Clinical Educational Guideline for the diagnosis and treatment of Pneumothorax.

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Introduction

This series of Clinical Education Guidelines focus on teaching Evidence-Based Medicine to medical students who are preparing to embark into residency programs of Emergency Medicine and those junior learners who are seeking up to date information while doing clinical rotation in the Emergency departments. Based on Problem-Based Learning (PBL), the guidelines adapt the presenting complaints to the emergency department as fulcrums to explore each emergency differential diagnosis separately.

The first edition of this series is anchored by the presenting complain of undifferentiated chest pain. Chest pain is one of the top five most common presenting symptoms to the emergency department. More than 50% of these patients are admitted to the hospital with diagnosis spectrum of non-specific “Chest pain”. These guidelines were not designed to alter this number but rather it was intended to be an educational tool to help the emergency medicine learners especially at their initial steps. It also serves as a cornerstone for an Evidence-Based Curriculum of Emergency Medicine for clinical clerks. This guideline is expected to be followed by subsequent guidelines of other presenting complaints to the emergency department.

Methodology

The detailed methodology of this project is documented separately. The following is a brief summary of the methodology of development for these guidelines. Initially clinical diagnoses of undifferentiated chest pain were ranked by emergency medicine attending physicians in terms of their importance for clinical clerks using Likert scales. The top five differential diagnoses were Acute Coronary Syndrome (ACS), Community Acquired Pneumonia (CAP), Acute Aortic Dissection (AAD), Pneumothorax (PTX), and Pulmonary Embolism (PE).

Current guidelines, recent literature and reviews were then compiled, then were used by the authors to create the clinical education guidelines for each topic.

The evidence was then reviewed by the committee members and a consensus was reached for recommendations and levels of evidence.

Three main clinical questions were answered. For instance if with talking about Pneumothorax then the main three questions were:

1. What are the important elements of clinical assessment (history/physical examination) utilized in the diagnosis of Pneumothorax?
2. What are the important elements of investigations and risk assessment of Pneumothorax?
3. What are the important initial interventions for treating Pneumothorax in the ED?

Strength of Recommendation (SOR) and Level of Evidence (LOE):

The Clinical Education Guidelines for undifferentiated chest pain study group agreed to use the GRADE (Grading of Recommendations Assessment, Development and Evaluation) as its grading system. The Level of Evidence (LOE) in the GRADE system is classified into one of four levels: High, Moderate, Low or very low quality. It is based on the study type i.e. Randomized Controlled Trials (RCTs) versus observational studies and can be either upgraded or down graded according to multiple factors including effect size, variability in the results and critical outcomes. The GRADE system classifies recommendations as either (strong or weak for using) or (strong or weak against using) the intervention. These recommendations are not based on LOE only but on the patient’s values and preferences and other management strategies also.

Introduction to this Topic

Pneumothorax (PTX), simply put, is the presence of air or gas in the pleural space, essentially between the lung and the chest wall. If air is discovered in pleural space, there one of the three following events has happened.

1. Communication between alveoli & pleural space
2. Direct communication between atmosphere & pleural space
3. Presence of gas-producing organisms in the pleural space

From clinical perspective, pneumothorax can be classified as spontaneous, traumatic or iatrogenic.
Clinical classification of pneumothorax:

**Spontaneous:**
- Primary: no apparent underlying lung disease
- Secondary: underlying lung disease
- Catamenial: in conjunction with menstruation
- Neonatal

**Traumatic:**
- Penetrating chest injury
- Blunt chest injury (alveolar rupture)

**Iatrogenic:**
- Secondary to diagnostic or therapeutic maneuvers (transthoracic or transbronchial lung biopsy, pleural biopsy, thoracentesis, central venous catheterization, barotraumas, nerve block, acupuncture).

Adapted from: Noppen M, Baumann M. Pathogenesis and treatment of primary spontaneous pneumothorax: an overview. Respiration 2003; 70: 431-438

Spontaneous pneumothoraces can be divided into primary spontaneous pneumothoraces (PSP) & secondary spontaneous pneumothoraces (SSP):
- PSP arises in patients without clinically apparent lung disease
- SSP is associated with underlying lung diseases such as cystic fibrosis, COPD, AIDS, etc.

Secondary spontaneous pneumothoraces can also be further classified into various groups based on etiology. An iatrogenic PTX is secondary to incursion of the pleural space secondary to therapeutic or diagnostic intervention. Traumatic PTX is secondary to either penetrating or blunt injury to the chest. Finally, the life threatening tension PTX is when air is progressively accumulating in inspiration and gets trapped in the pleural cavity during expiration in one-way-valve model. This leads to increase intrapleural pressure and impairs the venous return to the heart causing cardiovascular collapse.

