Essential Learning

Pericardial Tamponade

- **Pathophysiology of pericardial tamponade**
  - As fluid enters the pericardial cavity, intrapericardial pressure rises, and eventually exceeds the normal diastolic pressure of the right heart chambers (lower pressure system relative to the left heart). At this point, the filling of the right ventricle is compromised, and the effusion is defined as pericardial tamponade.
  - Back-up of blood from the right heart into the vena cava increases central venous pressure (CVP).
  - Rising intrapericardial pressure eventually exceeds LV diastolic pressure, resulting in reduction in the stroke volume and systolic blood pressure, thus reducing the pulse pressure and cardiac output and eventually causing obstructive shock.
  - The compensatory mechanisms include a catecholamine surge which increases systemic vascular resistance (SVR) and heart rate to maintain blood pressure.

- **Etiology of pericardial tamponade**
  - Non-traumatic pericardial tamponade
    - Gradual accumulation of fluid in the pericardial cavity causes stretching of the fibrous parietal pericardium and accommodation of relatively large volumes before a rise in intrapericardial pressure beyond that of the intraventricular pressures (and thus causing tamponade). For this reason, relatively large effusions may be seen in non-traumatic cases of pericardial tamponade.
    - Causes:
      - Metastatic malignancy
      - Acute or chronic Pericarditis
      - Uremia
      - Hemorrhage
      - Systemic lupus erythematosus
  - Traumatic pericardial tamponade
    - Occurs in up to 2% of all penetrating thoracic / upper abdominal trauma. A common source is stab wounds. Impalement causing hemopericardium is rare, although it is reported in the literature. Hemopericardium is less common in blunt chest trauma.
    - Causes of tamponade in the context of penetrating thoracic trauma:
      - Pericardial defect
      - Right ventricular wound
      - Coronary artery injury

- **Clinical presentation of acute traumatic pericardial tamponade**
  - History
    - Penetrating trauma to the chest, usually a stab wound
  - Examination

        - Beck's triad
            - Hypotension
            - Distant / muffled heart sounds
                - Difficult to appreciate in the noisy setting of the ED
            - Distended neck veins
                - May be absent in a trauma patient with co-morbid hypovolemia secondary to hemorrhage
            - Although Beck's triad is a classic presentation for pericardial tamponade, it is rare and present in less than 10% of cases.
        - Narrow pulse pressure
        - Pulsus paradoxus (drop in SBP by 10-15 mmHg during inspiration)
        - Kussmaul's sign (increase in JVP during inspiration)
    - Investigations
        - Echocardiography
            - Effusion: anechoic rim of fluid surrounding the heart
            - Tamponade: collapse of the RV during diastole

- **Chest X-ray in pericardial effusion**
    - Pericardial effusions with a volume of less than 200 mL of fluid are typically not visible on plain film CXR, and thus chest radiography has limited diagnostic utility in acute pericardial tamponade.
        - Rapid accumulation of pericardial fluid, such as in a trauma, typically requires only small volumes (60-100 mL) to produce hemodynamic effects on the heart and lead to symptoms.
        - On the other hand, an effusion that has accumulated chronically, such as in malignancy, may gradually stretch the pericardium to become visible on CXR. In these cases, one may observe the "water bottle sign" on CXR, where the expanded cardiac silhouette becomes globular in appearance.

- **Management of pericardial tamponade**
    - When possible, intubation should be avoided until tamponade (or tension pneumothorax) is treated.
    - Temporizing measures:
        - Resuscitation with IV fluids or blood products
            - Increases the central venous pressure temporarily to maintain diastolic filling and thus preserve the cardiac output
        - Pericardiocentesis
            - Ultrasound-guided subxiphoid approach to aspirate blood or other fluid from the pericardial space and thus reduce intrapericardial pressure
            - Pericardiocentesis is a temporizing maneuver and does not omit the need for emergency surgery, particularly for traumatic mechanisms
        - ED thoracotomy (see below)
    - Definitive management:
        - Emergency surgery

- **POCUS Pearls**

- In life threatening penetrating trauma the FAST exam should be focused to evaluate windows that will directly impact management. In this case a rapid evaluation for pneumothorax and pericardial effusion could prompt chest tube placement, expedite operative care, or indicate need for emergent thoracostomy. A complete exam should not be performed at the expense of other potentially lifesaving interventions.
- FAST exam includes a subxiphoid view or parasternal long axis view of the heart; it doesn't matter which view you use, perform the view you are most comfortable with that will reliably get you the best images.
- Acute hemopericardium may appear as an anechoic stripe, but in cases of partially clotted blood you may see an area of mixed echoes within the pericardial sac. Appearance will vary.
- Don't be fooled by the anterior pericardial fat pad, which can appear anechoic or hypoechoic. Generally a pericardial effusion layers posteriorly first. However, in a case such as this one, any 'fluid-like' appearance in the pericardial sac is blood until proven otherwise.
- Hemorrhagic pericardial effusions occur rapidly and therefore can cause tamponade with even a small amount of fluid. In the case of penetrating trauma with potential cardiac injury, any effusion is worrisome, even in a stable patient.

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