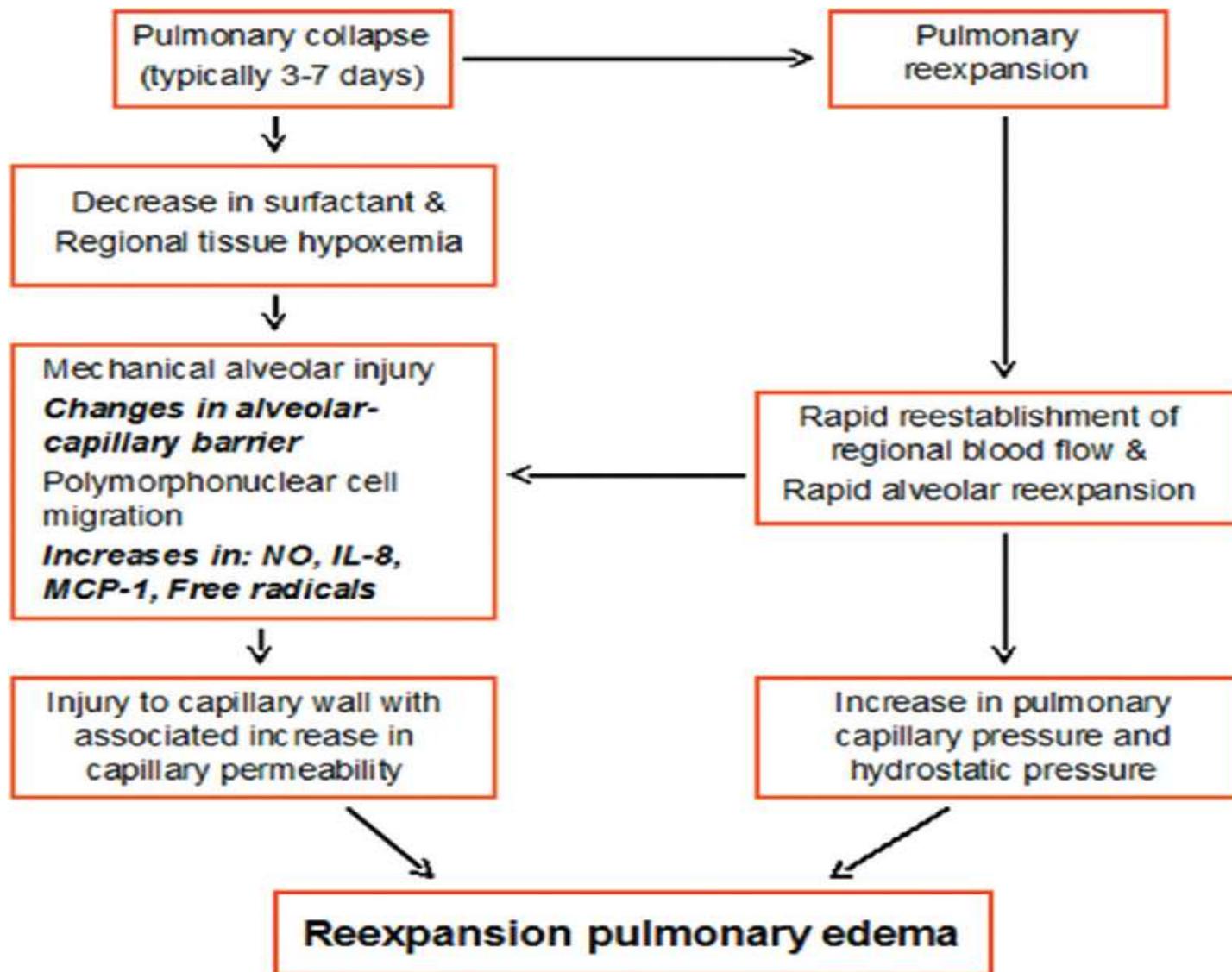
Ventilation and reperfusion production of reactive O₂ species and superoxide radicals increase capillary permeability.

