Case Report: Right Ventricular Free Wall Rupture Due to Displaced AICD Lead

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Introduction

- AICDs detects arrythmias when:
  - rate & length surpasses programmed cut-off parameters
- Cardiac Perforation is a rare complication after device implantation
  - 0.33% Incidence of RV wall perforation with ICDs noted on OPTIMUM registry (monitors SJM product performance)
  - Majority of RV wall perforations are asymptomatic
  - Categorized by timeframe between implantation and time of perforation detection
    - Acute Perforation: within 24hrs of implantation
    - Subacute Perforation: within 30 days of implantation
    - Chronic/Late or Delayed: detection after 30 days from implantation

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Introduction (cont.)

- Major Predisposing factor of RV perforation is RV lead placement
  - RV is a low-pressure system, consisting of a thin RV anterior wall (3-5mm)

  Interventricular Septum (IVS) is notably thicker in comparison (0.6-1cm)

  Ideally ICD lead placement is directed within RV outflow tract or within IVS
- ICD lead displacement can cause cardiac perforation, leading to RV free wall rupture, cardiac tamponade, and cardiogenic shock
  - These severe consequences require immediate surgical intervention with:

    Pericardial Window

    RV wall repair

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Case Presentation

• Patient is a 73-year-old female with a known history of aortic stenosis treated recently with TAVR with subsequent ventricular fibrillation arrest 8 days later. She underwent emergent left heart catheterization that revealed normal coronary arteries and placement of dual-chamber AICD at another facility.

• She presented to the emergency room within one day of discharge from the facility that placed the AICD with the complaints of generalized weakness, shortness of breath, and productive cough. The patient was recently on anticoagulation with a NOAC, however, this was discontinued when she was discharged from the outside institution one day prior. Of note, patient was only on single anti-platelet therapy due to patient request and no noted recent use of steroids. In the ED, she screened positive for sepsis and was admitted with atrial fibrillation with concerns for pneumonia. She was started on antibiotic coverage for hospital acquire pneumonia with Vancomycin and Cefepime given her recent hospitalization.

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Case Presentation (cont.)

• On day four of hospitalization, the patient developed symptoms of peri-arrest with systolic blood pressures in the 60's. The patient was resuscitated by the critical care team and intubated. A central line was placed, and the patient was started on multiple pressors for treatment of cardiogenic shock. Echocardiogram was completed and reveled an EF of 65-70% and significant mitral valve inflow was suggestive of possible cardiac tamponade but no clear findings of hemodynamic compromise. Her RV lead was noted to be in an unusual position raising concerns for perforations. CT scan showed bilateral pleural effusions with moderate pericardial effusion that had progressed from prior study. Pacemaker wire noted to be traversing the pericardium as shown in Figure 1. Hemoglobin was noted to be 8.9 g/dL with a PT of 18.7 seconds and INR of 1.59. A right heart catheterization was completed which showed a low cardiac index and low filling pressures. Right ventricular systolic pressure was noted to be 20 mm Hg.

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Case Presentation (cont.)

