Cardiac Injuries

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Blunt Cardiac Injuries

- Common Mechanisms of Injury
- Pathophysiology
- Presentation
- Management

Penetrating Cardiac Injuries

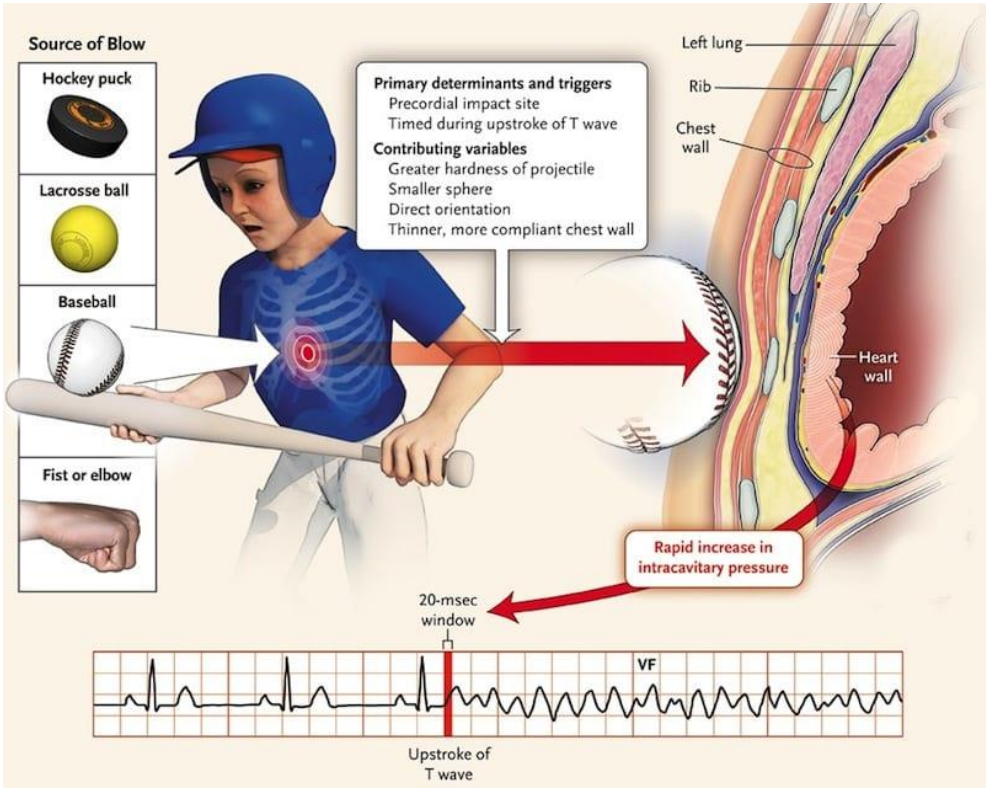
- GSW vs low energy penetrating trauma
- Presentation
- Management

Blunt Cardiac Injuries

- Multiple types of injuries
  - Myocardial contusions (>60%)
    - Right more common than left
  - Myocardial rupture
  - Pericardial rupture
  - Valvular Injury
  - Cord rupture
  - Commotio Cordis (sudden death without injury)
- Incidence: unknown (8-71%)
  - 20% of all blunt thoracic injuries
  - Up to 20% of all MVCs

Mechanism of Injury

- Significant force:
  - MVC, Auto-ped
  - Fall
  - Crush
  - Sports-related (baseball to the chest, etc.)



- Severe abdominal compression → inc. blood flow through IVC → inc. blood within the right heart → chamber rupture from sudden inc. intracardiac pressure
- Blunt coronary artery injury (rare)

- Myocardial Contusion
  - Presentation: tachycardia
    - May develop conduction abnormalities/arrhythmias
- Myocardial rupture:
  - Presentation: tamponade or death
    - Ventricle – more dramatic presentation
      - Right has been survival than left
    - Atrial – potentially more gradual onset
- Valvular rupture (aortic > mitral):
  - Presentation: heart murmur, heart failure (dyspnea, crackles, hypotension)
- Septal rupture
  - Presentation: delayed – often with heart failure symptoms
- Commotio cordis: blow to anterior chest without pre-existing disease
  - Presentation: ventricular fibrillation (timing of cardiac cycle may play a role)
- Pericardial rupture:
  - Presentation: cardiac evisceration and great vessel torsion → HS instability or arrest

Diagnosis of BCI

- Suspicion (must maintain high index of suspicion):
  - Chest trauma with palpitations, arrhythmia, new murmur, unexplained tachycardia/hypotension
- EKG (no pathognomonic finding):
  - ST changes – ischemia vs infarction
  - Conduction abnormalities:
    - Atrial fibrillation, right BBB, simple/multiple PVC
- FAST: cardiac view with pericardial fluid, tamponade
- ECHO (TEE>TTE)
- Troponin: rule out, not in (EKG and troponin normal = no BCI)

Grade I

1. Blunt cardiac injury with minor EKG abnormality (non specific ST of T wave changes, premature atrial or ventricular contractions, or persistent sinus tachycardia
2. Blunt or penetrating pericardial wound without cardiac injury, tamponade, or cardiac herniation

Grade II

1. Blunt cardiac injury with heart block or ischemic changes without cardiac failure
2. Penetrating tangential cardiac wound, up to but not extending through endocardium, without tamponade

Grade III

1. Blunt cardiac injury with sustained or multifocal ventricular contracations
2. Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion without cardiac failure
3. Blunt pericardial laceration with cardiac herniation
4. Blunt cardiac injury with cardiac failure
5. Penetrating tangential myocardial wound, up to but not through endocardium, with tamponade

Grade IV

1. Blunt or penetrating cardiac injury with septal rupture, pulmonary or tricuspid incompetence, papillary muscle dysfunction, or distal coronary artery occlusion producing cardiac failure
2. Blunt or penetrating cardiac injury with aortic or mitral incompetence
3. Blunt or penetrating cardiac injury of the right ventricle, right or left atrium

Grade V

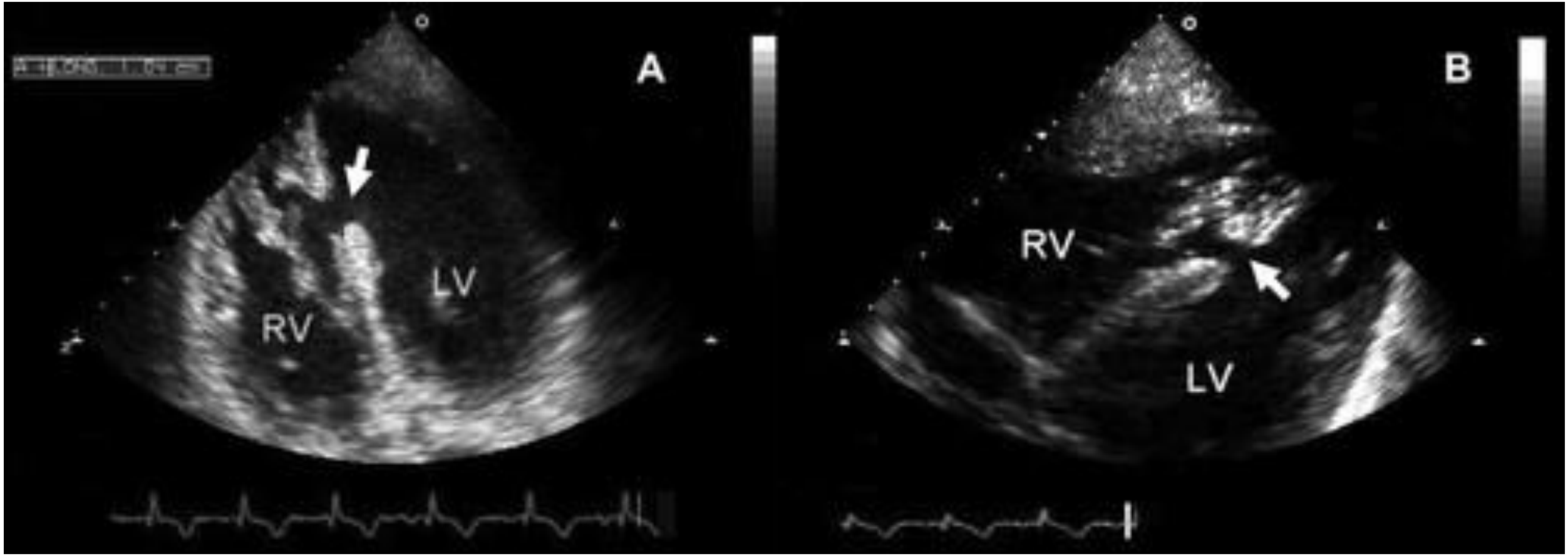
1. Blunt or penetrating cardiac injury with proximal coronary artery occlusion
2. Blunt or penetrating left ventricular perforation
3. Stellate injuries, less that 50% tissue loss of the right ventricle, right or left atrium

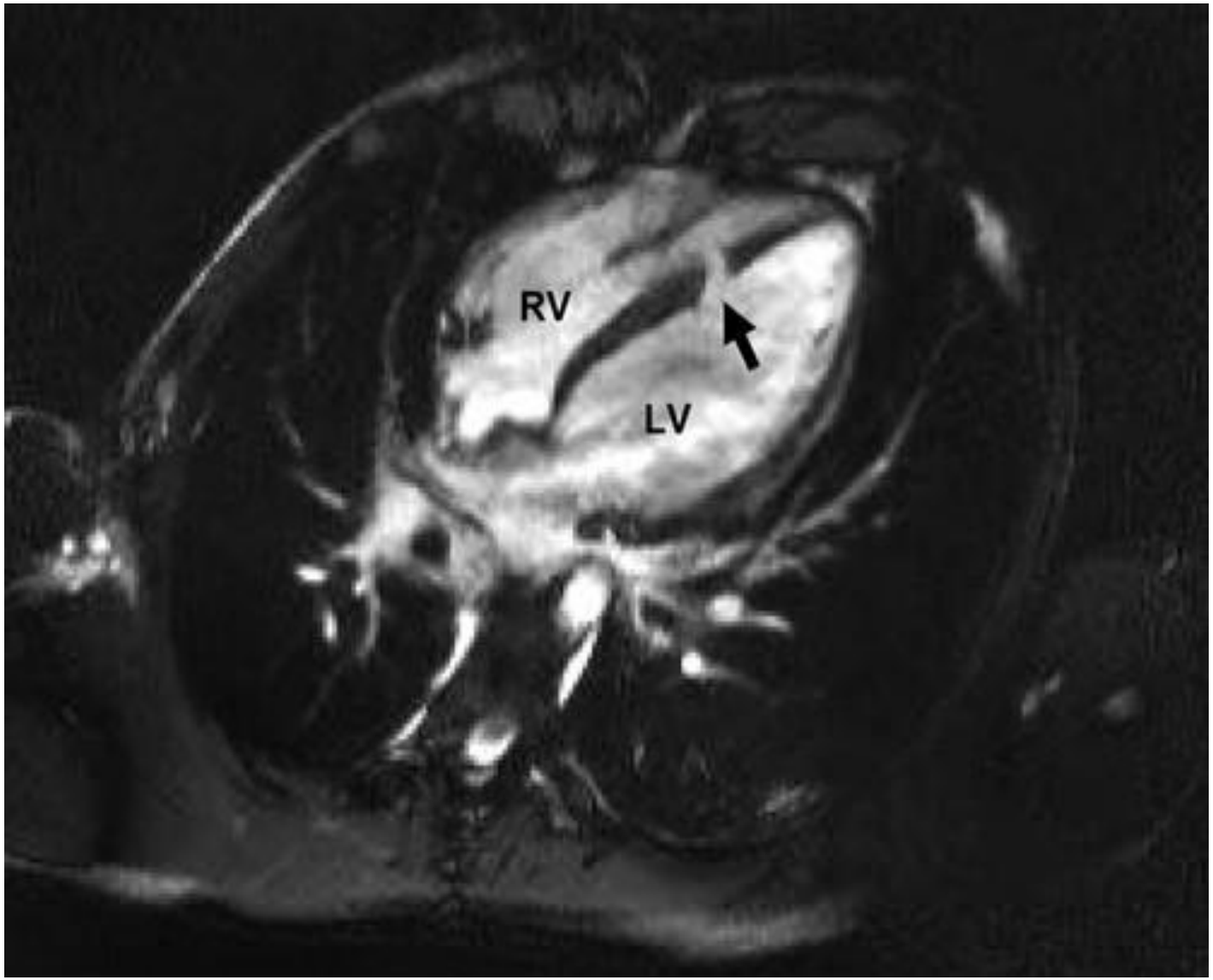
Grade VI

1. Blunt avulsion of the heart
2. Penetrating wound producing more than 50% tissue loss of a chamber


RATIVE
TEE
0 0 180

Ventricular septal rupture (ECHO & MRI)





Franck Thuny. Circulation. Ventricular Septal Rupture After a Nonpenetrating Chest Trauma, Volume: 112, Issue: 22, Pages: e339-e340, DOI: (10.1161/CIRCULATIONAHA.105.538199)

Management of BCI

- EAST Evidence-based management guideline
  - Admission
  - Imaging
  - Procedures
  - Predictions

EAST guidelines

A. Level I

1. An admission EKG should be performed on all patients in who there is suspected BCI.

B. Level II

1. If the admission EKG is abnormal (arrhythmia, ST changes, ischemia, heart block, unexplained ST), the patient should be admitted for continuous EKG monitoring for 24 to 48 hours. Conversely, if the admission EKG is normal, the risk of having a BCI that requires treatment is insignificant, and the pursuit of diagnosis should be terminated.
2. If the patient is hemodynamically unstable, an imaging study (echocardiogram) should be obtained. If an optimal transthoracic echocardiogram cannot be performed, then the patient should have a transesophageal echocardiogram.
3. Nuclear medicine studies add little when compared to echocardiography and, thus, are not useful if an echocardiogram has been performed.

C. Level III

1. Elderly patients with known cardiac disease, unstable patients, and those with an abnormal admission EKG can be safely operated on provided they are appropriately monitored. Consideration should be given to placement of a pulmonary artery catheter in such cases.
2. The presence of a sternal fracture does not predict the presence of BCI and, thus, does not necessarily indicate that monitoring should be performed.
3. Neither creatinine phosphokinase with isoenzyme analysis nor measurement of circulating cardiac troponin T are useful in predicting which patients have or will have complications related to BCI.

Screening of Blunt Cardiac Injury. **Pasquale, N K and Clark, J.** s.l. : The Eastern Association for the Surgry of Trauma, 1998.

