

REVIEW ARTICLE

Right Atrial Thrombus and Challenges in its Management

Vidya Suratkal¹, Ayaz Ahmed²**Abstract**

Right atrial thrombi is a serious complication of central venous cannulation although incidence is less as compared to left atrial thrombi.¹ Right atrial thrombi develops at anastomotic foci or on injured endothelium, implanted devices or foreign bodies including tumours, pacemakers and indwelling right atrial catheters. They have been associated with triple-lumen catheters for chemotherapy, intravenous fluids or parenteral nutrition, pulmonary artery catheters, hemodialysis and implantable venous access devices.² Right atrial thrombi can have severe consequences leading to pulmonary embolism, septic emboli, mechanical problems of cardiac function or even systemic embolization in case of atrial septal defect or patent foramen ovale. Incident rates of CVC-related thrombosis reported in the literature are inconsistent and vary according to host factors, catheter characteristics, cannulation site and the infusates administered. Thrombi within cardiac chambers are associated with an increased risk of mortality due to their propensity for embolization to the pulmonary vasculature.

Introduction

The actual incidence of RA thrombi is unknown. Gilon et al noted incidence of Right heart thrombus is around 12.5% and significantly associated with a catheter tip in the right atrium, malignancy, concurrent infection, procoagulant states and structural abnormalities.³ Estimates of CVC-related thrombosis vary depending on the site of insertion,

with the incidence of Peripherally Inserted Central Catheter (PICC)-related thrombosis, in general, ranging from 2% to 4%. Catheter related right atrial thrombus is reported in around 8-13% in oncologic population and 5.4% in hemodialysis population. A review from Sweden reported showed a prevalence of RA thrombi of 7% in 23,796 autopsies, which was similar to the prevalence of left cardiac thrombi. Right heart thrombi are associated with Pulmonary embolism in approximately 4% to 6% of cases and increase the three-month mortality rate from 16% to 29%.⁴ Right atrial thrombi are prone to form in the presence of atrial fibrillation but at a significantly reduced rate.⁵ A proposed explanation for this finding is the differing anatomy of the right and left atrial appendages, the portions of the atria most likely to provide a nidus for thrombosis. The right atrial appendage, being considerably more shallow than the left, provides a less hospitable environment for thrombus formation.⁶ In patient with atrial fibrillation, the incidence of Right atrial appendage thrombi is 3% to 6%, while left atrial thrombi is 13% of the same population.

Table 1: Risk factors for the development of Catheter related right atrial thrombus

Factors	Variable	Effect on risk
Patient factors	Hypercoagulable states including malignancy, sepsis, critical illness, renal failure, previous VTE, use of certain drugs (e.g. thalidomide), possibly inherited thrombophilias	Increased
Catheter type	PICC (additional risk with increased diameter/number of ports) ⁷	Increased
Insertion	Tip located above the junction between the SVC and atrium ⁸ Left sided Femoral Multiple insertion attempts	Increased

Pathogenesis and risk factors for right atrial thrombus

Pathogenesis of thrombus depends on three factors endothelial damage, stasis of blood and hypercoagulable states (Virchow's triad). Indwelling catheters can cause both endothelial damage and stasis of blood. Most of right atrial thrombus are adherent to catheter tip or endocardium. Free floating right atrial thrombus are rare, associated with pulmonary embolism and have a poor prognosis.

Clinical presentations of right atrial thrombus⁹

- Asymptomatic (most common)
- Swelling of head/neck/limb
- Localized pain/numbness
- Jaw or shoulder pain Headaches/sensation of head fullness
- Superficial venous distension
- Inflammation/phlebitis
- Erythema of limb
- Difficulty with infusion or aspiration

Classifications of Right atrial thrombi-based on morphology¹⁰

Type A: Thrombi are morphologically serpiginous, highly mobile, may prolapse through the tricuspid valve and are associated with deep vein thrombosis and pulmonary embolism.

