

# CARDIAC INJURY

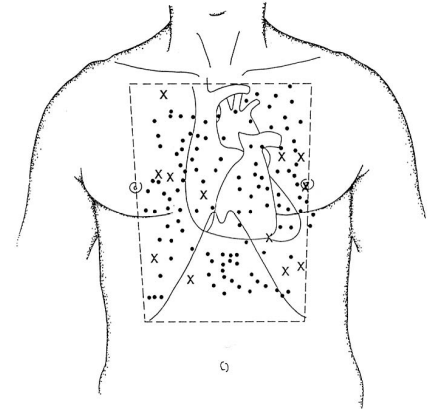
- Cardiac injury accounts for ~10% of deaths from GSW & ~ 75% of these die before receiving any medical care.
- *The diagnosis should be suspected in patients with chest, lower neck, epigastric and precordial injuries.*

## **PENETRATING CARDIAC INJURY:**

- MOST COMMON CAUSE OF SIGNIFICANT CARDIAC INJURY, MOSTLY FROM GUNS AND KNIVES
  - Survival for stabbing is 17x greater than GSW.
- ANATOMY OF INJURY:
  - Ventricles are at greatest risk due to their ANTERIOR LOCATION
  - RV 40%, LV 35%, RA 20%, LA 5%
    - RV is at greatest risk due to large anterior exposure

### The CARDIAC BOX:

- STERNAL NOTCH superiorly
- XIPHOID PROCESS inferiorly
- NIPPLES laterally



- **TWO CATASTROPHIC COMPLICATIONS:**
  - EXSANGUINATING HAEMORRHAGE:
    - If pericardial defects are large or remain open present with massive haemothorax or rapid exsanguination
  - PERICARDIAL TAMPONADE:
    - If the linear defect in a stab wound is small and seals itself, the resultant intrapericardial haemorrhage may progress to tamponade
    - RIGHT VENTRICULAR wounds seal themselves more readily than right atrial wounds due to thicker, more muscular walls
    - Gunshot wounds less likely to cause tamponade
    - Characterised by BECK'S TRIAD:
      - PLUS:
        - Sinus tachycardia
        - Pulsus paradoxus
        - narrowed pulse pressure
      - Jugular distension
      - Hypotension
      - Muffled heart sounds

**Beware:** hypovolaemic shock (from other injuries) may lower CVP & potentiate hypotension !

- Coronary artery injury can occur in 5% cases
  - If major vessel --> repaired or bypassed. If minor --> ligated
- **MANAGEMENT:**
  - Follow ABCs of trauma evaluation.
  - At the scene, patients with either penetrating or blunt cardiac trauma without electrical activity who have never exhibited vital signs may be PRONOUNCED DEAD
  - Candidates for ED thoracotomy include those that had penetrating trauma who are unstable and *demonstrated signs of life in ED* or in the field who then deteriorated.
  - If vital signs are regained and the patient makes to the operating room, 70-80% of stab victims survive, and 30-40% of gunshot victims survive
    - SIGNS OF LIFE:
      - Palpable pulse
      - BP
      - Papillary reactivity
      - Organised cardiac rhythm
      - Any respiratory effort
    - PERICARDIOCENTESIS:
      - Nowhere near as effective as thoracotomy as most of the blood in the pericardial cavity is CLOTTED; hence only a few millilitres can be removed at a time
      - However, removal of as little as 5-10mL from the pericardial sac may ↑ stroke volume by 25-50%

### **BLUNT CARDIAC TRAUMA:**

- Up to 20% of all MVA deaths are due to blunt cardiac injury
- Leads to death due to arrhythmias, free-wall rupture or coronary artery laceration (resulting in extracardiac haemorrhage).
  - Most lead to death at the scene
- COMMOTIO CORDIS:
  - A primary electrical event
  - Sudden death as a result of blunt trauma to the chest wall from innocent mechanism (eg. baseball or hockey puck to chest).
  - Second-most common cause of death in young athletes after HCM
  - Leads to VF
- The only accepted practice is to observe all patients with evidence of blunt cardiac injury with haemodynamic and continuous cardiac monitoring
  - Thoracotomy is much more controversial and far less successful in those with blunt trauma

Consider valvular injury (or one to papillary muscles, chordae or septum) with new murmur or pulmonary oedema post-blunt chest trauma.

## DIAGNOSTIC MODALITIES:

- **ECG:**
  - NPV of ECG for cardiac injury = 80-90%
  - Normal ECG does NOT exclude development of clinically significant cardiac event which usu. occurs within first 24 hours.