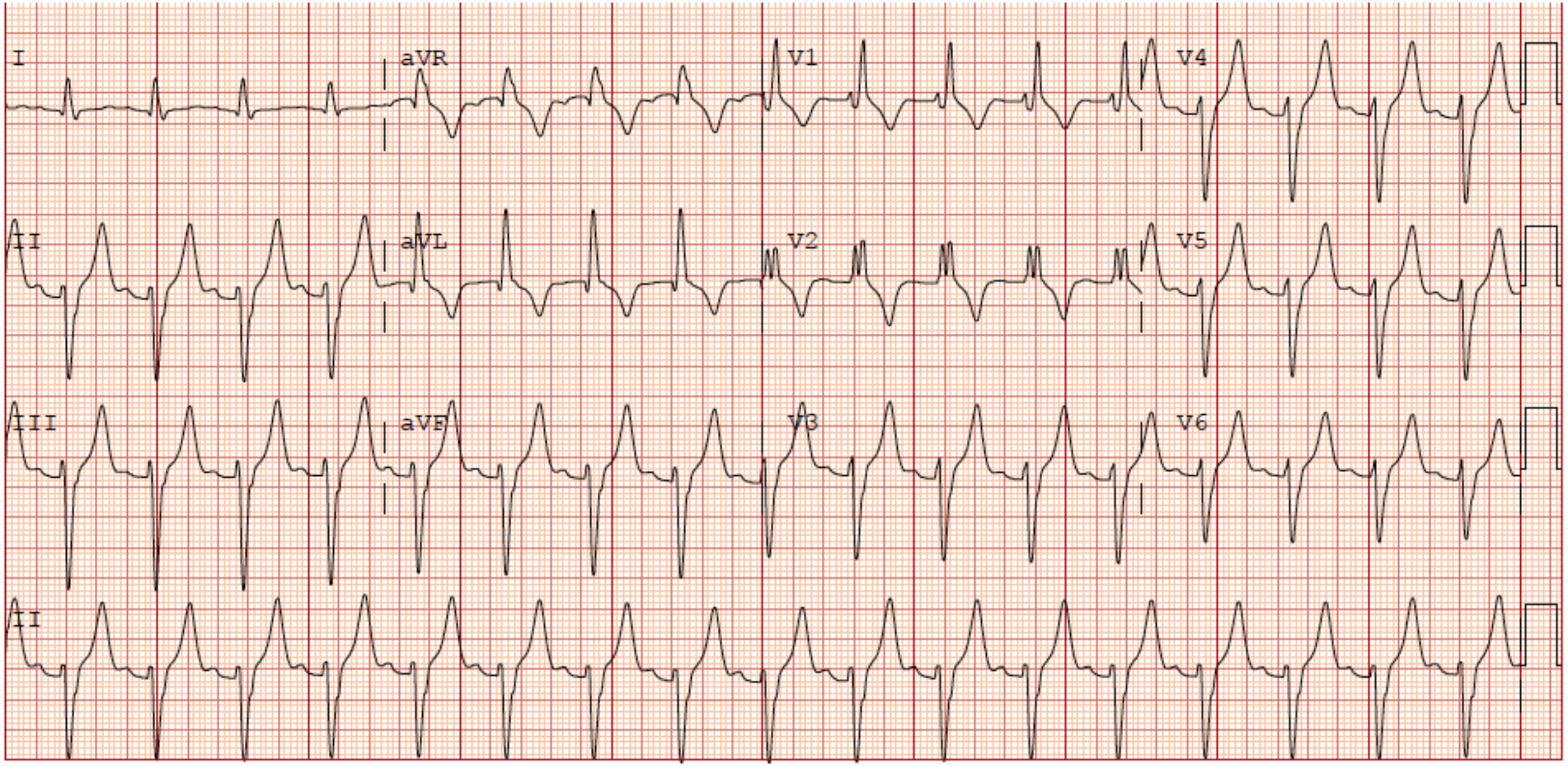
Septal repair following blunt rupture

Franck Thuny. Circulation. Ventricular Septal Rupture After a Nonpenetrating Chest Trauma, Volume: 112, Issue: 22, Pages: e339-e340, DOI: (10.1161/CIRCULATIONAHA.105.538199)

Denver Health Case

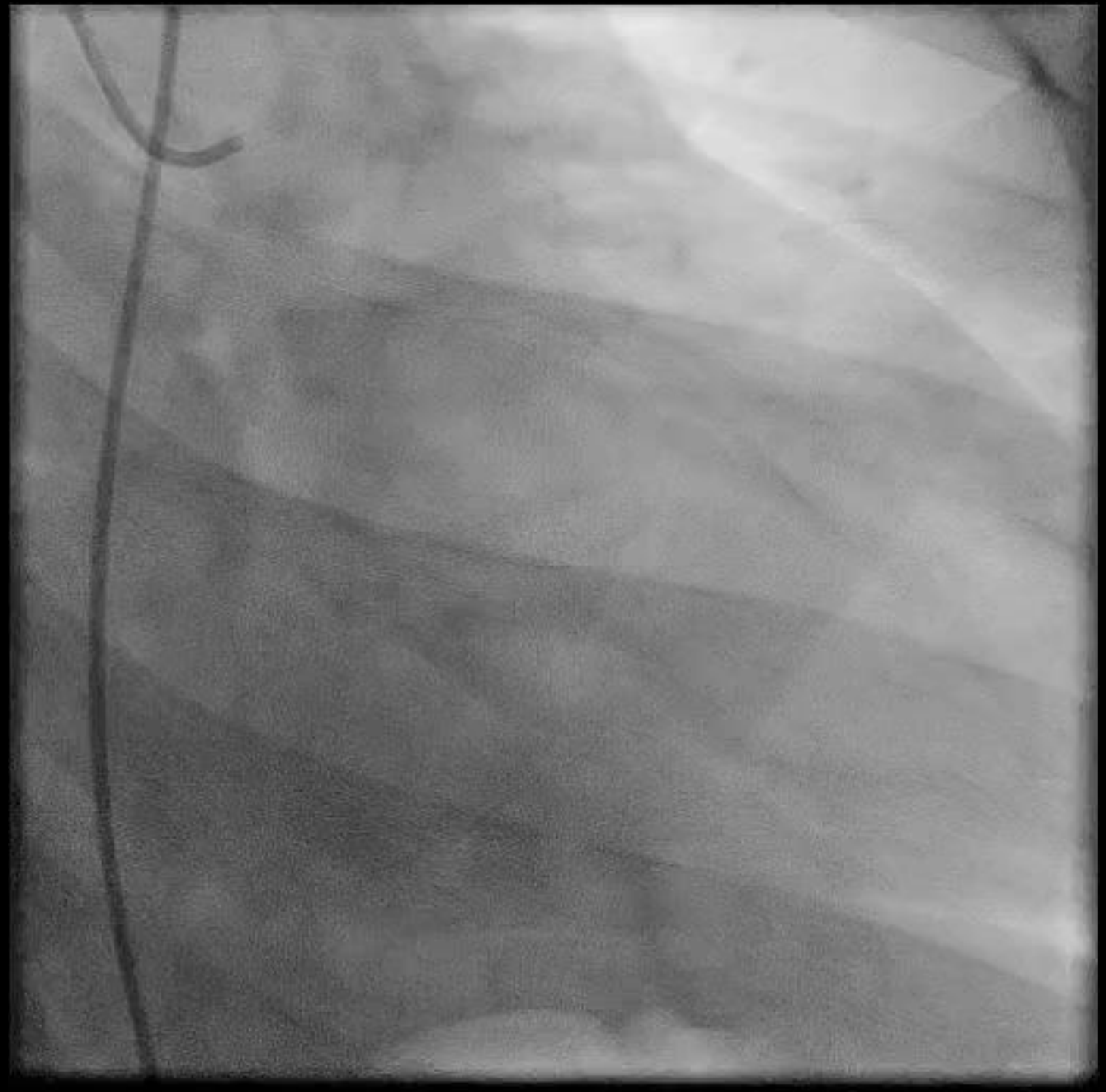
- 25 yo male s/p helmeted MCC.
- Initially hypotensive and tachycardic in the trauma bay and responded to resuscitative efforts.
- Labs showed a base deficit of 8.
- Imaging showed a transverse sternal fracture with retrosternal hematoma.

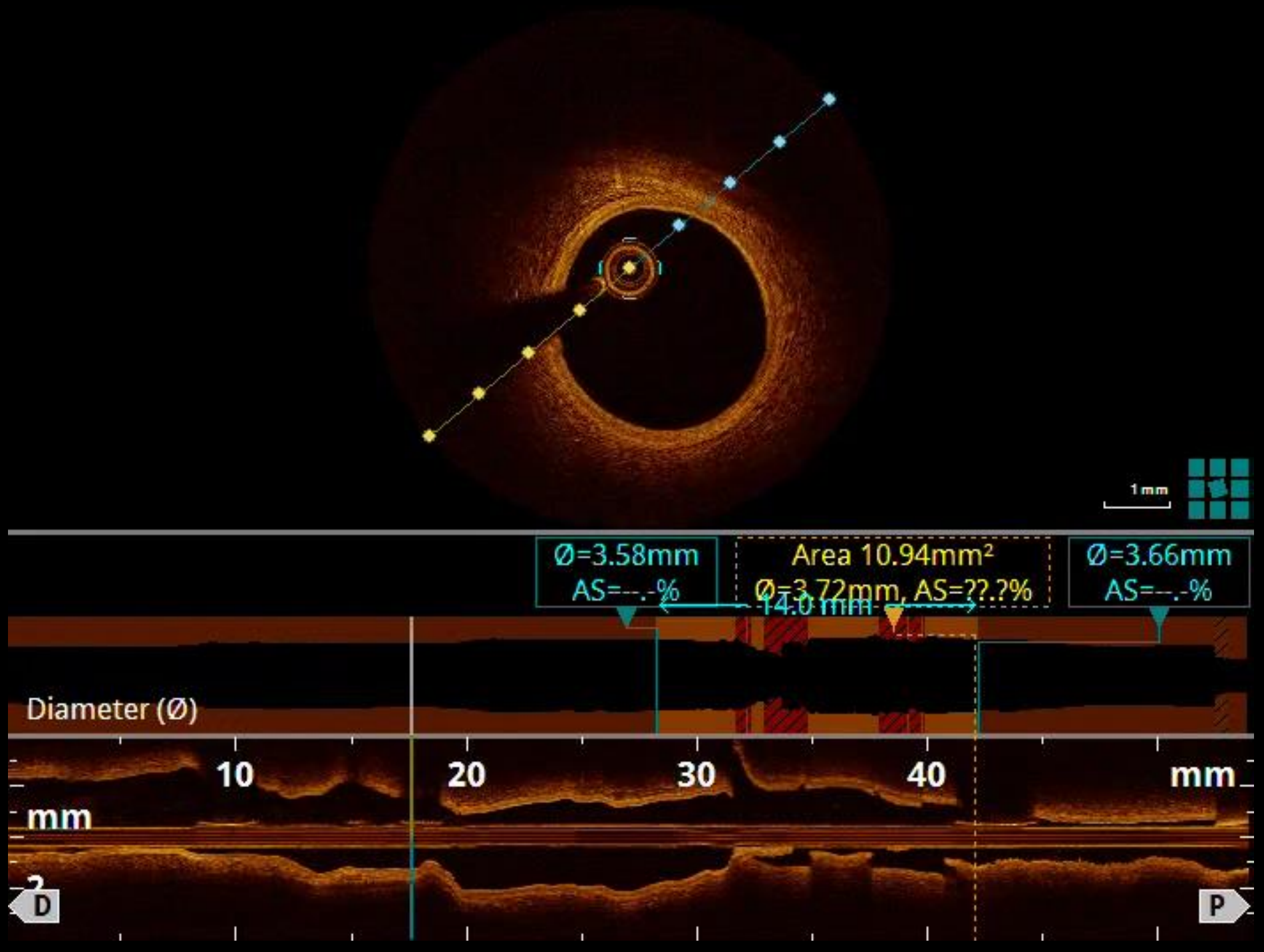
Image 1



Case cont’d

- TTE showed anterior wall motion abnormalities.
- Troponin was 15.5.
- Cardiology initially wanted to observe. We placed the patient in the ICU.
  - Developed two runs of non-sustained ventricular tachycardia overnight
  - Troponin now > 30

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Area 10.94mm²
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40
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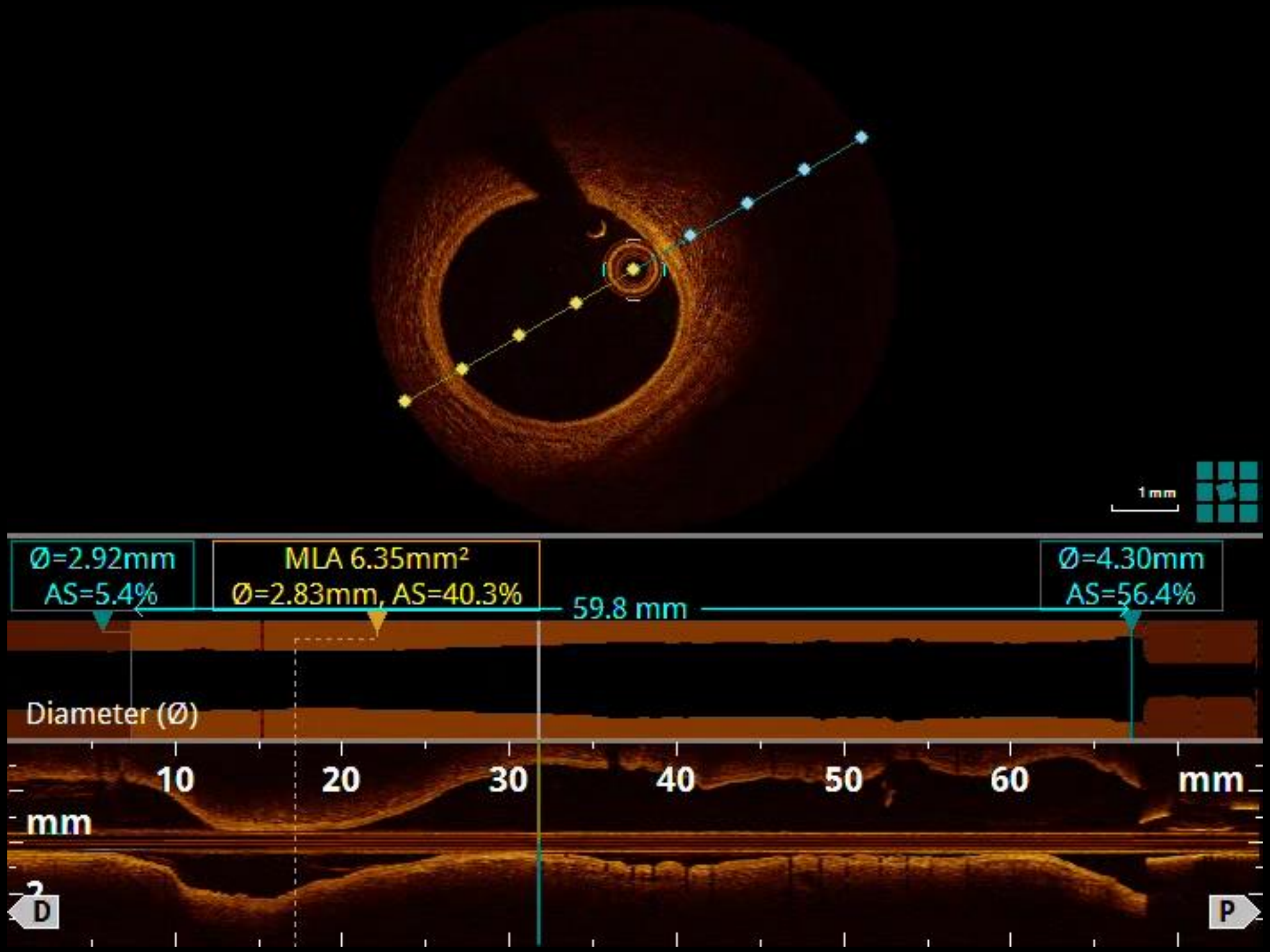
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MLA 6.35mm²
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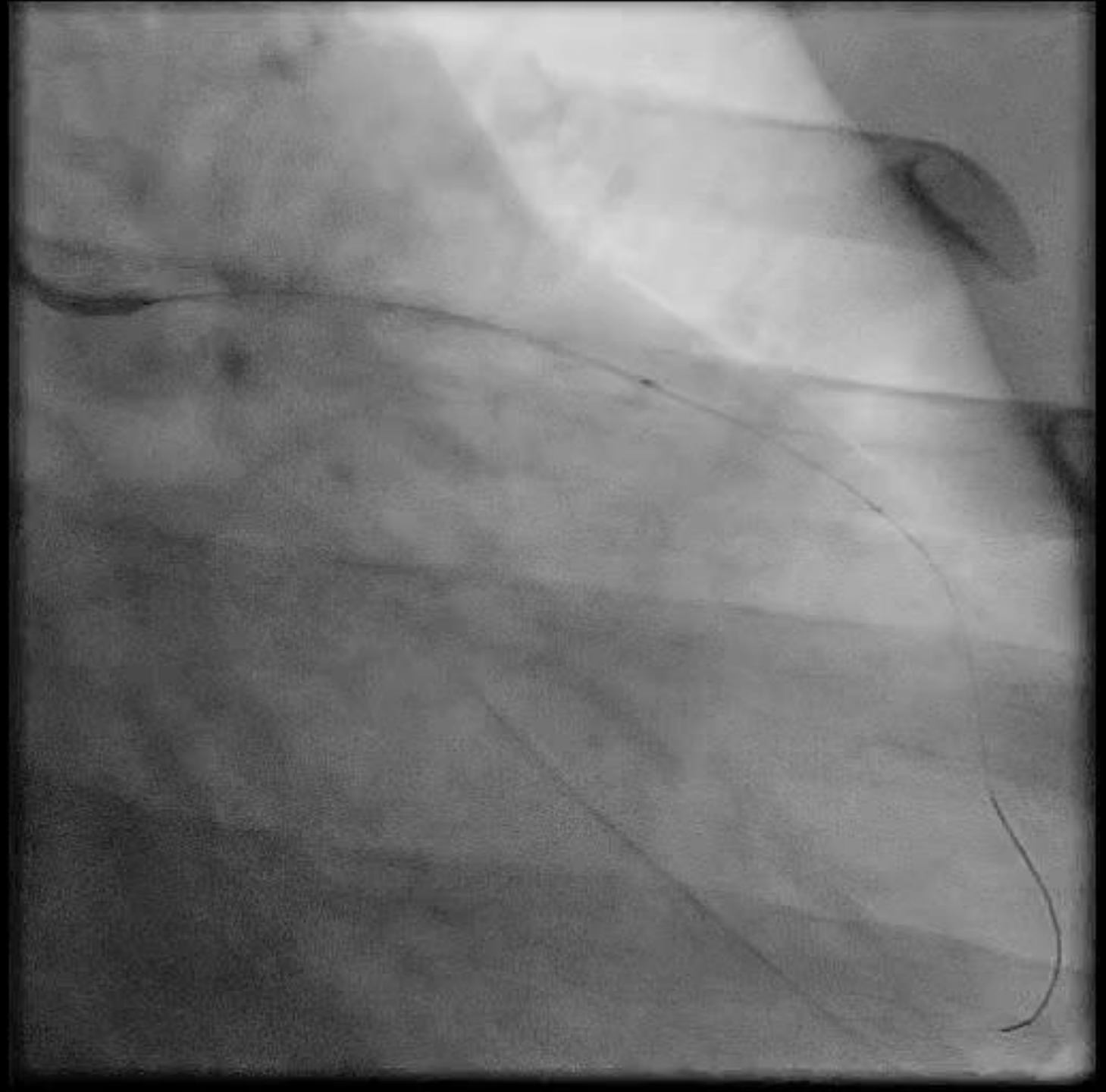
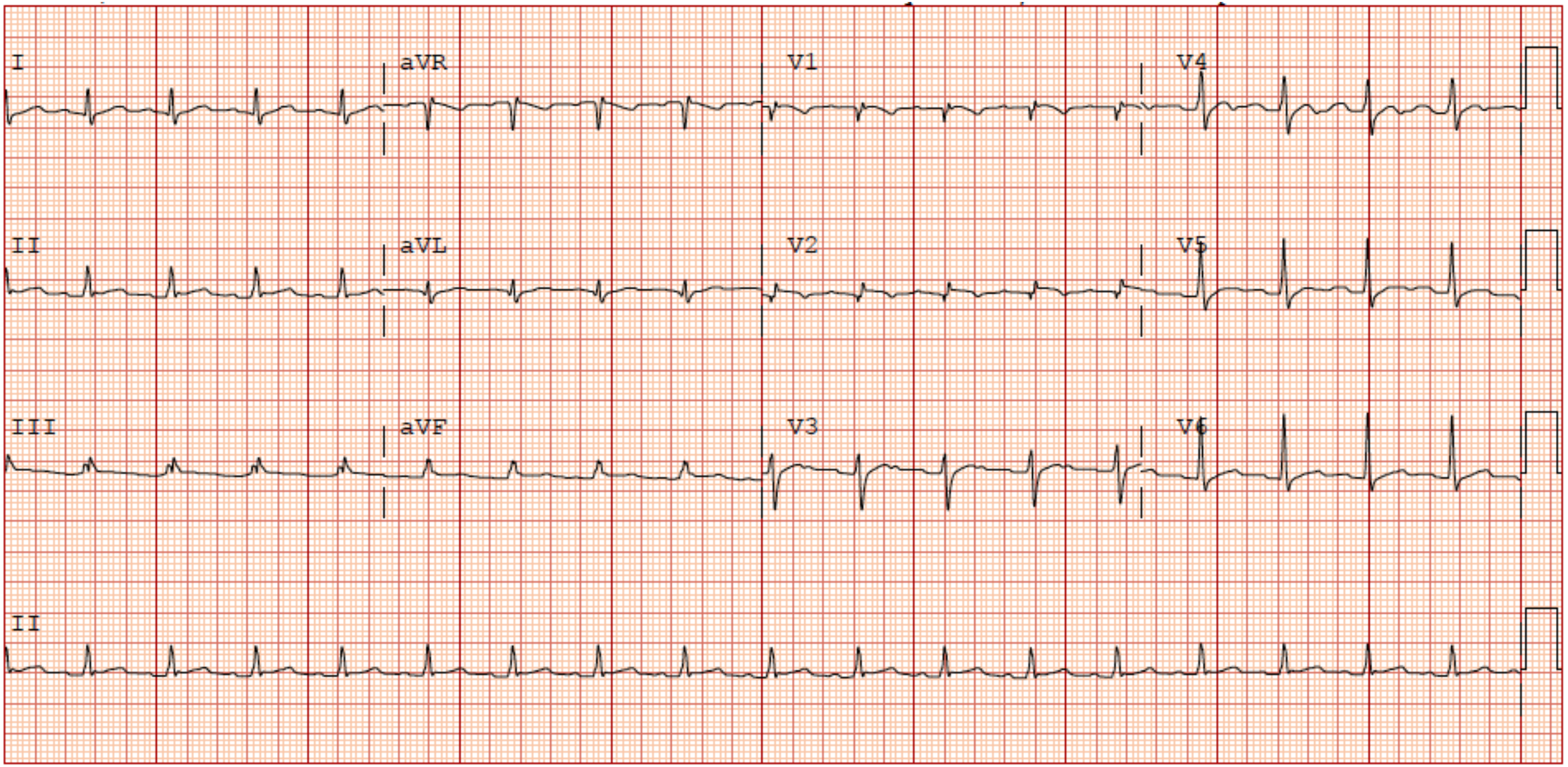