Type B: Thrombi- are less mobile, attached to the right atrial or ventricular wall and originate in association with foreign bodies or in structurally abnormal chambers.

Type C: Thrombi are rare, share a similar appearance to a myxoma and are highly mobile.

Complications of right atrial thrombus

Complications can include pulmonary embolism (PE) in 10– 15%, loss of venous access in 10%, infection,

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Fig. 1: Transthoracic echocardiogram showing large thrombus in right atrium

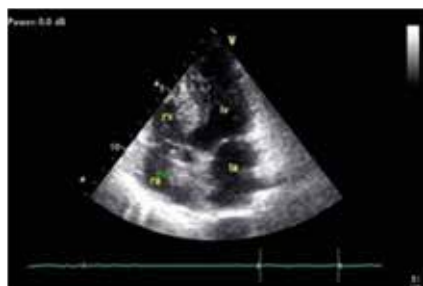


Fig. 2: Catheter related right atrial thrombus with catheter shown as green arrow

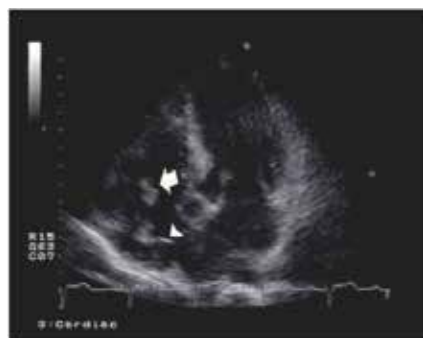
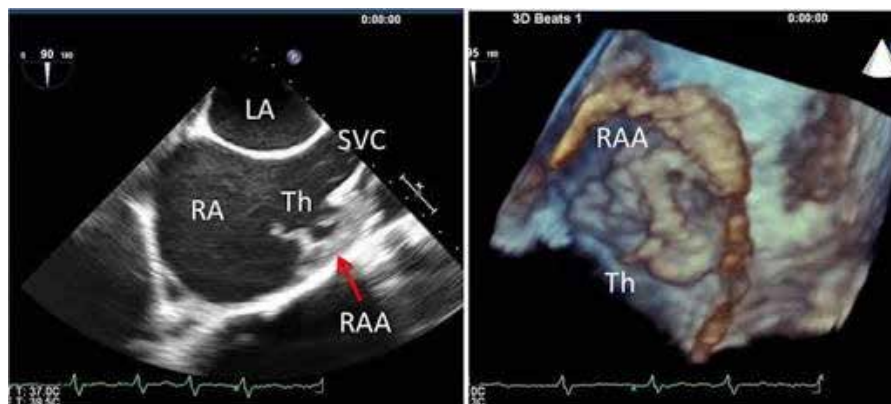


Fig. 3: Pacemaker wire with right atrial thrombus attached to it

post thrombotic syndrome (PTS) and delays in treatment.¹¹

Diagnosis

Transthoracic Echocardiography (TTE) forms the hallmark for diagnosis of RA-thrombi. Advantages of TTE are its non invasive, easily available, cheap and can be repeated several times. It also helps in classification of thrombi, prognostification and respond to treatment. Echo will show echodense, mobile mass in right atrium. Transesophageal echocardiography is preferable to TTE because of its improved ability to detect RHTE and characterize clot morphology viz the size, mobility, and site of attachment of thrombus. TEE has few drawback. It is invasive and costly. Doppler



Mid-esophageal bicaval view

3D-TEE

RAA thrombus (40 × 10 mm)

