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CASE REPORT
Other

Suction thrombectomy of a massive, hypermobile (type C) right atrial thrombus: a case report

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Background Right atrial thrombus (RAT) may be managed according to morphology and aetiology, i.e. Type A thrombi ('clot-in-transit', hypermobile) are managed with thrombolytics and surgical embolectomy due to high risk of embolization; Type B thrombi (broad-based, globular) may be managed medically as they will very likely maintain a benign course. Experience with management of a Type C thrombus (hypermobile but also broad-based) has not been explicitly described in the literature.

Case summary A 25-year-old man with history of leukaemia with prior right subclavian vein chemoport is found to have massive RAT. Multimodal imaging shows a hypermobile mass attached to the right atrial lateral wall inferior to superior vena cava and prolapsing into right ventricle in diastole. Given the thrombus morphology and likely propagation from subclavian port, risk of catastrophic embolization was deemed high and as such, intervention was indicated. Systemic anticoagulation was considered but deferred due to theoretical risk of dissolving the thrombus stalk leading to embolization. Surgical thrombectomy was offered but the patient declined. Due to evidence for success in RAT, the AngioVac System: Generation 3 (Angiodynamics, Inc., Latham, NY, USA) was chosen for intervention. The RAT was successfully removed without any complication.

Discussion AngioVac suction thrombectomy is a safe alternative option for removal of a Type C, massive, hypermobile RAT.

Keywords Thrombus • Imaging • Hybrid imaging • Echocardiography • Cancer • Case report

Learning points

- Right atrial thrombi should be managed according to clinical circumstance and thrombus morphology. Optimal management of Type C (hypermobile, non-serpinginous) thrombi has not been thoroughly studied.
- This case provides evidence for the safe and effective removal of a Type C, right atrial thrombus using percutaneous suction thrombectomy with the AngioVac: Generation 3 device.

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Introduction

Right atrial thrombus (RAT) may be managed according to morphology and aetiology, i.e. Type A thrombi ('clot-in-transit', hypermobile) are managed with thrombolytics and surgical embolectomy due to high risk of embolization; Type B thrombi (broad-based, globular) may be managed medically as they will very likely maintain a benign course.[1,2] Experience with management of a Type C thrombus (hypermobile but also broad-based) has not been explicitly described in the literature.

Timeline

Time	Events
4 years prior to case	Chemoport placed in right subclavian vein for treatment of leukaemia
3 years prior to case	Replacement of chemoport twice for malfunction
2 years prior to case	Chemoport removed
2 months prior to case	Echocardiogram shows right atrial thrombus (RAT) and trial anticoagulation started. Cardiac magnetic resonance imaging demonstrates findings consistent with thrombus
Day 1	Transthoracic and transoesophageal echocardiogram show persistent RAT
Day 2	AngioVac suction embolectomy performed
Day 4	Patient discharged home

Case presentation

A 25-year-old man with history of a large RAT on transthoracic echocardiogram done for preoperative risk assessment presented for management of persistent RAT. He had completed a trial of systemic anticoagulation with twice daily apixaban 5 mg for 1 month without improvement. His past medical history included relapsed acute myeloid leukaemia treated with chemotherapy and bone marrow transplant in remission at the time of presentation. He had a history of chronic steroid use due to graft vs. host disease which was complicated by avascular necrosis of the left hip requiring surgical repair 2 months prior to presentation. His surgical history was notable for a right subclavian vein tunnelled catheter placed for administration of chemotherapy. The catheter was later replaced by a Port-a-cath (Smith Medical, Inc., Minneapolis, MN, USA) which itself was replaced twice due to malfunction. The device was removed 2 years prior to presentation. The differential diagnosis of the right atrial mass included thrombus vs. tumour vs. vegetation. The patient's physical exam was significant for jugular venous distention but was otherwise unremarkable. Vital signs were within normal limits on room air.

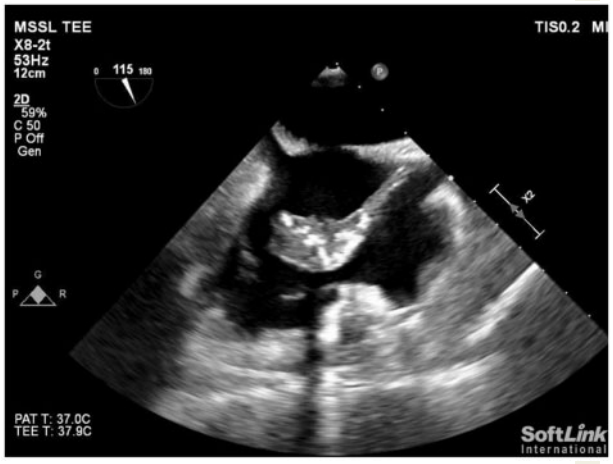
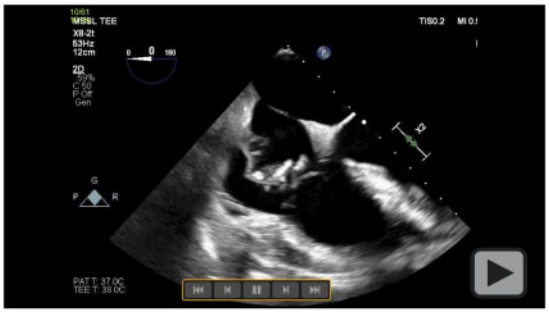


Figure 1 Transoesophageal echocardiogram of massive right atrial thrombus. Transoesophageal echocardiogram in bicaval view of a pedunculated, hypermobile and massive right atrial thrombus extending from the right atrial-superior vena cava junction.