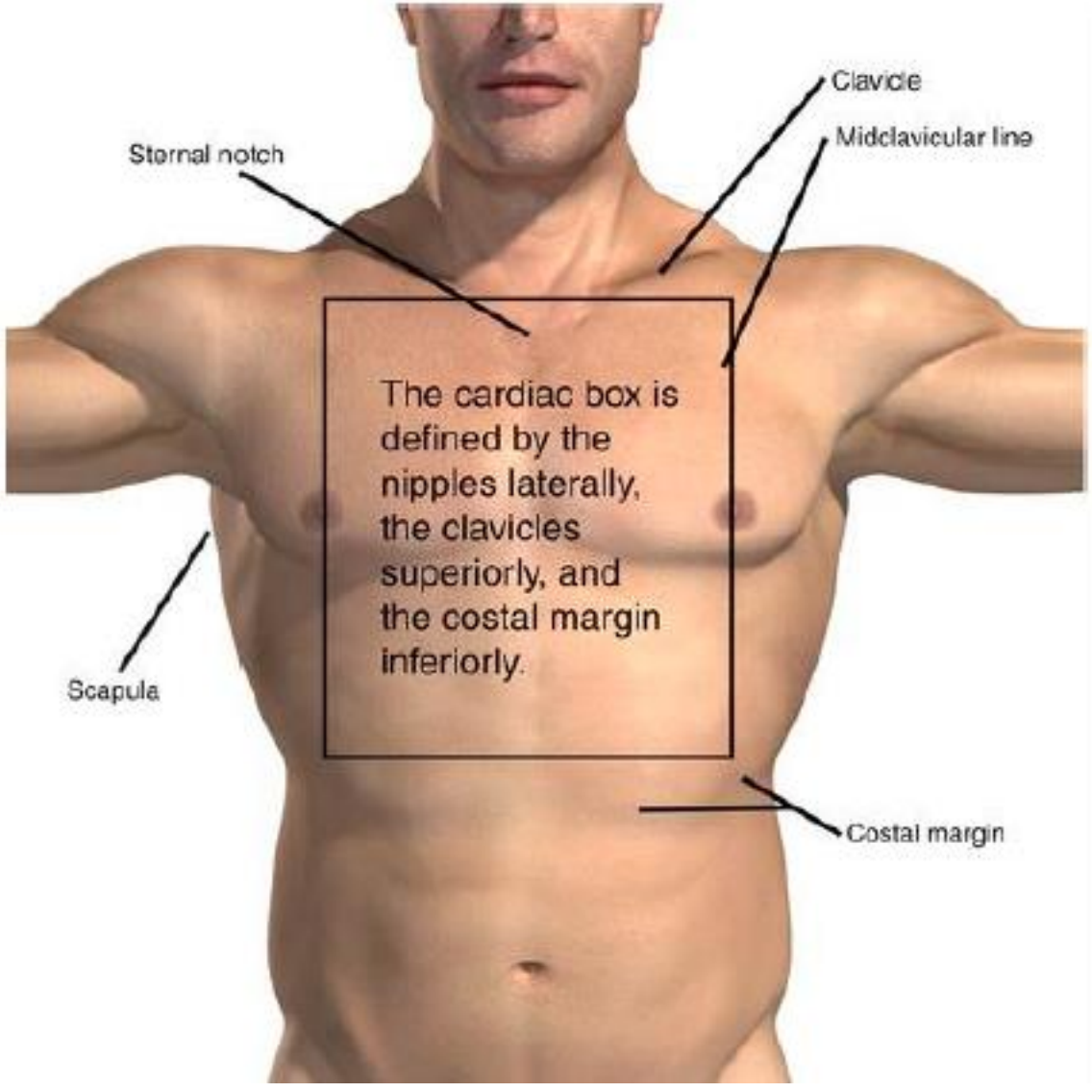
Image 2

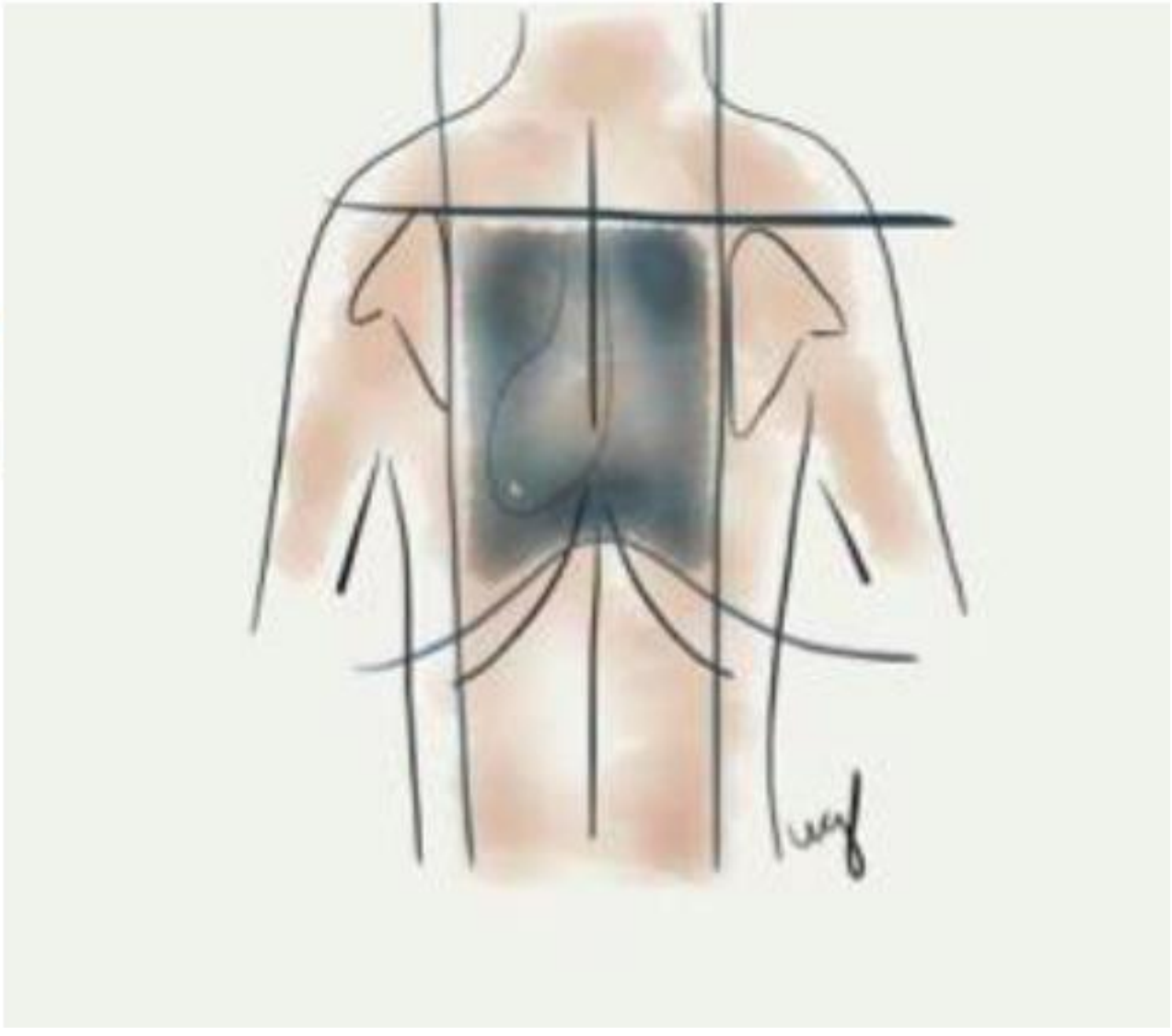


Penetrating cardiac injuries

- Mechanism:
  - Anything that penetrating the thoracic cavity into the heart
    - GSW
    - Knife
    - Sword
    - Ice pick
    - Fence post, etc.
- Injuries:
  - Simple – single chamber involvement
  - Complex – Multiple chambers or injuries beyond the myocardium
    - Coronaries, valves, septum, intracardiac fistulas

The Cardiac “Box”





Fatal thoracic gunshots and the cardiac box

Retrospective autopsy review, patients with penetrating torso gunshot 2011-3, Georgia

Excl: injuries above clavicle or below xiphoid

#paperinapic
@kirstychallen

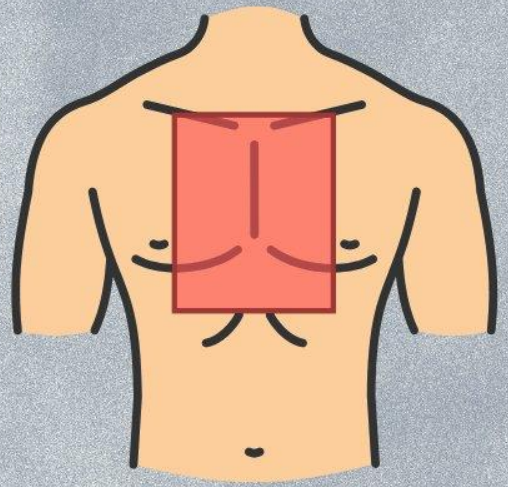
Wound in cardiac box n=257

Entry or exit

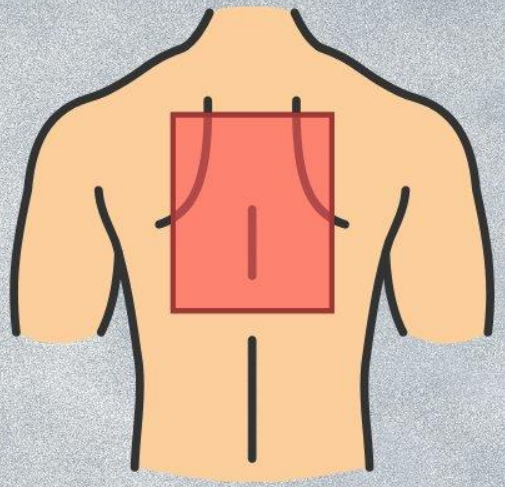
81 (31%) cardiac injuries

Wound outside cardiac box n=67

14 (21%) cardiac injuries



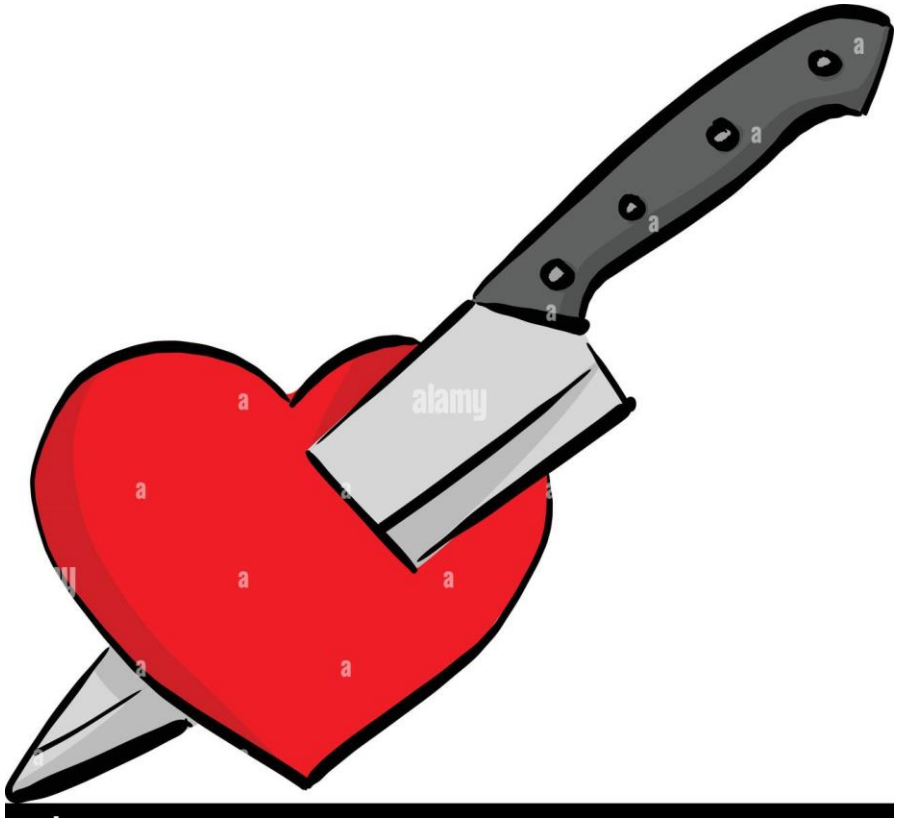
Cardiac box:
Clavicle to tip of xiphoid
Between midclavicular lines



