



LIETUVOS SVEIKATOS
MOKSLŲ UNIVERSITETAS



KAUNO
KLINIKOS

CARDIAC TRAUMA

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2024, Stockholm





I have nothing to disclose.

Plan



Etiology

Epidemiology

Evaluation (AAST injury Scoring Scale, Cardiac damage diagnostic algorithm)

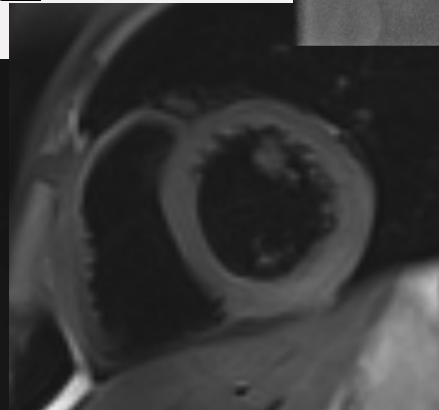
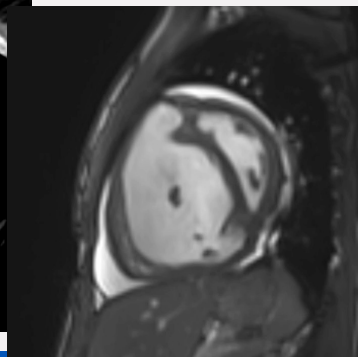
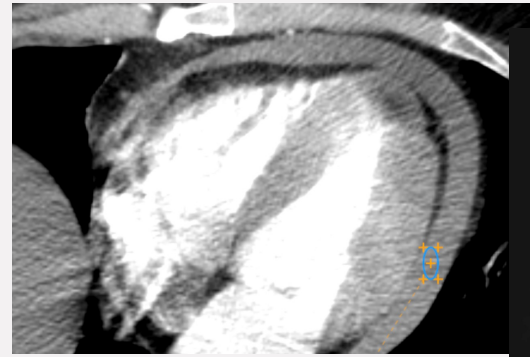
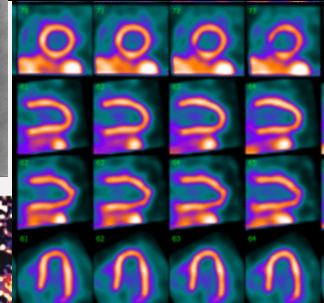
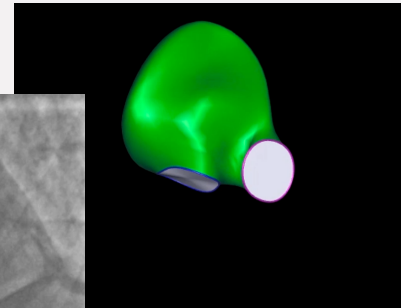
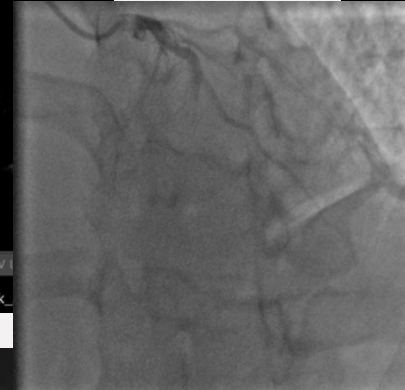
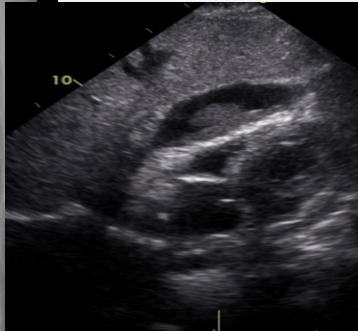
Cases

Ludwig Rehn - 1896

- Worldwide first successful cardiac operation
- Repaired a stab wound to the heart by direct suture.



Cardiac imaging



Etiology

- **Blunt cardiac trauma:**

- Direct impact to chest – compression
- Acceleration/deceleration forces.
- Indirect or hydraulic pressure
- Bidirectional forces
- Blast forces
- Concussive forces leading to fatal arrhythmia.

