MANAGEMENT OF PNEUMOTHORAX
PNEUMOTHORAX

DEFINITION
Pneumothorax is defined as presence of air in the pleural cavity with secondary lung collapse.

HISTORY
Term coined by Itard in 1803.
First described by Laennec in 1819.
Primary spontaneous Pnuemothorax - Kjaergard in 1932.
First ICD, traumatic hemothorax - Kenyon
CLASSIFICATION OF PNEUMOTHORAX

SPONTANEOUS
Primary- healthy patients
Secondary- underlying lung disease

TRAUMATIC
• IATROGENIC
  Pleural aspiration (30%)
  Central venous catheterization (3-6%)
  Transbronchial lung biopsy
  Chest tube malfunction
  Mechanical Ventilation (5%)
• NON IATROGENIC
  Penetrating Injury
  Blunt injury
AETIOLOGY OF SECONDARY SPONTANEOUS PNEUMOTHORAX

AIRWAY DISEASES
Chronic obstructive pulmonary disease
Cystic fibrosis
Acute severe asthma

INFECTIOUS LUNG DISEASE
Pneumocystis carinii pneumonia
Tuberculosis
Necrotising pneumonia

INTERSTITIAL LUNG DISEASE
Sarcoidosis
Idiopathic pulmonary fibrosis
Histiocytosis X
Lymphangioleiomyomatosis

CONNECTIVE-TISSUE DISEASE
Rheumatoid arthritis
Ankylosing spondylitis
Polymyositis/dermatomyositis
Scleroderma
Marfan’s syndrome
Ehlers-Danlos syndrome

CANCER
Lung cancer
Sarcoma
CLINICAL TYPES

CLOSED – Rent in pleural layer is closed / healed; fixed amount of air in pleural cavity.

OPEN – Rent is open allowing air into pleural cavity during inspiration & outside during expiration.

TENSION – Intrapleural pressure > atm pressure (throughout respiratory cycle); because of disruption visceral/parietal pleura in such a manner that a one way valve develops.
GLOBAL ANNUAL INCIDENCE

PRIMARY = 18 – 28/lac/yr (male)
1.2 – 6/lac/yr (Female)

SECONDARY = 6.3/lac/yr (male)
2.0/lac/yr (female)

• Tschopp, Rami-Porta et al.; Eur Resp J 2006; 28: 637-65
**AETIOPATHOGENESIS**

- **Subpleural blebs and bullae**
  - 90% (Thoracoscopy / Thoracotomy)
  - 80% (CT Scan)
  - 20% (Chest X Ray)

- **Smoking**
  - Lifetime risk - smokers (12%) v/s Nonsmokers (0.1%)

- **Familial** – HLA haplotype A2 B40
  - Alpha-1 Antitrypsin phenotype M1M2

- **Body stature** – 2 inch taller / 25 lb lighter.

- **Pleural space pressure dynamics**
  - Negative pleural pressure
  - Pleural pressure gradient 0.25cmH2O/cm between apex & base

- **Physiological Consequences**
  - Vital capacity
  - Pao2 (hypoxia)
    - l/A/ Q Ratio d/t airway closure
    - Alveolar hypoventilation
    - Increase Anatomic shunts (<25%)
      - b/o Hypoxic vasoconstriction & redistribution of blood)
Clinical features – suspect

Symptoms:
- Acute onset (catastrophic)
- Dyspnea (secondary > Primary)
- Chest Pain (Pleuritic)
- Rest (90%) / Exercise (10%)
SIGNS

General Physical Examination

- Tachycardia
- Diaphoresis
- Tachypnea
- Hypotension
- Cyanosis
- Distended neck veins
- Subcutaneous emphysema
- Tracheal deviation

Respiratory System Examination

- Movements reduced
- Vocal fremitus / resonance reduced
- Hyperresonant percussiion note (Tympanic)
- Breath sounds absent / reduced
- Hamman’s sign (Pneumomediastinum) crunching or clicking noises synchronous with the heartbeat.
CHEST SKIAGRAM

Diagnosis is established by demonstrating the outer margin of visceral pleura (and lung) separated from the parietal pleural (and the chest wall) by a lucent gas space devoid of blood vessel.

- Erect films better than supine film.
- Expiratory films – small Pneumothorax
- Lateral films give added information in 14% cases
- Lateral decubitus – as sensitive as CT Scan
- Supine films (critically ill)
ECG

**Left Pneumothorax v/s Anterolateral MI**
- Rt. axis deviation
- Decrease QRS complex
- T wave inversion
- Normal in upright /
- Rt. lateral decubitus

ABG

Degree of Hypoxia / Hypercarbia

CT SCAN

Not routine
Differentiating Pneumothorax from complex bullous diseases of lungs
When aberrant tube placement is suspected
When plain chest radiograph is obscured by surgical emphysema.
SIZE OF PNEUMOTHORAX

Rhea (1983)
Proposed a normogram to calculate the size of Pneumothorax, average intrapleural distance is calculated by measuring the interpleural distance at the apex and at the midpoints of both upper and lower lungs. Average is reported on normogram.

