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AngioVac aspiration of right atrial cardiac pacemaker lead-associated thrombus with concurrent PE under fluoroscopic and transesophageal echocardiographic guidance: a multidisciplinary collaboration for improved patient outcome

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ABSTRACT

In the U.S., pulmonary embolism (PE) is a common cause of cardiovascular death. Right heart thrombus (RHT) occurs in approximately 4% of patients with PE, and when concurrent is associated with increased 30-day PE-related and all-cause mortality. The consensus on optimal management of acute massive or high-risk PE is unclear, and even less so for concurrent RHT. In this report, we review a successful multidisciplinary coordination of vacuum-assisted thrombectomy (VAT) of a complex pacemaker lead-associated RHT in a patient with concurrent acute PE and significant comorbidities, using the AngioVac system (Vortex Medical, Norwell, MA). VAT is a reasonable treatment option that should be considered particularly for patients who are poor surgical or thrombolytic candidates. Procedural success and patient outcomes can be further optimized through multidisciplinary collaboration such as with the Pulmonary Embolism Response Team (PERT) model.

1. Introduction

In the U.S., venous thromboembolism is common, with an estimated greater than 900,000 events annually, including deep vein thrombosis (DVT) and pulmonary embolism (PE), with PE as the third most common cause of cardiovascular death.¹ Right heart thrombus (RHT) occurs in approximately 4% of patients with PE, and when concurrent associated with increased 30-day PE-related and all-cause mortality.² The consensus on optimal management of acute massive or high-risk PE is unclear, and even less so for concurrent RHT.^{1,2} In addition to conventional anticoagulation, available treatments include surgical embolectomy, systemic pharmacologic thrombolysis, and percutaneous vacuum-assisted thrombectomy (VAT). In this report, we review a successful multidisciplinary coordination of VAT of a complex pacemaker lead-associated RHT in a patient with concurrent acute PE and significant comorbidities, using the AngioVac system (Vortex Medical, Norwell, MA).

2. Case

A 79-year-old male with multiple comorbidities, including aortic valve replacement, permanent pacemaker, diabetes, hypertension, chronic kidney disease, metastatic lung adenocarcinoma on maintenance treatment with osimertinib, and achalasia with history of endoscopic myotomy presented with worsening dyspnea on exertion and right lower extremity swelling for three months. He was hemodynamically stable with a new oxygen requirement of 2 L on nasal cannula.

Laboratory workup was notable for hemoglobin of 8.8 g/dL and low normal platelet count $181 \times 10^3/\mu\text{L}$. Imaging demonstrated acute bilateral central PE with pulmonary infarction, right atrial thrombus with a dilated right ventricle, and right femoral vein occlusive thrombus (Figs. 1-2). On imaging, the right atrial thrombus slightly extended into the superior vena cava and appeared to involve the right atrial pacemaker lead (Fig. 1D). No thrombus extension into the inferior vena cava (IVC) or other deep veins was noted. Our institutional Pulmonary Embolism Response Team (PERT) was activated and recommended AngioVac thrombectomy of the right atrial thrombus in the setting of

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provoked submassive high-risk PE with intracardiac clot in transit, and high bleeding and surgical risk. Additionally, IVC filter placement was recommended given the heavy clot burden in the right lower extremity.

Given the case complexity and required multidisciplinary coordination, the case was scheduled on admission day 3 during a weekday with ample staff support. Electrophysiology was engaged to evaluate the pacemaker leads pre- and post-procedure. Anesthesiology induced general anesthesia. Gastroenterology performed intraoperative esophagogastroduodenoscopy to rule out contraindications to transesophageal echocardiography, given the patient's esophageal surgical history. Intraoperative transesophageal echocardiography (TEE) by cardiology revealed a large multilobulated mass encasing up to 4 cm of the right atrial pacemaker lead, with the mass/lead complex highly mobile and prolapsing across the tricuspid valve in diastole (Fig. 3). Under TEE and fluoroscopy guidance, interventional radiology (IR) performed AngioVac aspiration of the right atrial thrombus (Fig. 4). Approximately 8 cm of clot was successfully removed during a first pass via a right common femoral venous approach with the AngioVac third

generation 180 degree angled 22 French cannula, with 3 cm residual clot adherent to the pacemaker lead (Fig. 5). Additional advanced techniques, including right internal jugular venous approach with the AngioVac system, snare, and 20 degree angled cannula were attempted to remove the residual clot. Pulmonary angiography and catheter-directed thrombolysis of the central PE were also attempted but eventually aborted due to right ventricular ectopy. The case was completed with successful and uneventful IVC filter placement.

