

Iatrogenic Cardiac Injuries

Kings County Hospital Center

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Case Presentation

69 year old male recently diagnosed with a 3.8 cm x 4.3 cm hepatocellular CA in the superior segment of the left liver, s/p radiofrequency ablation (RFA) 2 months ago, admitted for repeat RFA

PMH: HTN, ESRD on HD, hepatitis C, gout

PSH: permacath placement, biliary stent placement

SH: heroin use (quit 10 years ago), tobacco use (60PY)

Meds: amlodipine, allopurinol, doxazosin, calcium acetate, nephrovite

NKDA

Case Presentation

PE on admission:

VS: temp 97.8 BP 115/71 HR 81

NAD, mild scleral icterus, AAOx3

Chest: CTA, permacath right subclavian vein

Abd: soft, nontender, mild distention, liver edge palpable
3 cm below costal margin

Ext: warm, peripheral pulses present

Labs on admission:

Cbc: 4/11/37/130

Chem: 138/4/98/23/55/8.89/140

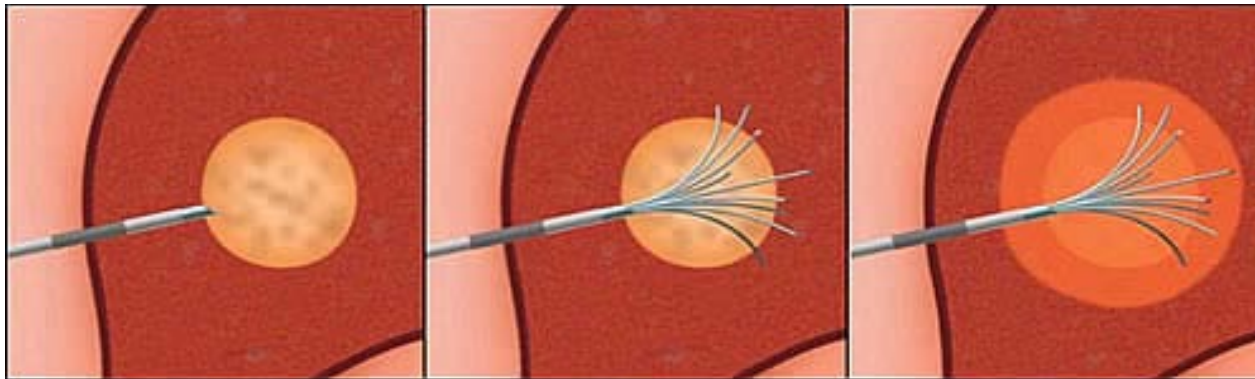
LFT: 8/3.7/60/32/99/0.3

Coags: 11/33

Case Presentation

RFA Procedure:

- sedated with versed and fentanyl
- RFA probe advanced under CT guidance, deployed after position was confirmed

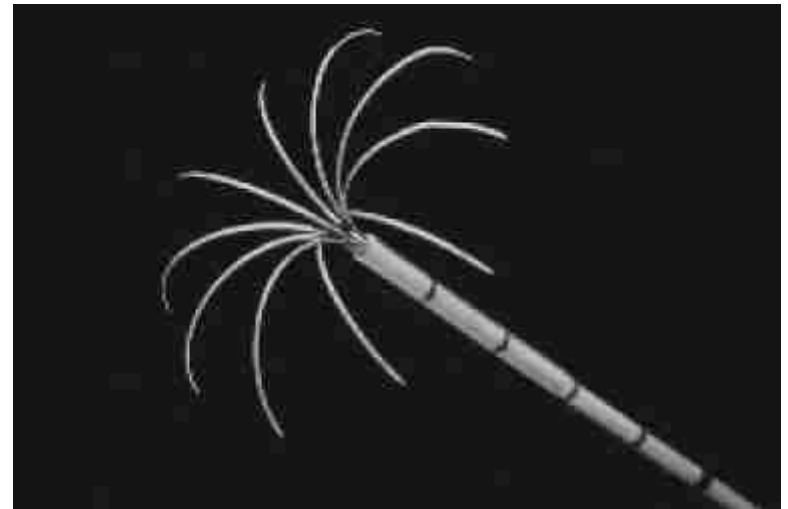


RFA of liver tumor

Case presentation

RFA procedure (cont):

- On reimaging, prongs were noted in close proximity to the right heart, hemopericardium was noted