**Table 259-4 Electrocardiographic Findings in Cardiac Injury**

Arrhythmias	Conduction Disorders	Myocardial Injury	Nonspecific Abnormalities
Sinus tachycardia (most common)	AV nodal conduction disorders (1, 2, and 3 degree AV block)	New Q wave	Pericarditis-like ST-segment elevation
Sinus bradycardia		ST-T segment elevation or depression	Prolonged QT syndrome
Atrial fibrillation	Fascicular block		
Atrial and ventricular extrasystoles	Right bundle-branch block		
Atrial tachycardia			
Ventricular fibrillation			
Ventricular tachycardia			

- **CARDIAC BIOMARKERS:**
  - Troponins: very specific (97-100%) but not at all sensitive (12-23%)
  - When combined with ECG, utility is much increased PPV 62%, **sensitivity 100%** for cardiogenic shock, dysrhythmia requiring intervention, structural cardiac anomalies as a result of trauma.
- **ECHOCARDIOGRAPHY:**
  - Provides information about global cardiac function, wall motion, valvular function as well as pericardial fluid.
  - TTE has poor views in up to 1/3 patients
  - Formal Echo required for patients w/ elevated troponins, dysrhythmias or myocardial dysfunction.
  - In penetrating injury, bedside US has sensitivity of 100% and specificity of 97% for pericardial effusion

## INJURY TO THE THORACIC GREAT VESSELS:

- The great vessels include the aorta and its brachiocephalic branches, the pulmonary arteries and veins, the SVC and IVC as well as the innominate and azygos veins
- The large volume of blood flowing through these vessels leads to exsanguinating haemorrhage, aneurysm or pseudoaneurysm formation.
- Most patients w/ these injuries die before reaching medical attention.
- **AORTIC INJURY:**
  - Majority of blunt aortic injury are from MVA.
  - Of these, 90% die at the scene. Of the 10% who survive, 50% die within 24 hours and 90% within 4 months.

- Most common site of injury is the proximal descending aorta because of the fixation of the vessels between the left subclavian artery and the ligamentum arteriosum.
- Proximal injury is assoc. w/ cardiac rupture & severe contusion.
- The more distal the injury, the better the outcome
- **SUBCLAVIAN AND BRACHIOCEPHALIC TRUNK INJURY:**
  - Sudden deceleration may lead to avulsion of the subclavian artery at its origin
    - More commonly, direct trauma to the distal artery with intimal damage and occlusion associated with first rib or clavicular fracture is more likely
- **VENOUS INJURY.**
  - Includes pulmonary veins as well as superior & inferior vena cava.
  - Consider IVC injury w/ major hepatic injury.

**WHEN TO SUSPECT A GREAT VESSEL INJURY:**

- Half of patients with blunt thoracic vascular injury present without external signs of injury...
- Consider if:
  - Hypotension
  - Discrepancy in BP between upper and lower limbs
  - External evidence of major chest trauma
  - Thoracic outlet expanding haematoma
  - Intrascapular murmurs
  - Flail chest
  - Sternal fractures

- **DIAGNOSIS:**
  - Plain radiography:
    - WIDENED MEDIASTINUM (>8cm):
      - Poor predictor of vascular injury
      - 20% with wide mediastinum have vascular injury, and normal mediastinum does not rule out vascular injury
    - Obliteration of aortic knob + calcium layering @ knob.
    - Lateral displacement of trachea or NGT.
    - Depression of *left main bronchus*.
    - Apical capping
    - Left haemothorax.
  - CT SCANNING:
    - CT angio is **the modality of choice** for both penetrating and blunt thoracic trauma.

- Alternatives include TOE, aortography



Mediastinal haematoma



Pseudoaneurysm

#### MANAGEMENT:

- A trauma or vascular surgeon should be notified at the time of initial suspicion of great vessel injury or immediately upon diagnosis
- Patients w/ great vessel injury plus haemodynamic instability or significant haemorrhage from chest drains --> straight to OT.
- PHARMACOLOGIC CONTROL OF BLOOD PRESSURE AND HEART RATE CRUCIAL IF OPERATIVE INTERVENTION DELAYED or if non-operative intervention is contemplated
  - ↓ HR first to decrease wall tension and shearing forces with titratable beta blocker (e.g. esmolol, metoprolol) and then add arterial vasodilator such as nitroprusside to control BP
  - Target pulse 60/min with systolic BP 100-120mmHg.

Vasodilators should not be used in isolation due to the reflex tachycardia they induce.

## DOES MY PATIENT HAVE BLUNT CARDIAC INJURY ??

- Obtain an ECG.
  - If the admission ECG shows a new abnormality including;
    - Arrhythmia
    - ST-changes
    - Ischaemia
    - Heart Block

*then admit for telemetry !!*
  - Normal ECG
    - & *normal* troponin --> **BCI has been ruled out !!**
    - & *elevated* troponin --> **admit for investigation.**
- Haemodynamic instability or persistent new arrhythmia --> **ECHO & ADMIT !!**
- The presence of sternal fracture alone does *not* predict BCI.
  - Sternal fracture with normal ECG & troponin --> **BCI excluded...**

### Reference:

1. Clancy, K et al. Screening for blunt cardiac injury: an Eastern Association for the Surgery of Trauma practice management guideline. J Trauma Acute Care Surg. 2012 Nov;73(5 Suppl 4):S301-6.