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 in1932.

First ICD, traumatic hemothorax -Kenyon

CLASSIFICATION OF PNEUMOTHORAX

CLASSIFICATION

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 peumoniua

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)
  ⇓V/A/ Q Ratio d/t airway closure
  Alveolar hypoventilation
  Increase Anatomic shunts (<25%
  - b/oHypoxic vasoconstriction & redistribution of blood)

DIAGNOSIS

- **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 percurssion note (Tympanic)
- Breath sounds absent / reduced
- Hamman's sign

(Pneumomediastinum) crunching or clicking noises synchronous with the heartbeat.

INVESTIGATIONS

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 collapsed lung.

% Pneumothorax = $100- x^3 / y^3$

Latest Guidelines (2003)

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
  - Acheive 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)

SURGERY

INDICATION FOR SURGERY

Second ipsilateral Pneumothorax
First Contralateral Pneumothorax
Bilateral spontaneous Pneumothorax
Persistent air leak (>5 – 7days 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…