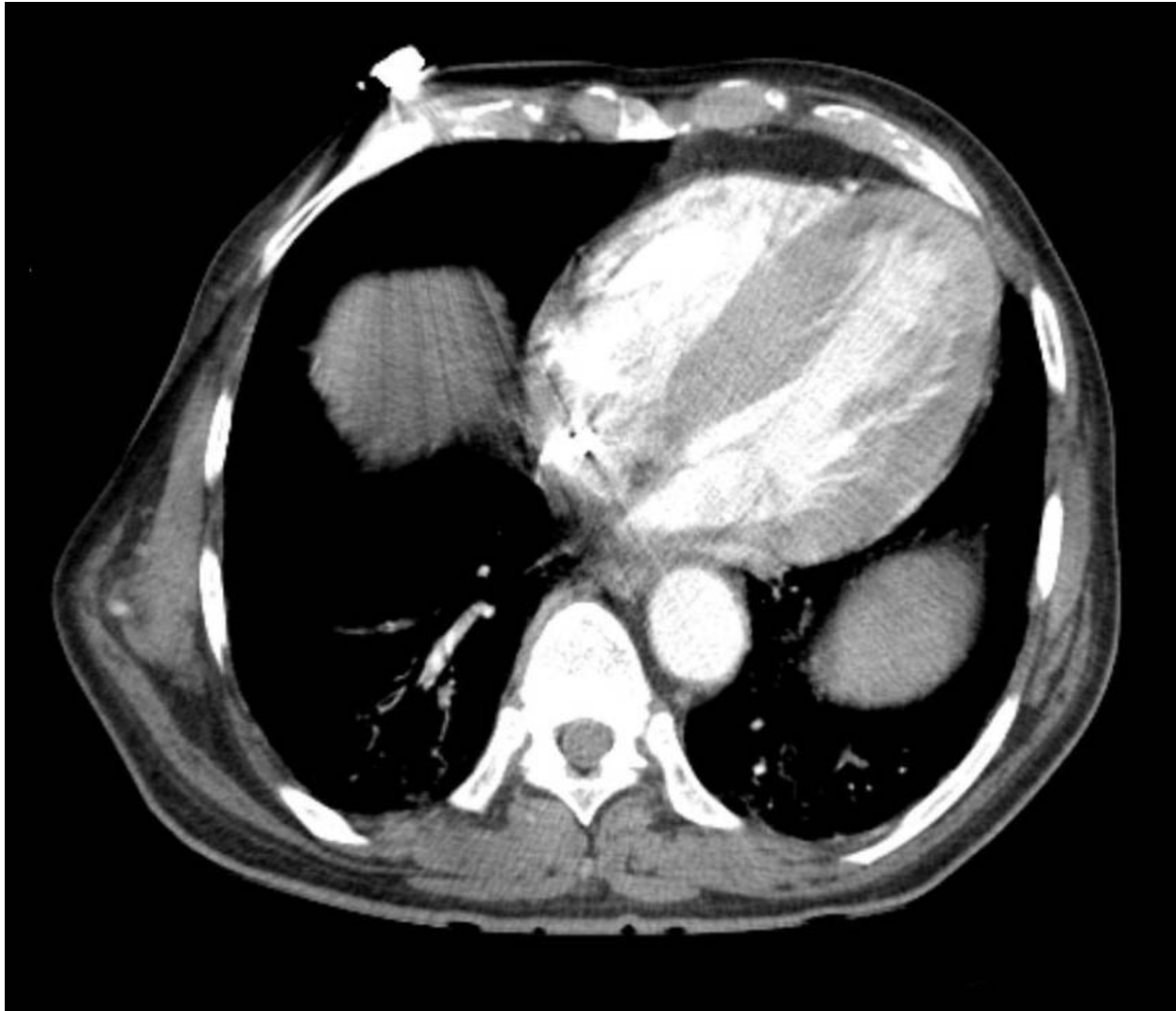
RFA Probes

Case Presentation

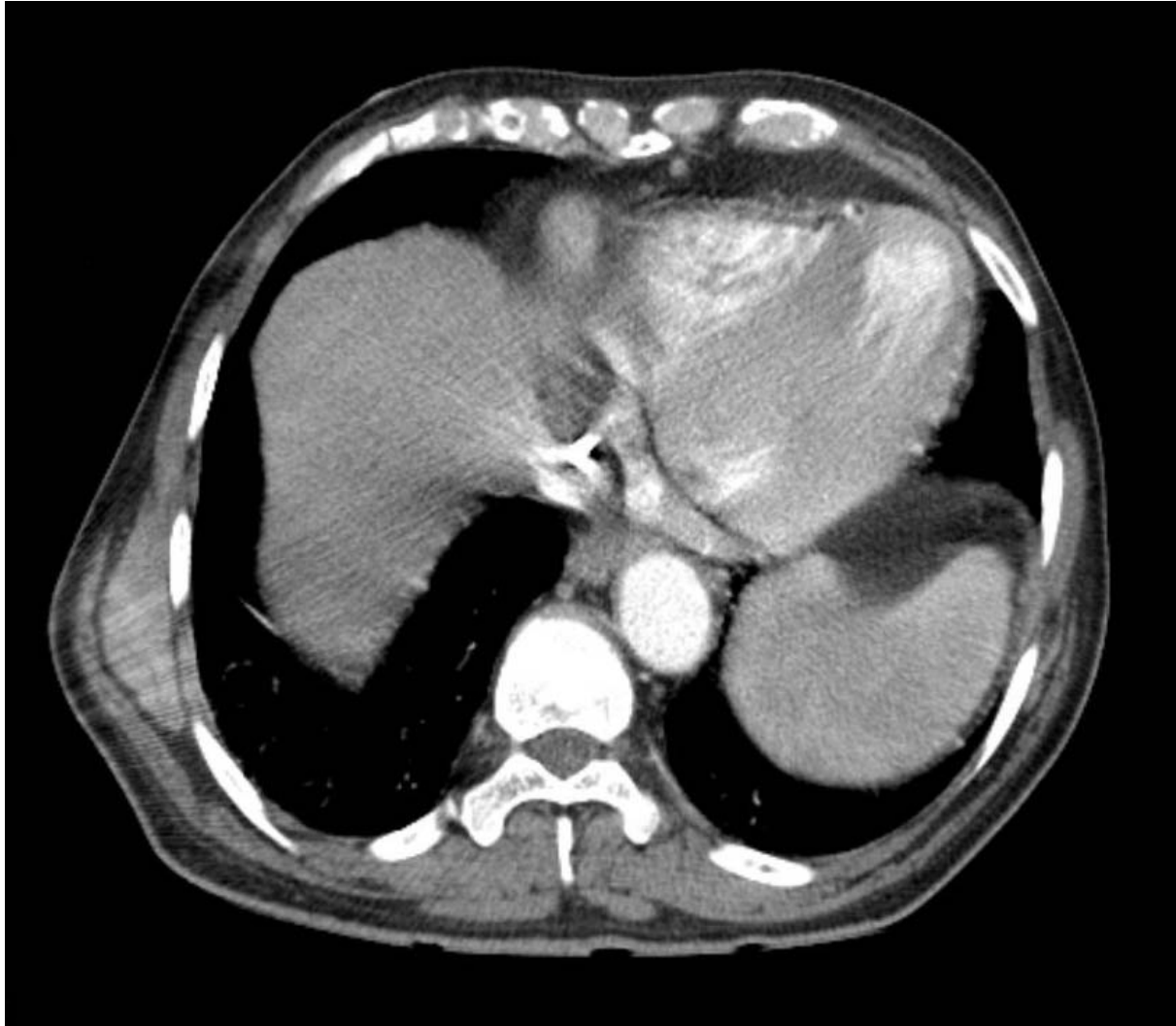
RFA procedure (cont):

- BP dropped to 60/40, patient became unresponsive, pericardiocentesis and pigtail catheter placement under CT guidance was performed, yielded 300 ml of blood, BP improved to 100/60
- Code called, patient was intubated by anesthesia, left femoral access obtained, NS bolus started, PRBC ordered
- Trauma code was called, patient remained hemodynamically stable, but pericardial drain stopped draining
- Patient was brought to the OR

