

Primary spontaneous pneumothorax: why all the confusion over first-line treatment?

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ABSTRACT The management of PSP continues to be a source of debate. There are few randomised control trials comparing treatment options, and current guidelines based on specialist opinion vary in their recommendations. Initial management options include observation, aspiration, intercostal drainage with and without pleurodesis, and video-assisted thoracoscopic surgery. Primary spontaneous pneumothoraces arise in patients without clinically apparent lung disease, and no obvious precipitating factor. It is a relatively common presentation with a reported incidence of 18 to 28 per 100,000 men per year and 1.2 to 6 per 100,000 women per year. Primary spontaneous pneumothorax usually occurs in young, tall males between the ages of 15 and 34.

The BTS and ACCP have both published guidelines on the treatment of PSP. While they agree on the management of small asymptomatic PSP (observation and out-patient review) and clinically unstable PSP (intercostal drain insertion and admission), they differ on the management of symptomatic small PSP and clinically stable large PSP. The ACCP advise that simple aspiration is rarely appropriate in the treatment of PSP, while the BTS recommend simple aspiration as a first-line treatment. A 2007 Cochrane report, which systematically reviewed all published randomised control trials comparing aspiration to intercostal drain insertion, concluded that there was no difference in the immediate success rate, early failure rate, or one-year success rate between the two interventions. However, aspiration resulted in a lower number of patients requiring admission, and decreased the duration of hospital stay. Current evidence supports the 2003 BTS guidelines, and simple aspiration as first-line treatment in clinically stable pneumothoraces. Until a large randomised control trial is performed, and provides a conclusive evidence base for the most appropriate management of spontaneous pneumothorax, confusion will remain over first-line treatment.

KEYWORDS Spontaneous pneumothorax, first line treatment

LIST OF ABBREVIATIONS American College of Chest Physicians (ACCP), British Thoracic Society (BTS), emphysema-like changes (ELC), primary spontaneous pneumothorax (PSP), video-assisted thoracoscopic surgery (VATS)

DECLARATION OF INTERESTS No conflict of interests declared.

Primary spontaneous pneumothoraces arise in patients with no obvious precipitating factor, and no clinically apparent underlying lung disease. It is a relatively common presentation to hospital, with a reported incidence of 18 to 28 per 100,000 men per year and 1.2 to 6 per 100,000 women per year. Primary spontaneous pneumothoraces usually occurs in tall, thin males between the ages of 15 and 34, and rarely affects individuals over the age of 40. Smoking increases a healthy male's lifetime risk of developing a pneumothorax from 0.1 to 12%.

PATHOPHYSIOLOGY

The exact pathophysiological mechanisms that result in PSP remain unclear. Historically it was believed that distal airway inflammation, and obstruction due to external and

internal factors resulted in the development of small subclinical bullae or blebs, often located at the apex of the lung, and the rupture of these led to pneumothoraces. These bullae are often described as ELC. However, recent studies have indicated that ELC is not always the cause of PSP. Diseased areas of lung parenchyma with increased visceral pleural porosity are now thought to play a role. These areas of increased porosity result in visceral pleural air leakage and may occur in isolation, or in conjunction with ELCs.

Height is thought to be a risk factor because the pleural pressure gradient increases from the base to the apex of the lung. Consequently, apical alveoli in taller patients are subject to far greater distending pressures, which may precipitate subpleural cyst formation.

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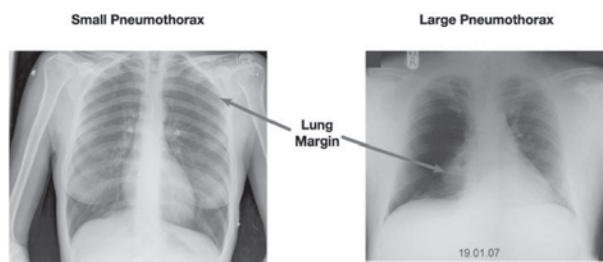


FIGURE 1 X-ray showing (a) small pneumothorax and (b) large pneumothorax.

PRESENTATION

Symptoms

Symptoms vary greatly depending on the volume of air in the pleural cavity, the degree of lung collapse, and the individual's underlying lung function.