- **Penetrating cardiac trauma:**

- Stab wounds,
- Gunshot wounds
- Non-firearm-related blast injuries

Jatrogenic cardiac injury

- Catheterisation
- Balloon valvuloplasty
- Pacemaker lead placement
- Septal defect closure
- Pericardiocentesis

Epidemiology

Blunt cardiac injury:

- Males in 30s.
- Motor vehicle accidents.
- Blunt thoracic trauma - 30% electrical abnormalities.
- Right ventricle → right atrium → left ventricle → left atrium

Penetrating cardiac injury:

- Any gender or aged individual
- Males in 3rd or 4th decade
- Right ventricle → left ventricle → atria → multiple-chamber

Cardiac Trauma

- **Incidence** – 11.9-54% in autopsy studies, 17-76% in a clinical series.
- Blunt cardiac rupture - 0.045%
- **Death rate:**
 - Blunt injuries - 45.2-64 %
 - Penetrating injuries - 10-70%.

Association with other thoracic injuries

- Rib fracture,
- Sternal fracture,
- Pneumothorax,
- Haemothorax
- Lung contusion

Diagnosis and evaluation

A high index of suspicion and mechanism

→ Asymptomatic

→ Chest pain

→ Shock (distinguished from other causes of hypotension: tension pneumothorax, neurogenic and hypovolemic shock).



AAST Injury Scoring Scale

- EKG abnormalities
- The depth of injury
- Chamber inclusion
- Valves incompetence
- Coronary artery occlusion
- Cardiac tamponade
- Cardiac herniation
- Cardiac failure

Heart injury scale

Grade	Description of injury
I	Blunt cardiac injury with minor ECG abnormality (nonspecific ST or T wave changes, premature arterial or ventricular contraction or persistent sinus tachycardia) Blunt or penetrating pericardial wound with out cardiac injury, cardiac tamponade, or cardiac herniation
II	Blunt cardiac injury with heart block (right or left bundle branch, left anterior fascicular, or atrioventricular) or ischemic changes (ST depression or T wave inversion) without cardiac failure Penetrating tangential myocardial wound up to, but not extending through endocardium, without tamponade
III	Blunt cardiac injury with sustained (≥ 6 beats/min) or multilocal ventricular contractions Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid valvular incompetence, papillary muscle dysfunction, or distal coronary arterial occlusion without cardiac failure Blunt pericardial laceration with cardiac herniation Blunt cardiac injury with cardiac failure
IV	Penetrating tangential myocardial wound up to, but extending through, endocardium, with tamponade Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid valvular incompetence, papillary muscle dysfunction, or distal coronary arterial occlusion producing cardiac failure Blunt or penetrating cardiac injury with aortic mitral valve incompetence Blunt or penetrating cardiac injury of the right ventricle, right atrium, or left atrium Blunt or penetrating cardiac injury with proximal coronary arterial occlusion Blunt or penetrating left ventricular perforation Stellate wound with < 50% tissue loss of the right ventricle, right atrium, or of left atrium
V	Blunt avulsion of the heart; penetrating wound producing > 50% tissue loss of a chamber

VI

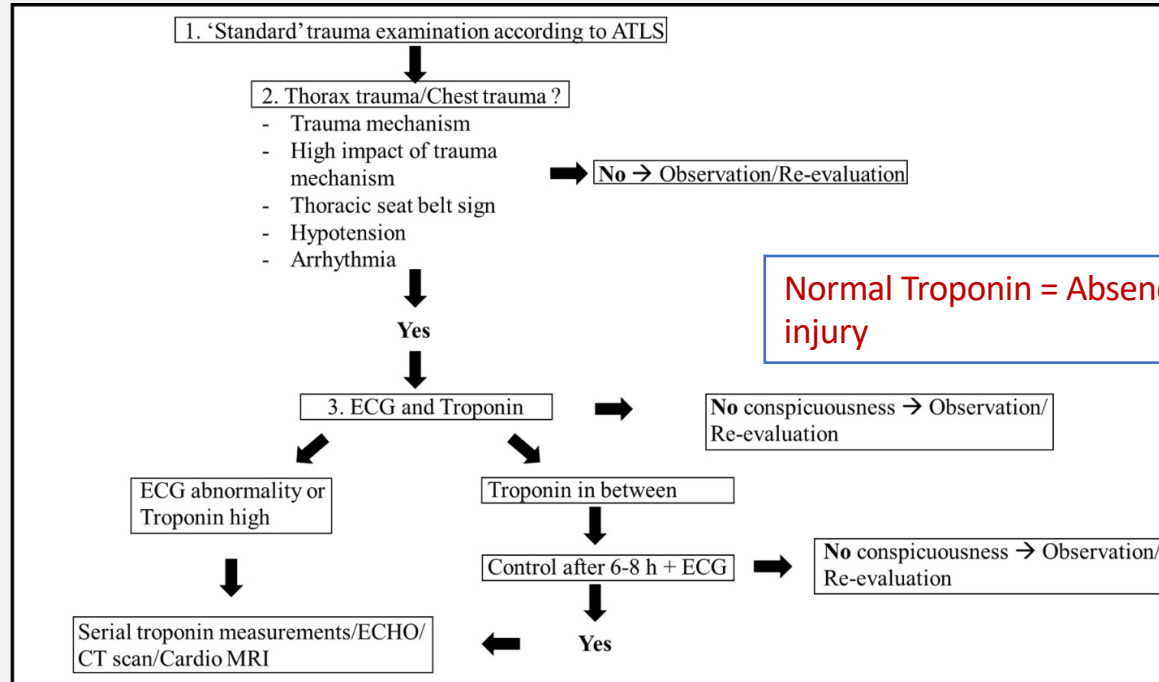
*Advance one grade for multiple wounds to a single chamber or multiple chamber involvement.
From Moore et al. [3]; with permission.