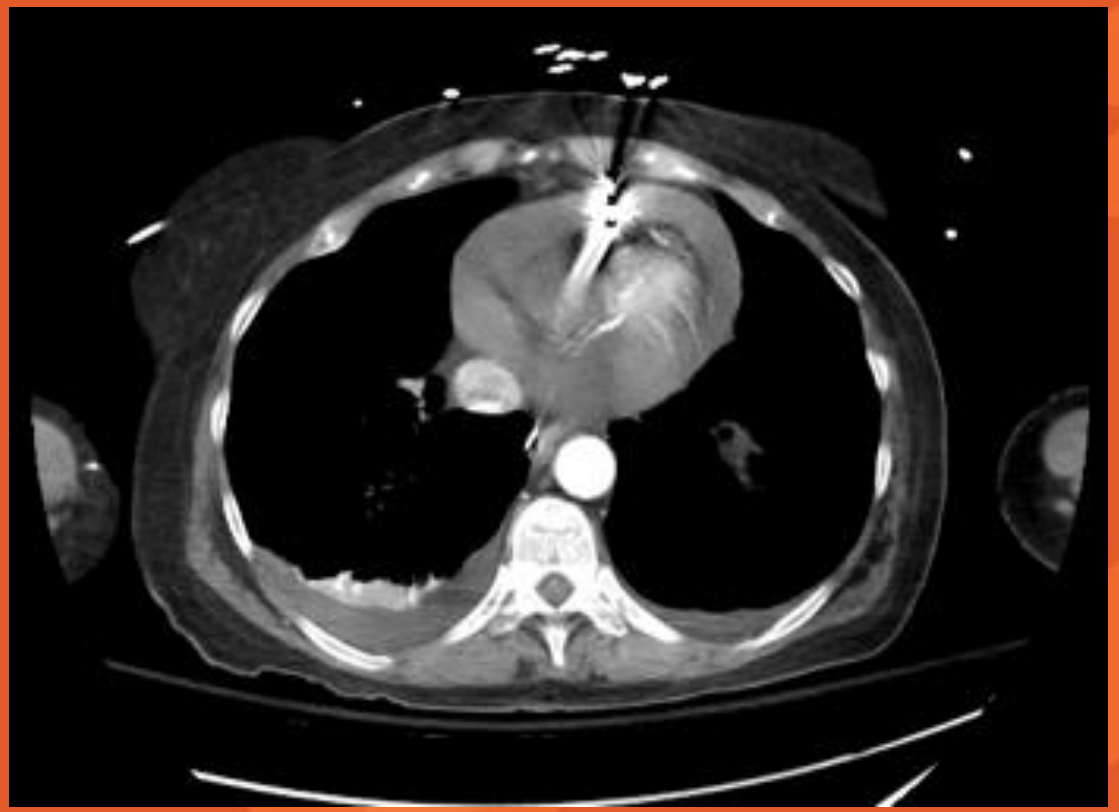

Figure 1

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Case Presentation (cont.)

Cardiothoracic surgery was consulted, and plan was made for pericardial window and evacuation. Tamponade treated with subcostal pericardial window, right ventricular repair. Right ventricular lead revision was eventually completed once the patient clinically improved and is doing well at 2 month follow up.

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Discussion

• Cardiac perforation is a rare, potentially life threatening, complication of pacemaker implantation with an estimated incidence rate of between 0.1-3% (1-4). Perforations are acute, subacute, or chronic depending on when the perforation occurs after pacemaker implantation. Acute perforation occurs within 24 hours, subacute occurs within one month and perforation after one month is considered chronic (5, 6). Affected sites include the walls of the large veins, atria, or ventricles, with the thinner RV apex being more common.

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Discussion (cont.)

- The mechanism of wall perforation is related to the physical properties of the lead and overtorquing of the leads during implantation. The lead dimensions are very thin with a heavy tip, which is thought to increase wall stress. Furthermore, all cases of lead perforation with His-bundle pacing (HBP) and left bundle branch area pacing (LBBAP) were associated with a specific type of lead used (SelectSecure 3830-69, Medtronic). Regarding technique, the operator's torque was likely all in the tip of the lead with a non-retractable screw, further propagating stress to the deeper layers of the myocardium. Resisting from screwing a lead too deeply and reducing slack are modifiable technical components that may prevent this complication from occurring.

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Discussion (cont.)

• Chest X-ray and echocardiography (ECHO) are inexpensive and convenient, though may not always reveal the diagnosis. If the lead extends beyond the cardiac silhouette, a chest X-ray can be diagnostic. A lateral view more accurately localizes the pacemaker lead position. The added benefit of the chest x-ray is to detect extracardiac complications including pleural or pericardial effusion and pneumothorax. ECHO can also help detect a pacemaker lead in the pericardium and a pericardial effusion, however, like the chest X-ray, may not correctly locate the pacemaker lead tip. Thus, if suspecting a pacemaker lead perforation that is not clearly evident on chest X-ray or ECHO, a CT scan should be ordered . This is the most accurate modality in assessing pacemaker lead placement with the added benefit of confirming extra cardiac disease. However, it should be noted that image artifact may rarely lead to misinterpretation of the position of pacemaker wires.

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Discussion (cont.)

• Pacing abnormalities can also aid in the diagnosis, as seen in a case of left ventricular free wall perforation by a right ventricular pacemaker. The lead likely perforated through the septum, indicated by the first pacing failure, then resolved due to the intermittent LV wall pacing after septum penetration, then penetrated through the LV free wall, indicated by complete pacing failure. However, absence of sensing and pacing failure and normal function on device interrogation do not exclude perforation.

• Predictive factors of lead perforation include temporary leads, steroid use, active fixation leads, low body mass index (< 20 kg/m^2), age greater than 80, female gender, and concurrent anticoagulation. Conversely, right ventricular systolic pressure > 35 mm Hg is a protective factor likely due to associated right ventricular hypertrophy.

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