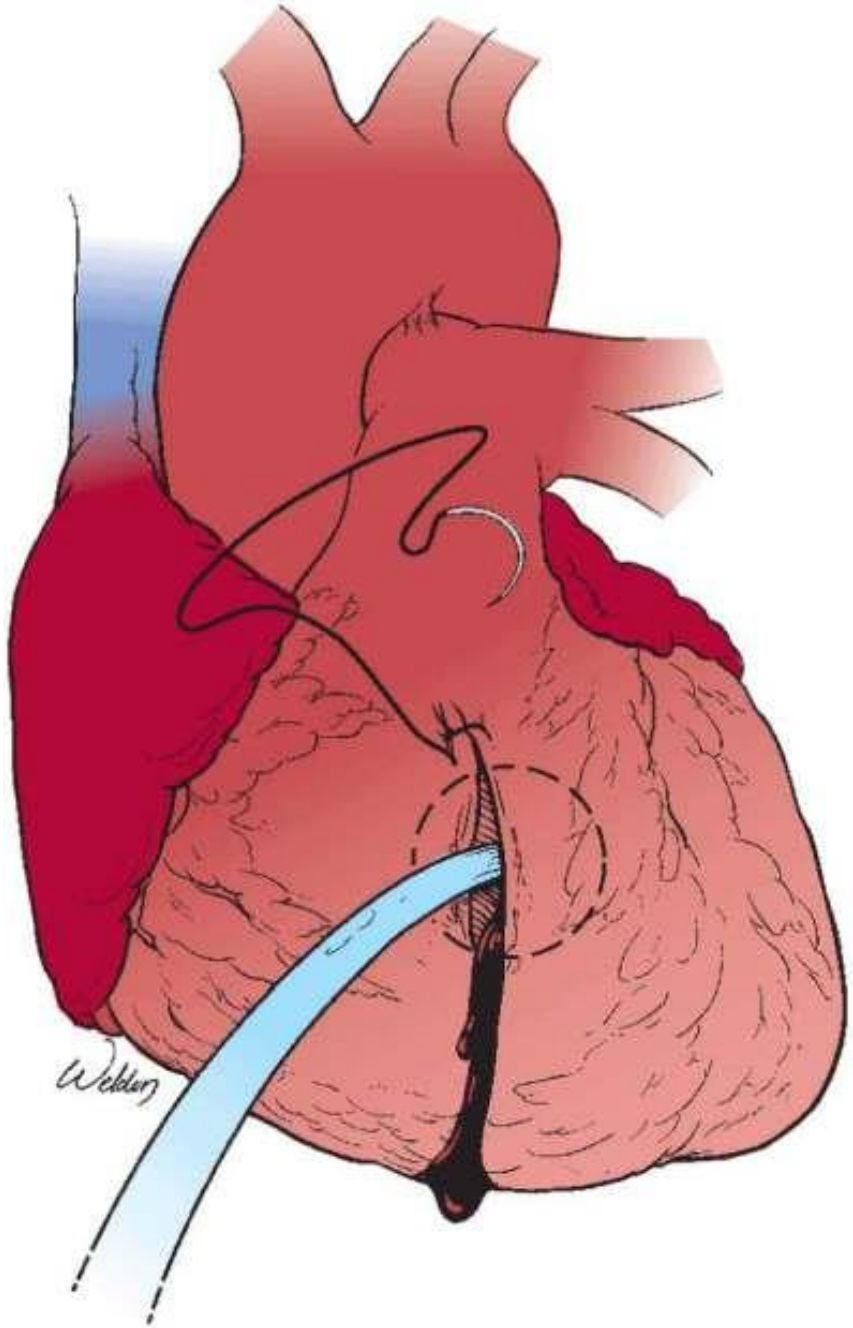
Jhunjhunwala J Trauma Acute Care Surg 2017;83:349

SGEM #332

Etiology



- Incidence
  - Right ventricle: 37-67%
  - Left ventricle: 19-40%
  - Right atrium: 5-20%
  - Left atrium 2-12%
- GSW (42%) vs Stab (54%)
  - Less common: shotgun wound, impalement, laceration from rib fractures, iatrogenesis
- Epidemiology:
  - 18-55 per year in urban level I trauma centers
  - 50% dead at the scene, 25% DOA



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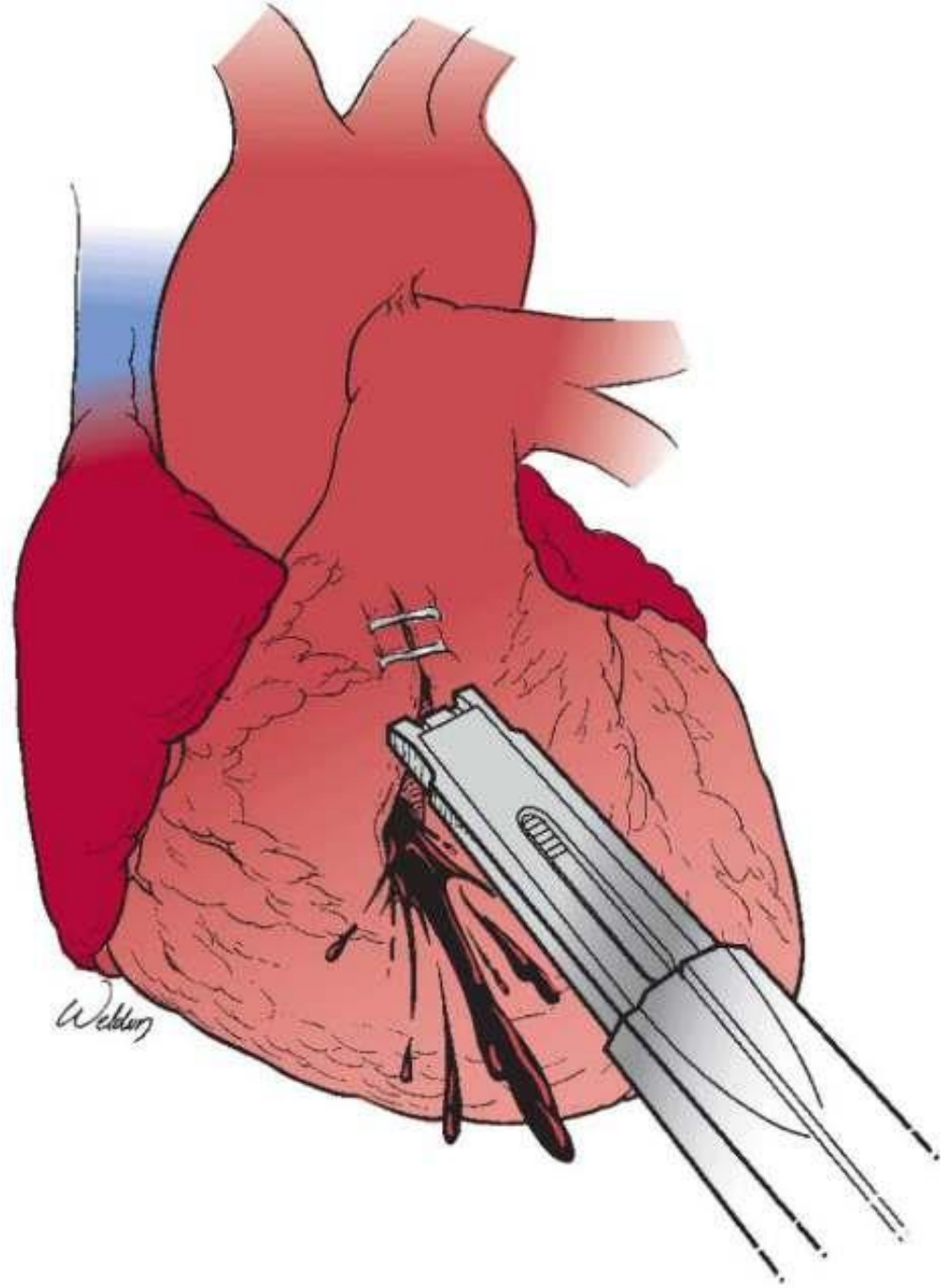

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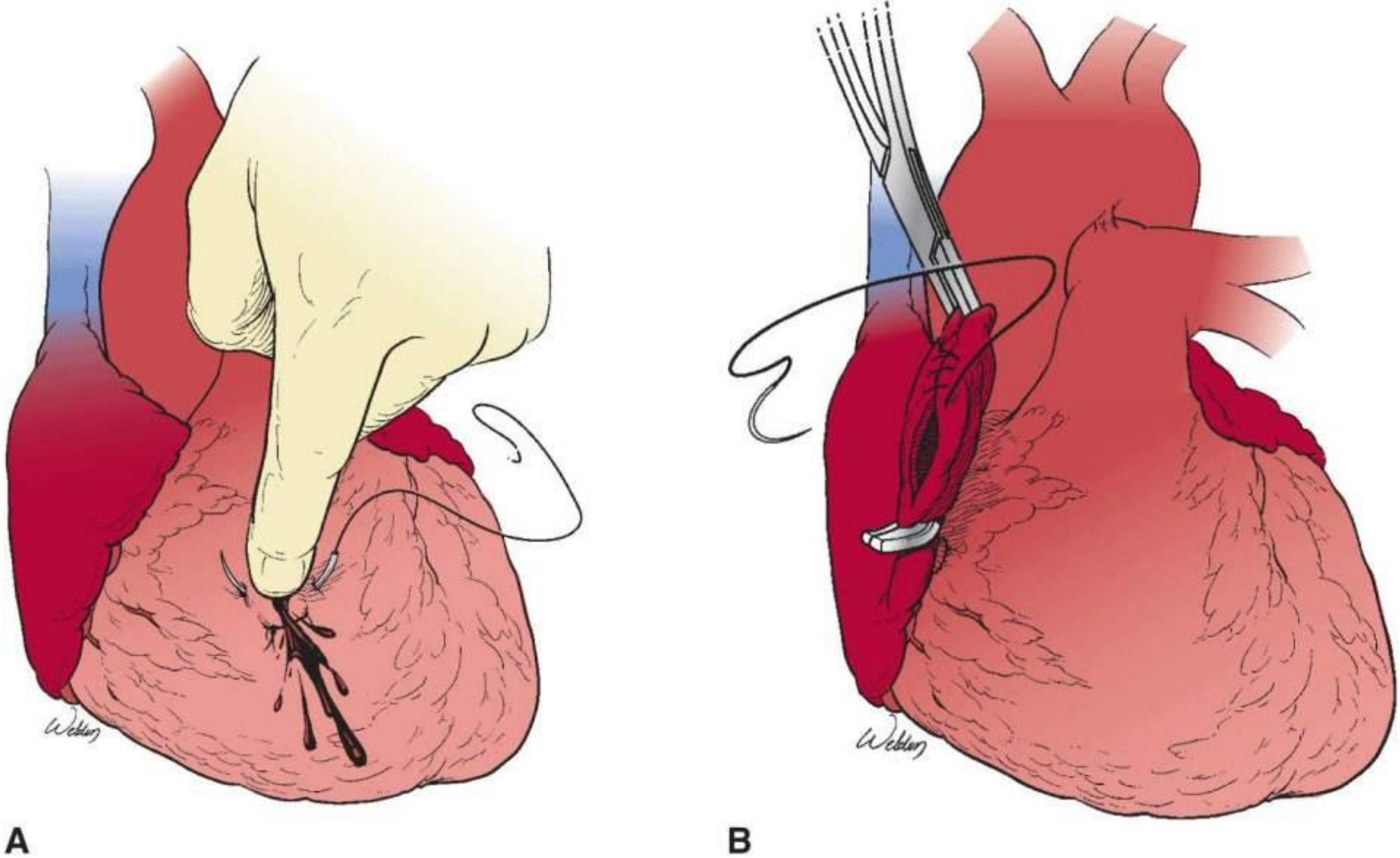
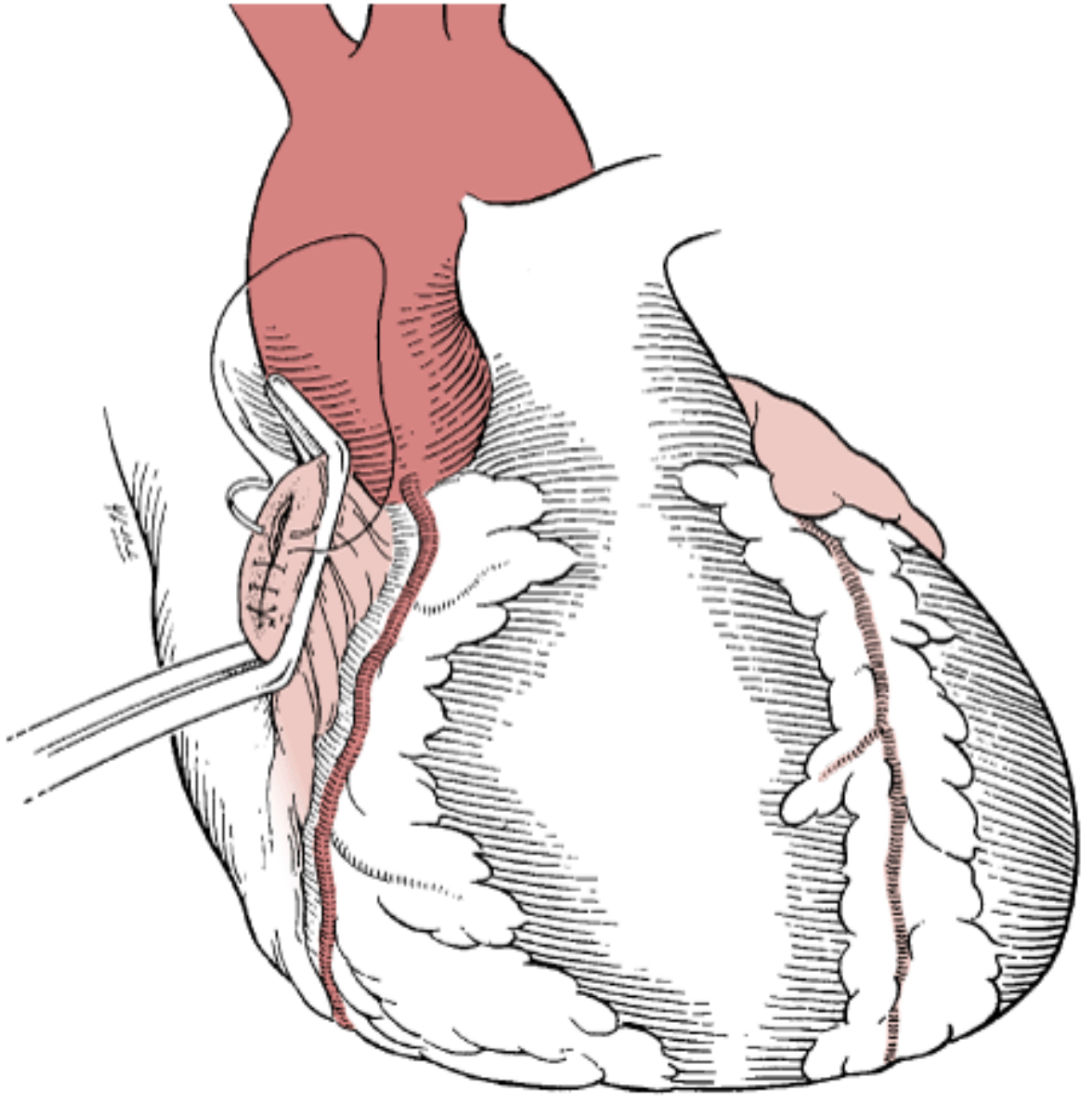
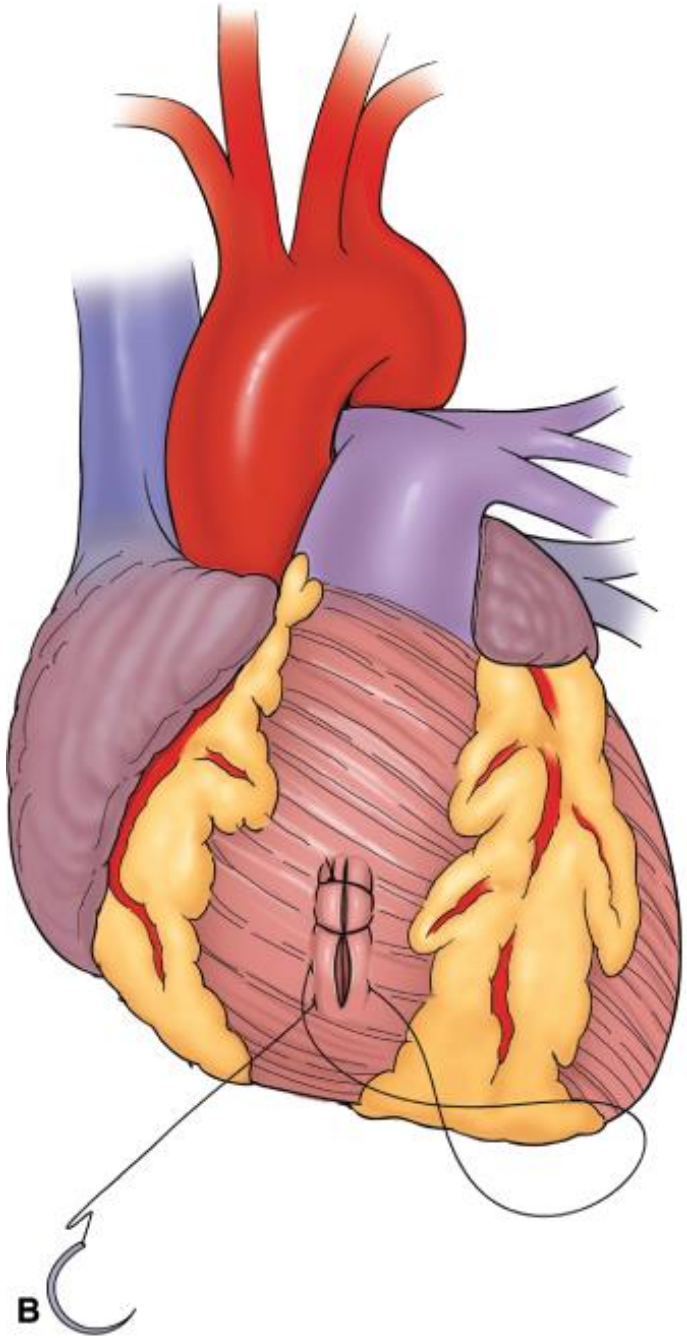