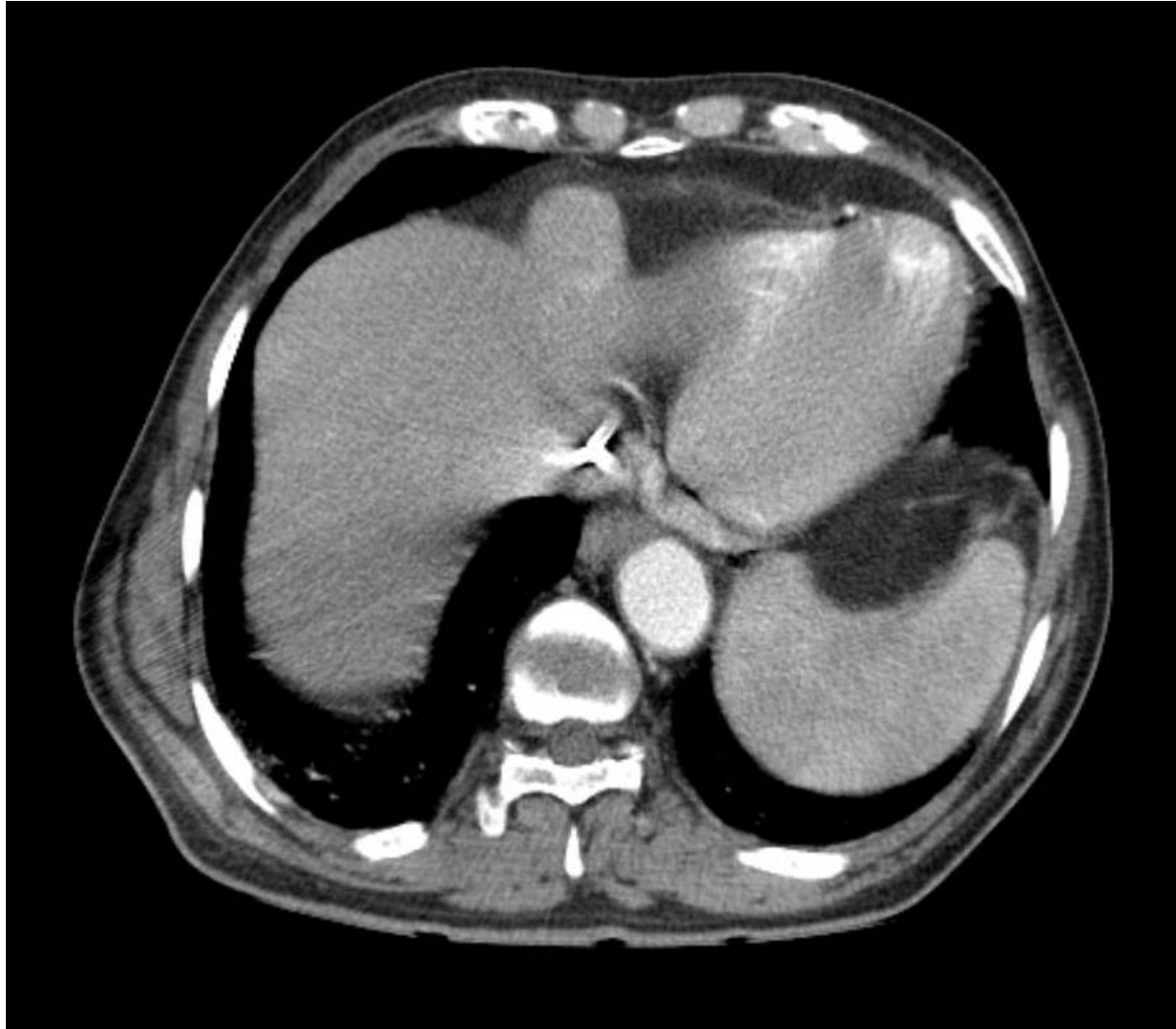
Pre-procedure CT



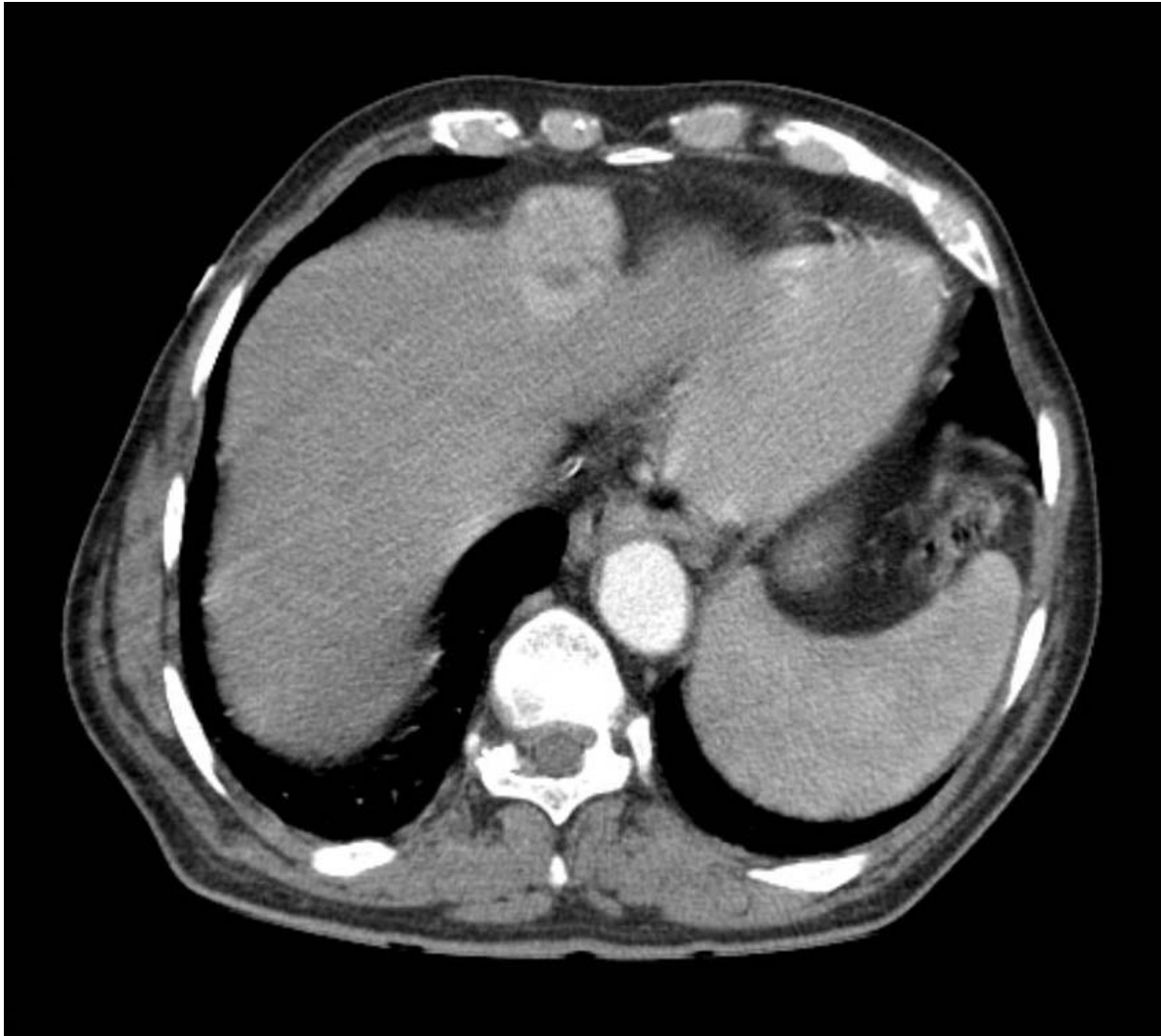
Pre-procedure CT



Pre-procedure CT



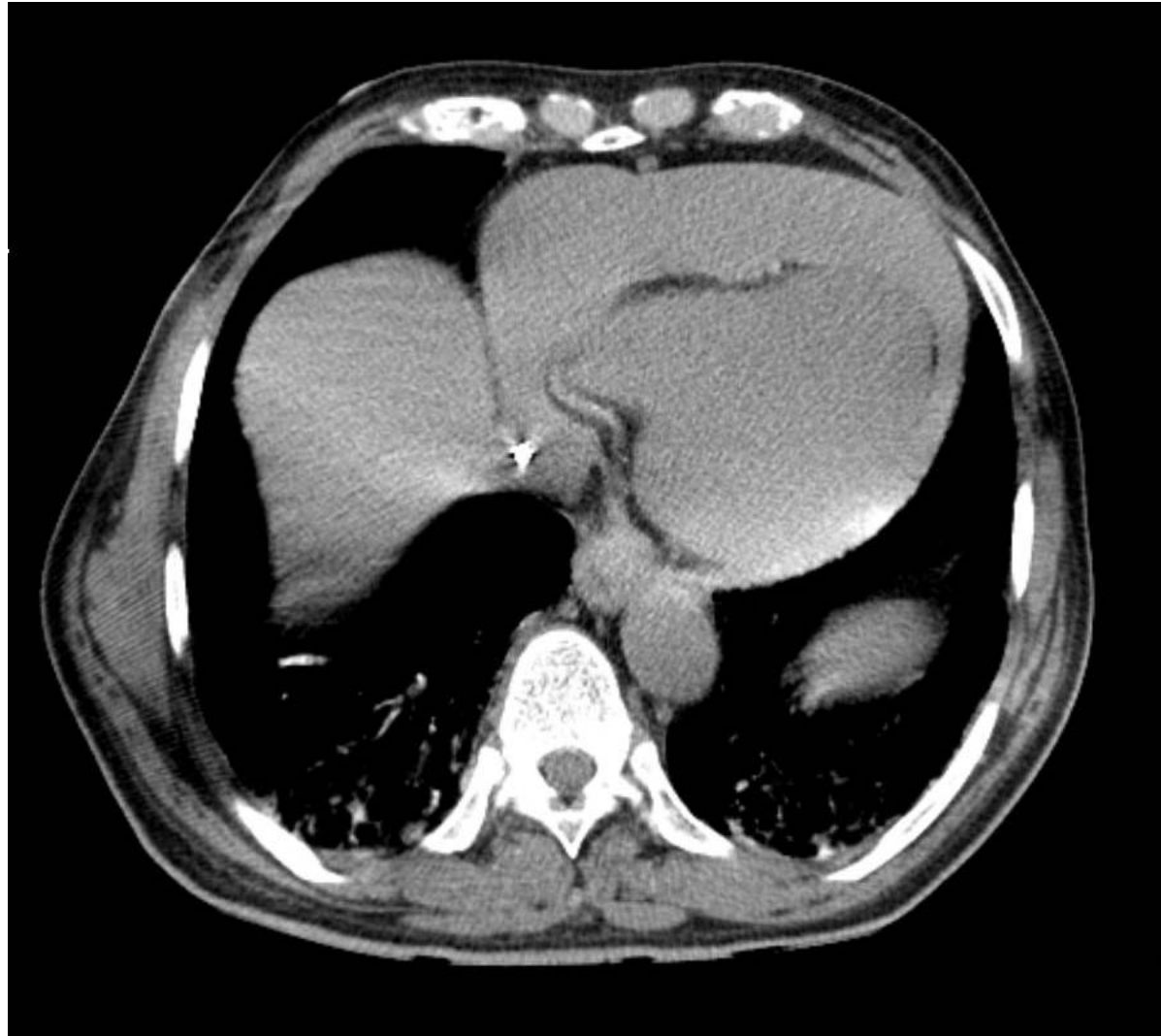
Pre-procedure CT



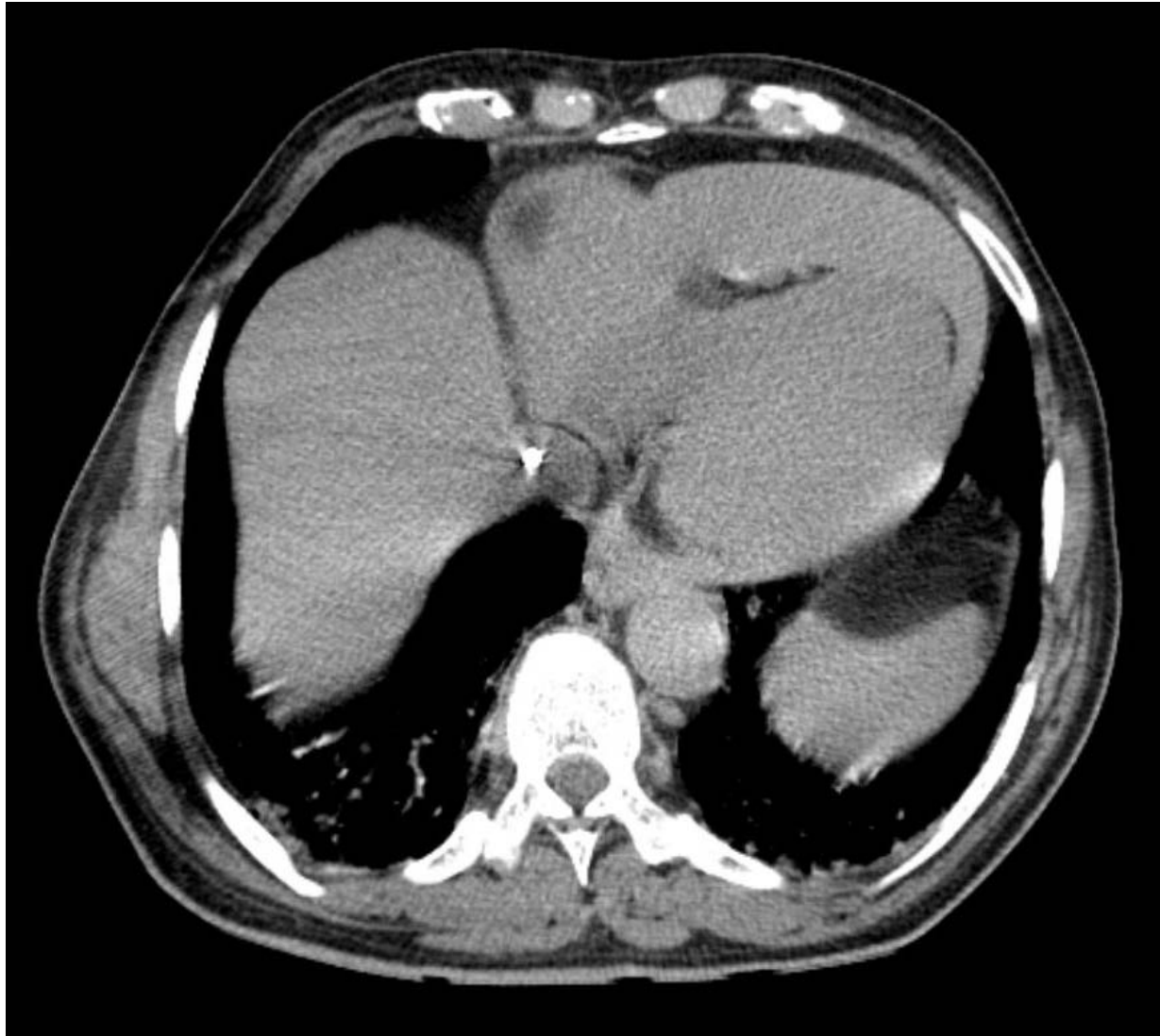
Post-procedure CT



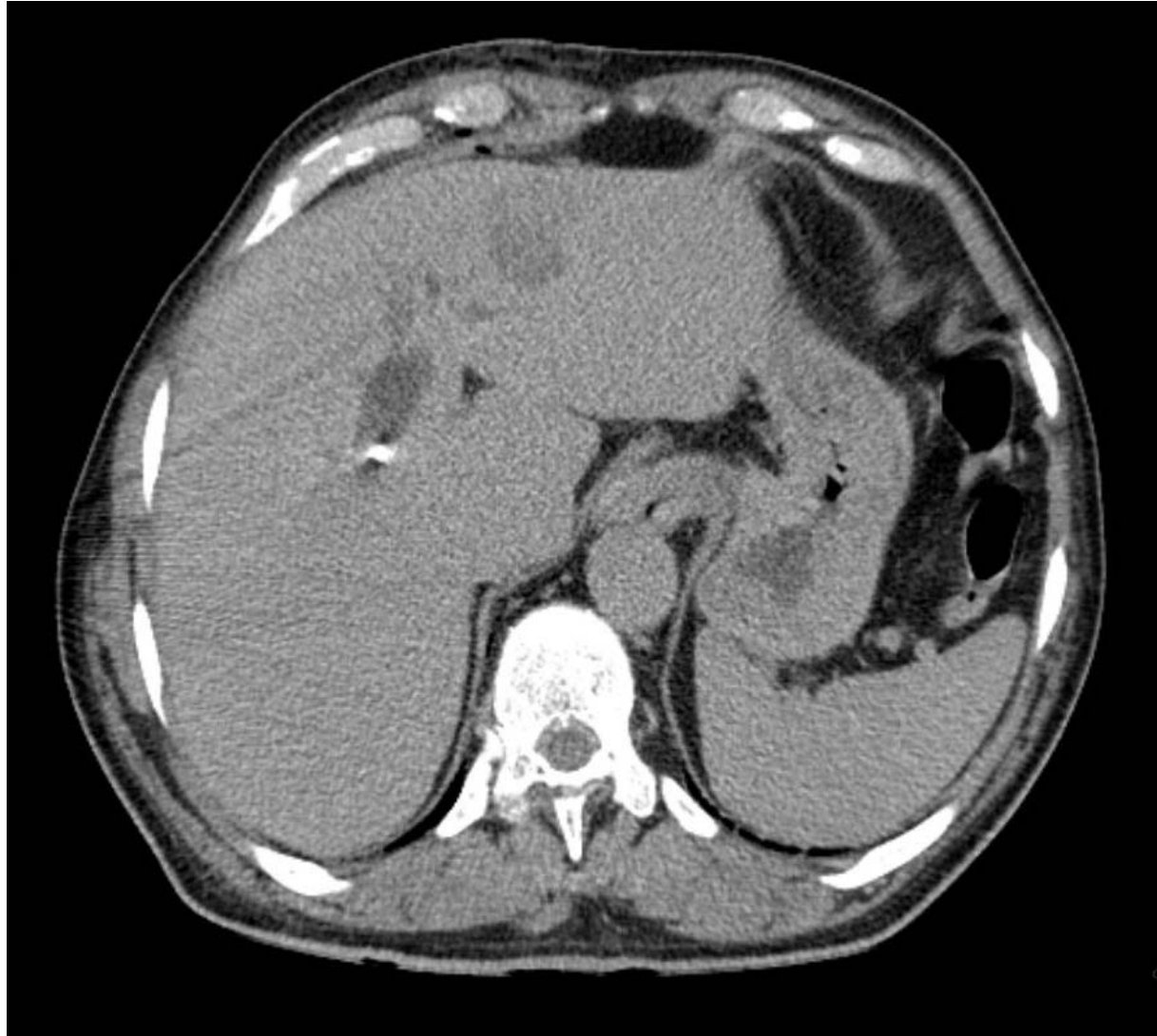
Post-procedure CT



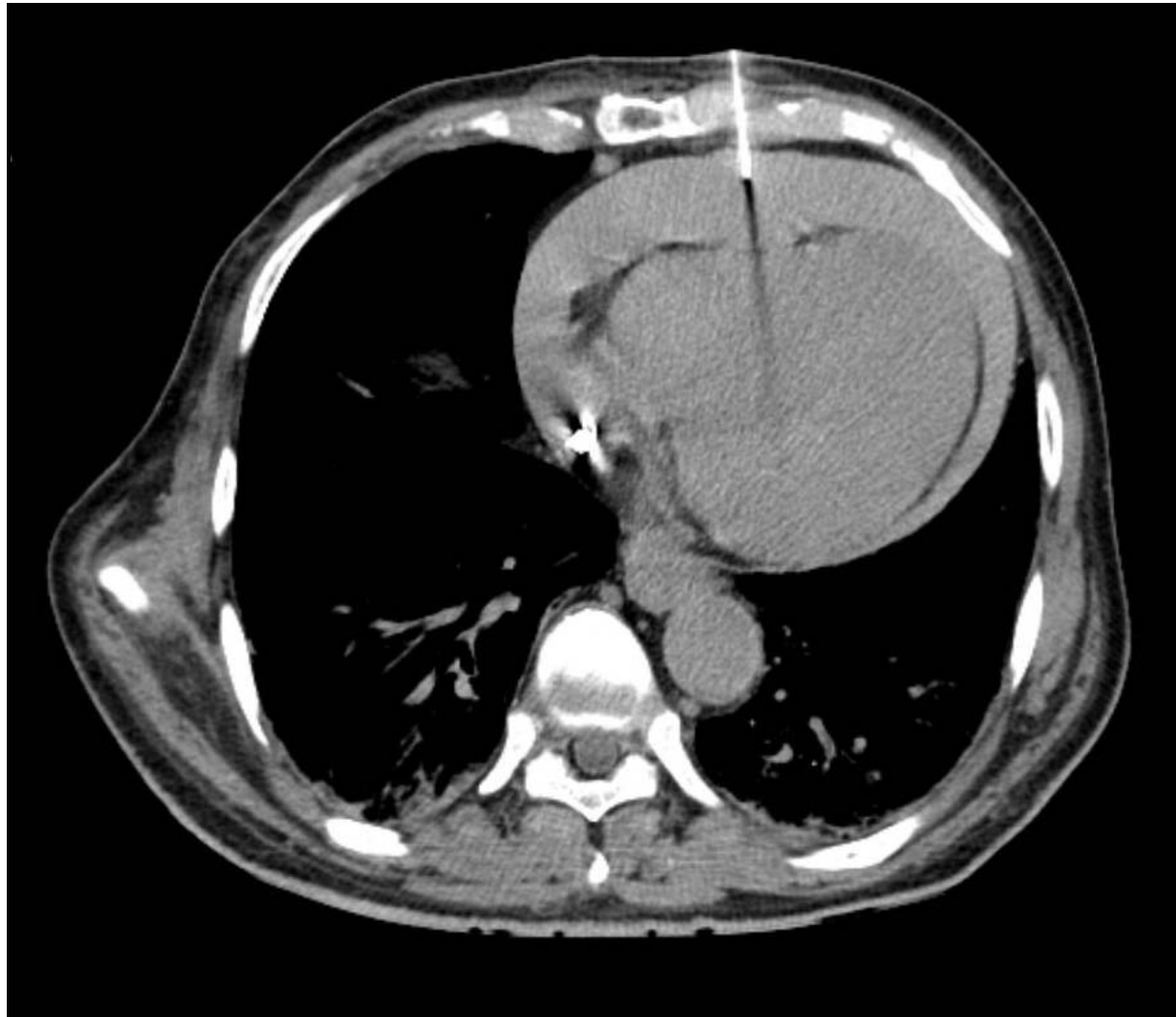
Post-procedure CT



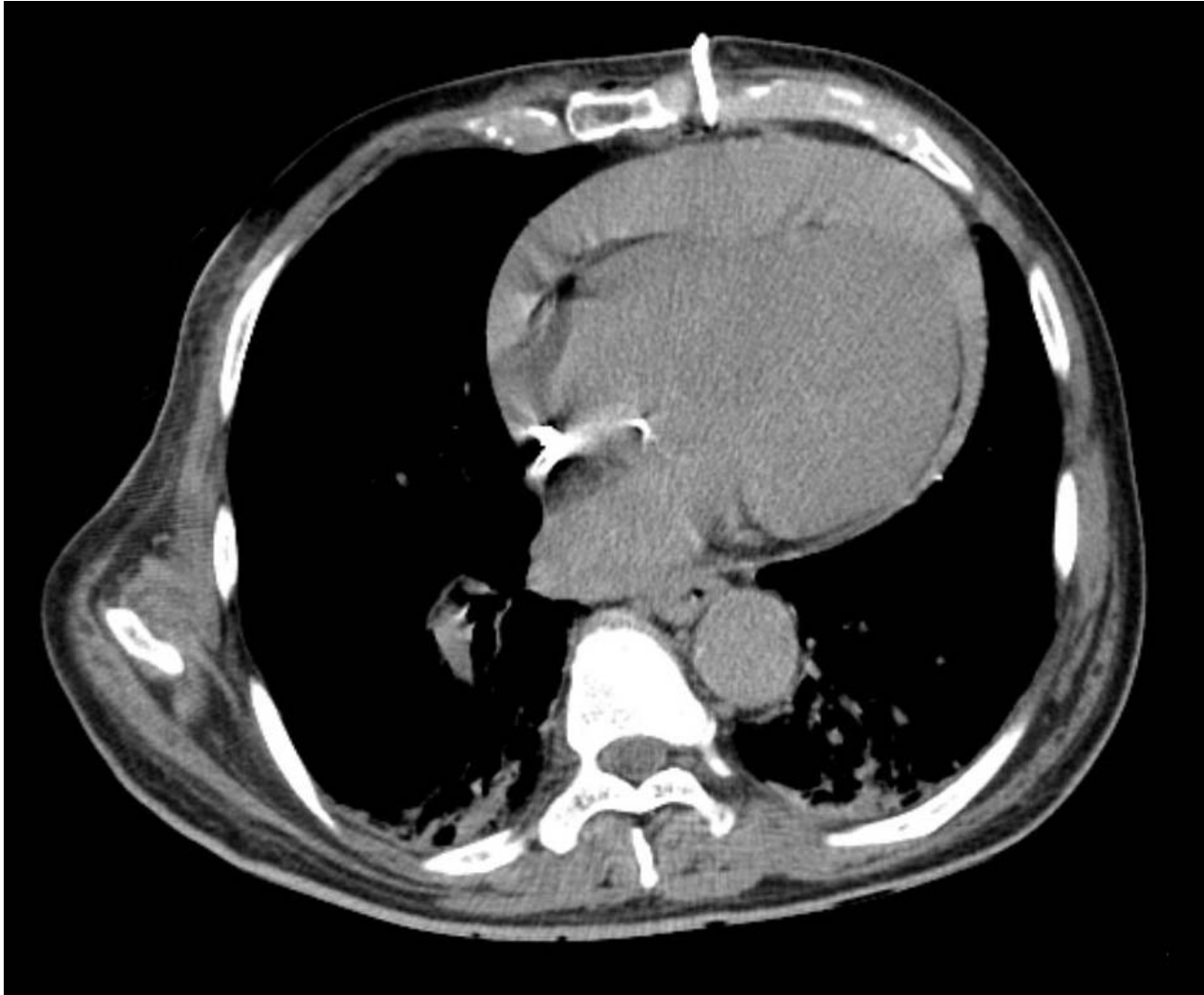
Post-procedure CT



Pericardiocentesis and pericardial drain placement



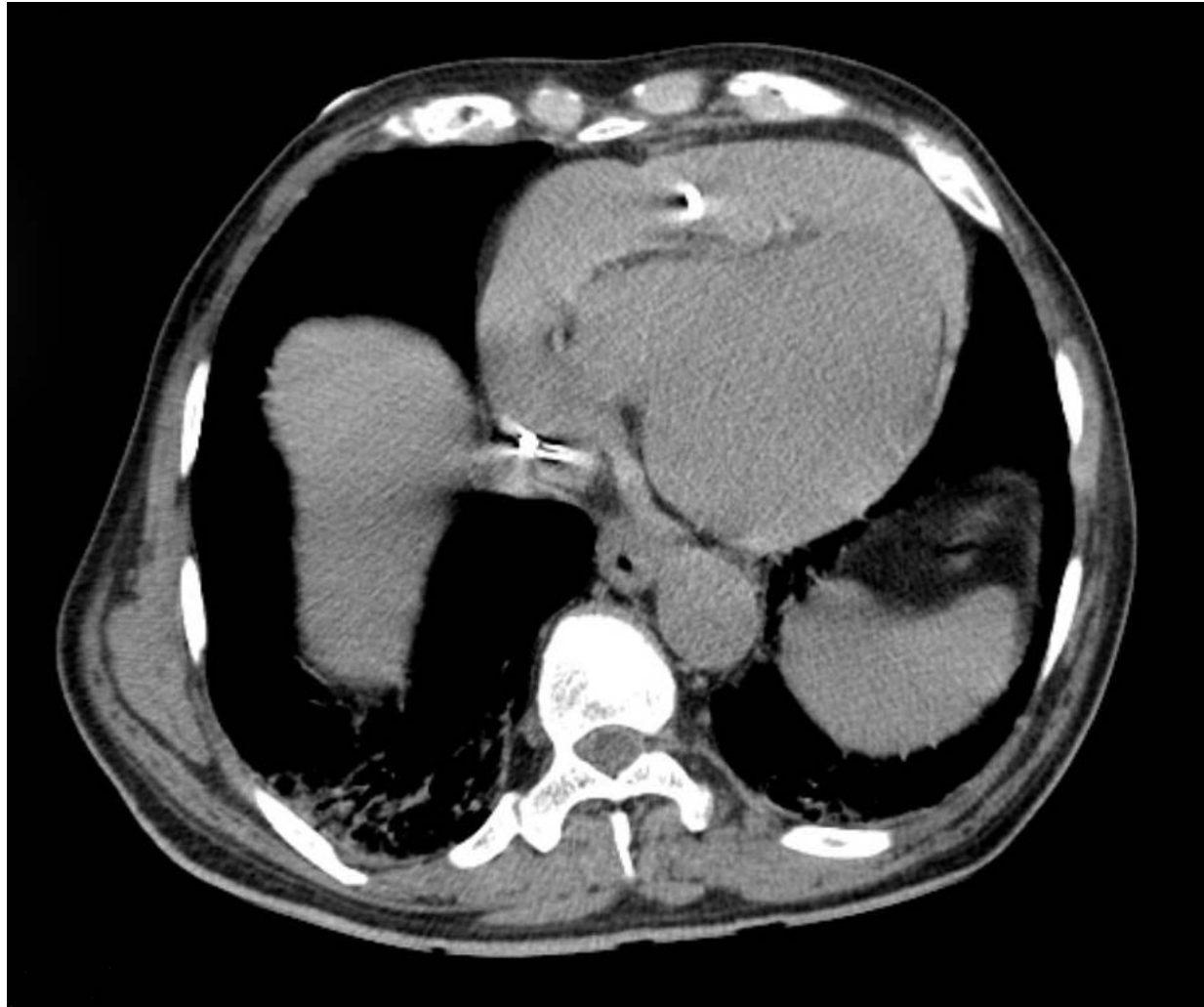