Higher Heart injury grade
→ Higher mortality



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Cardiac damage diagnostic algorithm



Normal Troponin = Absence of myocardial injury

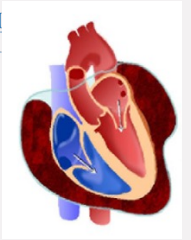
Blunt cardiac injuries

Structural injuries

- **Cardiac concussion** (wall motion abnormality with no anatomic or cellular injury)
- **Cardiac contusion** (anatomic injury: increased cardiac enzymes or tissue damage at surgery or autopsy)
- **Other cardiac injuries:**
 - Pericardial rupture,
 - Myocardial rupture (wall or septal)
 - Papillary muscle injury,
 - Coronary artery injury

Electrical changes: Arrhythmias

- **Non-specific changes (50-70%):**
 - Sinus tachycardia/bradycardia, PAC/PVC, conduction delays, ST-T wave changes
- **Atrial arrhythmias (4-30%)**
 - Atrial fibrillation most common arrhythmia to require treatment
- **Ventricular arrhythmias (2-10%)**



Pericardial injury

Patogenesis: direct high energy impact or acute increase in intraabdominal pressure.

Ruptures: diaphragmatic or pleural surface

May lead to: cardiac evisceration and torsion of the great vessels.

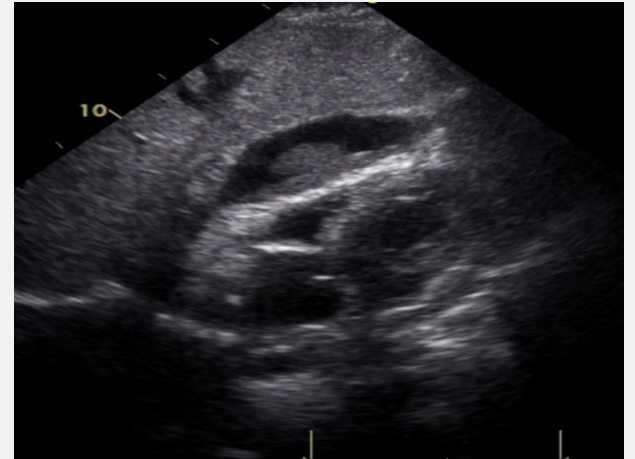
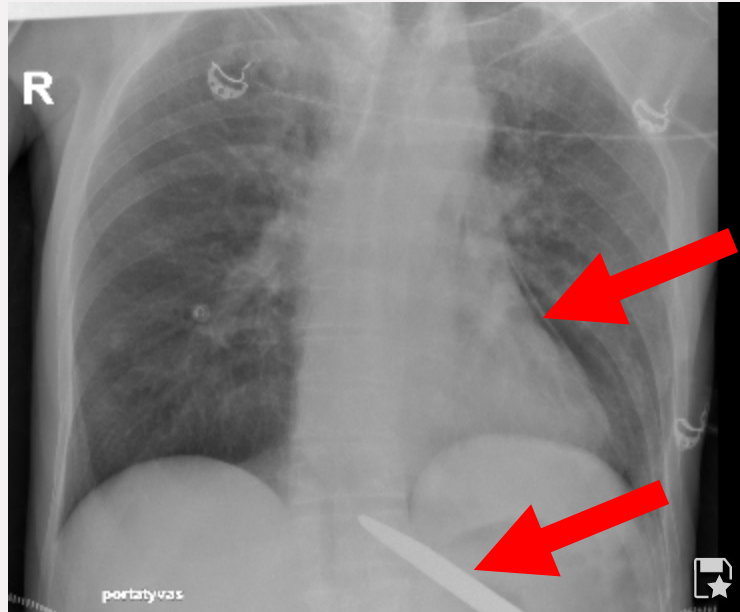
Clinical presentation: hemodynamic instability → cardiac arrest.

