

Rare Lung, Pleura, and Airway Disorders



Primary Spontaneous Pneumothorax

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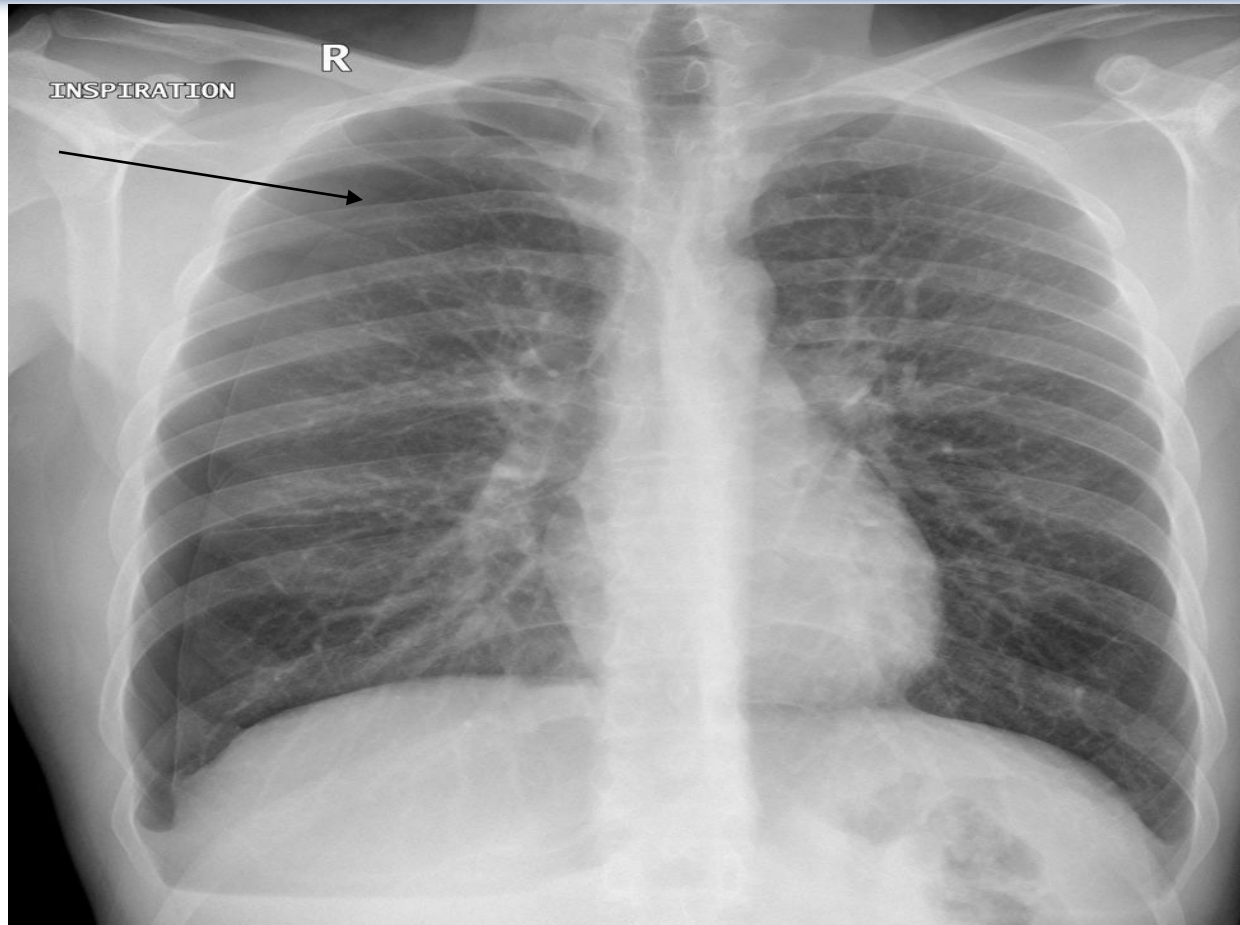
Primary Spontaneous Pneumothorax Background

- Primary spontaneous pneumothorax (PSP) : Pneumothorax without any known underlying lung disease
- Incidence : More common in men
 - 18-28/100,000 cases/yr for men
 - 1.2-6/1000,000 cases /yr for women
- Age 15-34 years commonly
- Recurrence rates for PSP: 17-54%