Inflammatory mediators involved -

- Interleukin 8
- Leukotriene B4
- Monocyte chemotactic activating factor

Alternatively, research suggests that mechanisms such as increased pulmonary hydrostatic pressure caused by -

- Enhanced venous return
- Pressure-induced mechanical disruption of the alveolar capillaries
- Decreased levels of functional surfactant
- Increased pressure across the capillary-alveolar membrane from bronchial obstruction
- Altered lymphatic clearance



Risk factors

- Age 20 - 40 years
- Duration of collapse >72 hours
- Re-expansion technique
- Application of high negative pressure during thoracic drainage (> 20 cm H₂O)
- Rapid lung expansion, drainage of large volume fluid (> 1.5 L)

Presenting symptoms

- Chest discomfort
- Persistent severe cough
- Production of frothy sputum
- Dyspnoea
- Asymptomatic in mild case

The onset of symptoms is usually within 24 hours, with 64% of patients having onset within 1-2 hours after lung re-expansion.

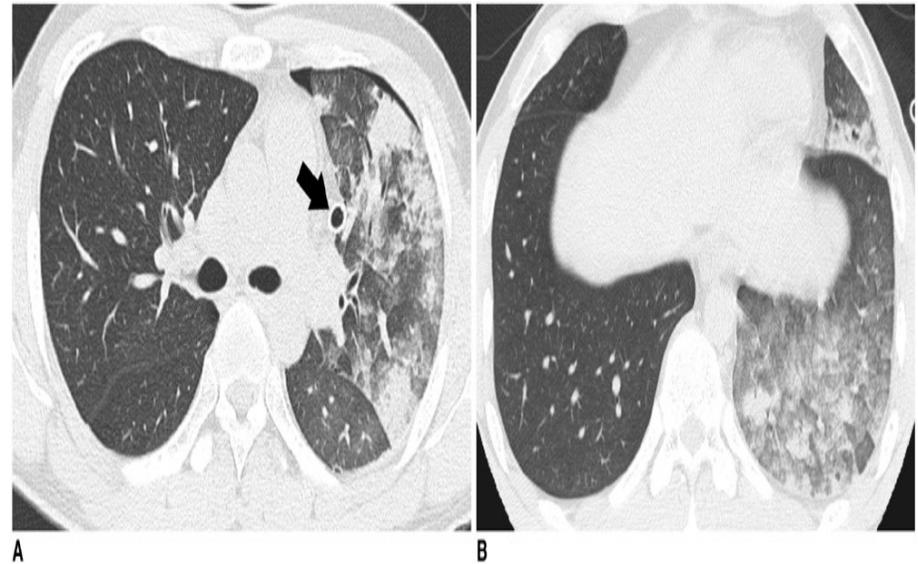
Cardinal signs

- Tachypnea
- Tachycardia
- Crackles on the affected side of the lung
- Hypoxemia, which may be refractory to O₂
- Cyanosis

The edema generally affects the entire re-expanded lung. Occasionally, it may affect a single lobe or the contra-lateral lung, or it may be a bilateral process.

The radiological evidence

- Interstitial opacity
- Consolidations
- Air bronchogram
- Evidence of lung clefts
and of Kerley's B lines



Differential diagnosis

- Aspiration
- Haemorrhage
- Pulmonary infection/ pneumonitis, especially in immune-compromised patients.

- Mahajan VK et al. Re-expansion pulmonary edema. Chest 1979;75:192-4.

Treatment

Treatment consists of support measures, includes

- O₂ supplementation
- Ventilatory support, either by invasive or non-invasive
- Hemodynamic support eg, Swan-Ganz catheter monitoring, volume reposition (use of inotropic agents, diuretics).