A
B

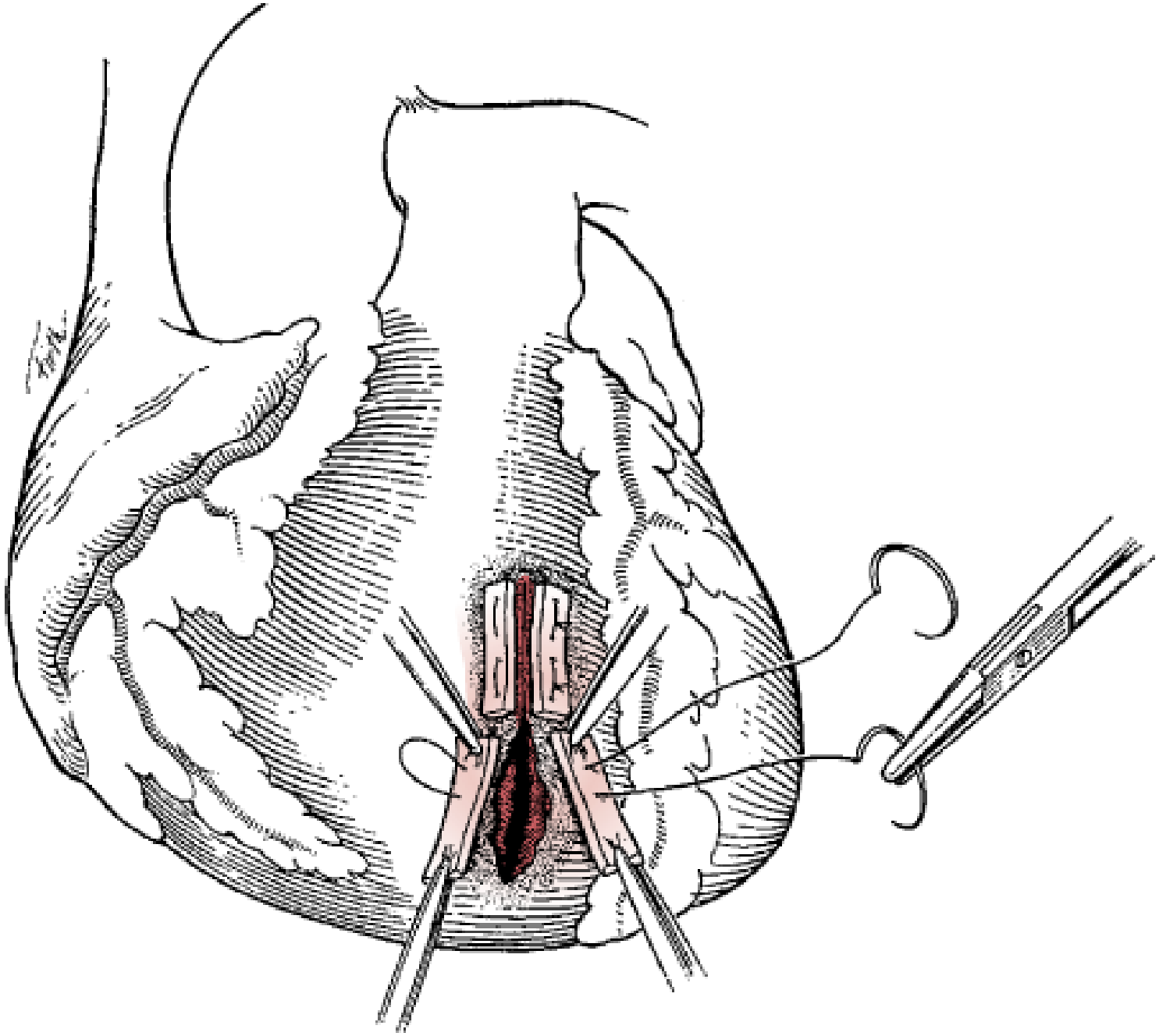
- Management of atrial injury



Source: Feliciano DV, Mattox KL, Moore EE: *Trauma*, 6th Edition:
http://www.accesssurgery.com



Source: Mattox KL, Moore EE, Feliciano DV: *Trauma, 7th Edition:*
www.accesspharmacy.com



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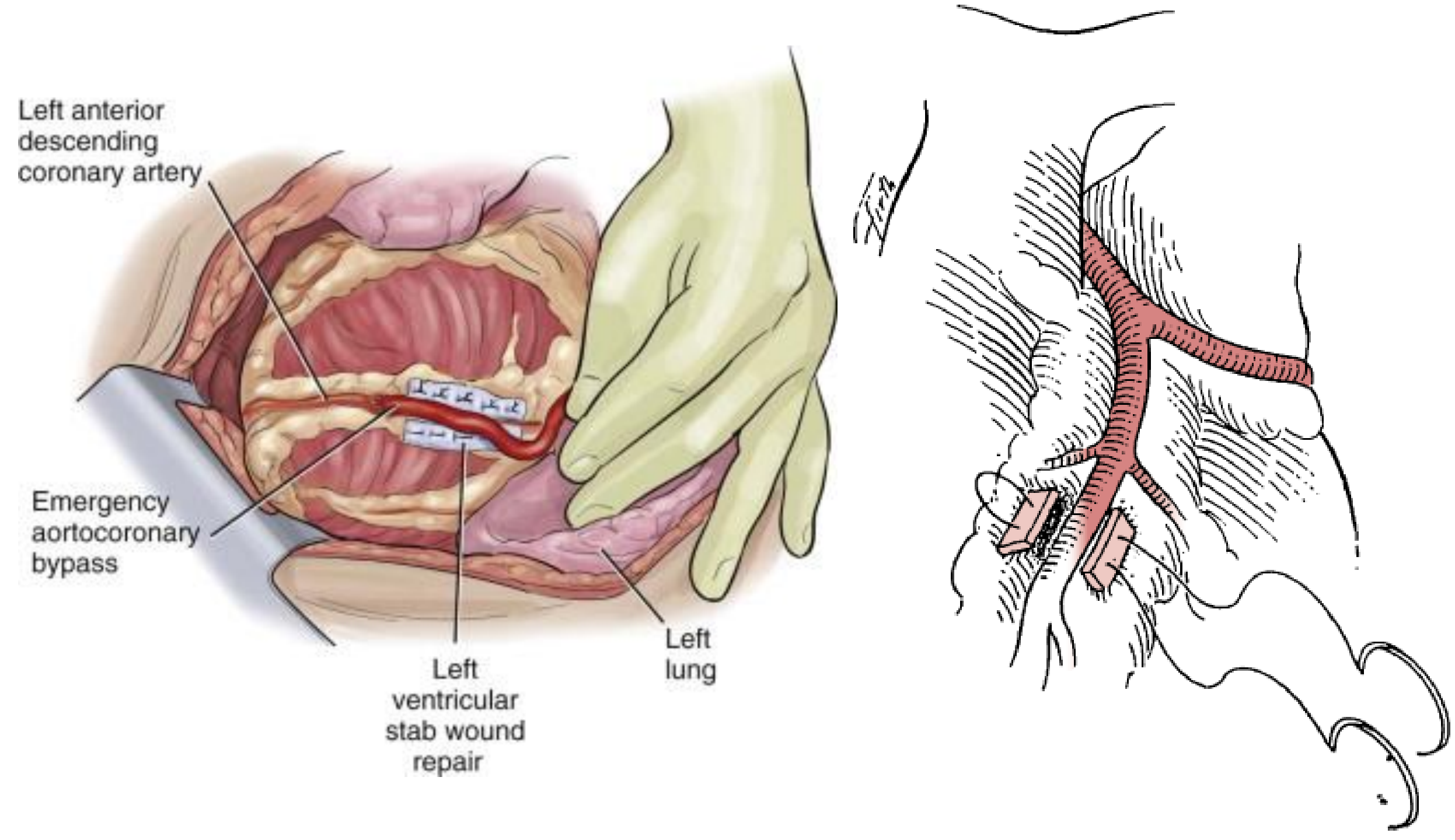
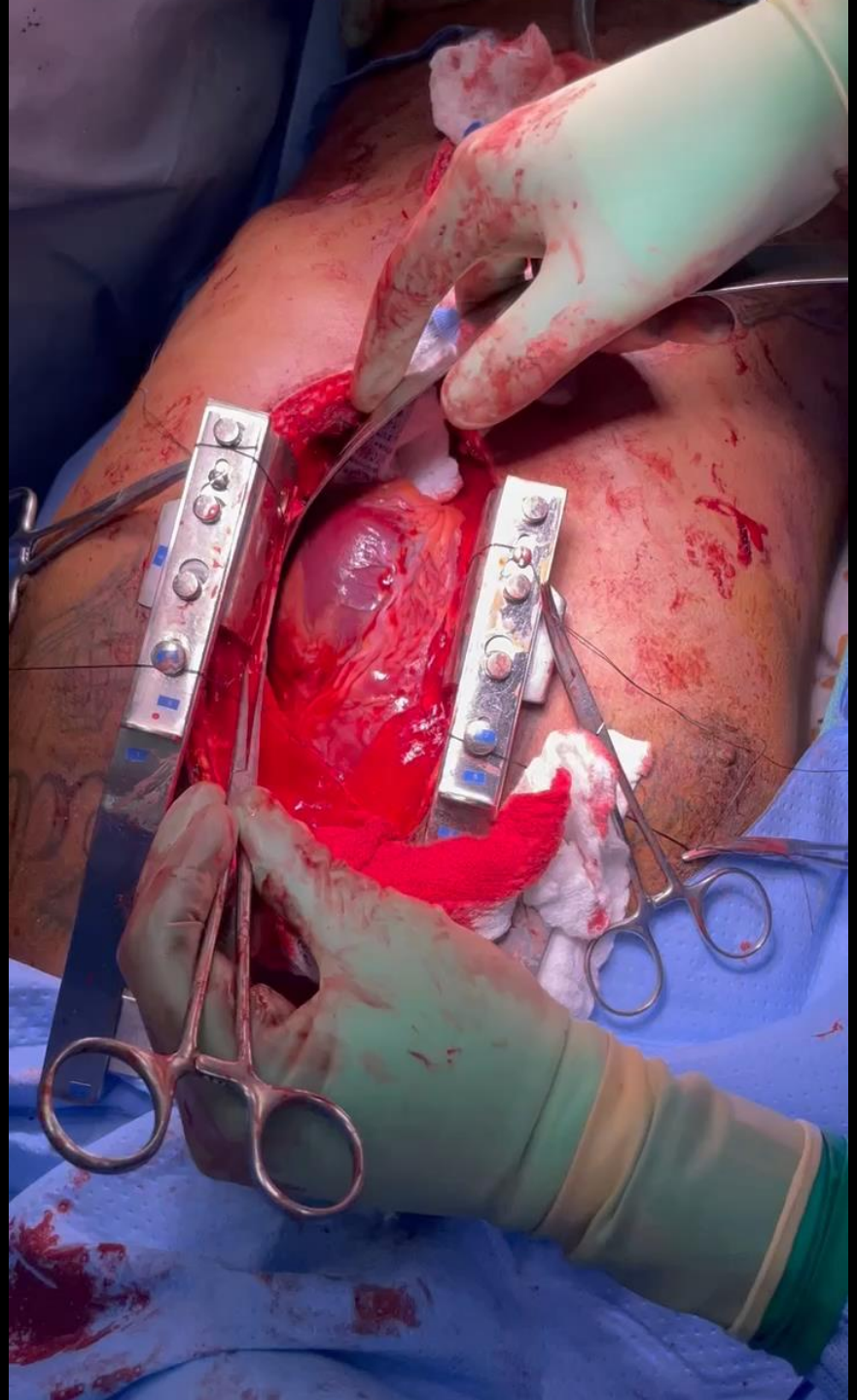

Left anterior descending coronary artery
Emergency aortocoronary bypass
Left ventricular stab wound repair
Left lung