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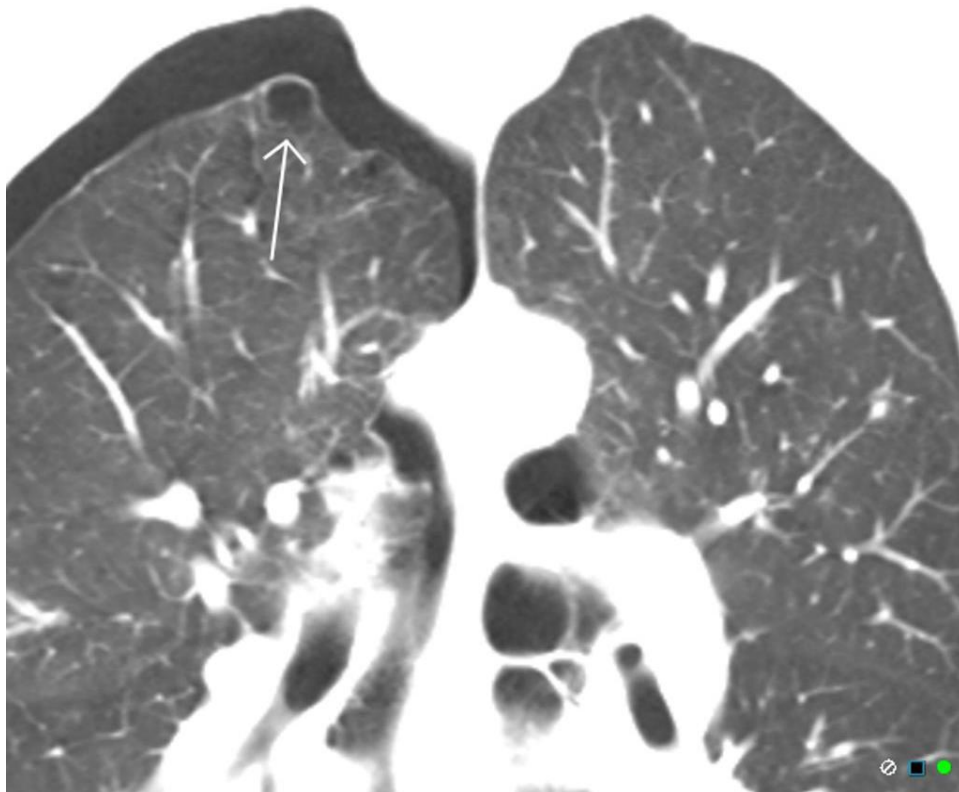
Primary Spontaneous Pneumothorax





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Primary Spontaneous Pneumothorax



Right apical bleb and
pneumothorax



Primary Spontaneous Pneumothorax Pathogenesis

- No totally clear
- Rupture of apical subpleural blebs (< 1 cm in size)
- Increase in pleural porosity secondary to inflammation. Auto-fluorescence has demonstrated pleural porosities in patients
- Emphysema like changes(ELCs) may appear in small airways



Video assisted thoracoscopic surgery (VATS) showing blebs. [Respir Med Case Rep.](#) 2016; 19: 109–111



Primary Spontaneous Pneumothorax Risk Factors

- Cigarette smoking: >90% patients are smokers
- Cannabis
- Tall, thin males
- Genetic :Birt-Hogg-Dubé syndrome, Marfan's syndrome, homocystinuria

Chest 1987;92:1009
Eur J Carthiorac Surg 2017;52:679
Thorax 1997;52:805-9
AM J Med Genet 1991;40:155



Primary Spontaneous Pneumothorax Presentation

- Often asymptomatic
- Chest pain, shortness of breath
- Tachypnea, use of accessory muscles
- Tracheal shift might be visible: Trail sign
- Hyper resonance on percussion
- Auscultation: Diminished / no air entry on affected side
- Tension pneumothorax from PSP is very rare



Primary Spontaneous Pneumothorax Diagnosis

- Erect posteroanterior chest x-ray is the modality of choice:
 1. White visceral pleural line
 2. Pulmonary vessels are not visible beyond the pleural line
- CT chest is usually not necessary but is helpful for:
 1. Size estimation
 2. Visualizing the parenchyma