No peri- or postprocedural complications were noted. Pathology of the removed intracardiac mass resulted as unorganized thrombus. Postoperative transthoracic echocardiography demonstrated no significant residual thrombus in the right heart, and return to normal right ventricular size and systolic function. The patient's oxygen requirement resolved, and the patient was discharged on admission day 5 (two days post procedure) on oral anticoagulation. On two-month follow-up, repeat lower extremity ultrasound demonstrated decreased right femoral vein clot burden and the IVC filter was successfully retrieved.

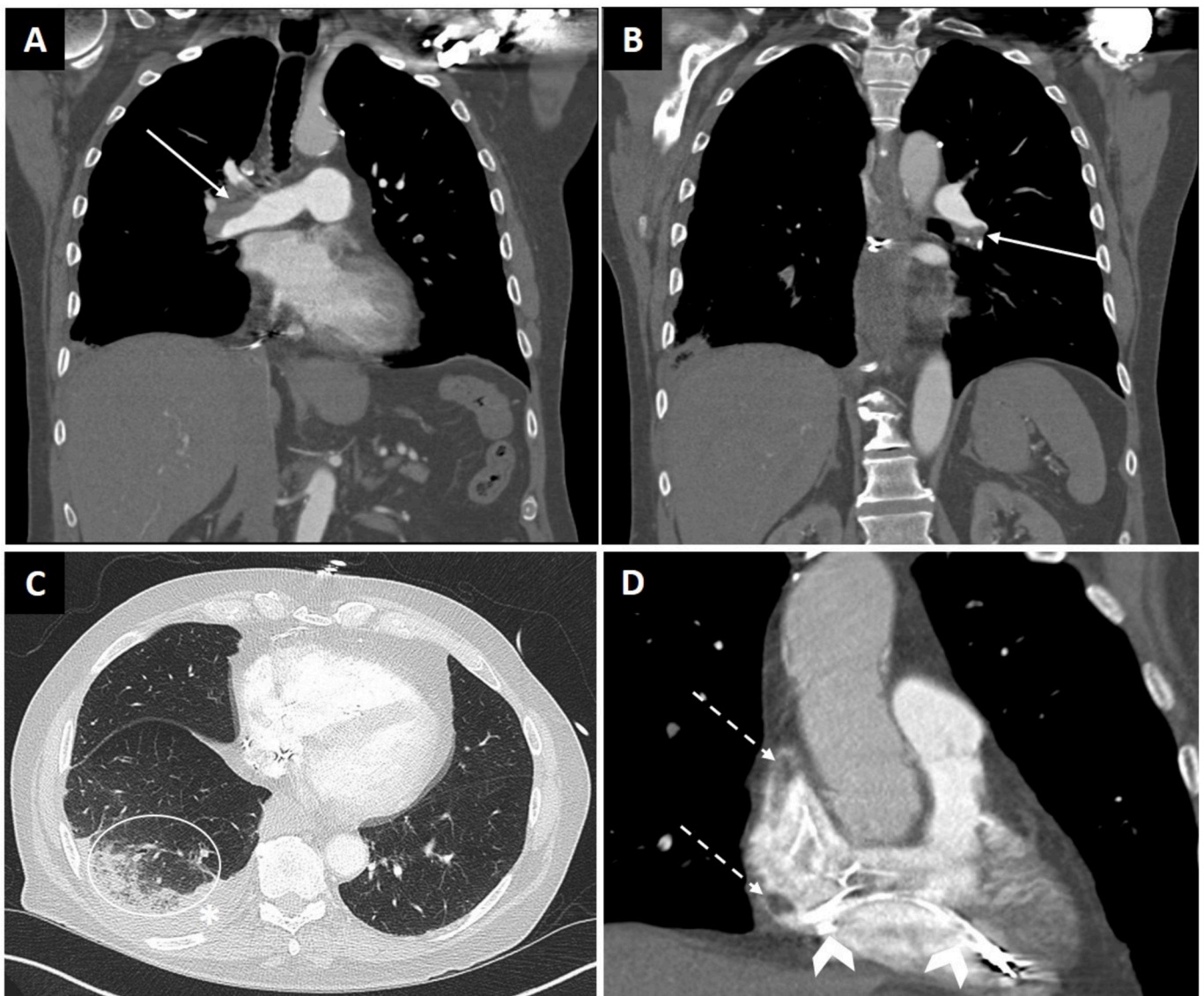


Fig. 1. Computed Tomography Angiogram (CTA) of the Chest with Acute Pulmonary Embolus and Pacemaker Lead-Associated Thrombus. A, B: Coronal views in soft tissue window demonstrate nearly occlusive acute bilateral central pulmonary emboli (solid arrows). C: Axial view in lung window shows a developing right lower lobe infarction (circle) and small pleural effusion (asterisk). D: Zoomed in coronal image of the heart (soft tissue window) demonstrates a filling defect extending into the right atrium from the superior vena cava (dashed arrows), which was thrombus associated with a pacemaker lead (chevrons). Consecutive images through the right atrium strongly suggested a continuous filling defect (thrombus) rather than multiple smaller thrombi, and was better characterized on echocardiography.



Fig. 2. Deep Vein Thrombosis on Computed Tomography Venogram (CTV) of the Abdomen/Pelvis. Axial view on vascular window at the level of the ischium demonstrates acute occlusive thrombus in the right femoral vein (arrow). Compare to the normal left femoral vein which is opacified with contrast (dashed arrow).

3. Discussion

Lack of consensus on optimal management for concurrent PE and large RHT-in-transit presents significant challenges with the care of these often complex patients with high risk of mortality. Creating even greater sense of urgency is the universal agreement that such cases should be recognized as therapeutic emergencies with timely treatment to reduce mortality.^{3,4} Our case highlights two important factors for successful outcomes, namely the ability to deploy VAT and efficient multidisciplinary response via our institutional PERT.