Primary spontaneous pneumothorax is a worldwide problem. There are two epidemiological groups seen:

PSP having peak incidence in young people (peak age incidence 20-30 years) with an annual incidence: 18-28 /100,000 in males and 1.2-6.0/100,000 in females. SSP peak incidence in those >55 years with an annual incidence: 6.3/100,000 in males and 2.0/100,000 in females.

CRITICAL QUESTION

1.1 What are the important elements of history utilized in the diagnosis of PTX?

**Patient Management Recommendations**

1.1.1 Primary spontaneous pneumothorax (PSP):

- Almost all patients report a sudden ipsilateral chest pain which typically resolves within 24 hours.
- Dyspnea is a rare complaint in patients with PSP unless there is a complete or tension pneumothorax & is usually mild.
- Risk factors are male gender, cigarette smoking and an asthenic physiognomy (slender build with long limbs, an angular profile, and prominent muscles or bones).
- Lifetime risk of developing pneumothorax is 12% in smoking males vs. 0.1% in non-smoking males.
- No precipitating cause(s) can usually be identified for any episode of PSP in individual patients and the majority occur at rest. Physical activity does not play a role in PSP.
- There have been associations of PSP with atmospheric pressure or weather changes but a causative role has yet to be established.
- Recurrence rates for ipsilateral or contralateral PSP reported to be 20-60% in patients with PSP and bilateral PSP is seen in 7.8-21% of cases. Most recurrences tend to occur within two years after the first event.
- There is an association with family history of PSP with one study showing 9.1-11.5% of patients presenting having a positive family history or in close relatives.
- One study showed that first-onset PSP had significantly high levels of anger and perceived stress & a low BMI and trait anger could be associated with first-onset PSP.

### Table 1:

<table>
<thead>
<tr>
<th>Complaints on Presentation</th>
<th>% of Episodes</th>
<th>Findings on Presentation</th>
<th>% of Episodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest Pain</td>
<td>95</td>
<td>Breath Sounds to</td>
<td>85.6</td>
</tr>
<tr>
<td>On side of PSP</td>
<td>91.2</td>
<td>Affected Side</td>
<td></td>
</tr>
<tr>
<td>Bilaterally</td>
<td>3.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Pain</td>
<td>56.8</td>
<td>Hyperresonance on</td>
<td>31.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>percussion</td>
<td></td>
</tr>
<tr>
<td>Shoulder Pain</td>
<td>40.2</td>
<td>Tachypnea with RR &gt; 24</td>
<td>5.0</td>
</tr>
<tr>
<td>Abdo Pain</td>
<td>6.0</td>
<td>Tracheal Shift from</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Midline</td>
<td></td>
</tr>
<tr>
<td>Shortness of Breath</td>
<td>77.1</td>
<td>Crepitations</td>
<td>3.2</td>
</tr>
<tr>
<td>Severe Cough</td>
<td>19.3</td>
<td>Pleural Rub</td>
<td>2.2</td>
</tr>
<tr>
<td>Loss of Consciousness</td>
<td>4.4</td>
<td>Tachycardia with HR &gt;120 bpm</td>
<td>1.8</td>
</tr>
<tr>
<td>Diaphoresis</td>
<td>4.0</td>
<td>Cyanosis</td>
<td>1.4</td>
</tr>
<tr>
<td>Numbness or weakness in</td>
<td>2.4</td>
<td>Wheezing</td>
<td>1.4</td>
</tr>
<tr>
<td>ipsilateral upper extremity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemptysis</td>
<td>1.6</td>
<td>Distant Heart Sounds</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Table 2  Risk factors for patients with spontaneous bilateral PSP (SBPSP) and patients with unilateral pneumothorax

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non SBPSP</th>
<th>SBPSP</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>22.6 ± 5.8</td>
<td>20.9 ± 4.7</td>
<td>0.226</td>
</tr>
<tr>
<td>Gender ratio (M:F)</td>
<td>349 : 27</td>
<td>13 : 0</td>
<td>0.139</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>172.5 ± 7.5</td>
<td>173 ± 4</td>
<td>0.719</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>59 ± 8</td>
<td>52.8 ± 8.4</td>
<td>0.018</td>
</tr>
<tr>
<td>Ht/Wt ratio</td>
<td>2.9 ± 0.4</td>
<td>3.3 ± 0.4</td>
<td>0.004</td>
</tr>
<tr>
<td>BMI</td>
<td>19.5 ± 2.3</td>
<td>17.6 ± 2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Smoking</td>
<td>48</td>
<td>46</td>
<td>0.517</td>
</tr>
<tr>
<td>Blebs/Bullae on HRCT of lung (%)</td>
<td>63.5</td>
<td>88.5</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Ht = Height; Wt = Weight; HRCT = high resolution Computerized Tomography scan.