Pericardiocentesis and pericardial drain placement



Pericardiocentesis and pericardial drain placement

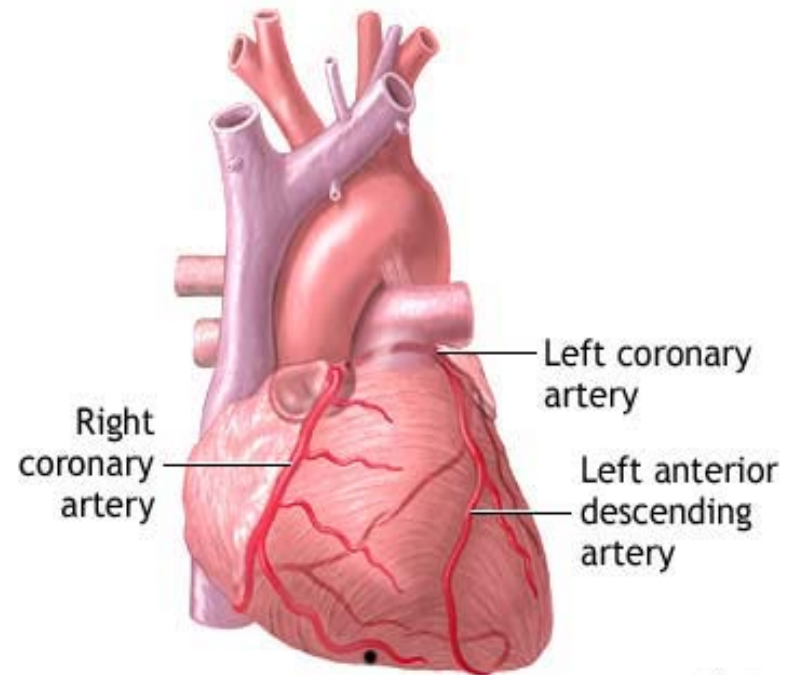


Pericardiocentesis and pericardial drain placement



Operation

- Median sternotomy
- Pericardiotomy, revealing clot and fresh blood, small 3 mm hole in the anterior surface of the right ventricle below acute marginal branch of RCA identified and repaired with 2 pledgeted 3-0 prolene mattress sutures
- Good hemostasis, no further injuries
- 4 units PRBC, 3000 ml cristalloids
- EBL- 1000 ml



Postop Course