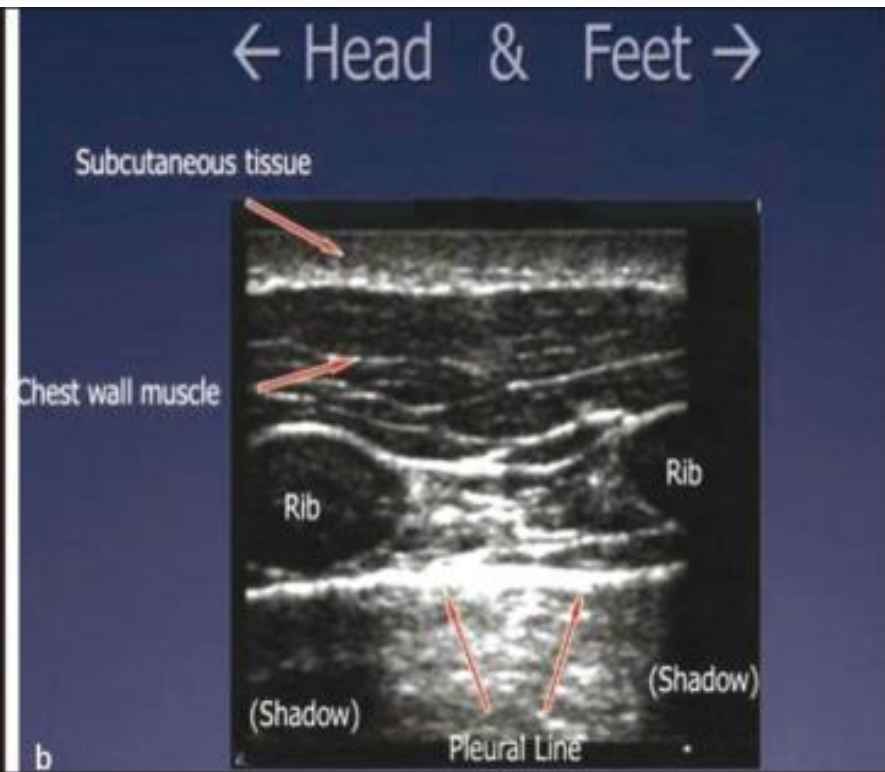
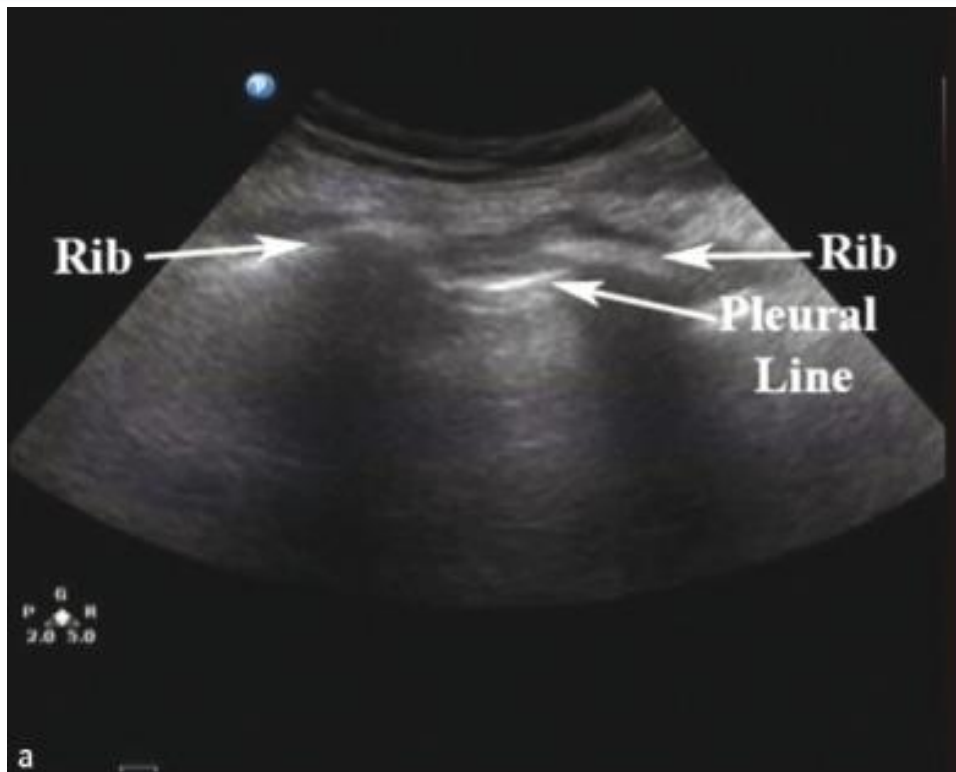
Primary Spontaneous Pneumothorax Ultrasound

- Lack of lung sliding
- Absence of normal comet tail or reverberation artifacts
- Presence of Barcode/ Stratosphere Sign
- Presence of a “lung point” or “transition point”



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Primary Spontaneous Pneumothorax Ultrasound-Normal Lung



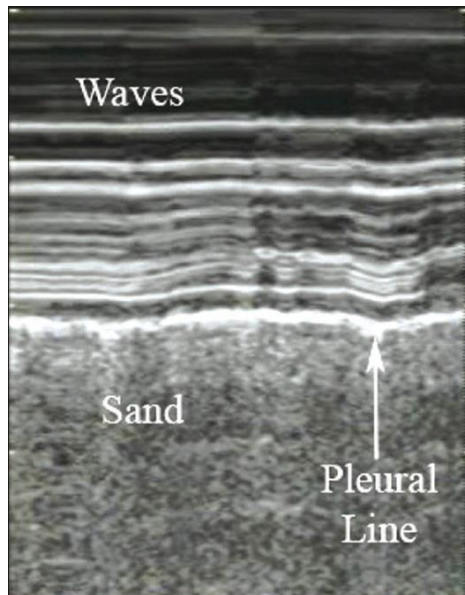
(a) The 'bat sign.' Two ribs with posterior shadowing represent the wings of the bat, and the hyperechoic pleural line, its body