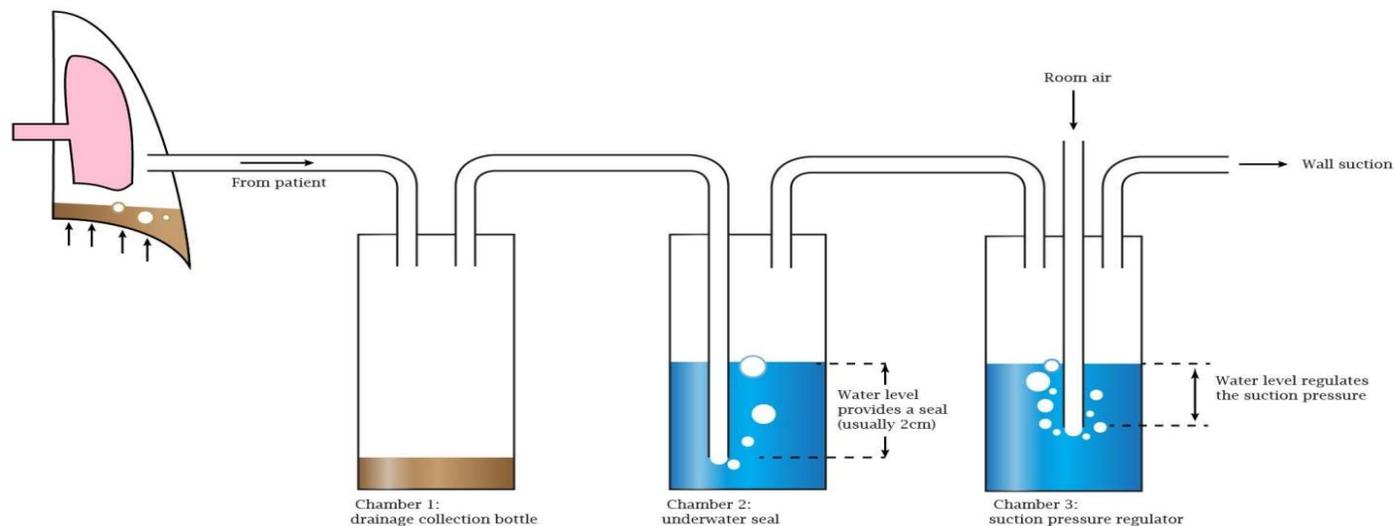
Several strategies to reduce RPE morbidity-mortality

- Placing the patient in lateral decumbency with the affected side up
- Occlusion of the affected side pulmonary artery with a balloon catheter
- Trachiotis GD et al. Reexpansion pulmonary edema. Ann Thorac Surg 1997;63:1205-6.
- Matsuura Y et al. Clinical analysis of reexpansion pulmonary edema. Chest 1991;100:1562-6.

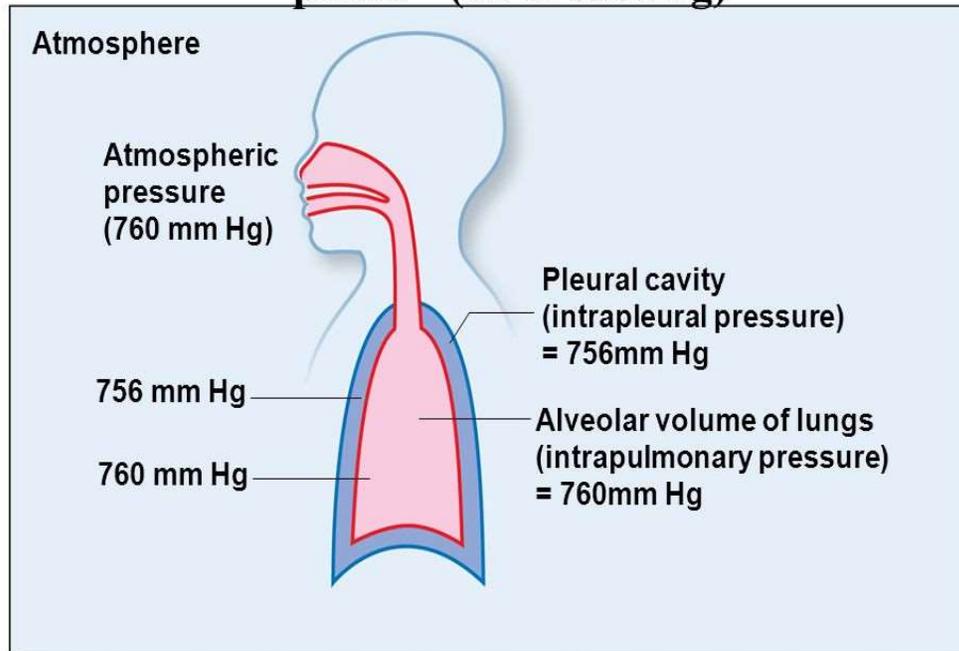
- Within 5 to 7 days - most patients completely recover
- In few patients - shock and possibly death