VAT is an important reasonable alternative to treating patients with concurrent PE and RHT, particularly those considered high-risk for surgery or pharmacologic thrombolysis. Operative mortality risk of surgical embolectomy has been reported up to 3.6% in stable patients with PE, and 10% in unstable patients.⁵ While non-invasive, pharmacologic thrombolysis has been associated with 9–11% major bleeding and 2% intracranial hemorrhage risk.⁶ Thus, up to one third of patients may be ineligible for either surgical embolectomy or thrombolysis due to significant associated morbidity.⁷ In 2009, AngioVac became the first VAT system approved by the U.S. Food and Drug Administration for en bloc removal of intravascular material such as thrombus, tumor, foreign bodies, and vegetation through veno-venous extracorporeal bypass. While reported experience and data on VAT use is limited, AngioVac is

the most well-described with several case series and one meta-analysis demonstrating its effectiveness in aspirating large volumes of intravascular and intracardiac thrombus, with clinical benefit such as relief of symptoms.^{7,8} Factors for procedural success include chronicity and location of the clot, with greatest success for acute thrombus and ilio-caval clots without right heart extension.⁹

Our greatest technical challenges were thrombus association with a pacemaker lead and thrombus size. Use of AngioVac for pacemaker lead-associated thrombi has recently been reported as highly effective for debulking large vegetations prior to lead extraction in the setting of device infection, with low complication rates.¹⁰ A case series of 101 patients with cardiac implantable device infection with large lead vegetations reported 94.0% “complete” aspiration success, 5.0% “partial” success (removal of 70% of vegetation), three major complications, and mean lead vegetation size of 3.1 ± 1.4 cm.¹⁰ Our patient's thrombus was significantly larger, with the extracted portion measuring 8 cm. Otherwise our procedural success aligns with these findings, with 70% of lead-associated thrombus aspirated and no major complications.