(b) A sagittal scan at the upper intercostal spaces depicting normal anatomy

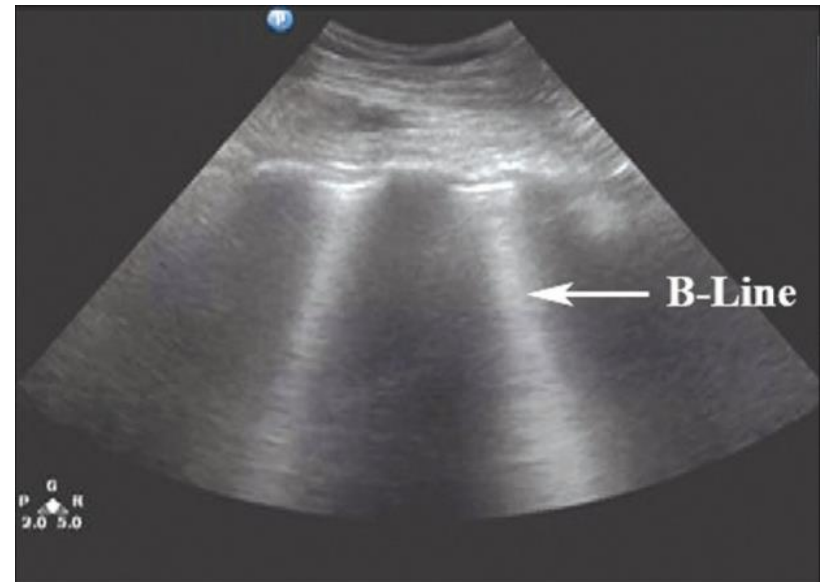


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Primary Spontaneous Pneumothorax Ultrasound-Normal Lung



M-mode illustrating the 'seashore sign.' The pleural line divides the image in half: The motionless portion above the pleural line creates horizontal 'waves,' and the sliding line below it creates granular pattern, the 'sand'



'B-lines' or 'comet-tail artifacts' are seen originating from the bright white hyperechoic pleural line, extending vertically to the edge of the screen. 'B-lines' move in synchrony with the sliding pleura in a normal well-aerated lung

