"I Can’t Breathe!"
Rapidly Assessing & Intervening in Air Leak Syndromes

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 objectives
• Explain the causes of air leak syndromes
• Describe the treatment strategies for air leak syndromes
• Identify characteristics on CXR that indicate these air leak syndromes

Classifications of air leak syndromes
1. Primary pneumothorax
2. Secondary pneumothorax
3. Iatrogenic pneumothorax
4. Pneumomediastinum
5. Pneumopericardium
6. Hydropneumothorax

As Easy as Black & White: CXR Interpretation 101

Basics of Xrays
• Photograph negative principle
• White color indicates lack of exposure
• Black color indicates intense exposure
• Dense substances absorb all the rays and appear white on the film
• Soft tissues and air absorb part of the beam and appear gray or black

Whitest
• Bone: Ribs, Sternum, Spine, Clavicle
• Barium
• Calcium Deposits
• Prosthetic valves
• Surgical wires, clips
Clinical Findings that show up **White**
- Pulmonary Edema
- Pneumonia
- Pleural Effusion
- Atelectasis
- Tumors
- ARDS

Off White -- Gray
- Fluid
- Blood
- Heart
- Veins/arteries
- Aorta
- Skin/fat

**Blackest**
- Air
- Lungs
- Trachea
- Stomach
- Bowel

Clinical Findings that show up **BLACK**

**AIR LEAK SYNDROMES!**

Normal Chest X-ray
- Pleural is only able to be identified if separated from the thoracic lining by fluid or air

Pneumothorax
- Air in the pleural space that inhibits complete lung expansion
- A thin, white line represents the displaced visceral pleura
Pneumothorax Clinical Presentation

- Diminished or absent lung sounds over the affected lung
- Dyspnea
- Tachypnea
- Acute pain on affected side of the chest
- Decreased Sp0₂ & p0₂
- Subcutaneous emphysema
- Black area over lung field with no lung markings on CXR

Pneumothorax

- Initial Treatment:
  - Chest tube insertion if greater than 10 – 15 %
  - If tension pneumothorax ---- it is a medical EMERGENCY and needs immediate needle decompression
Tension Pneumothorax

- Distended neck veins
- Hypotension
- Tracheal deviation

Note compressed swan gantz

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Primary Spontaneous Pneumothorax (PSP)

- Occurs without a precipitating event in a person who does not have lung disease
- Actually, most individuals with PSP have unrecognized lung disease

Primary Spontaneous Pneumothorax

- Incidence
  - 7.4 per 100,000
  - Greater in men than women
- Risk Factors
  - Smoking
  - Family History
  - Marfan’s Syndrome
  - Homocystinuria
  - Thoracic endometriosis

PSP Clinical Presentation

- Usually occurs at rest
- Sudden onset of dyspnea and pleuritic chest pain
- Symptoms related to the volume of air in the pleural space
- Hypoxemia
- Rarely hypercapnia – no underlying lung disease
- Acute respiratory alkalosis if pain, anxiety and hypoxemia
- Age = early 20’s, rare after 40

PSP Treatment

- Initial
  - Removal of air from the pleural space
    - Needle aspiration, if small
    - Chest tube, if large
  - Supplemental oxygen
- Subsequent
  - Preventing reoccurrence
  - Reoccurrence is 35 - 54%
PSP Treatment
• If after 6 hours the pneumothorax reabsorbs, patient may be sent home
• Needs to live close to emergency medical center if d/c in 6 hours.

PSP Treatment: Supplemental Oxygen
• Air in the pleural space is reabsorbed when the communication between the alveoli and the pleural space (air leak) closes.
• Supplemental oxygen markedly increases the rate of reabsorption.

PSP: Persistent Air leak after 3 days
1. Heimlich valve
2. Infusing autologous blood into the pleural space
3. Video-Assisted Thoracoscopy (VATS) to oversew the area of the leak and perform pleurodesis

Heimlich Valve
• One way valve
• Can be discharged
• Call 911 if sudden sharp chest pain and severe shortness of breathe

Autologous Blood Patch
• Withdrawal of blood from peripheral vein & infuse blood into the pleural space via chest tube.
• Infuse 24 – 200 ml
• After infusion, drape chest tube tubing over a hook 60 cm above the patient’s chest and then to the WSD chamber.
• Chest tube removed 24 hours after cessation of air leak.