1.1.2 Secondary spontaneous pneumothorax (SSP):

- Virtually every lung disease has been reported to be associated with SSP but COPD is by far the most common underlying disorder with a reported incidence of 26/100,000 population per year.\(^{15,16}\)
- In COPD patients the incidence corresponds to the incidence of COPD\(^6\)
- Spontaneous pneumothoraces have been known to develop in 2-6% of HIV patients with pneumocystis pneumonia\(^17\)
- Recurrence rates can be high depending on etiology with incidences varying from 40-80%\(^7\)
- SSP usually occurs with dyspnea or respiratory insufficiency and can be life-threatening because of the poor respiratory reserve of these patients\(^8\)
- It is accompanied by ipsilateral chest pain, hypoxemia or hypotension, or even hypercapnia.\(^9\)
- Should always be considered in cases of decompensated COPD or cystic fibrosis\(^10\)
- Cannabis & cocaine use is also described as risk factors for development of spontaneous pneumothorax\(^11,12\)

<table>
<thead>
<tr>
<th>Airway disease</th>
<th>Connective tissue disease</th>
<th>Infectious lung disease</th>
<th>Interstitial lung disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>Rheumatoid arthritis</td>
<td>Pneumocystis carini pneumonia</td>
<td>Sarcoidosis</td>
</tr>
<tr>
<td>Cystic fibrosis</td>
<td>Ankylosing spondylitis</td>
<td>Tuberculosis</td>
<td>Idiopathic pulmonary fibrosis</td>
</tr>
<tr>
<td>Acute severe asthma</td>
<td>Polymyositis/dermatomyositis</td>
<td>Necrotising pneumonia</td>
<td>Histiocytosis X</td>
</tr>
<tr>
<td></td>
<td>Scleroderma</td>
<td></td>
<td>Lymphangioleiomyomatosis</td>
</tr>
</tbody>
</table>


### CRITICAL QUESTION

1.2 What are the important elements of physical examination?

#### 1.2.1 Tension Pneumothorax

**Strong Recommendation for Usage, Low LOE**

- Mediastinal shifting is an inconsistent finding on exam. Even with chest radiological evidence of mediastinal displacement, the trachea is often noted to be central. Presence of tracheal displacement is neither diagnostic of tension pneumothorax nor is its absence exclude the diagnosis.\(^{29}\)

**a) Awake non-ventilated patients:**

- Hypoxemia is predominant sign with progressive respiratory deterioration and potential final respiratory arrest.\(^{29}\)
- Cyanosis & neurological changes may be present with decreasing level of consciousness.\(^{29}\)
- Decreased blood pressure & cardiac output are not common signs.\(^{29}\)
- Tension pneumothorax induced hypotension +/- rapidly decreasing SpO\(_2\) is almost certainly pre-terminal.\(^{29}\)
- Ipsilateral chest hyper-expansion is rarely seen on clinical exam but consistently present on chest radiography. Chest hypo-mobility may occur as a result of pain from associated rib fractures. Contralateral hyper-mobility is however expected as part of compensatory mechanisms to maintain negative intrapleural pressures.\(^{29}\)
- Other potential chest signs may include ipsilateral wheezing or crackles, decreased air entry +/- increased percussion tone, sternal resonance and displaced apex beat.\(^{29}\)

**Signs of tension pneumothorax in awake patients:**

- Common findings (50 – 75% of cases)
  - Tachycardia
  - Ipsilateral decreased air entry
- Inconsistent findings (< 25% of cases)
  - Low SpO\(_2\)
  - Tracheal deviation
  - Hypotension
- Rare findings (~ 10% of cases)
  - Cyanosis
  - Hyper-resonance
  - Decreased level of consciousness
  - Ipsilateral chest:
    - Hyper-expansion
    - Hypo-mobility
- Acute epigastric pain
- Cardiac apical displacement
- Sternal resonance

b) Ventilated patients:
- Sudden fall in SpO₂ followed by hypotension (over a few minutes).
- Decreased cardiac output is consistent, early and progressive with hypotension being a pre-terminal finding which if not recognized early & aggressively treated, could easily progress to sudden cardiac arrest.