Xray: displacement of the cardiac silhouette, pneumopericardium, or abnormal gas pattern due to herniated hollow viscera.

FAST and EKG may aid in diagnosis.

Treatment - surgical intervention

Stabbed/M65 - Xray



Stabbed/M65 - Trauma surgeon steps

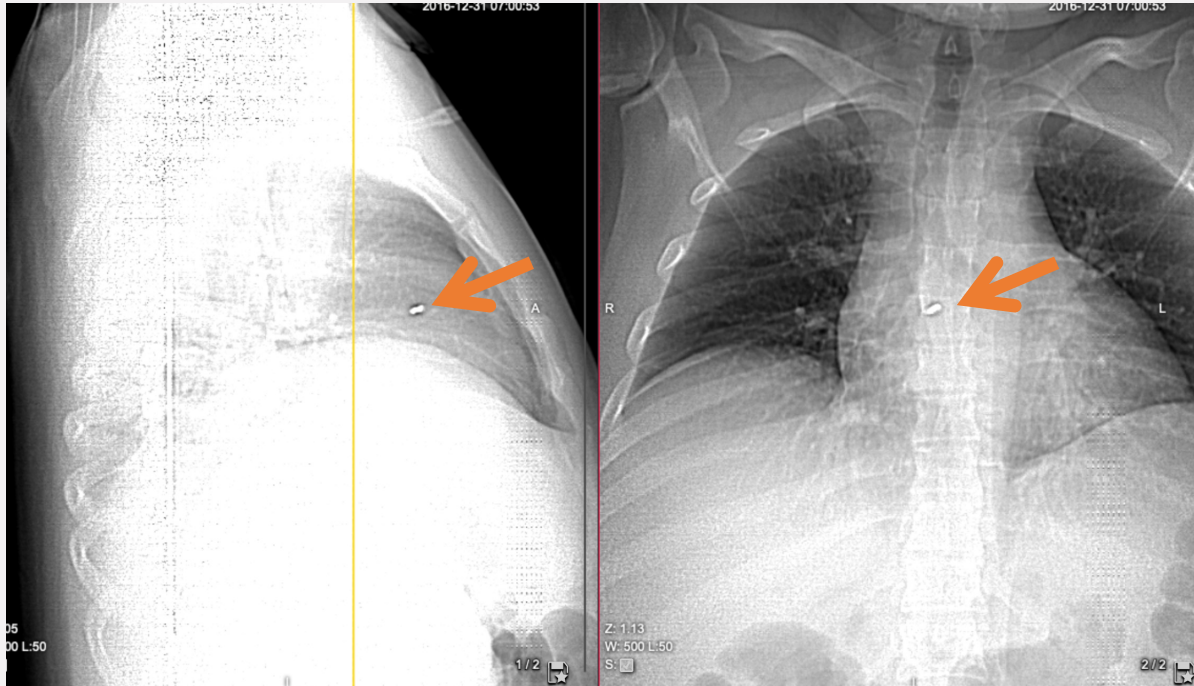
- Pericardiocentesis:

150 mL of fresh blood and air

- Thoracotomy:

- A penetrating stab injury of the pericardium (lesion 8 cm length), diaphragm (10 cm) and left liver lobe (3 cm) with active bleeding
- Fresh blood in the pericardium, left pleural cavity and abdomen
- Repair pericardial and diaphragmatic defect, treat/cautery of hepatic laceration and arterial bleeders, and drain left pleura hemopneumothorax