Prevention

- Use of low negative pressure (<-20 cm H₂O) for suction, during tube thoracostomy
- Limiting the drainage if the patient reports chest discomfort.
- Recent evidence suggests that large volume can be safely drained as long as pleural pressures are monitored



Intrapulmonary pressure during the resting phase – (no breathing)



(c) Volumes and pressures with breathing (at the end of an expiration)

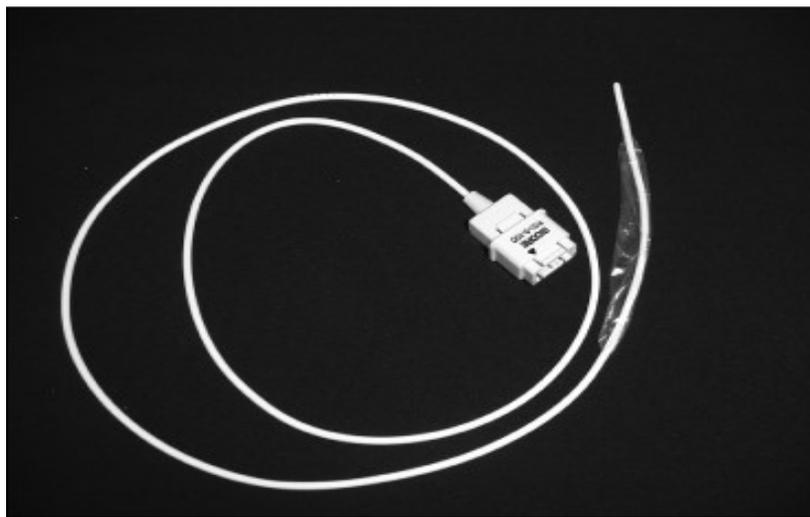


Figure 1 – Esophageal Catheter-Balloon used in Adults



- Pleural manometry is being increasingly advocated for the drainage of large pleural effusion