Patients commonly present complaining of sudden onset unilateral pleuritic chest pain, which may be associated with varying degrees of dyspnoea, depending on the size of the pneumothorax. Other symptoms include dry cough, palpitations, chest tightness, and shoulder tip pain.

In the majority of cases of PSP, symptoms will reduce or resolve spontaneously within 24–48 hours. Spontaneous air absorption from the pleural space occurs at approximately 1.25–1.8% of the volume of hemithorax per day, and high flow (10 l/min) supplemental oxygen will increase the rate of absorption fourfold.

Clinical signs

On examination, chest expansion and breath sounds may be reduced, and percussion of the chest wall hyper-resonant on the affected side. In patients with a small pneumothorax, tachycardia and tachypnoea may be the only finding on clinical examination immediately after development of the pneumothorax. Normal clinical examination in the context of a history of possible pneumothorax should not preclude investigation. Depending on the size of the pneumothorax, and underlying lung function, oxygen saturations may be reduced. However, in the vast majority these will be normal.

INVESTIGATION

A plain chest radiograph normally confirms the diagnosis of a pneumothorax. Small pneumothoraces may be difficult to detect on a PA (posteroanterior) film, and in cases where there is high clinical suspicion a lateral chest or lateral decubitus radiograph may confirm the diagnosis. Expiratory films are no longer routinely recommended as they do not increase diagnostic yield.

ESTIMATING THE SIZE OF A PNEUMOTHORAX

The estimated size of a pneumothorax is a key factor in determining the initial management. There is no universally accepted method for correlating the appearance on a plain PA radiograph to the size of the pneumothorax. Both the BTS and ACCP guidelines divide pneumothoraces into small or large depending on the degree of lung collapse; however, they differ in their absolute definition.

The BTS guidelines state that a 2 cm radiographic pneumothorax extending throughout the lung field on a plain chest X-ray occupies approximately 50% of the hemithorax. When the visible rim between the lung margin and the chest wall is less than 2 cm the PSP is defined as small, and when the rim is greater than 2 cm it is termed large. The ACCP define a PSP as small when the distance from apex to cupola is less than 3 cm, and large when the distance is greater than 3 cm (see Figure 1).

MANAGEMENT

Primary spontaneous pneumothorax treatment aims to eliminate intrapleural air, and should always be guided by the clinical presentation of the patient. The size and aetiology of the pneumothorax, recurrence risk, the patient's profession, and patient preference also play key roles in deciding the therapeutic pathway. Management options include observation, simple aspiration, intercostal drain insertion, and VATS.

The BTS and ACCP have both published guidelines for the treatment of PSP, however they give contradictory recommendations for first-line treatment.

The ACCP advises that simple aspiration is rarely appropriate in the treatment of PSP, while the BTS recommend simple aspiration as the first-line treatment in all PSP requiring intervention.

A recent Cochrane report in 2007 systematically reviewed all published randomised control trials that compared simple aspiration versus intercostal tube drainage for spontaneous pneumothorax in adults. It concluded that there was no difference in the immediate success rate of the procedure, early failure rate, or one-year success rate between the two groups. However, simple aspiration conferred a number of advantages including; lower percentage of patients hospitalised, decreased duration of stay, and the fact it is a relatively simple procedure to perform. While the Cochrane report appears to validate the BTS guidelines, the power of the effect measures drawn from the review are limited owing to the small number of published studies eligible for consideration.

Clinically stable small pneumothorax

Both guidelines agree that clinically stable patients with a small pneumothorax (<2 cm, BTS; <3 cm, ACCP) and minimal symptoms should be treated with simple observation, and discharged with careful instructions. ACCP suggest observation for 3–6 hours with pre-discharge chest X-ray and out-patient follow-up within two days. The BTS guidelines do not define either the observation period or timing of follow-up.

Large pneumothorax and symptomatic small pneumothorax

All large pneumothoraces and symptomatic small pneumothoraces require intervention. Differences between the BTS and ACCP recommendations are outlined above. The recent Cochrane report supports the BTS guidelines, therefore simple aspiration is recommended as the first-line treatment of clinically stable large pneumothoraces and symptomatic small pneumothoraces.