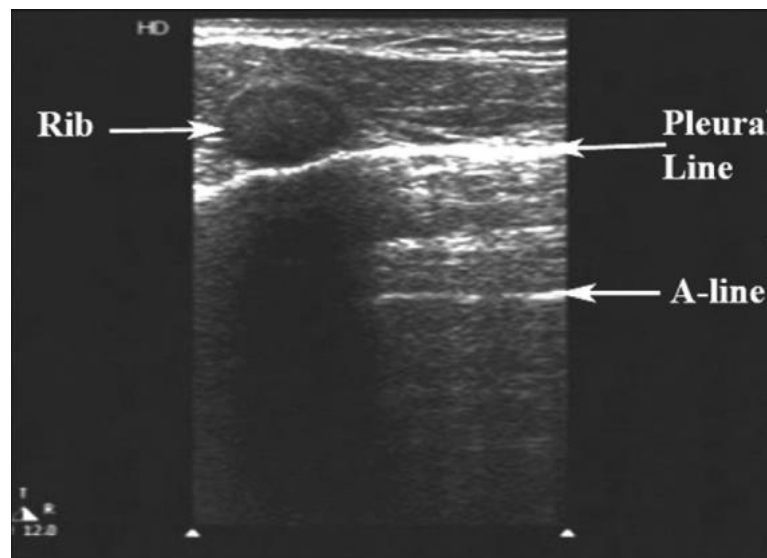


Primary Spontaneous Pneumothorax

Ultrasound-Pneumothorax



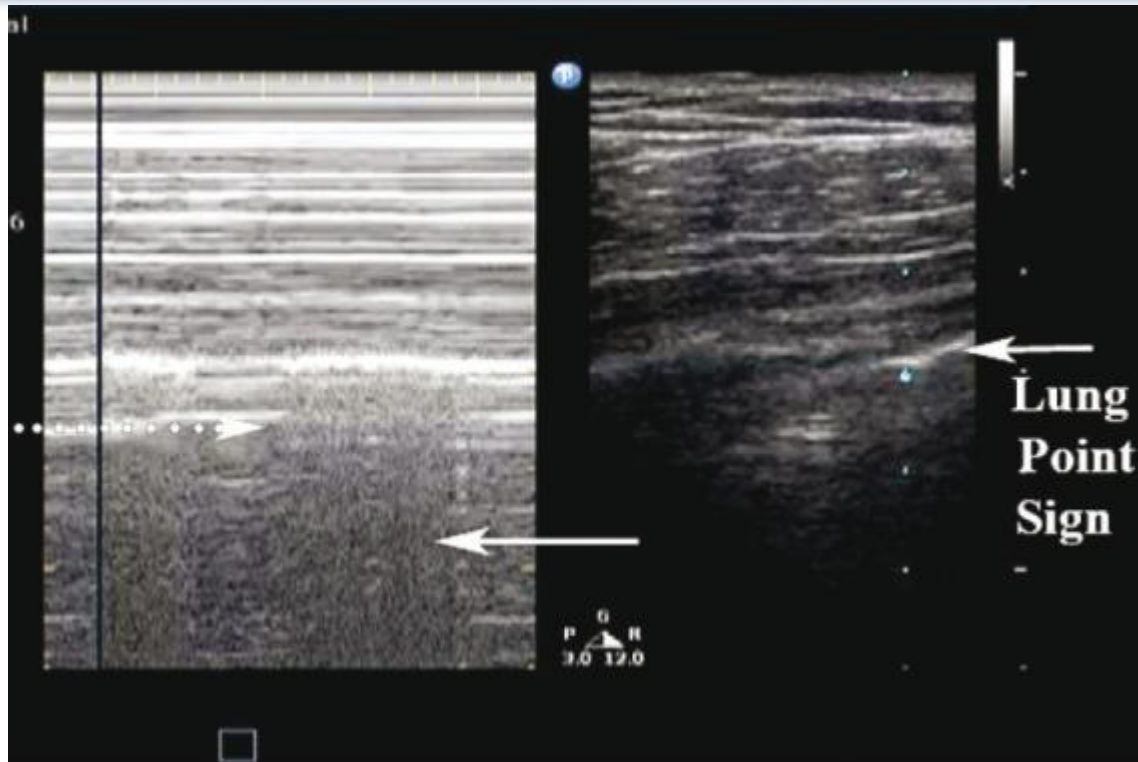
M-mode and the absence of lung sliding are shown as the 'stratosphere sign': Parallel horizontal lines above and below the pleural line, resemble a 'barcode.' This sign indicates a pneumothorax at this intercostal space



'A-lines', a type of reverberation artifact, are horizontal, equally spaced lines seen originating from the bright white hyperechoic pleural line. If 'B-lines' are present, they extend out from the pleural line and erase the 'A-lines' in their path



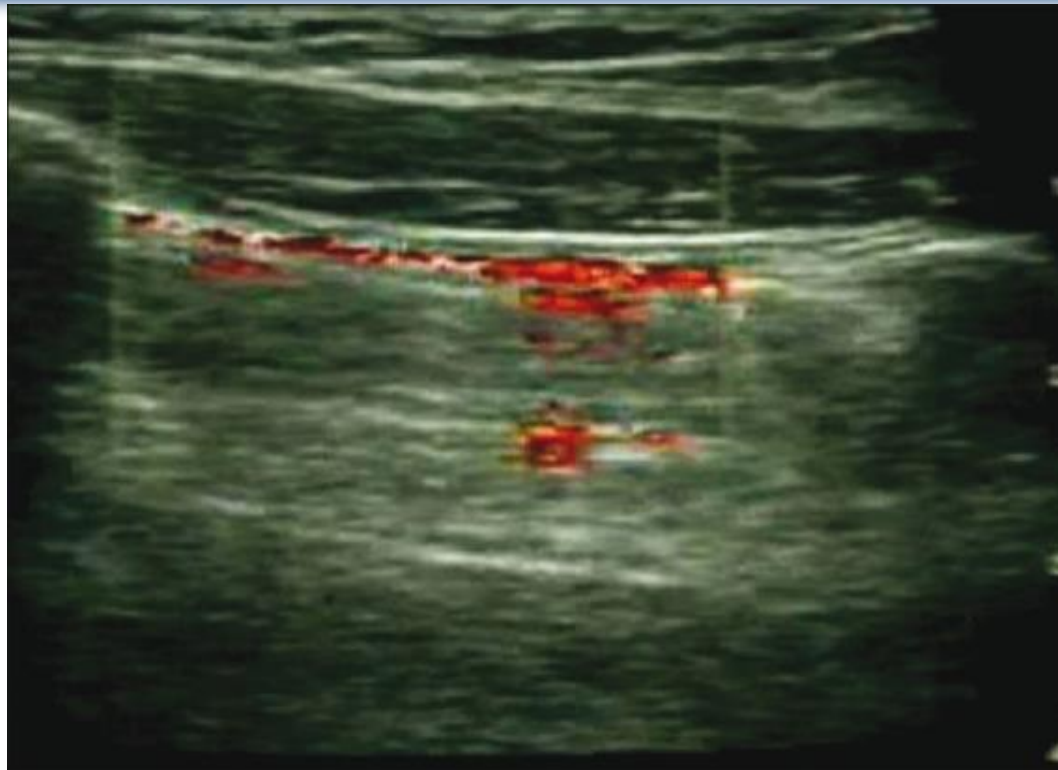
Primary Spontaneous Pneumothorax Ultrasound



'Lung point sign.' (Right) B-mode depicting the lung point: Sliding lung touching the chest wall. (Left) The 'seashore sign' (white arrow) and the 'stratosphere sign' (dotted arrow) as the lung intermittently contacts the chest wall