Signs of tension pneumothorax in ventilated patients:
Universal findings:
- Rapid onset
- Immediate and progressive decrease in arterial and mixed venous SpO₂
- Immediate reduction in cardiac output +/- blood pressure

Common findings (each in ~33% of cases)
- High ventilation pressures
- Ipsilateral chest:
  - Hyper-expansion
  - Hypomobility
  - Decreased air entry

Inconsistent findings (each in ~20% of cases)
- Surgical emphysema
- Venous distension


Signs of advanced tension pneumothorax in ventilated patients:

<table>
<thead>
<tr>
<th>Signs</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcutaneous emphysema</td>
<td>100</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>95</td>
</tr>
<tr>
<td>Decreased breath sounds</td>
<td>87</td>
</tr>
<tr>
<td>Hyper-resonance</td>
<td>85</td>
</tr>
<tr>
<td>Systolic BP &lt; 90</td>
<td>81</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>75</td>
</tr>
<tr>
<td>Low paO₂</td>
<td>70</td>
</tr>
<tr>
<td>Tracheal deviation</td>
<td>60</td>
</tr>
</tbody>
</table>


1.2.2 Primary Spontaneous Pneumothorax

Patient Management Recommendations

**Strong Recommendation for Usage, Moderate LOE**
- Physical examination can be normal in small pneumothoraces. In larger pneumothoraces, breath sounds and tactile fremitus are typically decreased or absent, and percussion is hyperresonant.
- The diagnosis of PSP is usually made by chest x-ray in the case of sudden chest pain +/- dyspnea.

1.2.3 Secondary Spontaneous Pneumothorax

Patient Management Recommendations

**Strong Recommendation for Usage, Low LOE**
- Usually presents with respiratory insufficiency or dyspnea which is often severe. It is accompanied by ipsilateral chest pain, hypoxemia or hypotension or even hypercapnea sometimes resulting in acute respiratory failure.
- The presence of underlying lung disease along with the size of PTX predicts the degree of hypoxemia.
- In general, clinical symptoms associated with secondary pneumothoraces are more severe than those associated with primary PTX.
- Findings of ipsilateral decreased breath sounds, tactile fremitus and hyperresonance are potentially unreliable as they may already exist in patients with underlying COPD.

Summary of Important Elements of Clinical Features
There are no prospective studies evaluating the clinical examination for spontaneous pneumothoraces. Historical risk factors for primary spontaneous pneumothorax include young age, male gender, tall & thin body habitus and history of smoking or previous spontaneous pneumothorax. Secondary spontaneous pneumothorax is by definition associated with underlying lung parenchymal disease, with COPD being by far the most commonly associated condition.

Bottom Line:
Although history and physical exam are important in terms of formulating clinical suspicion of pneumothorax, the symptoms & signs are very non-specific. Diagnosis requires suspicion and a low threshold for obtaining a chest radiograph.

**CRITICAL QUESTION**

2.1 What are the key diagnostic tests that can aid the student in confirming or rejecting the diagnosis of pneumothorax when assessing an adult patient with undifferentiated chest pain in the ED?

Patient Management Recommendations

**Strong Recommendation for Usage, Moderate LOE**
- Pneumothoraces be confirmed in the majority of cases with an upright porsteroanterioir chest radiograph, which also makes it possible to estimate the pneumothorax size with reasonable accuracy.
- Contralateral shift of the trachea & mediastinum is a normal phenomenon in PSP and not at all suggestive of tension pneumothorax.
- In small pneumothoraces, computer tomography may be necessary to diagnose the presence of pleural air.
• Expiratory chest radiographs (as in Inspiratory + Expiratory views) are not recommended for the routine diagnosis of PTX. 8
• A lateral chest or lateral decubitus radiograph should be performed if the clinical suspicion of PTX is high, but a PA radiograph is normal. 8
• The lateral decubitus radiograph is superior to the erect or supine chest radiograph and is felt to be as sensitive as CT scanning in PTX detection. 34

Weak Recommendation for Usage, Low LOE
• ABG measurements are frequently abnormal in PTX patients with the arterial oxygen tension (PaO2) being less than 10.9 kPa (80mm Hg) in 75% of patients 32

