Agenda

Present Patient
- HPI
- Review Imaging

Anatomy Review

Evaluation of Pneumomediastinum
- Diagnosis/Signs
- Causes
- Treatment

Conclude Case
History:

HPI: Patient is a 63-year-old man who is complaining of fatigue and dyspnea. 5 days prior to admission the patient was struck by his a car door due to a gust of wind forcefully whipping the door into his right side. Since that time he has noticed that he has marked swelling spanning approximately from the epigastric area to the scalp.
Physical Exam

General: BP 120/80, PR70 and regular, O2 sat 95% RA, RR 16 per minute.
HEENT: Significant for dramatic subcutaneous emphysema involving the face; eyelids and forehead.
CV: RRR, No MRG, No extra heart sounds
Pulm: CTAB, No wheezes, rales, rhonci
Menu of Radiologic tests

PA CXR Inspiration

PA CXR Expiration

Lateral CXR

Lateral decubitus

Neck Films
Our Patient J.K: Frontal CXR

Upright CHEST (PA)

Pneumomediastinum

Rib Fracture

Subcutaneous Emphysema

Rib Film views were ordered to elucidate fracture

SOURCE: BIDMC Patient OMR
Our Patient J.K: Lateral CXR

Upright CHEST (LAT)

Significant Air Collection in Anterior Mediastinum

SOURCE: BIDMC Patient OMR
Our Patient J.K: Rib, Unilateral CXR

Two transverse non-displaced rib fractures of ribs 7 and 8

Moderate Right Pleural effusion

Diffuse subcutaneous emphysema

SOURCE: BIDMC Patient OMR
Companion Patient #1

Subcutaneous Emphysema tracking up to face

What is the Mediastinum?

...is the central compartment of the thorax between the two pleural cavities.

Covered by mediastinal pleura.

Contains all thoracic viscera EXCEPT lungs

Looseness of structures enable mediastinum to accommodate changes in movement, volume & pressure in the thoracic cavity.
Superior Mediastinum
extends from the thoracic inlet to
a plane at the level of the sternal
angle and the T4/5 intervertebral
disc

Inferior Mediastinum
T4/5 intervertebral disc to the
diaphragm

SOURCE: *Kaplan*
Superior Mediastinum contains:

- Esophagus
- Trachea
- Arterial Layer
- Venous Layer
- Thymus (not shown)
Inferior mediastinum is subdivided into

**anterior mediastinum**
- contains fats, remnant of thymus, lymph nodes.

**middle mediastinum**
- heart surrounded by the pericardium
- great vessels:
  - ascending aorta
  - superior vena cava
  - pulmonary trunk

**posterior mediastinum**
- esophagus
- descending aorta
- thoracic duct
- azygos and hemiazygos veins
- thoracic sympathetic trunks
- thoracic splanchnic nerves
- tracheobronchial lymph nodes

**SOURCE:** Agur R., Dalley A., Grant's Atlas of Anatomy; pg 29-32
EVALUATION OF PNEUMOMEDIASTINUM

SYMPTOMS:

**Adults**-
- May complain of retrosternal chest pain radiating down both arms that is exacerbated by respiration and swallowing
- Dyspnea
- Fever—due to cytokine release with an air leak
- Throat or jaw pain, dysphonia, dysphagia, neck swelling and torticollis

**Infants**—
- Typically Asymptomatic

**SOURCE:** UpToDate: Spontaneous pneumomediastinum in children and adolescents
EVALUATION OF PNEUMOMEDIASTINUM
PHYSICAL EXAM:

Subcutaneous Air

Associated Pneumothorax

Low Oxygen Saturations

Hamman’s Sign-
“Crunching” sound heard over the apex of the heart with the cardiac cycle

SOURCE: UpToDate: Spontaneous pneumomediastinum in children and adolescents
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EVALUATION OF PNEUMOMEDIASTINUM:
SIGNS

The upcoming slides will address pneumomediastinum on:
- Frontal Views
- Lateral Decubitus Views
- Lateral Views
- Neck Films

Additionally you will be shown:
- Continuous Diaphragm Sign
- Extrapleural Air Sign
- Spinnaker Sign (Thymic Sail Sign)
PNEUMOMEDIASTINUM: ON FRONTAL CXR

Characterized by lucent streaking lines or bubbles of gas that:
- outline mediastinal structures
- elevate the mediastinal pleura
- extend into the neck or chest wall
- most often visible just above the heart on the left

Gas commonly outlines the:
- Inner surface of mediastinal pleura
- Main pulmonary artery
- Aortic arch,
- Left superior intercostal vein

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
PNEUMOMEDIASTINUM: ON LATERAL CXR

Findings can be more conspicuous

Gas outlines:
- Pulmonary artery
- Ascending aorta (arrows)
- Thymic remnant
- Trachea
- Proximal bronchi.

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
PNEUMOMEDIASTINUM: ON LATERAL AND NECK FILMS

Lateral Decubitus

Air remains in place regardless of change in position
This is extremely important when comparing this to
- Pneumopericardium
- Pneumothorax

Neck Films

Show pneumomediastinum and air in the neck and soft tissues. Air in retropharyngeal space

SOURCE: Castellote A, Vázquez E., Cervicothoracic Lesions in Infants and Children1; Radiographics October 2012, 32 (6)
COMPANION CASE 2: Extrapleural Air Sign on CXR

Characterized by:

- a collection of free mediastinal air between the parietal pleura and the diaphragm.

- This collection is limited above by a sharp pleural stripe, is located posterior to the domes of the diaphragm, and, unlike a pneumothorax, does not shift with a change in body position.

In infants: Mediastinal air causes elevation of the thymus producing an appearance similar to that of a windblown spinnaker sail.