Shot/M29



Tamponade CT findings (non-specific):

- SVC and/or IVC enlargement
- Hepatic and renal veins enlargement
- Periportal edema
- Reflux of C/M into IVC or v.azygos
- Coronary sinus compression
- IVS angulation or bowing
- RV collapse
- Aortic blood contrast level

No CT signs of Tamponade

Myocardial Injury

Myocardial contusion

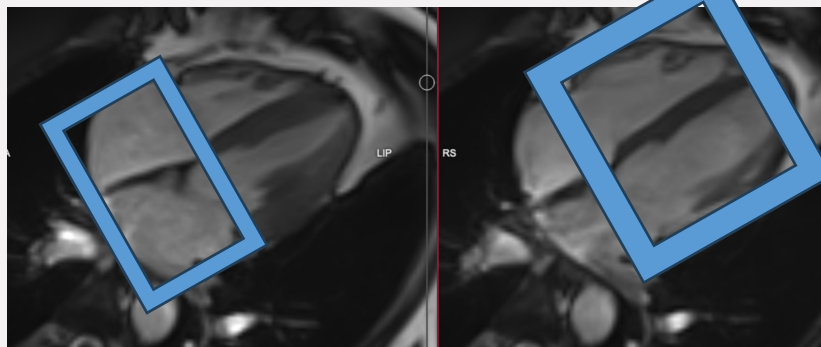
- Most common,
- Least dangerous
- Direct injury to the muscle
- Manifested as EKG changes or elevation in cardiac enzymes.
- Many are missed or misdiagnosed.

Myocardial rupture (wall or septal)

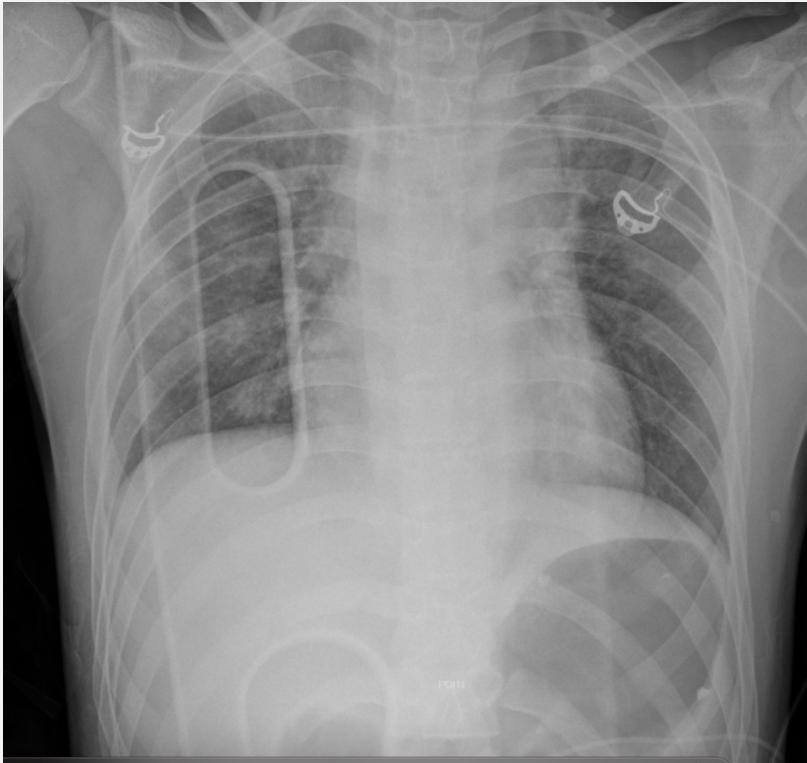
- Ventricular or atrial septum
- Free wall of the heart.
- Highly lethal - death often at the scene

Late systole

Late diastole



MVH driver/M20



E-FAST

+ peritoneal fluid

- pericardial fluid
- pneumothorax
- hemothorax

Hemodynamically Unstable (Hypotension
(51/34), tachycardia (119))
→ OR.