Strong Recommendation for Usage, Low LOE
• CT scanning is recommended when differentiating a PTX from complex bullous lung disease, when aberrant tube placement is suspected, and when the plain chest radiograph is obscured by surgical emphysema 8
• Use of chest radiography to diagnose tension pneumothorax has been associated with a 4x increase in mortality. It has however been suggested that in stable awake patients in the emergency department, a chest radiograph may be obtained before intervention which could spare some patients the morbidity and discomfort of a potentially unnecessary procedure. Ventilated patients on the other hand, should be decompressed prior to radiography when a tension pneumothorax is suspected. 29

Chest Radiological Signs of Pneumothorax:
Ipsilateral
• Sharp lung edge running parallel to the chest wall
• Lucency
• Deep lateral costo-phrenic angle (deep sulcus sign)
• Abdominal quadrant hyperlucency


Strong Recommendation for Usage, Moderate LOE
• Observation should be the treatment of choice for small closed non-expanding pneumothoraces without significant breathlessness 8
• Patients with small (< 2 cm) primary pneumothoraces not associated with breathlessness should be considered for discharge with early outpatient review. These patients should receive clear written advice to return in the event of worsening breathlessness. 8
• If a patient with a pneumothorax is admitted overnight for observation, high flow (10 L/min) oxygen should be administered, with appropriate caution in patients with COPD who may be sensitive to higher concentrations of oxygen 8
• Suction to an intercostal tube should not be applied directly after tube insertion, but can be added after 48 hours for persistent air leak or failure of a pneumothorax to re-expand 8

Strong Recommendation for Usage, High LOE
• Simple aspiration is recommended as first line treatment for all primary pneumothoraces requiring intervention. 8 Needle aspiration reduces the need for admission dramatically as well as length of hospital stay if needed. 14 There is no significant difference in the immediate success rate of simple aspiration compared with intercostal tube drainage (RR = 0.93; 95% CI 0.62 to 1.40) nor is there a significant difference in the early failure rate of simple aspiration compared with intercostal tube drainage (RR = 1.12; 95% CI 0.59 to 2.13) 21

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Critical Question
2.2 Are there any valid risk stratification tools or clinical decision rules that can be used to aid in the diagnosis and or prognosis in assessing PTX?

Patient Management Recommendations
• An extensive search of existing literature revealed no valid risk stratification tools or clinical decision rules.

Critical Question
3. What are the important initial interventions for treating PTX in the ED?

The principles of pneumothorax treatment are to:
• eliminate the intrapleural air collection,
• facilitate pleural healing, and
• attempt to prevent recurrence. 35

The management will depend on the severity of symptoms, the size and presence of underlying lung disease. 33

Patient Management Recommendations

Critical Question
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Critical Question
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Patient Management Recommendations
• An extensive search of existing literature revealed no valid risk stratification tools or clinical decision rules.
• Simple aspiration is less likely to succeed in secondary pneumothoraces and, in this situation, is only recommended as an initial treatment in small (< 2 cm) pneumothoraces in minimally breathless patients under the age of 50 years.  
• Repeated aspiration is reasonable for primary pneumothorax when the first aspiration has been unsuccessful (ex: patient still symptomatic) and a volume of < 2.5 L has been aspirated on the first attempt.  
• Catheter aspiration of pneumothorax (CASP) can be used where the equipment and experience is available.  
• If simple aspiration or catheter aspiration drainage of any pneumothorax is unsuccessful in controlling symptoms, then an intercostal tube should be inserted. The failure rate for needle aspiration is measured by failure of the procedure to resolve the pneumothorax after at least 2 attempts.  
• Intercostal tube drainage is recommended in secondary pneumothorax except in patients who are not breathless and have a very small (< 1 cm or apical) pneumothorax.  
• If simple aspiration or catheter aspiration drainage of any pneumothorax is unsuccessful in controlling symptoms, then an intercostal tube should be inserted. The failure rate for needle aspiration is measured by failure of the procedure to resolve the pneumothorax after at least 2 attempts.  

**Strong Recommendation for Usage, Low LOE**

• Breathlessness patients should not be left without intervention regardless of the size of the pneumothorax on a chest radiograph.  
• In cases of suspected tension pneumothorax, treatment may be necessary without a chest radiograph and a plastic cannula should be placed in the mid-clavicular line in the second intercostal space. A release of air should be heard when the internal needle is removed upon entry of the pleural space. The cannula should be then left in place until a chest drain is inserted and bubbling.  
• Patients with secondary pneumothoraces treated successfully with simple aspiration should be admitted to hospital and observed for at least 24 hours before discharge.  
• Catheter aspiration kits with an integral one way valve system may reduce the need for repeat aspiration.  
• If a chest tube for pneumothorax is clamped, this should be under the supervision of a respiratory physician or thoracic surgeon, the patient should be managed in a specialist ward with experienced nursing staff, and the patient should not leave the ward environment.  
• If a patient with a clamped drain becomes breathless or develops subcutaneous emphysema, the drain must be immediately unclamped and medical advice sought.