What is a Spinnaker?

**COMPANION CASE 4: Continuous Diaphragm Sign**

**Thin band of gas** between heart and diaphragm, making diaphragm visible where it is normally silhouetted out by heart.

DIFFERENTIAL DIAGNOSIS OF PNEUMOMEDIASTINUM

The Three Places Air Can Arise From:

Inside
Outside
Gas Producing Organisms

SOURCE: Lieberman Interactive Tutorials: Aberrant Air in the Chest
CAUSES OF PNEUMOMEDIASTINUM: Inside

Alveolar Rupture
Esophageal
Head and neck
Abdominal or retroperitoneal

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
INSIDE CAUSES OF PNEUMOMEDIASTINUM: Alveolar Rupture

Alveolar Rupture = Most common cause

Mechanism

Increased Alv Pressure -> Alveolar Rupture -> leads to pulmonary interstitial emphysema -> gas travels centrally along the bronchovascular interstitial sheaths -> enters the mediastinum

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
INSIDE CAUSES OF PNEUMOMEDIASTINUM:
Increased Alveolar Pressure

Airway Obstruction
Asthma; foreign body; acute obstructive laryngitis; congenital stenosis

Mechanical ventilation
General anesthesia; positive end-expiration pressure

Deep respiratory maneuvers
Strenuous activity; vital-capacity maneuvers; acidosis (Kussmaul respiration)

Valsalva maneuver
Weight lifting; Heimlich maneuver; defecation; parturition; inhalation of nitrous oxide, marijuana, or cocaine

Vomiting
Diabetic ketoacidosis; anorexia nervosa

Change in atmospheric pressure
Caisson disease; rapid change in altitude

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
INSIDE CAUSES OF PNEUMOMEDIASTINUM: Alveolar Rupture

Alveolar rupture due to alveolar disease

**Infection**
- measles, influenza, smallpox, chickenpox, mycobacteria (tuberculosis)

**Emphysema**

**Interstitial lung disease**
- Sarcoidosis; silicosis

**Adult respiratory distress syndrome**

INSIDE CAUSES OF PNEUMOMEDIASTINUM: Esophageal

Esophageal

Perforation due to:
Vomiting
Iatrogenic injury
Trauma (penetrating)
Neoplasm

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
INSIDE CAUSES OF PNEUMOMEDIASTINUM: Head and Neck

Compromise due to:
Perforation of nasopharynx
Facial fractures or surgery
Dental procedures
Neck surgery

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
INSIDE CAUSES OF PNEUMOMEDIASTINUM: Abdominal or retroperitoneal

Due to:
- Bowel perforation
- Diverticulitis
- Hernia
- Ulcer
- Trauma
- Rectosigmoid surgery

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
CAUSES OF PNEUMOMEDIASTINUM:
Outside

Trauma
- Rib Fractures
- Gunshot/Knife
- Rupture of trachea or mainstem bronchus
- Trauma to the neck
- Boerhaave’s Syndrome
- Barotrauma

Iatrogenic
- Instrumentation
- Mediastinoscopy
- Mediastinal surgery
- Bronchoscopic biopsy
- Head and neck surgery
- Thyroideectomy
- Tonsillectomy

SOURCE: Bejvan S, and Godwin J. D., Pneumomediastinum: Old Signs and New Signs; AJR 1996;166:1041-1048 0361
COMPLICATIONS OF PNEUMOMEDIASTINUM

Mediastinal Communications:

The mediastinum communicates with the:
- submandibular space
- retropharyngeal space and
- vascular sheaths within the neck
- retroperitoneum via sternocostal
  attachments to the diaphragm
- periaortic fascial
- periesophageal fascial planes

Because of these communications

- Subcutaneous Emphysema
- Deep Cervical Emphysema
- Pneumopericardium
- Pneumothorax
- Pneumoretroperitoneum

SOURCE: Standring., Gray's Anatomy: The Anatomical Basis of Clinical Practice, CHAPTER 55: Mediastinum
Often managed conservatively with analgesia, rest, and avoidance of maneuvers that increase pulmonary pressure
- Valsalva
- forced expiration
- spirometry

More severe cases will require intervention.
- Mediastinoscopy to alleviate life-threatening pneumomediastinum.
- Percutaneous placement of mediastinal drains.
- Chest tube in coexisting pneumothorax
- Bronchoscopy if tracheobronchial perforation is suspected
- Esophagoscopy if an esophageal perforation is suspected

TREATMENT

Treatment depends upon severity

- Alister Martin, HMSIII
- Gillian Lieberman, MD

SOURCE: UpToDate: Spontaneous pneumomediastinum in children and adolescents
Managed Conservatively
Discharged on HD2 with no evidence of subcutaneous emphysema or dyspnea
Thank You!
Dr. Gillian Lieberman
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Bejvan S. and Godwin J. D., **Pneumomediastinum: Old Signs and New Signs; AJR** 1996;166:1041-1048 0361

Singh M P , et al., **Is this really pneumothorax?; Thorax** 2009;64:276 doi:10.1136/thx.2007.094375

Lieberman G., Lieberman Interactive Tutorials: Aberrant Air in the Chest

Kaplan: USMLE Step 1 Anatomy

Standring ., Gray's Anatomy: The Anatomical Basis of Clinical Practice, CHAPTER 55: Mediastinum


**Castellote A, Vázquez E., Cervicothoracic Lesions in Infants and Children1; Radiographics** October 2012, 32 (6)

UpToDate:Spontaneous pneumomediastinum in children and adolescents

Agur R., Dalley A.,Grant's Atlas of Anatomy: pg 29-32

http://withfriendship.com/user/sathvi/subcutaneous-emphysema.php