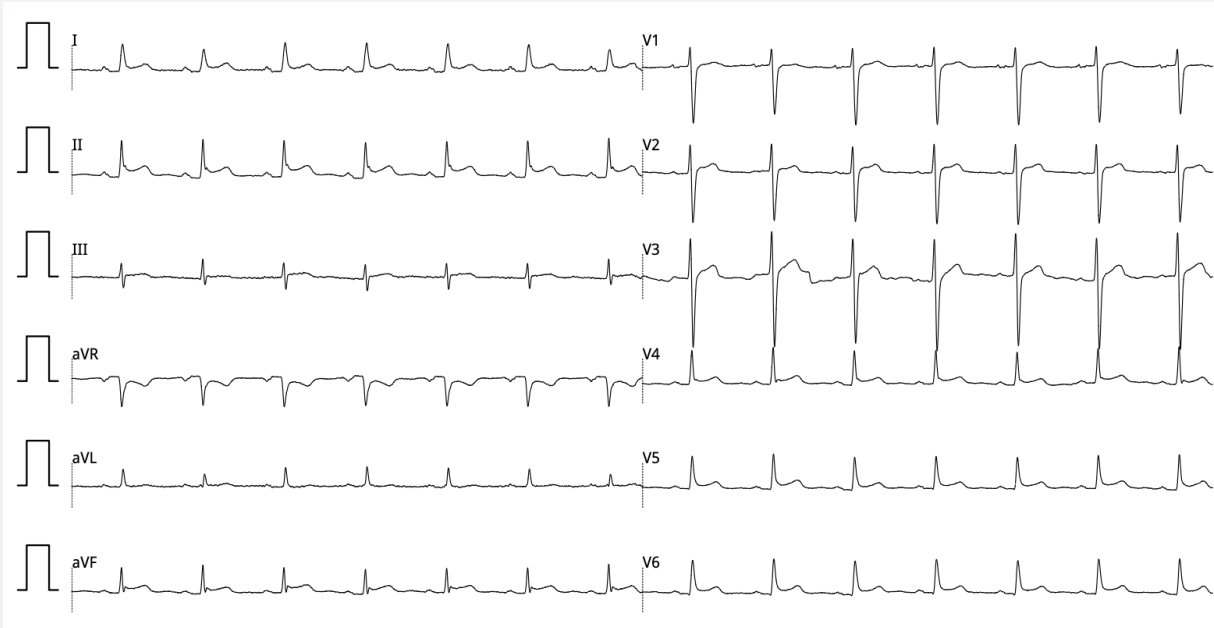
MVH driver/M20



- Severe liver injury with active extravasation
- Hemoperitoneum (~500 ml)
- Massive retrohepatic hematoma
- Liver hemostasis