Primary Spontaneous Pneumothorax Ultrasound



‘Power slide’ in normal sliding lung. Power (angiography) Doppler is used at the pleural line, which is visualized lighting up with color flow as subtle sliding is detected. The probe must be steady to avoid unwanted color artifacts



Primary Spontaneous Pneumothorax Management

- In the first episode of PSP, symptoms rather than pneumothorax size should determine further course
- Asymptomatic patients can be safely observed
- Needle aspiration(NA) alone can be the first line treatment in symptomatic first PSP
- Persistent/ recurrent episodes require definitive management including pleurodesis or surgery



Primary Spontaneous Pneumothorax Management

- Oxygen fastens pneumothorax resolution 3-4 times compared to room air
- Theoretically, oxygen reduces the partial pressure of nitrogen in the alveolus compared with the pleural cavity, and a diffusion gradient for nitrogen accelerates resolution
- Hyperoxemia especially in small pneumothoraces should be avoided



Primary Spontaneous Pneumothorax Management

- British Thoracic Society guidelines suggest needle aspiration (NA) as an initial intervention in patients with a large or symptomatic primary pneumothorax.
- The American College of Chest Physicians (ACCP) does not recommend needle aspiration for PSP
- More recent data has suggested similar outcomes between needle aspiration and chest tube immediately, at 2 weeks and 1 year for first PSP



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Primary Spontaneous Pneumothorax Management



**NEEDLE
ASPIRATION**



Primary Spontaneous Pneumothorax Management



Heimlich valve is a one way, rubber flutter valve that prevents
Evacuated air to re enter the thoracic cavity



Primary Spontaneous Pneumothorax Management

- Small bore chest tubes/ pigtail catheters suffice and have similar recurrence rates when compared to larger chest tubes
- Compared to pigtail catheters, large-bore chest tubes are associated with higher complication rate with more infectious complications and significantly longer drainage duration



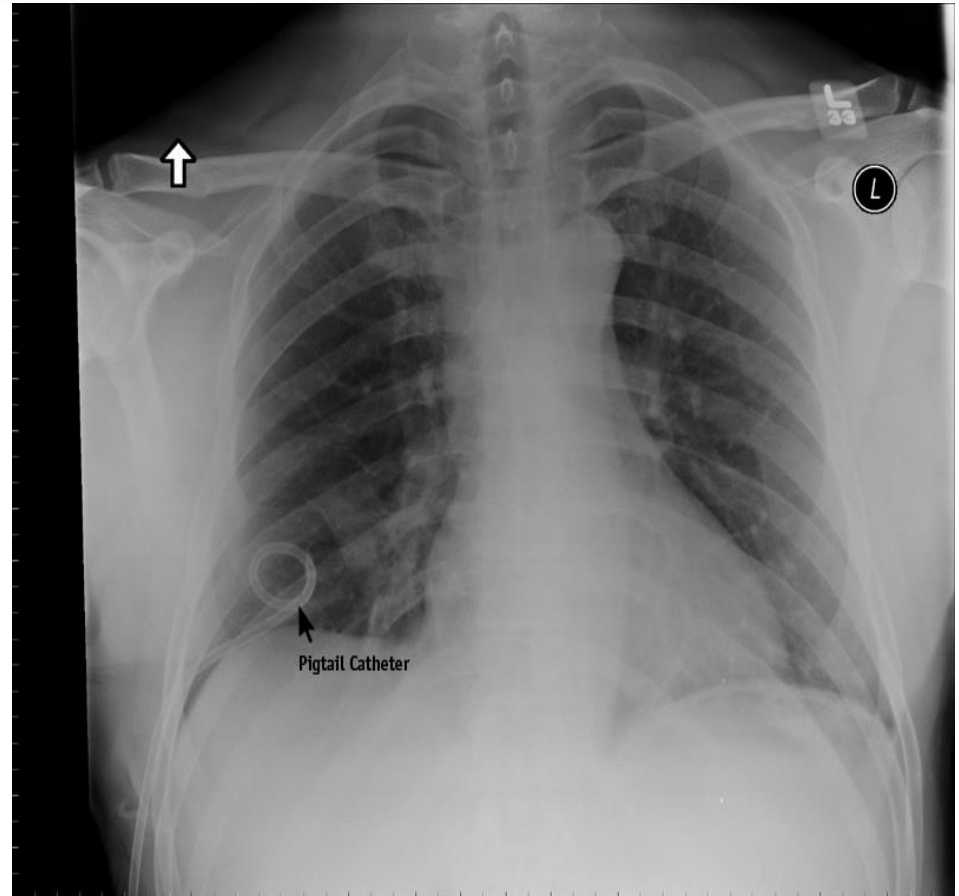
Primary Spontaneous Pneumothorax Management

- Chest tube can be attached to water seal until pneumothorax resolves
- No role of suction in most cases unless an ongoing air leak and persistent pneumothorax on chest imaging
- Once there is no more air leak and the lung has re expanded, chest tubes can be clamped and removed if chest X-ray is stable