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**Flow Chart for primary spontaneous pneumothorax (SP)**

1. **Primary SP**
   - **Size < 20%**
     - Observation
   - **Size > 20%**
     - 1st Episode
       - Air Evacuation
       - Aspiration
         - Success
         - Unsuccessful
       - Thoracic drain
         - Success
         - Persistent air leak
     - 2+ or more episode
       - Recurrence prevention
       - Video Assisted Thoracic Surgery (VATS)
       - Chemical pleurodesis

- There is no evidence that large tubes (20-24 French [F]) are any better than small tubes (10-14 F) in the management of pneumothoraces. The initial use of large (20-24 F) intercostal tubes is not recommended, although it may become necessary to replace a small chest tube with a larger one if there is a persistent air leak.  
- Pneumothoraces which fail to respond within 48 hours to treatment should be referred to a respiratory physician.  
- High volume, low pressure (-10 to -20 cm H2O) suction systems are recommended.  
- Patients requiring suction should only be managed on lung units where there is specialist medical and nursing experience.  
- Patients discharged without intervention should avoid air travel and high altitudes until a chest radiograph has confirmed resolution of the pneumothorax.  
- Diving should be permanently avoided after a pneumothorax, unless the patient has had bilateral surgical pleurectomy.  
- Primary pneumothorax patients treated successfully by simple aspiration should be observed to ensure clinical stability before discharge. Secondary pneumothorax patients who are successfully treated with simple aspiration should be admitted for 24 hours before discharge to ensure no recurrence.

### Indications for needle decompression (decompensation)

- **SpO2 < 92% on high flow O2**  
- **Systolic blood pressure <90mm Hg (in absence of other cause)**  
- **Respiratory rate (RR) falling from previous high RR (>35)** (in absence of ex: opioids, head injury)  
- **Decreased level of consciousness on high-flow O2**

**Needle decompression** may be considered when following criteria are met to avoid potential decompensation:  
- One-way valve dressing on open chest wounds  
- Oxygen applied  
- Extreme respiratory distress:  
  - RR>35  
  - Single word dyspnea  
  - Anxiety excluded as cause of tachypnea (consistent with no drops in RR)  
  - Progressive over 5 min period  
- Chest signs allowing laterization of the condition:  
  - Pneumothorax signs  
  - Hyperexpansion and hypomobility  
  - Tracheal deviation  
- Caution exercised in severe flail chest

### Comparison of Guidelines Recommendations (in stable patients)

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Definition of Large PSP</th>
<th>Small PSP</th>
<th>Large PSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Thoracic Society</td>
<td>Presence of visible rim of 2cm between lung and chest wall</td>
<td>Conservative outpatient management</td>
<td>Simple aspiration</td>
</tr>
<tr>
<td>American College of Chest Physicians</td>
<td>More than 3cm apical interpleural distance</td>
<td>Observation in ED followed by conservative outpatient management</td>
<td>Pleural catheter insertion &amp; drainage</td>
</tr>
<tr>
<td>Belgian Society of Pneumology</td>
<td>Pleural gap along the entire length of the lateral chest wall</td>
<td>Conservative outpatient management</td>
<td>Aspiration or pleural catheter insertion and drainage</td>
</tr>
</tbody>
</table>

Adapted from: Kelly AM, Kerr D, Clooney M. Outcomes of Emergency Department Patients Treated for Primary Spontaneous Pneumothorax. Chest 2008; 134 (S)

### Bottom Line for Pneumothorax Management:

Small primary spontaneous pneumothoraces, in the absence of dyspnea, can be managed on an observational, outpatient basis if instructed appropriately when to return to hospital. If requiring intervention, simple aspiration is the procedure of choice in primary pneumothoraces versus intercostal chest tube drainage of all but the simplest of secondary pneumothoraces.

### Listing of References:

2. Wackers F.J., Chest pain in the emergency department: role of cardiac imaging, Heart 2009;95;1023-1030.
4. Guyatt G et al., important to clinicians? What is "quality of evidence" and why is it, BMJ, 2008;336;995-998.
5. Guyatt G et al., Going from evidence to recommendations, BMJ 2008;336;1049-1051.