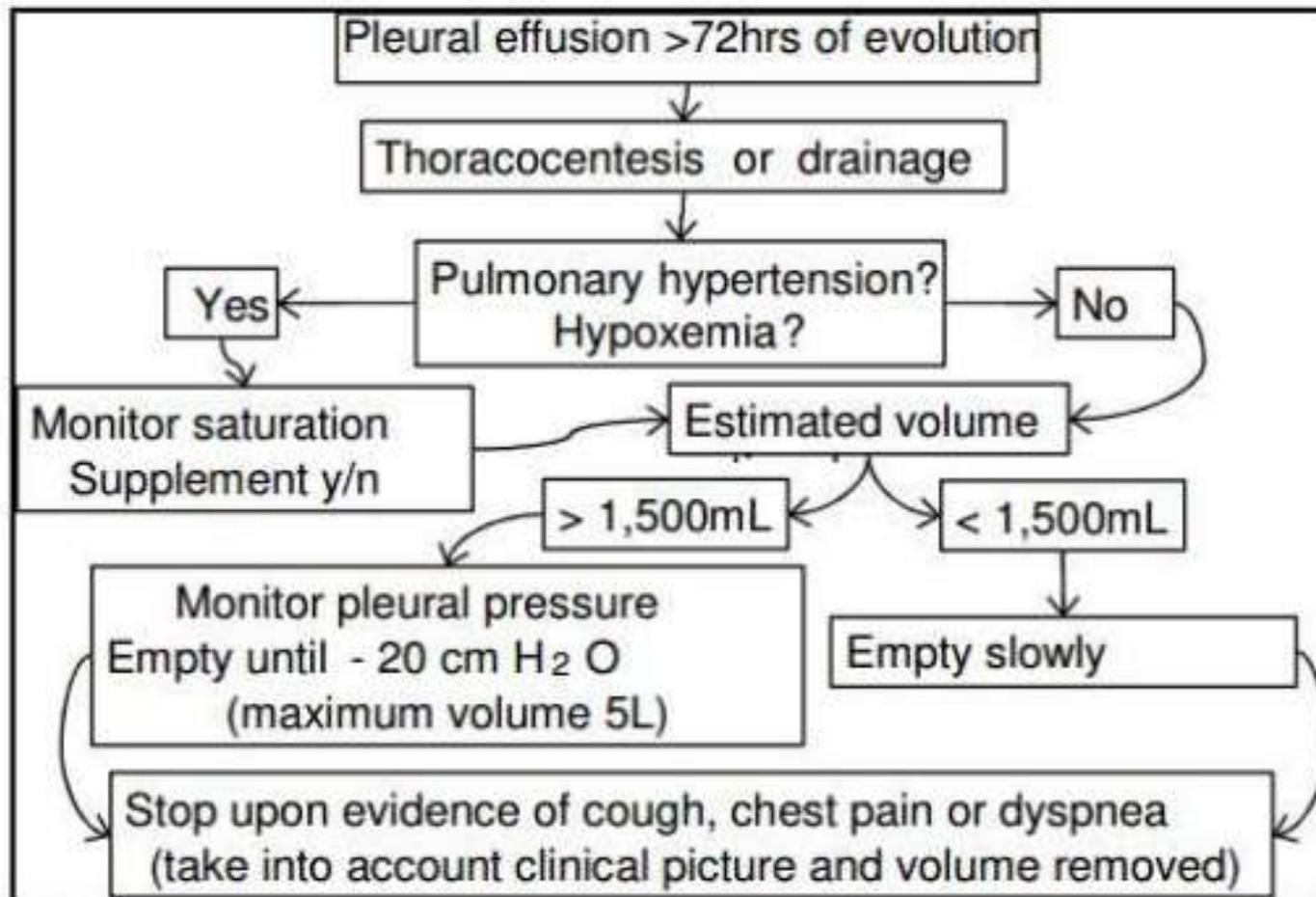
- Slow evacuation of air or fluid from the pleural space by under water seal drainage alone or **by repeated aspirations of <1,000 ml of fluid or air** may aid in preventing RPE as well as the re-expansion hypotension that sometimes occurs concomitantly

- Light RW et al. Observations on pleural fluid pressures as fluid is withdrawn during thoracentesis. *Am Rev Respir Dis* .1980; 121:799
- Pavlin DJ et al. Re-expansion hypotension, a complication of rapid evacuation of prolonged pneumothorax. *Chest*. 1986; 89:70

- During pleural drainage, use of water stamp minimizes the risk of re-expansion pulmonary edema, mainly if the pulmonary collapse >3 days.
- The negative pressure in pleural drainage, if necessary should be employed only after 24 to 48 hrs of the drainage, thus avoiding the risk of RPE.



Algorithm to drain pleural effusion and to avoid re-expansion pulmonary edema



Future perspectives

Searching for anti-inflammatory and cell protecting effects -

- Indomethacin / ibuprofen
- Prostaglandin analogue (Misoprostol)

In animal studies, role in protecting re-expansion pulmonary edema is promising -

- Monoclonal antibody against IL-8
- Trachiotis GD et al. Re-expansion pulmonary edema. *Ann Thorac Surg.* 1997;63:1205-6.
- Nakamura M et al. Importance of interleukin-8 in the development of re-expansion lung injury in rabbits. *Am J Respir Crit Care Med* 2000;161:1030-6.

What we need to know?

- Re-expansion pulmonary edema is **very rare**.
- Mainly affect **unilateral lung**, which has been rapidly re-expanded after being collapsed.
- **Treatment is supportive**
- **Prevention is the most important. Avoid rapid re-expansion of lung.**

- Use of low negative pressure (<-20 cm H₂O) for suction during tube thoracostomy
- Slow evacuation of air or fluid from the pleural space by under water seal drainage alone or by repeated aspirations of <1000 ml of fluid or air
- Stop the drainage if the patient reports chest discomfort