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Primary Spontaneous Pneumothorax Management





Primary Spontaneous Pneumothorax Management

- There is a lack of data from randomized controlled trials regarding management of persistent or recurrent PSP. Recurrence rate reported :17-54%

Indications for definitive management:

- Second episode of PSP
- Persisting air leak >3–5 days
- Hemopneumothorax(3-7% of PSP can be hemopneumothorax)
- Bilateral pneumothorax(1 % of PSP can be bilateral)
- Professions at risk (aircraft personnel, divers)



Primary Spontaneous Pneumothorax Recurrence

- Pleurodesis involves permanent apposition of the visceral and parietal pleura to seal the pleural space and can be :
 1. Medical
 2. Surgical

Current guidelines do not specify the optimal pleurodesis approach or agent for chemical pleurodesis



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TALC PLEURODESIS





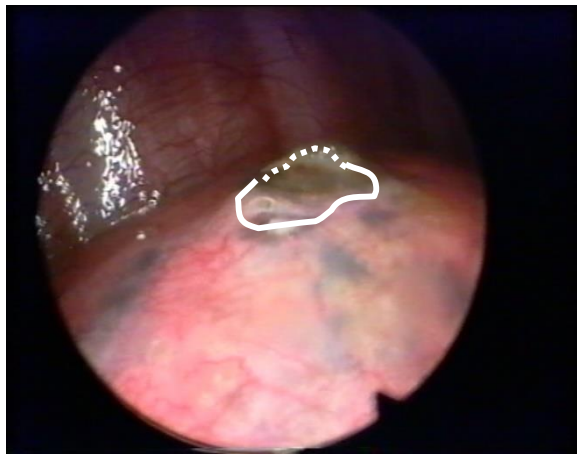
Primary Spontaneous Pneumothorax ACCP/BTS

- **2001:** The American College of Chest Physicians (ACCP) Delphi consensus statement recommends **surgical pleurodesis** (including bullectomy) for ongoing air leak or recurrence prevention at second occurrence.
- British Thoracic Society in 2010 recommended surgical pleurodesis using open/video-assisted thoracoscopic surgery(VATS) compared to medical pleurodesis via Chemical agents due to less recurrences with the surgical approach but noted that direct comparative trials are lacking
- No consensus on the utility of additional talc poudrage during the surgery
- Chemical pleurodesis via a chest tube : Only for patients in whom surgery was contraindicated or patients who refused an operative procedure. Doxycycline or talc as the preferred agents.

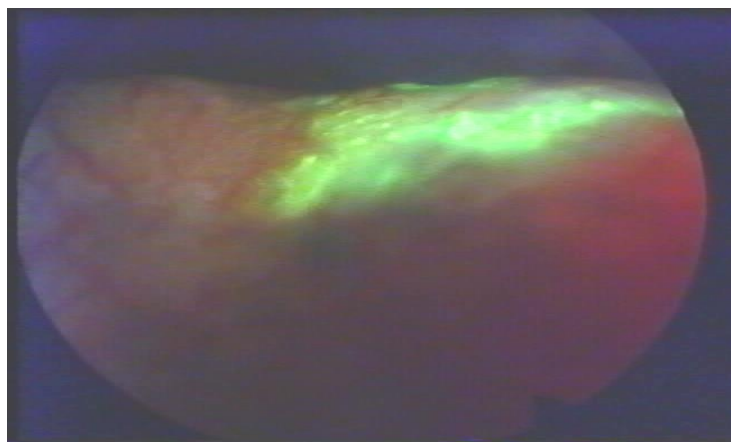
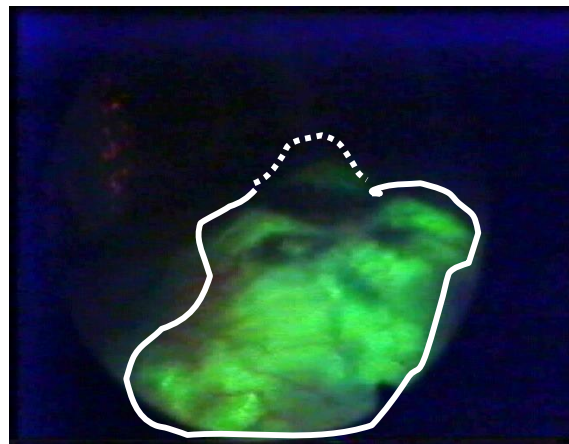


Fluorescein-enhanced Autofluorescence Thoracoscopy

Normal light thoracoscopy, the abnormal area is
about 2 x 2 cm



On autofluorescence, area is 7 by 6 cm, 10 times bigger



Abnormal area where there can
be a leak is much bigger than
what you see with thoracoscopy or
surgically