The successful outcomes demonstrated in this case are largely owing to the multidisciplinary effort coordinated by our institutional PERT. Our institutional PERT includes pulmonology/critical care, cardiology, and IR. For this particular case, gastroenterology and electrophysiology were also consulted due to the patient's procedural history. Akin to the well-described multidisciplinary trauma-response team model, PERTs are being established around the world to standardize and improve acute PE management.¹ The availability of numerous yet poorly studied or high-risk treatment options and lack of consensus and standardization of care make treatment decisions challenging. This model facilitates simultaneous engagement of multiple experts for timely, comprehensive, coordinated, and individualized treatment plans for these high-risk, complex patients. Additionally, review of early adopters of PERTs suggests that PERTs facilitate greater access to advanced therapies,¹ including VAT which at a minimum requires access and coordination among anesthesiology, cardiology, and interventional radiology.⁹ This collaboration was critical for our complex patient with acute concurrent PE and RHT, for which optimal management is even more debatable than for acute PE alone.

In conclusion, RHT with concurrent PE is a life-threatening event for which optimal management remains debatable and complex. VAT is a reasonable treatment option that should be considered particularly for patients who are poor surgical or thrombolytic candidates. Technical considerations include clot chronicity, location, size, and association with cardiac device leads. Procedural success and patient outcomes can be further optimized through multidisciplinary collaboration such as with the PERT model.

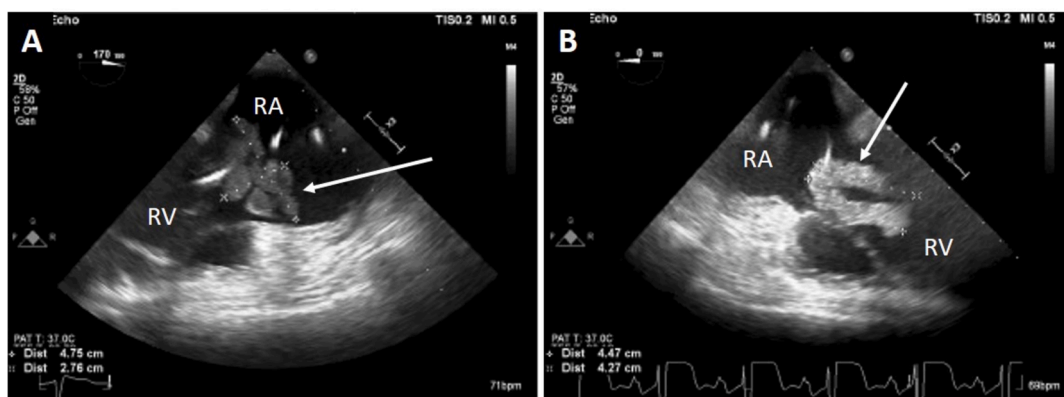


Fig. 3. Intraprocedural Transesophageal Echocardiogram (TEE) of Right Heart Thrombus. Intraprocedural TEE, midesophageal views at (A) 170 degrees and (B) 0 degrees of the right atrium (RA) and right ventricle (RV) demonstrate a large multilobulated mass (arrow) encasing approximately 4.5 cm of a right atrial lead, with the highly mobile mass/lead complex prolapsing across the tricuspid valve in diastole.