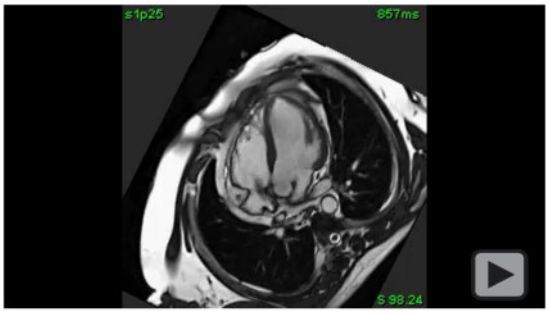
Transoesophageal echocardiogram demonstrated a persistent, hypermobile, massive RAT attached via a thin stalk to the lateral right atrial wall at the junction of the superior vena cava (SVC) and the right atrium with extension of the mass into the right ventricle during diastole (1.8 cm stalk, 3.0 cm × 1.3 cm mass) (*Figure 1*, *Video 1*). No atrial septal defect or patent foramen ovale was noted. Cardiac magnetic resonance imaging, completed to characterize the right atrial mass in the setting of prior malignancy, demonstrated features consistent with thrombus and confirmed normal right ventricular function (*Video 2*). Computed tomography was completed to establish baseline absence of pulmonary embolus prior to any intervention. Of note, clinical suspicion for pulmonary embolism was low (Wells criteria score 1.5). Computed tomography also demonstrated extension of the RAT up into the SVC with partial thrombus in the right internal jugular vein. Ultrasound of the internal jugular veins and femoral veins did not show obstruction.

Given the precarious morphology of the RAT and failure of the mass to regress with systemic anticoagulation, the decision was made to mechanically remove the mass. Surgery was offered to the patient given young age and some uncertainty that the mass could be safely removed percutaneously; however, the patient declined due to an already arduous medical history up to this point. Given the location and size of thrombus, the Angiovac generation 3 (Angiodynamics, Inc., Latham, NY, USA) was deemed most appropriate for removal of the mass.

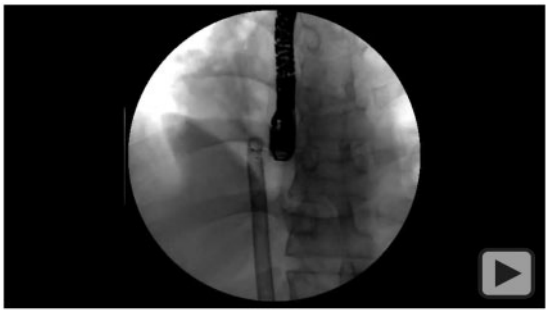
The procedure was performed under general anaesthesia in order to facilitate transoesophageal echocardiogram guidance. Access was gained via bilateral femoral veins. An 18-Fr Fem-Flex cannula (Edwards Lifesciences, Irvine, CA, USA) was inserted into the left femoral vein. A standard 0.035 J wire was advanced through the right femoral 6-Fr sheath into the right atrium. A diagnostic catheter was



Video 1 Transesophageal Echocardiography: 4 chamber view demonstrating pedunculated mass in right atrium.



Video 2 Cardiac Magnetic Resonance Imaging: 4 chamber view showing right atrial mass prolapsing through tricuspid valve in diastole.



Video 3 Fluoroscopic and transesophageal guidance of AngioVac device for removal of right atrial mass.

then advanced over the wire, then the J wire was exchanged for a stiff Lunderquist 0.035 cm wire (Cook Medical, Bloomington, IN, USA). The 6-Fr sheath was then removed in exchange for the 26-Fr Gore DrySeal (Gore Medical, Newark, DE, USA). The Angiovac catheter was advanced over the wire to the right atrium and wire removed. The patient was anticoagulated by bolus infusion of Heparin at a dose of 150 units per kg in order to achieve a target