- POD#0 remained intubated, hemodynamically stable over night
- POD#1 extubated
- POD#2 regular diet, HD as per patient's schedule
- POD#3 1st mediastinal tube removed
- POD#4 2nd mediastinal tube removed, transferred to floor
- POD#10 transferred to rehab, doing well, sternotomy healed. Patient does not want further RFA, will be started on sorafenib after discharge

Causes of iatrogenic injuries to the heart

Cardiac procedures:

- EP procedures, including radiofrequency ablation procedures
- Implantation of pacemakers
- Percutaneous mitral valvuloplasty
- Right ventricular endomyocardial biopsy
- Percutaneous coronary interventions
- Pericardiocentesis
- Swan-Ganz Catheterization

Non-cardiac procedures:

- Chest tube placement
- Acupuncture
- RFA for liver tumors
- TIPS

Sequelae of iatrogenic cardiac injuries

- Ventricular or atrial perforation: mainly right ventricle and right atrium, presenting with pericardial effusion tamponade
- Perforation of atrial or ventricular septum
- Perforation of valve leaflets
- Perforation of coronary arteries and coronary sinus

Iatrogenic injuries to the heart: Incidence for EP procedures and temporary pacemaker placement

Table 1. Procedure-based and catheter-based incidences of right heart perforations

| | Electrophysiological study | Transvenous temporary pacemaker | Total |
|---------------------------------|----------------------------|---------------------------------|-------|
| No. of procedures | 1,287 | 1,098 | 2,385 |
| No. of catheters | 4,505 | 1,098 | 5,603 |
| No. of right heart perforations | 3 | 5 | 8 |
| Incidence of perforations | | | |
| Procedure-based | 0.23% | 0.46% | 0.34% |
| Catheter-based | 0.07% | 0.46% | 0.14% |