Video Assisted Thoracoscopy (VATS) Pleurodesis
• Pleurodesis:
  – Mechanical or chemical irritation between the parietal and the visceral layers of the pleura to close off the space between them and prevent further air or fluid from accumulating.
Pleurodesis
- Mechanical
  - Parietal pleurectomy
  - Laser abrasion of the parietal pleura
  - Pleural abrasion with dry gauze
- Chemical
  - Intrapleural instillation of a chemical irritant
    - usually tetracycline derivative or talc

Case Study #1
- 18 y/o female walking up a hill and felt a “pop” in chest
- Abruptly becomes SOB and severe stabbing pain in left chest area
- Couldn’t take deep breaths
- Pain eventually subsided and whole lung area felt weak and bruised

Next day
- Walking on college campus and had to stop 2 – 3 times during the walk
- Breathing was labored and pain was stabbing.
- Came to ED

Dx: Spontaneous Pneumothorax
- 90% collapse of left lung
- Chest tube inserted
- Resolved after several days
- No family history

PMH
- Looking back as a senior was running sprints on a really cold windy day. I felt something “pop” in my chest and couldn’t take deep breaths.
- Stopped running, went home, rested. Just felt “tight/bruised” feeling.
- Now questions if it was a small pneumothorax.
- Had a few more of these episodes in HS

Medical workup
- Found underlying asthma
A year later...
- Walking, Abruptly becomes SOB and severe right chest pain
- Dx: spontaneous right pneumothorax (90%)
- Chest tube inserted
- Took 10 days to resolve
- "There was just a moment when I just knew that it had closed"

Another year later --- age 20
- Tubing in the ocean waves
- Sudden stabbing pain in left lung
- Xray: 10% pneumothorax that resolved on it’s own.

Treatment
- Inhalers for asthma and steroid inhaler for next 10 years
- Kinesiologist: natural supplements to boost the adrenal system
- Now at age 42, off inhalers and has not had any further episodes

Secondary Spontaneous Pneumothorax (SSP)
- A pneumothorax that occurs as a complication of an underlying lung disease
- Can be a complication of any lung disease. Most often occurs with:
  - COPD
  - Pneumocystis jirovecii infection
  - Cystic fibrosis
  - Tuberculosis

SSP Clinical Presentation
- C/O of dyspnea and chest pain on the same side as the pneumothorax
- Symptoms more severe than with PSP as SSP patients have less pulmonary reserve due to the underlying lung disease.
- Persistent air leaks are more common and tend to persist longer than PSP

SSP Treatment
- Should be hospitalized: diminished pulmonary reserve increases their risk for adverse outcomes.
- Initial Treatment
  - Chest tube insertion
  - Chest tube should remain in place until a procedure if performed to prevent recurrent SSP
SSP: Prevention of recurrence
- Video-Assisted Thoracoscopy (VAT) with stapling of blebs and pleural abrasion.
- Chemical pleurodesis
- Pleural Blood Patch
- Heimlich valve

Case Study # 2
63 y/o white male (RK) comes to ED with SOB and left sided chest pain for the past hour
- Woke up "feeling weird" and felt very SOB
- The left sided chest pain, which does not radiate, started when the SOB started.
- The pain is mildly sharp and stabbing in quality

PMH
- COPD – wears continuous oxygen at home
- CHF
- AAA repair
- Hx PE
- PVD
- Idiopathic thrombocytopenia purpura
- Antiphospholipid antibody syndrome
- Recurrent small bowel syndrome

RK 12-2 at 2200
- BP 136/77
- HR 134, regular
- RR 32
- Temp 97 oral
- SpO2 91% on 15 liters nonrebreather
- Pain 7/10

RK 12-2 in ED
Spontaneous pneumothorax on 12 – 2
CT scan view post chest tube insertion

- BP 101/65
- HR 113, regular
- RR 20
- SpO₂ 100% on 15 liters nonrebreather
- Pain 2/10

RK 9 hours post chest tube insertion at 0800
Is the pneumo resolved?

RK CXR 9 hours post chest tube insertion at 0800

12-3 at noon
- C/O chest discomfort, SOB, left leg tingling
- Totally absent lung sounds on left

RK 12 – 3 at 1215 after 2nd chest tube inserted

- Patient did not go to surgery for decortication due to pulmonary hypertension – poor surgical candidate
- Sent home with Heimlich valve
PSP and SSP – high risk activities

- Patients with resolving pneumothorax should be cautioned not to fly until intrapleural air has completely resolved.
- Deep sea diving should be avoided unless thoracotomy or pleurodesis has been performed.

Nursing Care of Chest Tubes

- Bubbling in the water seal chamber indicates air leak
- If suction is ordered for PSP or SSP, keep suction going even when ambulating.

Case #3

- Ms Syncope came to the ED because of an episode of lightheadedness today that caused her to fall to the ground. There was no actual LOC.
- She was working in the garden at the time and also had a mild pressure sensation over her chest which is still present in ED.