BUFFALO FILTER



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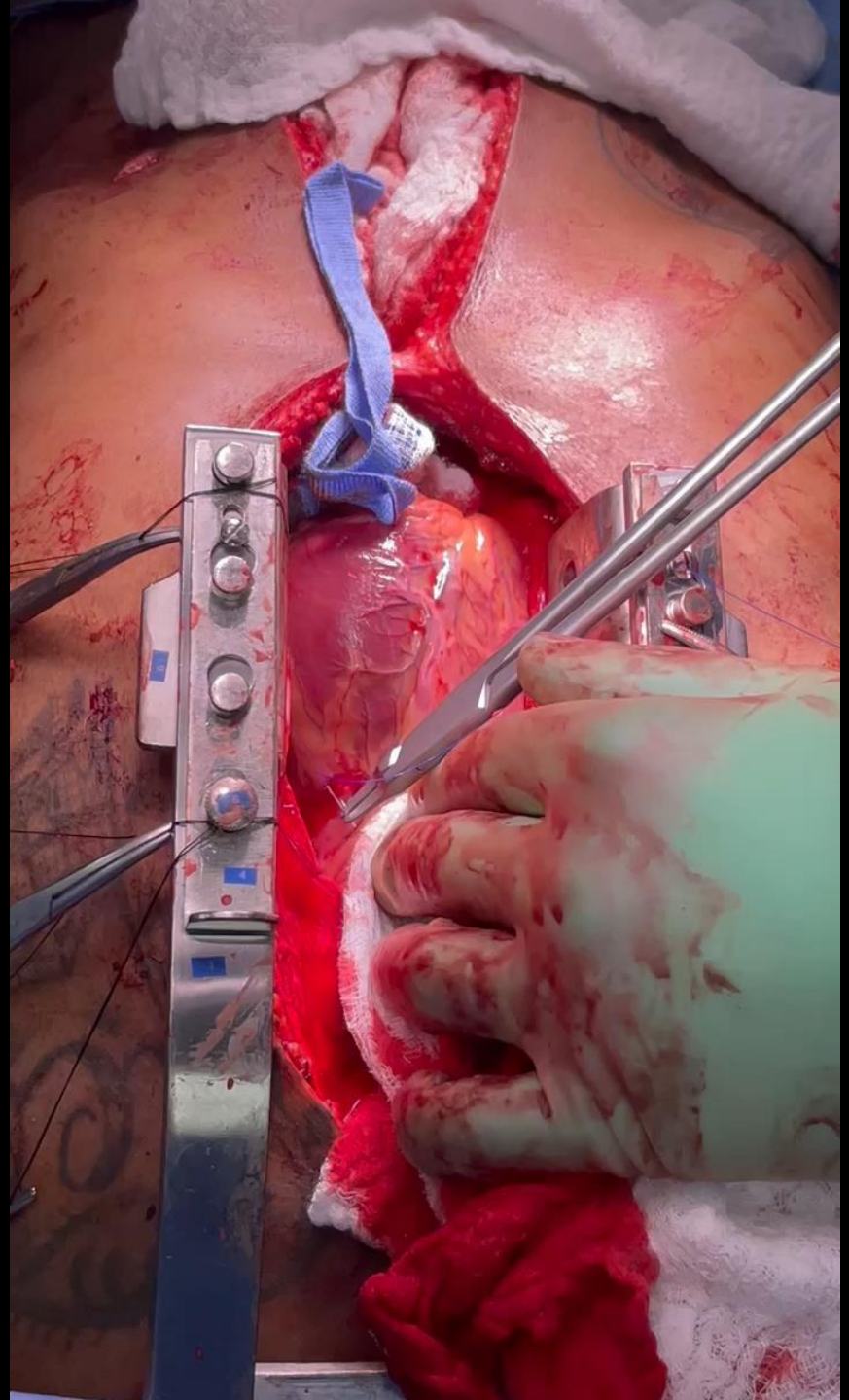
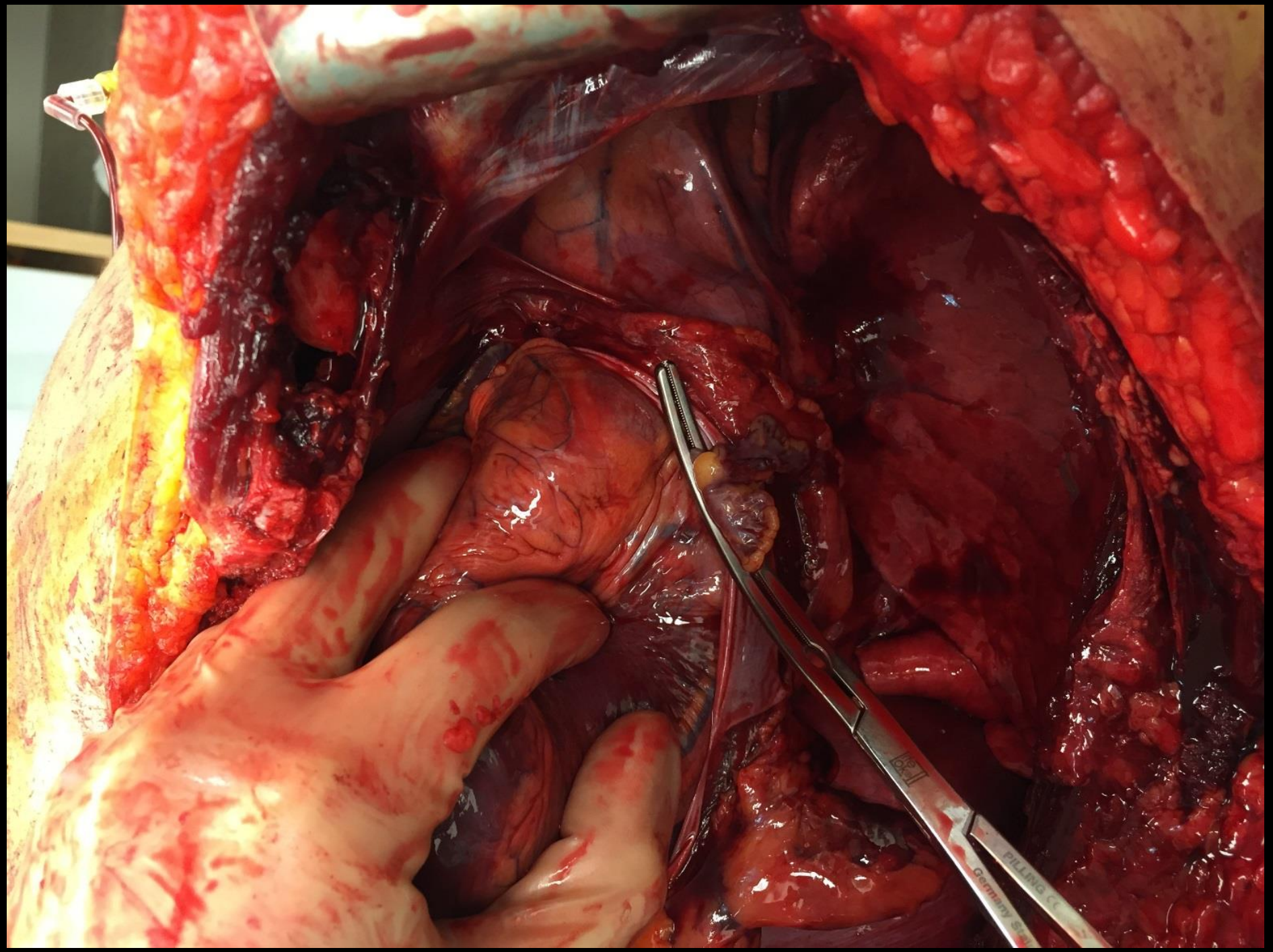
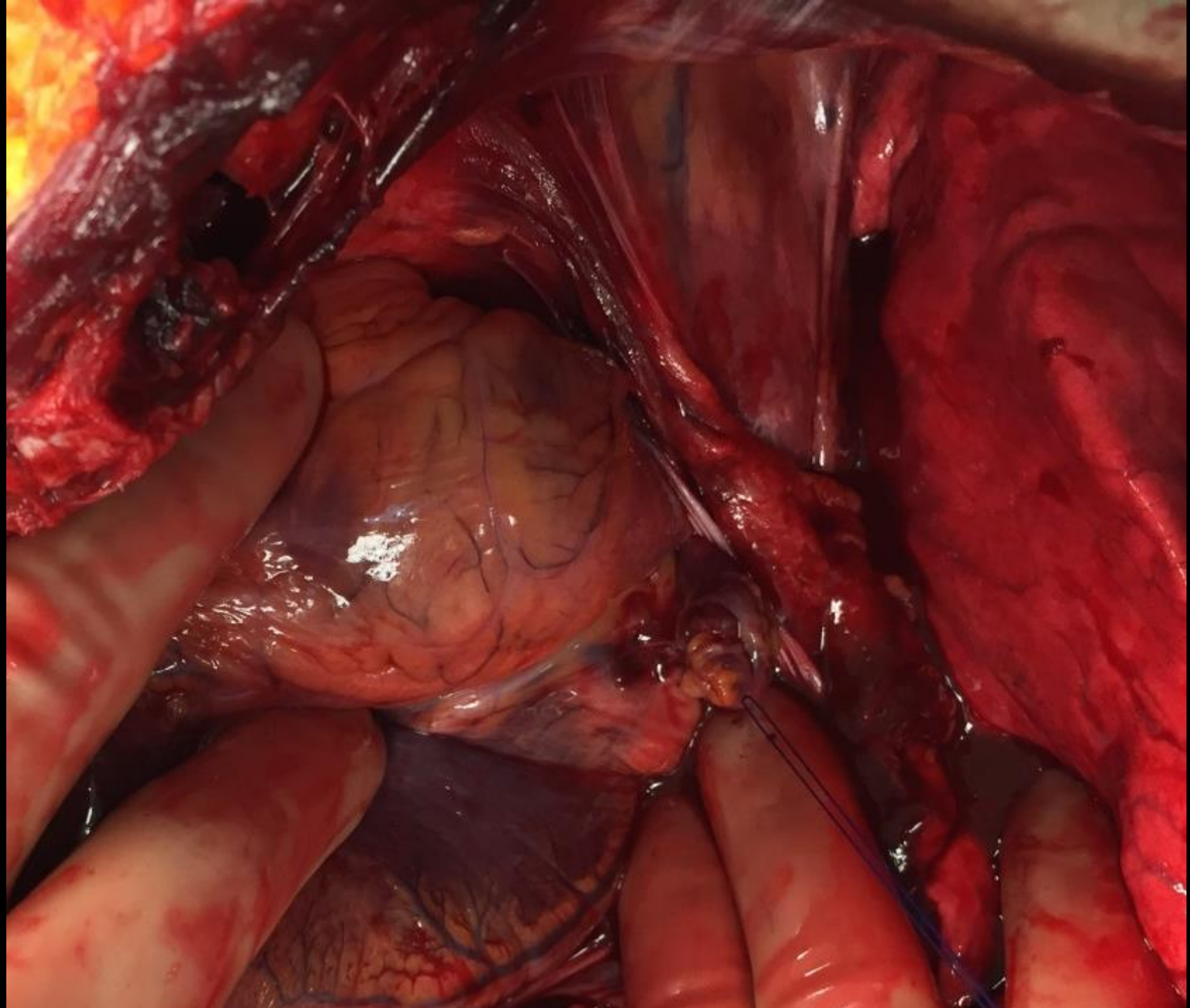


Atrial Injury with clamp

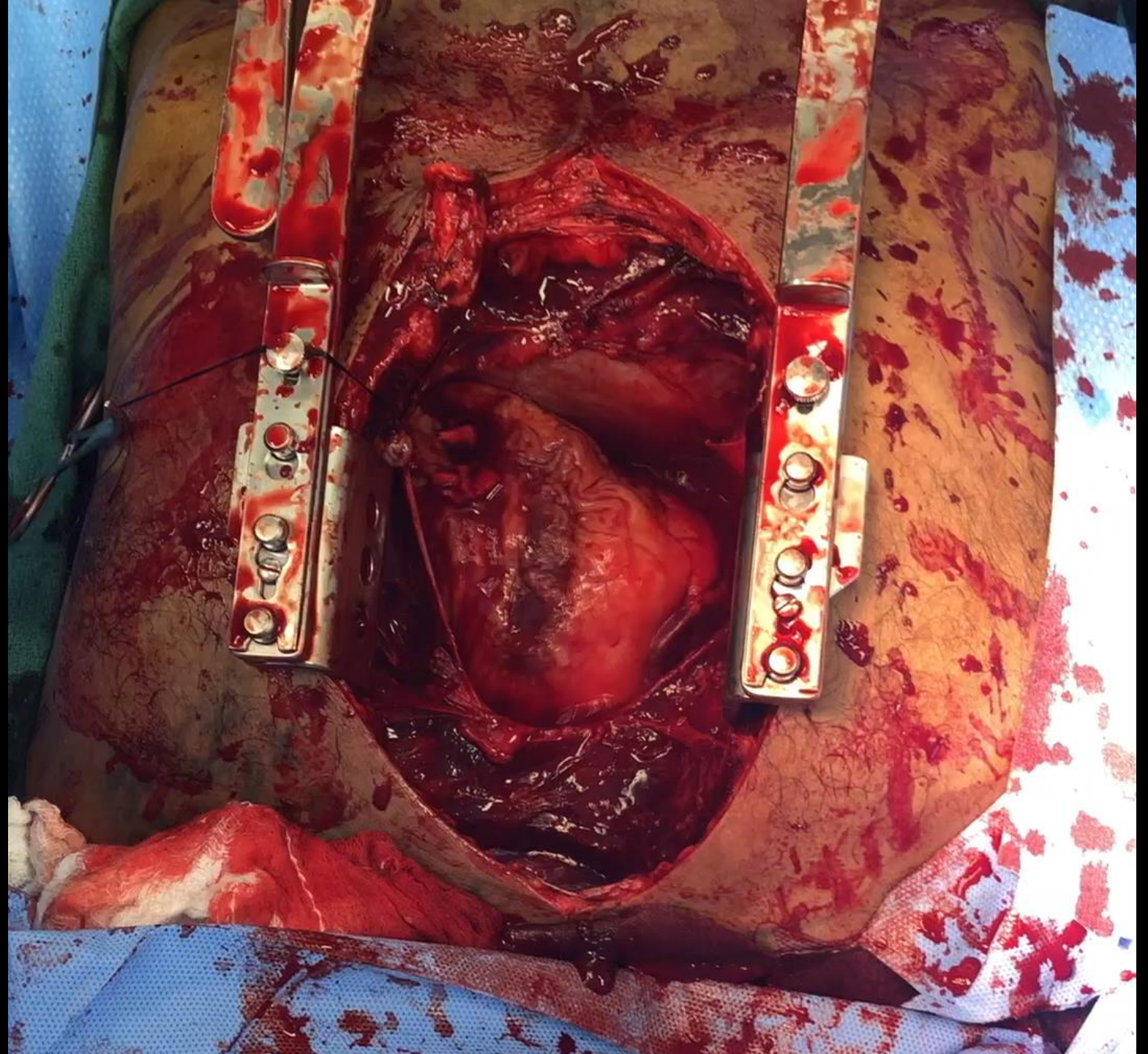


Atrial injury
suture repaired

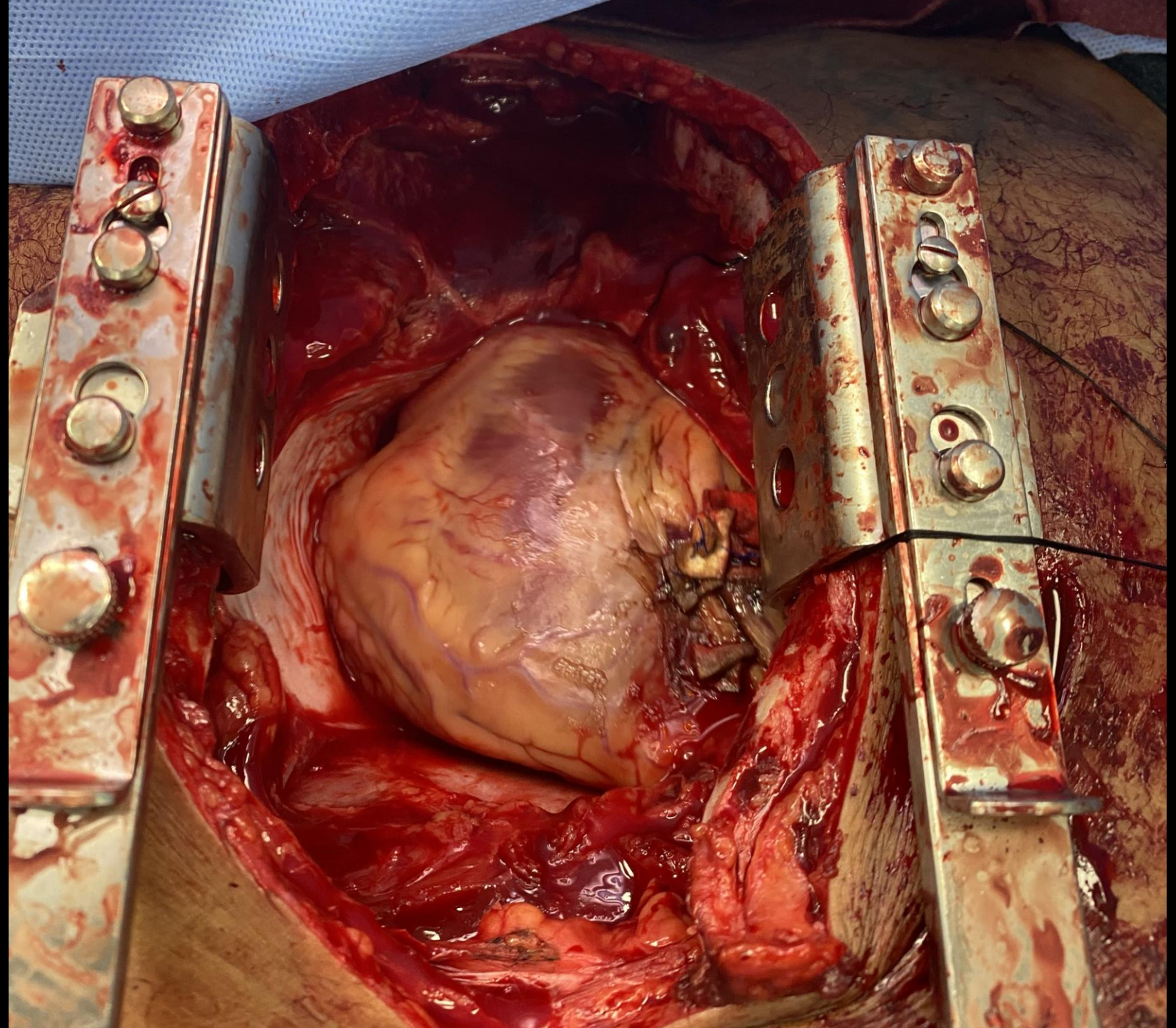


Trying to place a foley in the injury

Injury located next to LAD



Final repair with pledgets near LAD



Saved the best for last

Pre-Hospital Communication

- 58 year old male found down at place of work…framing shop.
- Reported to have chest pain and a suspected intentional overdose.
- Patient found on the ground, holding his left chest, complaining of severe pain.