After aspiration, a chest X-ray is obtained to determine whether there is any improvement. If there is no improvement, or the patient is still symptomatic, repeated aspiration may be performed (if less than 2.5 litres were aspirated on the first attempt). If more than 2.5 litres were aspirated on the first attempt, or repeated aspiration was unsuccessful, an intercostal drain should be inserted.

Clinically unstable patients with a large pneumothorax should all have an intercostal drain inserted, and be admitted to hospital. The lung should be fully expanded for a period of 24 hours prior to drain removal.

Intercostal drain size

There has been extensive debate regarding the optimal size of the intercostal drain. Evidence now suggests that small-bore pleural catheters are as effective as larger bore intercostal drains in the treatment of spontaneous pneumothorax. No significant correlation has been found between drain size and complication rate, recurrence rate, and length of hospital stay. However, small calibre catheters may not be suitable in the presence of pleural fluid (where they could block) or a large or persistent air leak (owing to inadequate re-expansion). Suction should only be considered 48 hours after chest drain insertion, to limit the development of re-expansion pulmonary oedema and after consultation with a senior respiratory physician. High volume, low pressure (-10 to -20 cm H₂O) suction systems are recommended by the BTS guidelines.

It is not recommended that chest drains are clamped unless specifically requested by a respiratory physician or cardiothoracic surgeon. Drain clamping is potentially hazardous and there is no conclusive evidence that it

improves success rates, or prevents recurrence. A drain clamped in the presence of an ongoing air leak, could potentially result in the development of a tension pneumothorax.

Surgical intervention

Thoracic surgical opinion should be sought if there is a persistent air leak, or the lung fails to re-expand after 3–5 days. Indications for operative intervention include: second ipsilateral pneumothorax, first contralateral pneumothorax, bilateral pneumothorax, and professionals at risk, e.g. divers and pilots.

Patients who are divers or pilots should undergo bilateral surgical intervention. Surgical treatment options include VATS, pleural abrasion, surgical talc pleurodesis, pleurectomy, and open thoracostomy.

KEYPOINTS

- Emphysematous-like changes (bullae and blebs) are not always the cause of PSP. Diseased areas of lung parenchyma with increased visceral pleural porosity are also thought to play a role.
- Current evidence supports simple aspiration as first-line treatment for stable primary spontaneous pneumothoraces that require intervention. If re-expansion does not occur after 2.5 litres of air has been aspirated then an intercostal drain should be inserted.
- Small-bore pleural catheters are as effective as larger intercostal drains in the treatment of spontaneous pneumothorax.
- If there is a persistent air leak, or the pneumothorax fails to resolve in 3–5 days then a thoracic surgical opinion should be sought.

FURTHER READING

- Baumann MH, Strange C, Heffner JE et al. AACP Pneumothorax Consensus Group. Management of spontaneous pneumothorax: an American College of Chest Physicians Delphi consensus statement. *Chest* 2001; **119(2)**:590–602.
- Henry M, Arnold T, Harvey J; Pleural Diseases Group, Standards of Care Committee, British Thoracic Society. BTS guidelines for the management of spontaneous pneumothorax. *Thorax* 2003; **58(Suppl 2)**:ii39–52.
- Mendis D, El-Shanawany T, Mathur A, Redington AE. Management of spontaneous pneumothorax: are British Thoracic Society guidelines being followed? *Postgrad Med J* 2002; **78(916)**:80–4.
- Noppen M, Baumann MH. Pathogenesis and treatment of primary spontaneous pneumothorax: an overview. *Respiration* 2003; **70(4)**:431–8.
- Tschopp JM, Rami-Porta R, Noppen M, Astoul P. Management of spontaneous pneumothorax: state of the art. *Eur Respir J* 2006; **28(3)**:637–50.
- Wakai A, O'sullivan R, McCabe G. Simple aspiration versus intercostal tube drainage for primary spontaneous pneumothorax in adults. *Cochrane Database Syst Rev* 2007; **(1)**:CD004479.

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