Ref: Aliyev et al: Perforations of right heart chambers associated with diagnostic electrophysiology catheters and temporary transvenous pacing leads. Arch Turk Soc Cardiol 2011;39(1):16-22

Iatrogenic injuries to the heart: Incidence after fluoroscopy- guided pericardiocentesis

Complications in 352 fluoroscopy-guided percutaneous pericardiocenteses in 303 patients with pericardial effusion

| Complications | Surgical effusions n = 208 | | Non-surgical effusions n = 144 | |
|----------------------|-------------------------------|---------------------|-----------------------------------|---------------------|
| | Major complications | Minor complications | Major complications | Minor complications |
| Cardiac perforation | 2rv | 11rv 1rv + lv | 1rv + lv | 8rv |
| Cardiac arrhythmia | 1vt | | 1af | |
| Arterial bleeding | 3 | | 1 | |
| Pneumothorax | 1 | | 1 | |
| Abdominal pain | | 2 | | 2 |
| Pain | | 25 | | 30 |
| Fever – leukocytosis | | 4 | | 5 |
| Infection | 1 | | | |
| Vagal reaction | | 1 | 1 | |

rv – right ventricle. lv – left ventricle. vt – ventricular tachycardia.
af– atrial fibrillation.

Iatrogenic injuries to the heart: Incidence after echo-guided pericardiocentesis

Table 3. Procedural Outcomes: Success, Complications, Recurrences, and Other Management

| | Period | | | <i>P</i> value |
|---|----------------------|----------------------|----------------------|----------------|
| | 1 (2/1979-1/1986) | 2 (2/1986-1/1993) | 3 (2/1993-1/2000) | |
| Procedural success, No. (%) | 216 (98) | 400 (97) | 481 (97) | .86 |
| Total complications, No. (%) | 7 (3) | 20 (5) | 27 (5) | .20 |
| Major | 3 (1) | 6 (1) | 5 (1) | .62 |
| Minor | 4 (2) | 14 (3) | 22 (4) | .07 |
| Recurrences requiring further treatment | | | | |
| Recurrence \leq 90 d, No. (% of procedures) | 55 (25) | 79 (19) | 58 (12) | <.001 |
| Recurrence >90 d, No. (% of procedures) | 8 (4) | 5 (1) | 7 (1) | .09 |
| Surgery as part of management, No. (%) | | | | |
| Primary surgical treatment | 33 (15) | 32 (8) | 24 (5) | <.001 |
| Secondary surgical treatment | 27 (12) | 28 (7) | 14 (3) | <.001 |
| Other treatment, No. (%) | | | | |
| Sclerotherapy | 2 (1) | 14 (3) | 0 (0) | .06 |
| Nonsteroidal anti-inflammatory agents | 42 (19) | 84 (20) | 104 (21) | .54 |
| Corticosteroid (prednisone) | 37 (17) | 31 (8) | 52 (11) | .08 |

Complications overall 4.7%, major complications 1.2% including 6 cardiac perforations, 1 leading to death, 5 requiring surgical repair

Proposed classification and management of catheter-related right heart perforations

| Stages of perforation | Definition | Management | Prognosis |
|------------------------------------|---|---|---|
| Primary stage | Primary heart chamber perforation during or immediately after catheter manipulation or catheter dislodgement. | <ol style="list-style-type: none"> 1. Withdrawal of the catheter 2. Aggressive fluid replacement 3. Vasopressor or inotropic drugs 4. Vagolytic agent (atropine) 5. Surgery should be considered in patients with thin ventricular wall (e.g., Arrhythmogenic right ventricular dysplasia, severe dilatation of the right ventricle) and in those with perforation of the atrial wall. | Prognosis is good in case of ventricular perforation, but surgery should be considered in cases with atrial wall perforation. |
| Intermediate or inflammatory stage | This stage is characterized by necrotic process in tissue surrounding the catheter causing heart chamber perforation. | Open cardiac surgery must be the preferred therapeutic strategy. Withdrawal of the catheter should be avoided at this stage, especially in the presence of even a small amount of pericardial fluid. | Individualized approach should be employed, although surgery can be preferred at this stage. |
| Secondary stage | Rupture of the necrotic heart tissue surrounding the catheter. | Emergent surgical intervention is mandatory. | Poor |

Ref: Aliyev et al: Perforations of right heart chambers associated with diagnostic electrophysiology catheters and temporary transvenous pacing leads. Arch Turk Soc Cardiol 2011;39(1):16-22

Management and Outcome: Tamponade after EP procedures

Retrospective analysis of 33 consecutive patients at single institution, who developed cardiac tamponade within 24h of EP procedure:

Group A: managed conservatively

Group B: pericardiocentesis

Comparison of Hemodynamics and Clinical Outcomes

| | Group A (N = 19) | Group B (N = 14) | P- Value |
|--|---------------------|---------------------|-------------|
| Mean systolic BP (mmHg) | | | |
| Baseline | 133 | 133 | 0.977 |
| Diagnosis | 64 | 71 | 0.134 |
| Discharge | 124 | 122 | 0.788 |
| Mean heart rate (beats per minute) | | | |
| Baseline | 69 | 77 | 0.245 |
| Diagnosis | 96 | 108 | 0.208 |
| Discharge | 80 | 78 | 0.772 |
| Vasopressor use (%) | 16 (81) | 11 (79) | 1.000 |
| Mean volume of fluid resuscitation* (liters) | 3.28 | 3.85 | 0.371 |
| Transfusion [†] | 1 | 3 | 0.283 |
| Hospital LOS [‡] (days) | 4.65 | 4.93 | 0.750 |
| Survival to hospital discharge (%) | 19 (100) | 14 (100) | 1.000 |

Management and Outcome: Tamponade after RFA for liver tumor

Case report of tamponade after RFA of hepatocellular CA under sonographic guidance:

74 year old male patient with 2 cm hepatocellular CA in segment 2 in proximity to the diaphragm, underwent sono-guided RFA under GA. After completion of the ablation, the patient became hypotensive. US confirmed pericardial tamponade. Pericardiocentesis and catheter placement was performed yielding blood and clots, but patient expired after 45 min of resuscitation.

Summary

- Iatrogenic injuries are rare events that can be associated with any procedure in proximity to the heart
- Perforations mainly occur in the right ventricle
- Iatrogenic cardiac perforations present as pericardial effusion or pericardial tamponade
- Management is case-based, including observation and resuscitation, pericardiocentesis and operative exploration

References

- Aliyev et al: Perforations of right heart chambers associated with diagnostic electrophysiology catheters and temporary transvenous pacing leads. Arch Turk Soc Cardiol 2011;39(1):16-22
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