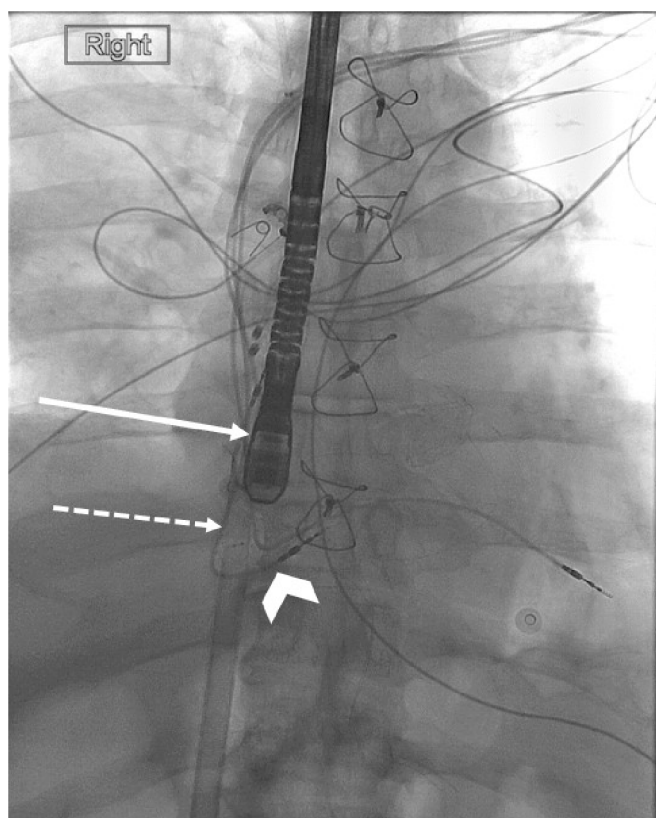


Fig. 4. Fluoroscopic Image of Vacuum-Assisted Thrombectomy (VAT) in the Right Heart. Under a combination of transesophageal echocardiographic (TEE) and fluoroscopic guidance, the AngioVac system was used to remove the right atrial pacemaker lead-associated mass. Fluoroscopic image, coronal view shows the coordination between the TEE probe (solid arrow) and right common femoral venous approach 180-degree angled 22 French cannula (dashed arrow) in the region of the right atrium and right atrial pacemaker lead (chevron).

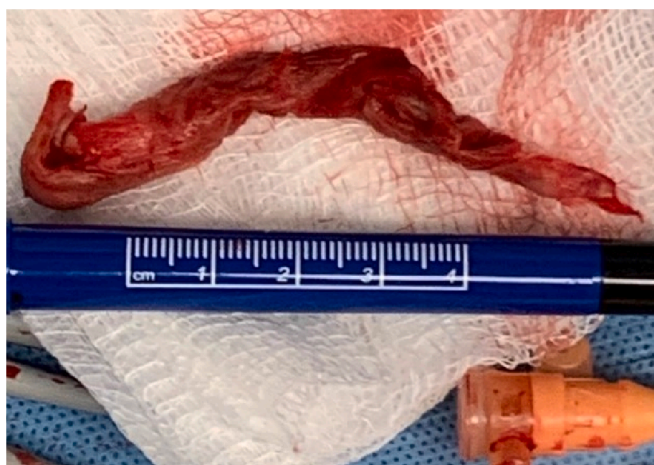


Fig. 5. Right Heart Thrombus Gross Specimen. An 8 cm mass was removed from the right atrium. Pathology resulted as unorganized thrombus.

Declaration of competing interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clinimag.2021.08.017>.

References

- Rosovsky R, Zhao K, Sista A, Rivera-Lebron B, Kabrhel C. Pulmonary embolism response teams: purpose, evidence for efficacy, and future research directions. *Res Pract Thromb Haemost* 2019;3:315–30.
- Koc M, Kostrubiec M, Elikowski W, et al. Outcome of patients with right heart thrombi: the right heart thrombi European registry. *Eur Respir J* 2016;47:869–75.
- Chartier L, Bera J, Delomez M, et al. Free-floating thrombi in the right heart: diagnosis, management, and prognostic indexes in 38 consecutive patients. *Circulation* 1999;99:2779–83.
- Athappan G, Sengodan P, Chacko P, Gandhi S. Comparative efficacy of different modalities for treatment of right heart thrombi in transit: a pooled analysis. *Vasc Med* 2015;20:131–8.
- Neely RC, Byrne JG, Gosev I, et al. Surgical embolectomy for acute massive and submassive pulmonary embolism in a series of 115 patients. *Ann Thorac Surg* 2015;100:1242–5.
- Chatterjee S, Chakraborty A, Weinberg I, et al. Thrombolysis for pulmonary embolism and risk of all-cause mortality, major bleeding, and intracranial hemorrhage: a meta-analysis. *JAMA* 2014;23:2414–21.
- Rajput FDL, Woods M, Jacobson K. Percutaneous vacuum-assisted thrombectomy using AngioVac aspiration system. *Cardiovasc Revasc Med* 2020;21:489–93.
- Moriarty JM, Al-Hakim R, Bansal A, Park JK. Removal of caval and right atrial thrombi and masses using the AngioVac device: initial operative experience. *J Vasc Interv Radiol* 2016;27:1584–91.
- C Basman U, Rashid Y, Parmar C, Kligler I, Kronzon. The Role of Percutaneous Vacuum-assisted Thrombectomy for Intracardiac and Intravascular Pathology.
- Starck C, Schaerf R, Breitenstein A, et al. Transcatheter aspiration of large pacemaker and implantable cardioverter-defibrillator lead vegetations facilitating safe transvenous lead extraction. *Europace* 2020;22:133–8.