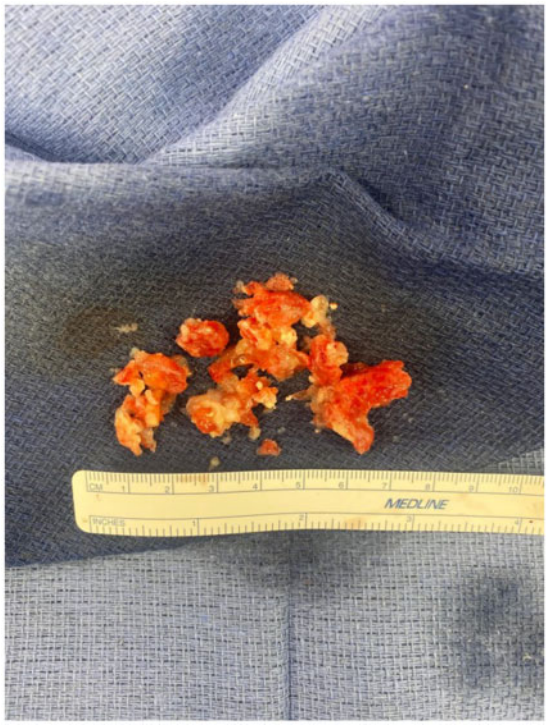


Figure 2 Pathologic specimen of extracted right atrial mass. Pathologic specimen determined to be organized and calcified thrombus.

activated clotting time of 300 s. The Angiovac funnel with 180° bend was advanced and positioned over the mass using fluoroscopic and transoesophageal guidance (*Video 3*). The vacuum was then initiated at 500 rpm and slowly escalated to 3500 rpm (equivalent to about 4–5 L flow). Once the cannula was blocked with the RAT, inflow ceased until the mass moved into and through the cannula (Supplementary material online, *Video S1*). A second pass was made to aspirate the partial remnant of the mass attached to the eustachian valve. A third run was made to aspirate remaining lateral right atrial wall mass however the mass was firmly adherent to the wall and repeated attempts at suction caused brief sinus pauses and bradycardia which resolved upon withdrawal of the suction cannula. The sheaths were removed and the percutaneous access sites closed with application of 2-0 silk purse-string suture and application of gentle pressure for 15 min bilaterally.

The patients post-procedure course was uneventful. There was no clinical evidence to suggest new pulmonary embolus. Transthoracic echocardiogram prior to discharge showed 1.4 cm immobile right atrial mass in proximity to the crista terminalis, normal right ventricular function and no pericardial effusion. Pathology of the extracted specimen demonstrated calcified organized thrombus (*Figure 2*). The patient was discharged on apixaban 5 mg twice daily to be discontinued only at the discretion of the patient's oncologist. Transthoracic echocardiogram completed at 3 months from discharge showed stable appearance of the remnant right atrial mass.

Discussion

RAT may be encountered in a number of clinical situations ranging from critically ill patients with haemodynamic compromise in the setting of acute pulmonary embolus to chronic, incidentally noted masses. Their management depends largely on the thrombus aetiology, morphology and clinical circumstances. It is helpful to characterize RAT into one of three categories in order to determine the best mode of action: Type A or 'transferred' clots are worm-like, hypermobile, and associated with deep venous thrombosis. These clots are essentially 'clots-in-transit' that have momentarily lodged in the right atrium and which almost invariably embolize to the lung with exceedingly high mortality.[2] These thrombi should be management according to their acuity i.e. thrombolytics or surgical embolectomy in cases with haemodynamic instability.[1,3] Type B clots are more non-specific in morphology, broad-based, and more or less immobile. These clots are thought to develop within the right atrium and are more likely associated with structural abnormalities such as congenital heart disease or prior surgeries. Type C clots are those that do not fit neatly into either of the preceding groups as they are mobile but not serpiginous. Predisposing factors for development of Type B or C clots may be prominent eustachian valve, low cardiac output, severe tricuspid regurgitation, pulmonary hypertension, or congenital heart disease.[4,5] Importantly, Type C clots still maintain some risk of catastrophic embolization where Type B clots appear to have a more benign course.[2]

Our patient appeared to fit the Type C category based on imaging, history of malignancy, recent pelvic surgery that may have provoked clot formation and prior chemoport in the right subclavian vein from which the present clot likely propagated. As Type C lesions are not known to indicate imminent pulmonary embolism they can be managed more tactfully compared with Type A lesions. Given the hypermobility of the mass, young age and failure of systemic anticoagulation, the decision was made to intervene. Of note also, thrombolytics and anticoagulation in these cases are assailed by some for a theoretic risk of dissolving the thrombus stalk consequently untethering the mass for embolization.[6] Surgical embolectomy was offered but the patient declined. The AngioVac device was deemed most appropriate given success rates in prior cases series however, its risk-benefit profile outside of the setting of acute pulmonary embolism and with such a precariously situated mass was unknown.[7] In this case, AngioVac suction thrombectomy allowed almost complete removal of the mass without incidental embolization. Importantly, on pathology, the thrombus was found to be calcified and organized which likely lent itself to removal. A fresher, more fragile clot may be predisposed to fragmentation and thus caution is advised in this clinical presentation.

Lead author biography

Pavan Reddy, MD is currently a cardiology fellow at Mount Sinai Morningside Hospital in New York City. He completed his residency training at the University of Southern California and medical school at SUNY Downstate in Brooklyn, NY, USA. Dr Reddy is planning to pursue a career in interventional cardiology.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

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