Pre-Hospital Exam

- Patient was found alert and oriented with an intact airway.
- BP 136/100, P 88, R 18, sat 100%
- 7 foreign bodies penetrating the left anterior chest
- Patient transferred via helicopter for direct OR transport.
- En route 2 large bore IVs established and oxygen delivered via NC.

Pertinent History

- Patient reportedly had shot himself several times with a nail gun the evening before and then awoke and shot himself again.

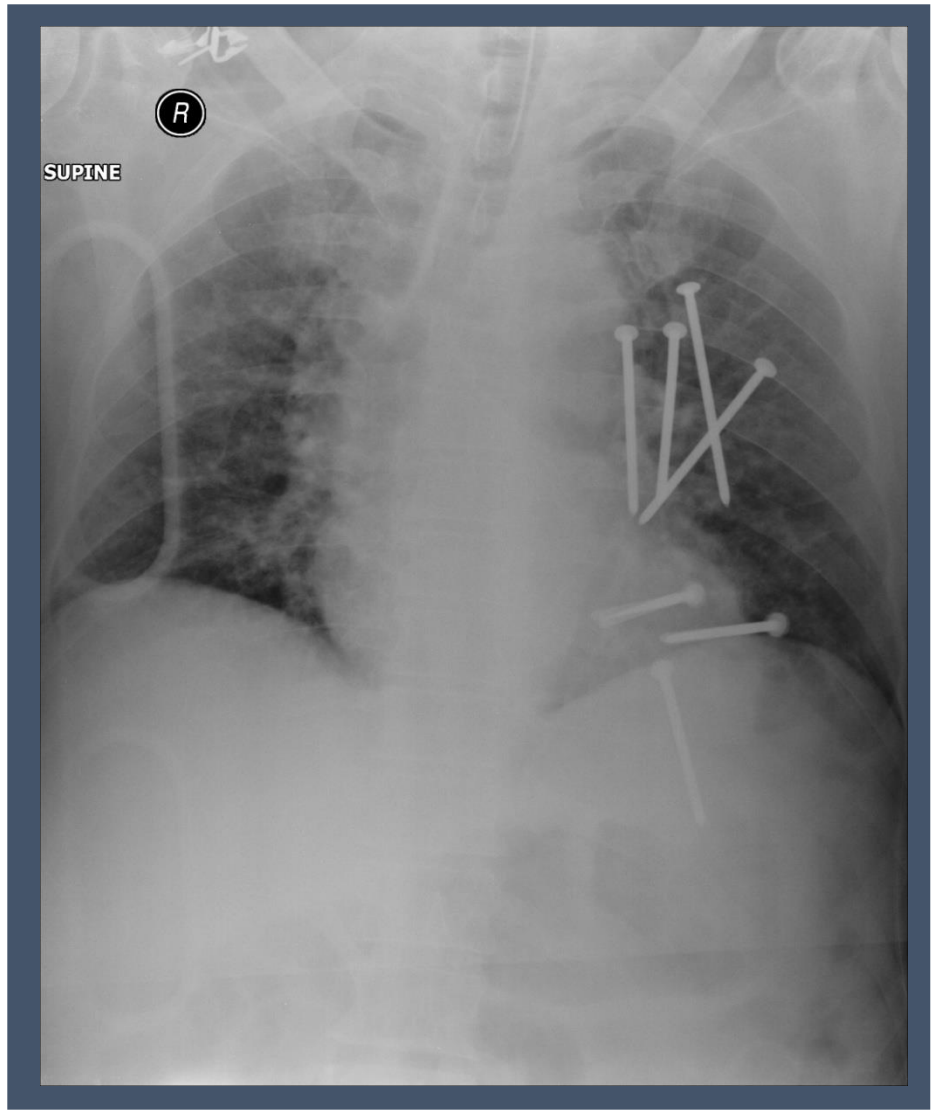
- Also reported to have stabbed himself in the left chest several years prior to this incident.

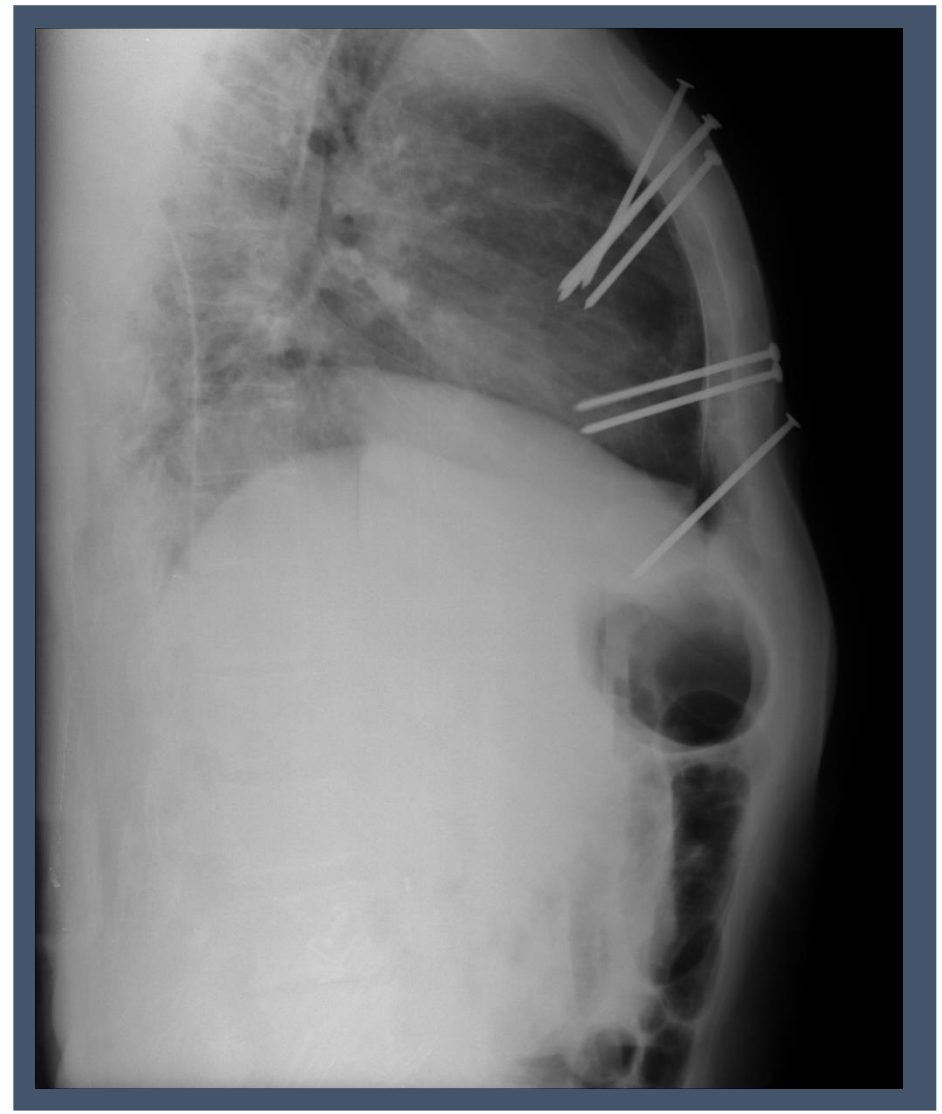
Hospital Presentation

- Primary Survey
  - Airway intact
  - Bilateral breath sounds
  - Circulation palpable pulses
    - BP 120/82, P 94, R 17, 100% on 15L
  - Disability: awake/alert, GCS 15
  - Exposure……

Secondary Survey

- Neck: no JVD noted, trachea midline, no crepitus
- Cardiac: NSR, good heart tones
- Pulmonary: previous left thoracotomy incision, seven penetrating left anterior chest wall wounds with nails in the chest, decreased breath sounds on the left
- GI: soft, nontender with no distention and good bowel sounds