Primary Spontaneous Pneumothorax

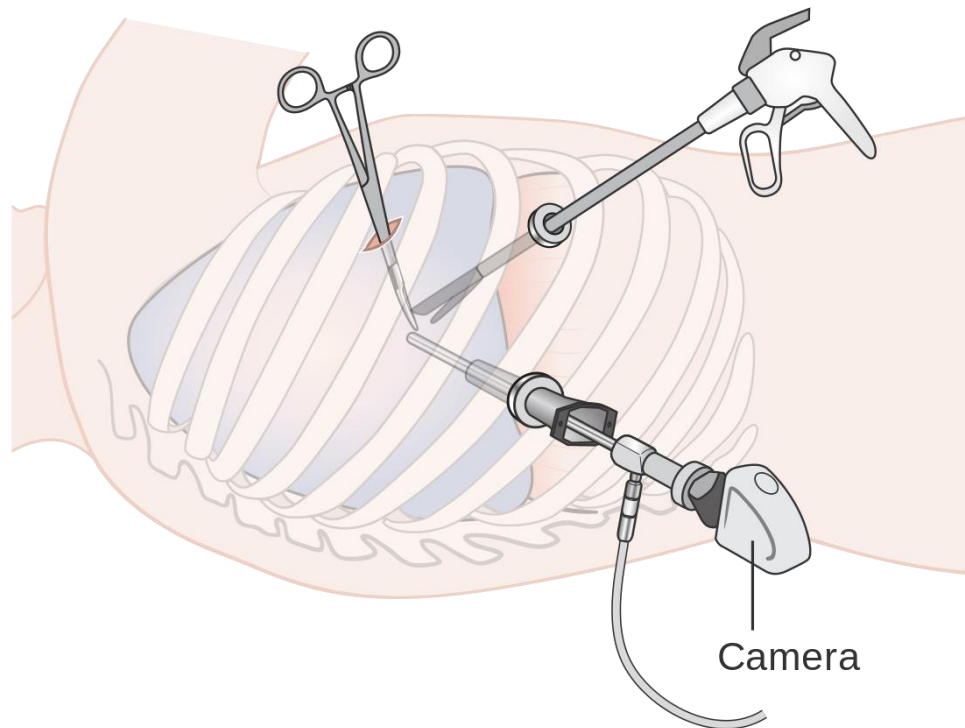
Recurrence rates after definitive treatment of PSP

Study Yr	Procedure	n	Follow up months	Recurrence	Complications
2015(1)	Talc poudrage via Chest tube	21	24	9.5%	None
2005(2)	Tetracycline via chest tube	138	36	16%(yr 1) 27%(yr 3)	None
2013(3)	Minocycline via chest tube	214	12	29.2%	None
2003(4)	Videothoracoscopic bleb excision and pleural abrasion	167	93	3%	27.4%(air leak, pneumonia),0 deaths
2010(5)	VATS bullectomy and talc poudrage	124	12	0	5.6%
2008(6)	Open thoracotomy	82	6	0	19.3%



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Primary Spontaneous Pneumothorax VATS





Primary Spontaneous Pneumothorax Knowledge Assessment

Question 1:

A 26 year-old male presented to the emergency department with right sided chest pain that started suddenly 2 hours ago. The patient does not have any other symptoms. His pulse oximetry indicated 100% on room air. His vital signs were: heart rate: 80 per minute, respiratory rate: 18 per minute and blood pressure: 115/75. The patient never had lung disease and has no past medical history. He started smoking 8 years ago about half pack a day.

Physical examination including lung auscultation was normal.

A chest x-ray showed right apical pneumothorax that is 3 cm from the apex.

What is next step?



Primary Spontaneous Pneumothorax Knowledge Assessment

Answer for question 1:

Because the patient is symptomatic, the next would be to perform needle aspiration of the right pneumothorax. Ultrasound of the chest may help in choosing the site of pneumothorax to place the needle. The patient may be observed for 6 hours with repeat imaging to evaluate for recurrence. Another option is to place a small bore chest tube for drainage.



Question 2:

The patient underwent pneumothorax aspiration and was discharged home after a repeat chest x-ray showing no recurrence. Three days later, he presented to the emergency department with right chest pain similar to the prior episode. He is also complaining of dyspnea and cough. His pulse oximetry was 95% on room air. His vitals were: heart rate: 130 per min, respiratory rate of 30 per min and blood pressure of 100/65.

An ultrasound of the chest was immediately performed and showed the absence of sliding sign, presence of A-line. Using the M mode, the stratosphere sign was shown.

An 8 French pigtail catheter was immediately placed which resulted in quick resolution of the patient's symptoms.

After admitting the patient to a regular hospital bed, what would be the next step?



Answer for questions 2:

Because this is the second episode of primary spontaneous pneumothorax, a thoracic surgery consult for video-assisted thoracoscopic surgery to manage the recurrent pneumothorax should be made. During the procedure, the surgeon may perform bullectomy with or without talc poudrage for pleurodesis.



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and reviewed for accuracy and content by members of the
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