MVH driver/M20

Sinus rhythm
Normal ECG



Troponin T – 0.69 ng/mL

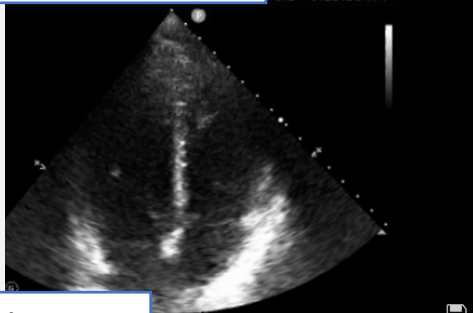
MVH driver/M20

Myocardial contusion

BL

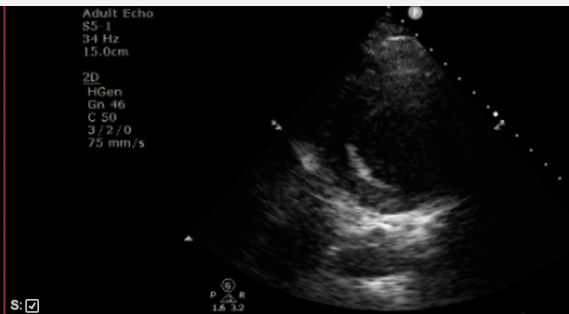


Impaired LV systolic function

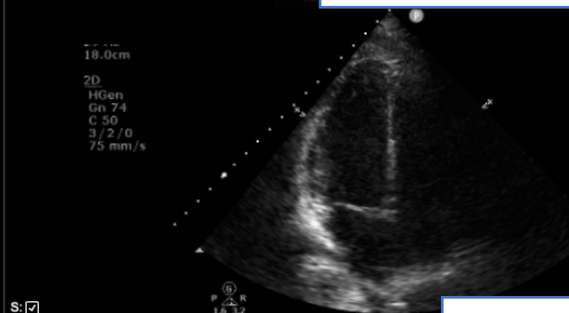


Troponin T – 0.69 ng/mL

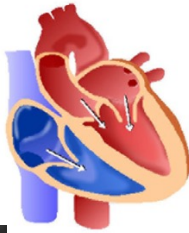
FU



Normal LV systolic function



Troponin T – 0.26 ng/mL



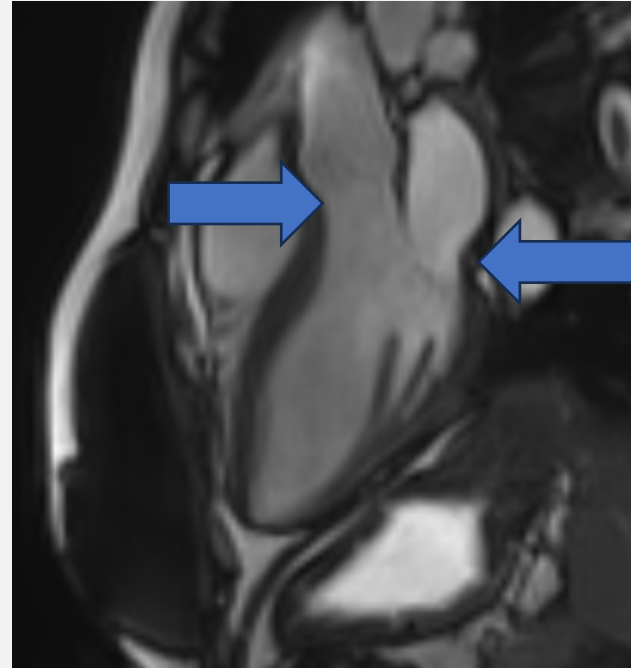
Valvular injuries

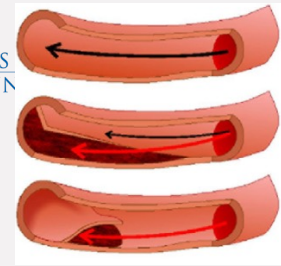
Rare

Most frequently injured: aortic → mitral.

Symptoms:

- Left ventricular dysfunction
- Cardiogenic shock
- Pulmonary edema





Coronary artery injuries

Extremely rare.

May cause:

- Arterial thrombosis
- MI
- Ventricular aneurysm
- Chamber rupture,
- Ventricular failure,
- Malignant arrhythmias

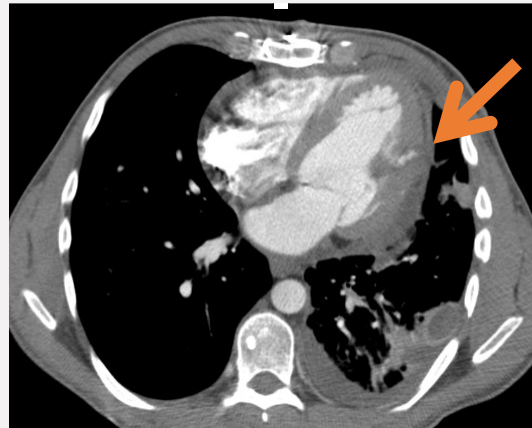
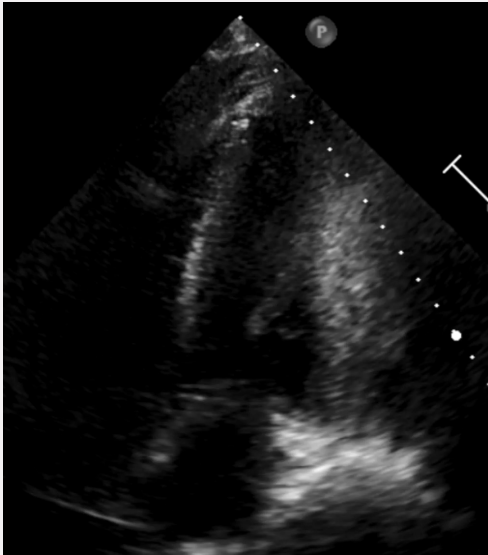
Case

- 37 y old male
- Stabbed wounds in left thorax
- Severe pain, fresh bleeding
- No loss of consciousness or respiratory failure
- Hypotension (77/30 mmHg), tachycardia (145 b/min).