Light (1990)
Average diameters of collapsed lung (x) and affected hemithorax (y) with cubing of these diameters to estimate the percentage of collapse lung.

\[ \% \text{ Pneumothorax} = 100 - \frac{x^3}{y^3} \]

Small – visible rim < 2cm
Large – visible rim > 2cm
2cm => 49% hemi thorax.

*Henry, Arnold et al; Thorax 2003;58:39-52*
*Michael et al; Chest 2001;119:590-602*
TREATMENT

THERAPEUTIC AIMS
- Remove the air from the pleural cavity
- Prevention of recurrence
  - Identification and treatment of cause
  - Achieve pleural symphysis

THERAPEUTIC OPTIONS

Conservative          Intermediate          Invasive
Observation           Pleurodesis                Pleurectomy
Conservative treat    Cauterization            Bullectomy
Aspiration            Pleural abrasion          VATS
Tube drainage          Thoracotomy
Medical Thoracoscopy  

# Recurrence of Pneumothorax

## Without Treatment
- 1st - 36%
- 2nd - 62%
- 3rd - 83%

## After Treatment
- Observation alone – 30-40%
- Aspiration - 25-40%
- Chest tube drainage – 25-30%
- Pleurodesis (tetracycline) – 20-25%
- Pleurodesis (talc) – 7-15%
- Surgery – 0.6-2%
CONSERVATIVE MANAGEMENT OF PNEUMOTHORAX

- Bed Rest, Cough suppression & Treatment of cause.
- High flow oxygen (10L/min)
- Normal rate of reabsorption of spontaneous Pneumothorax is 1.3-1.8\% of volume of hemithorax every 24hr,
- With oxygen supplementation there is four fold increase in rate of Reabsorption
- As oxygen is absorbed 62 times faster than nitrogen.
- Besides pressure gradient between Pneumothorax and venous blood will be larger.
SIMPLE ASPIRATION
- First line treatment of all primary Pneumothoraces requiring intervention (80% success rate).
- Secondary Pneumothorax in:
  - Small size (<50%)
  - <50yrs
  - minimal symptoms

REPEAT ASPIRATION
- First aspiration unsuccessful (patient still symptomatic)
- Volume of <2.5L in 1st attempt
- Catheter Aspiration of Pneumothorax (CASP) has integral one way valve system.

Shoaib Faruqi et al; IJCD 2004;46:183-190
INTERCOSTAL TUBE DRAINAGE

INDICATIONS
Simple aspiration unsuccessful.
Secondary Pneumothorax usually all except small and with minimal symptoms.

SITE
Emergency – 2nd Intercostal space just lateral to mid clavicular Line.
Elective- 5th intercostal space mid axillary Line.

COMPLICATIONS
Penetration / Injury of other organs ; aberrant tube placement; pleural infection , empyema ; surgical emphysema (malpositioned, kinked, blocked, clamped) tube.

SIZE OF TUBE
Large tube (20-24F) not better than small tubes (10-14F)
Indication for larger bore tube - Pleural fluid - Larger Air Leak

CHEST DRAIN SUCTION
Suction applied after 48hrs for persistent air leak
High volume, Low pressure (-10 to -20cmH2O) suction.
Specialized lung units with experience.
PLEURODESIS

Obliteration of pleural space
Trauma to Mesothelium -cellular / molecular mechanism-
activation of coagulation cascade – fibroblast recruitment,
activation and proliferation-fibrin and collagen deposition

1. Medical (Chemical)
   Tetracycline / Doxycycline (13%)
   Talc (2gm -10gm) (>25 µm)8%

2. Surgical
   Laser / Electro cautery
   Pleural abrasion (by dry gauze )
   Parietal pleurectomy (upper 1/2, 1/3)
INDICATION FOR SURGERY
Second ipsilateral Pneumothorax
First Contralateral Pneumothorax
Bilateral spontaneous Pneumothorax
Persistent air leak (>5 – 7 days of tube drainage)
Spontaneous haemopneumothorax
Occupational hazard (Pilots / Divers)

AIMS OF SURGERY
Resection of blebs / bullae (stapling devices)
Achieve pleural symphysis

SURGICAL APPROACHES
Open Thoractomy – Still gold standard as recurrence < 1%
Smaller incision thoractomy – Transaxillary Minithoracotomy (5-6cm)
VATS – Video Assisted Thoracoscopic Surgery
Three Ports – One for Thoracoscope
  Two for lung graspers & stapling devices
Currently, VATS more cost-effective but lack of trials
All the best...