As you are getting ready to give Metoprolol her rhythms changes to this.

EKG 3 days earlier in ED
• Started on Amiodarone and Atandolol.
  Monitor for 48 hours. Here are her strips – continued on next slide.

• Diagnosis: Tachybrady Syndrome
• Treatment: Pacemaker insertion

It is 6 hours post Ms Syncope's pacemaker insertion via the left subclavian.
• She is complaining of dyspnea and pain on left side of chest
• No lung sounds on left side
• CXR ordered

• Left pneumo from pacer insertion

Iatrogenic pneumothorax
• Medical procedure resulting in traumatic pneumothorax
Iatrogenic Pneumothorax Causes
- Transthoracic needle aspiration procedures
- Subclavian and supraclavicular needle sticks
- Thoracentesis
- Mechanical ventilation related to peak airway pressures
- Pleural biopsy
- Transbronchial lung biopsy
- CPR
- Tracheostomy

Traumatic Pneumothorax
- Blunt trauma from motor vehicle accident, falls, blows to chest, penetrating chest trauma, or blast injuries results in tear in pleura and causes pneumothorax

Iatrogenic & Traumatic Pneumothorax Treatment
- Needle Aspiration
- Chest Tube insertion
- Recurrence is not usually a factor

DM after CT insertion

DM

DS
Open Communicating Pneumothorax
- Also called Sucking Chest Wound
- Air enters the intrapleural space through the chest wall
- Cause: Penetrating trauma

Case # 4
- 71 y/o male
- Right lower lobe resection and lymph node resection for adenocarcinoma of the lung.
- Discharged on POD # 7
- On POD # 12 goes to surgeon’s office with c/o increasing SOB over last three days.
- CXR done

Patient became severely dyspnic after CXR.
CT was accidentally disconnected from bottle during CXR.

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5-24 readmission with pneumothorax
5-24 readmission with pneumothorax post CT insertion
Pneumomediastinum
- Air in the mediastinal structures that occurs spontaneously or following procedures or trauma
- Pneumothorax may occur secondary to pneumomediastinum

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Pneumomediastinum Causes
- Rupture of alveoli
- Acute production of high intrathoracic pressures (inhalational drug use)
- Smoking marijuana
- Inhalation of cocaine
- Asthma
- Respiratory tract infection
- Vomiting or severe coughing
- Mechanical ventilation
- Trauma or surgical disruption of the oropharyngeal, esophageal, or respiratory mucous
Pneumomediastinum Clinical Presentation
- May or may not have symptoms
- SQ emphysema
- Hammas sign
  - Precordial crunching noise synchronous with the heart beat
- Severe chest pain below the sternum that may radiate to the neck or arms
- Hypotension may occur due to compression of the veins from the air.

Pneumothorax & Pneumopericardium
- Pt (MR) on ECMO
- BP dropped
- PAS/PAD & CVP pressures equalized within a few minutes
- Mediastinal chest tubes can cause air to enter into mediastinum or pericardium to cause pneumomediastinum or pneumopericardium
Case # 5
67 y/o female comes to ED with increasing SOB
- Bilateral pleural effusions
- Compressive atelectasis, right greater than left
- No pneumothorax seen

Thoracentesis
- Ultrasound guided thoracentesis performed
  - 800 cc serosanguinous fluid removed from left hemithorax.
  - 1800cc straw color fluid removed from right hemithorax.

Following thoracentesis...
- On left, residual pleural fluid
- Right moderate pneumothorax
- Thought to represent trapped lung

A couple of days later...
- Moderate right-sided hydropneumothorax (trapped lung)
- Moderate amount of fluid in subpulmonic space
- Left base pleural effusion and/or atelectasis.

Post thoracotomy, debridement, chest tube placement

Case # 6
75 y/o female Aortic Valve Replacement
CXR on POD #4
In Summary

- PSP
  - no underlying lung disease
  - Seen in young adults
- SSP
  - Usually caused by underlying lung disease
  - More severe due to already compromised lung state
- Both may need treatment to prevent recurrence
- Apex chest tubes for pneumos as air rises
- Keep suction on chest tubes

Pneumoperitoneum

- The presence of air within the peritoneal cavity.
- Most common cause is a perforation of the abdominal viscus — a perforated ulcer

Iatrogenic pneumothorax

- Caused by medical procedure resulting in traumatic pneumothorax
- Chest tube to aspirate air
- No need for further treatment
Other types of air leak syndromes

- Pneumopericardium
- Pneumomediastinum
- Hydropneumothorax
- Pneumoperitoneum
- Treatment for All
  - aspirate air and treat underlying cause

Air Leak Syndromes:
Be Prepared to immediately assist to insert a chest tube!

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