Stabbed/37M

- Unstable: hypotension (77/30 mmHg), tachycardia (145 b/min).
- FAST – cardiac tamponade
- Asystole,
- Resuscitation → Pericardial puncture → hypotension → Thoracotomy → pericardial drainage (300ml blood) → LV defect → Compression → transportation to OR
- **OR**
 - → sternotomy
 - wound revision,
 - LV defect suture,
 - Left lung suture,
 - Left hemothorax drainage (1000 ml blood and clots)

Stabbed/37M

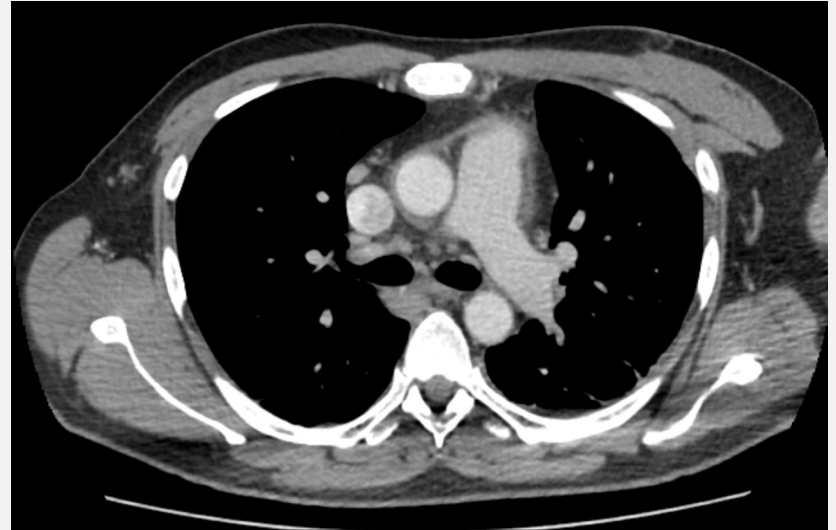
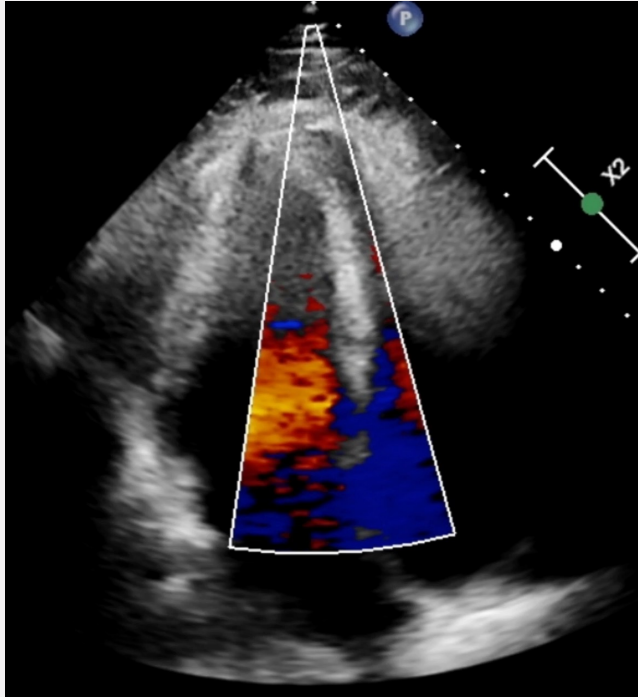


LV lateral wall myocardial defect

Case

- 44 y old male
- Stabbed to left thorax
- Cardiac tamponade and massive hemothorax
- Unstable →thoracotomy →pericardial defect with LV lateral wall rupture in the apex →sutures →hemopericardium and hemothorax drainage (2000ml blood and clots)
- Stabilized and transferred from regional hospital to LUHS Kauno Klinikos

Stabbed/44M



Intraventricular septum defect

Stabbed/44M



Conclusions



Clinically significant structural injuries very rare in survivors



Multiple injured patients with blunt cardiac trauma are at high risk of being underestimated.



Careful evaluation of trauma patients can predict the presence of blunt cardiac injury.



The severity of blunt cardiac injury should be stratified using the AAST injury scoring scale, as patient outcomes depend on the injury's severity.

Literature

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