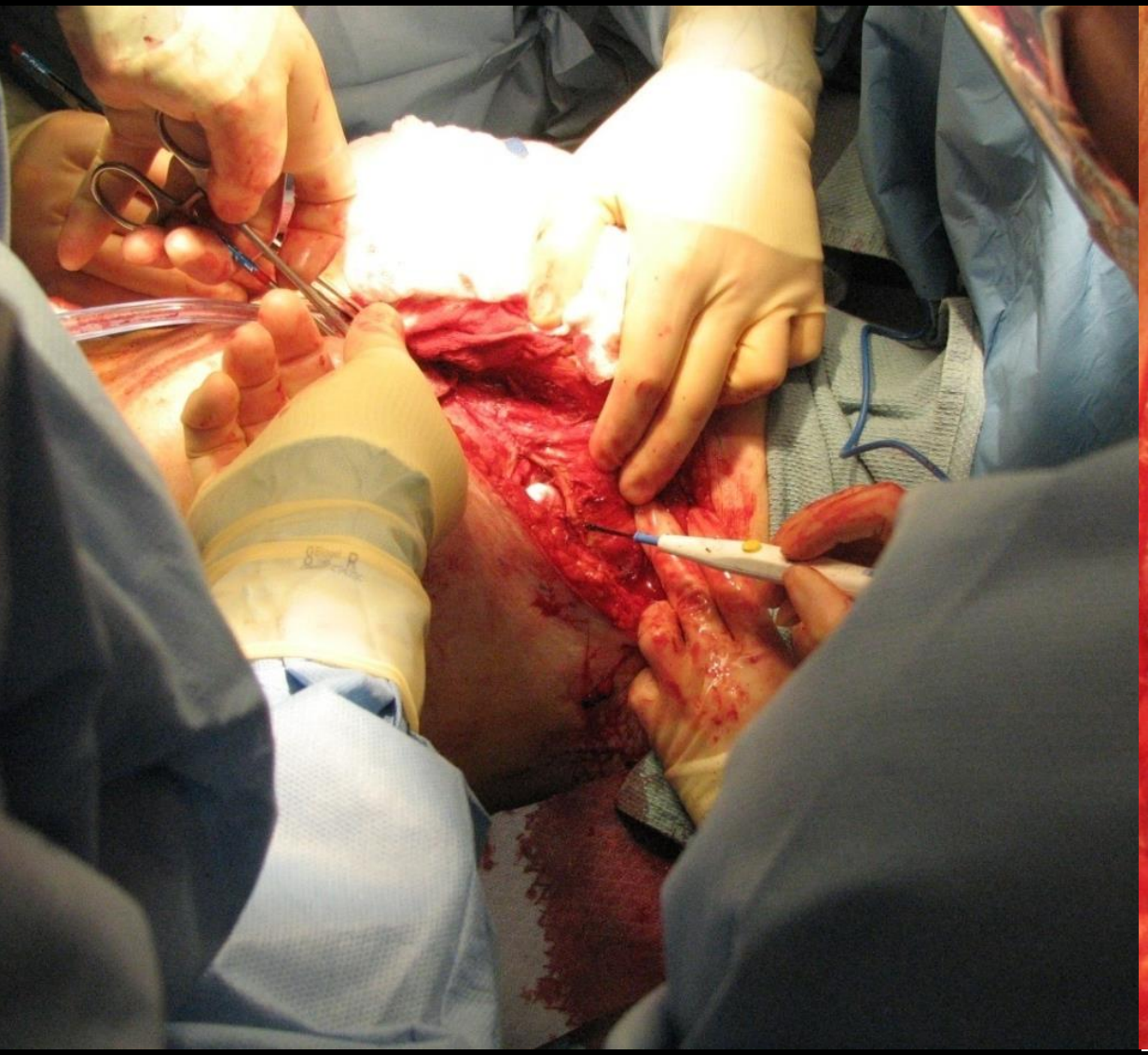

R
SUPINE

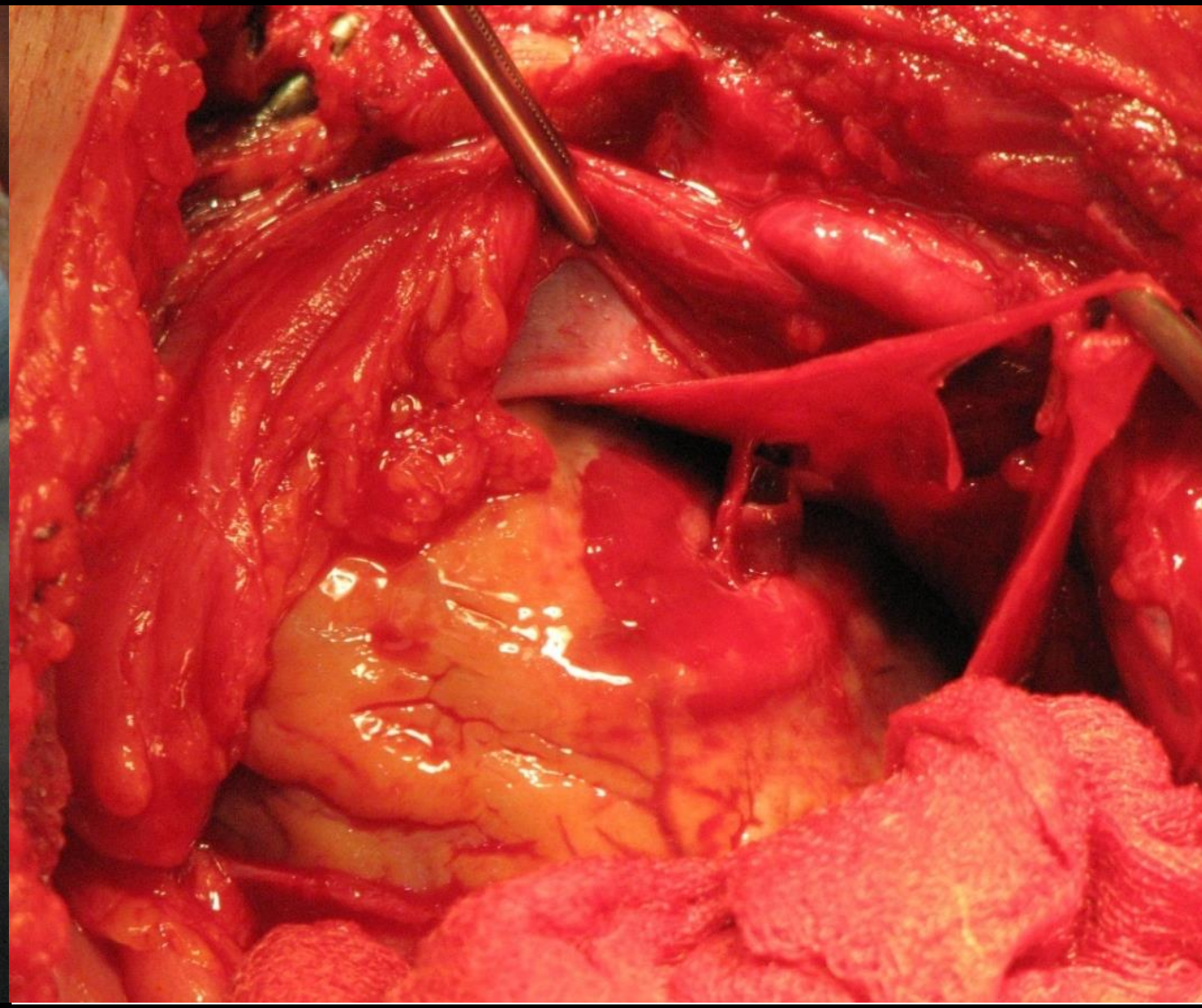


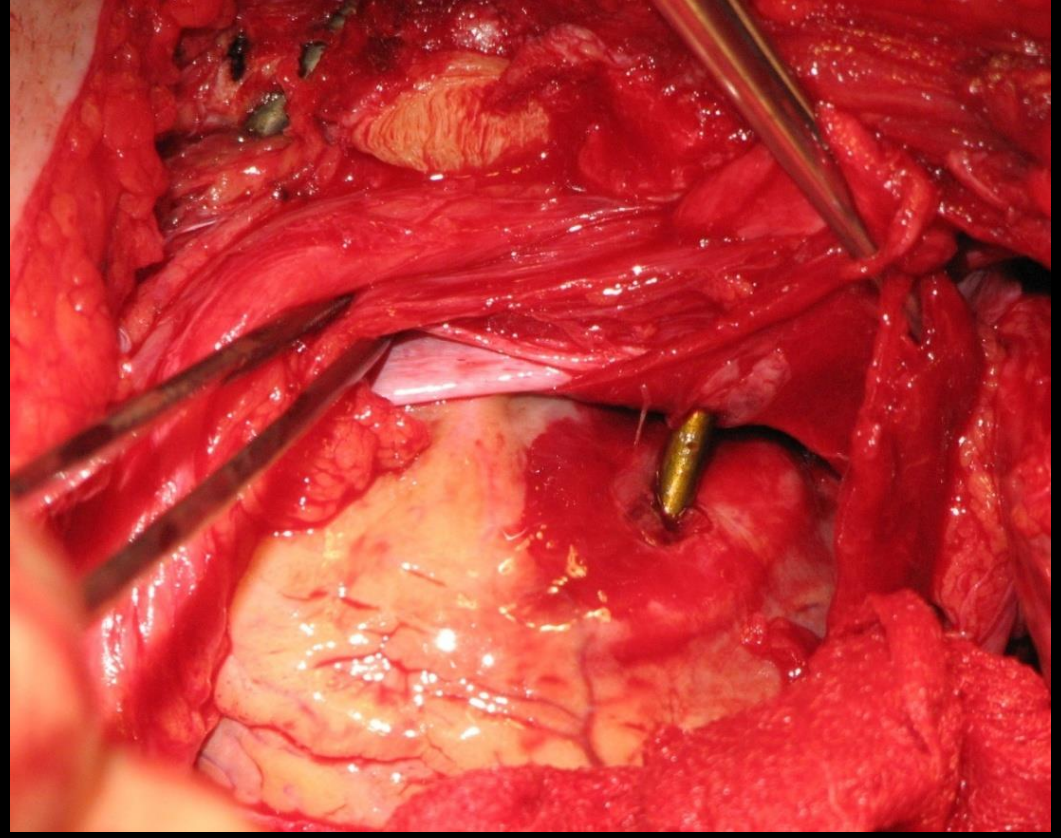
What should we do?

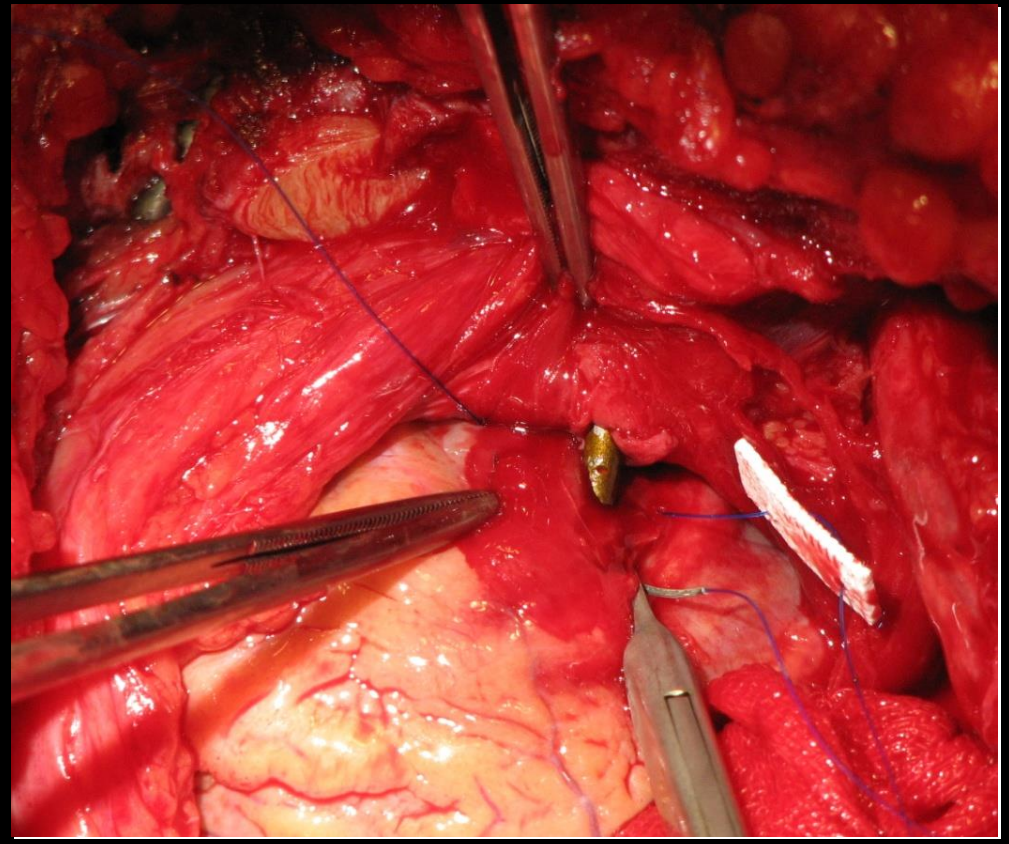
- Multiple penetrating injuries to left chest
  - Probable left lung injury
  - Probable cardiac injury
- Previous thoracotomy
- Currently awake and alert

Thoracotomy, redo!

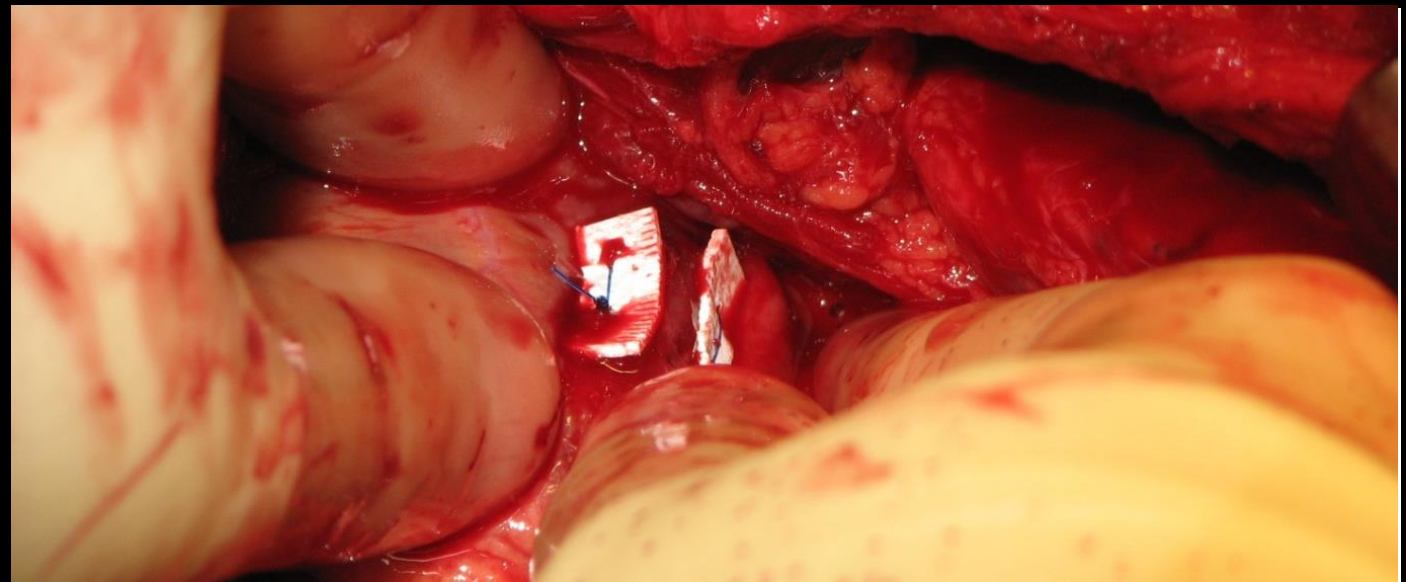


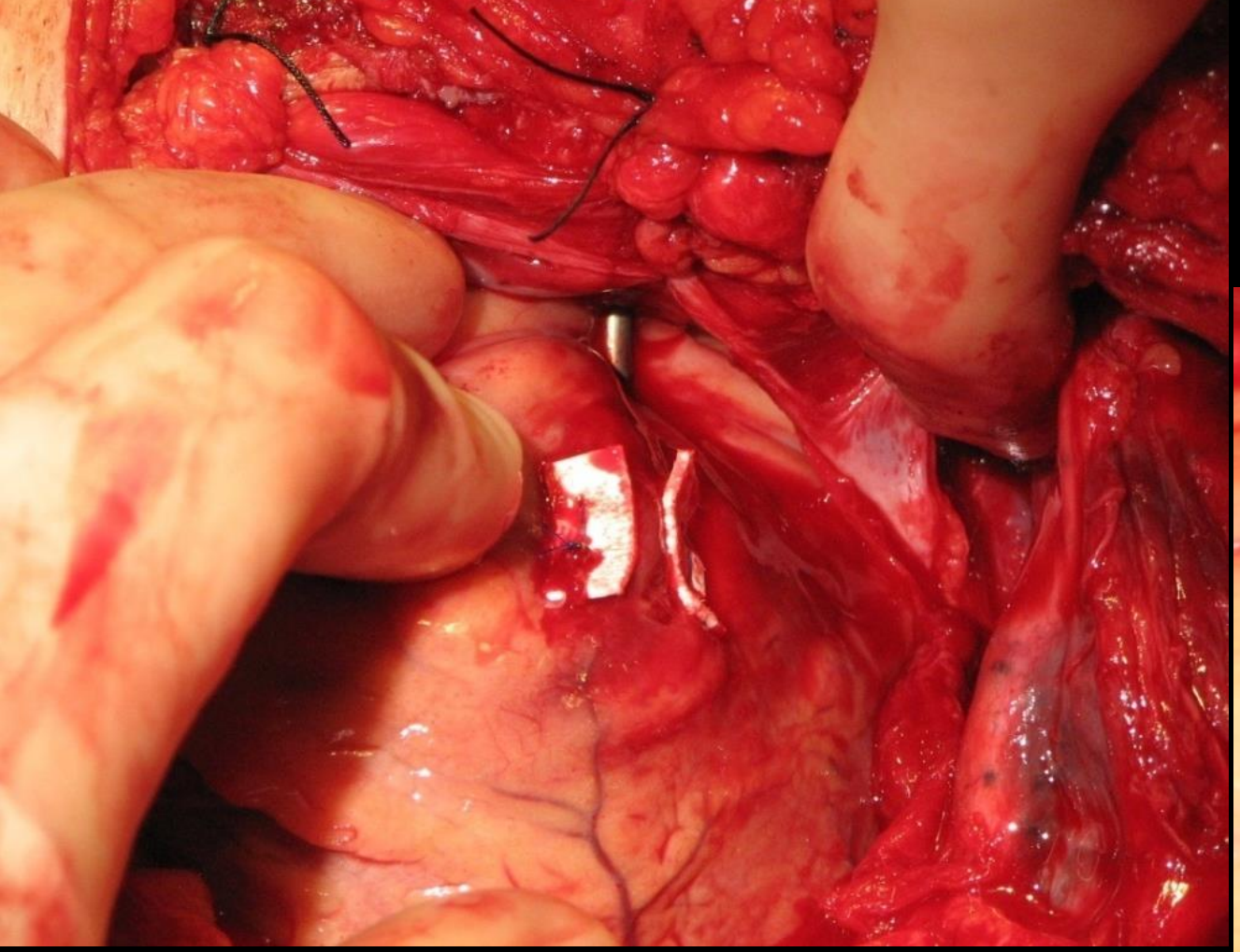


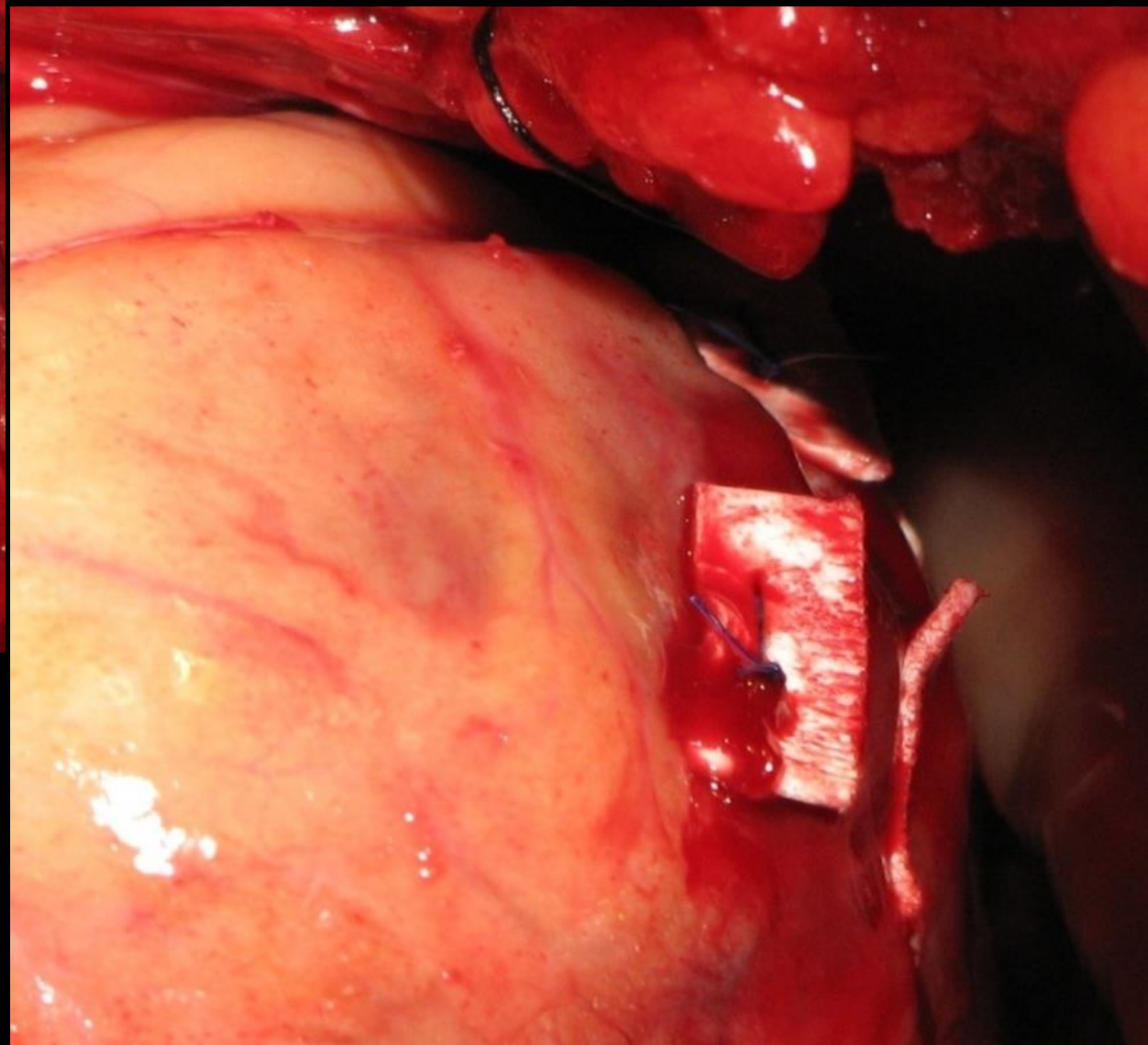




Nail #1







Nail #2

Four other nails found in upper chest and removed without difficulty
Non-anatomic wedge resection performed in left upper lobe of lung