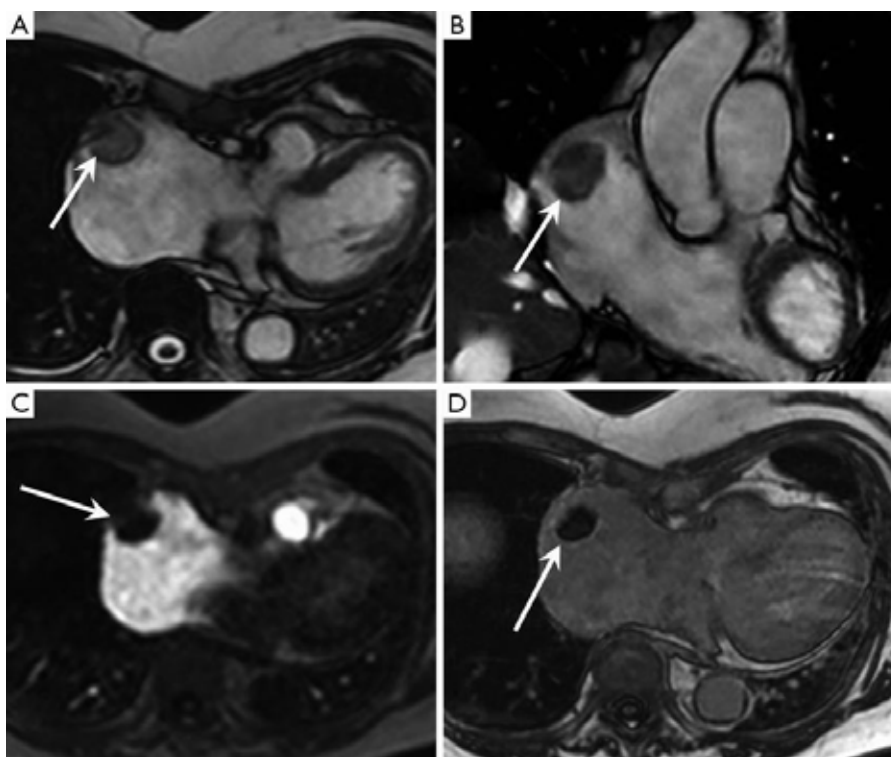


Fig. 4: Right atrial thrombus on MRI. (A) Axial SSFP image showing a 3 cm well circumscribed mass within the right atrium (arrow); (B) coronal SSFP image again showing the right atrial mass with no sign of invasion into the atrial wall (arrow); (C) axial image from a resting perfusion study showing an absence of first pass contrast enhancement (arrow); (D) axial late phase inversion recovery image with an inversion time of 600 ms post gadolinium showing the mass of uniformly low signal which is a characteristic feature of thrombus (arrow)

ultrasonography of the lower and upper extremities, especially in the presence of a CVC, should be obtained. A confirmatory spiral CT or perfusion scan is desirable if the patient is stable. *The MRI Cardiac is best to differentiate thrombus from myxoma. Right heart Angiography is the gold standard for diagnosis.*

Differential diagnosis of right atrial thrombus

Right atrial thrombus is easily detected by transthoracic echocardiography but sometimes it difficult to differentiate from congenital structures such as a Chiari network, persistent eustachian or thebesian valves, or atrial septal aneurysms, or acquired conditions such as intracardiac tumors or devices and vegetations.¹²



Fig. 5: Angiovac cannula

Management

There is a dual approach to manage right atrial thrombus and is still the subject of debate-surgical vs medical management. Several treatment options are available, including anticoagulation, embolectomy and thrombolysis.¹³ The success and survival rates of each approach vary, depending on the patient's clinical status. The United States Food and Drug Administration recently approved the AngioVac aspiration system in 2009 for removal of unwanted intravascular material through venovenous extracorporeal bypass circuit. Anticoagulation with heparin is generally considered to be the safest treatment, but its use has historically been associated with many complications, including potentially life-threatening ones, such as thrombocytopenia.¹⁴

Rose *et al.* reported lower mortality rate in the patients who received thrombolytic therapy when compared to the patients who underwent surgery or anticoagulation. Theoretically, the thrombolytic therapy has numerous advantages; it accelerates thrombolysis pulmonary reperfusion, reduces pulmonary artery hypertension, and improves right and left ventricle function and reverses cardiogenic shock. Thrombolysis dissolves the clot in three major sites, intracardiac, pulmonary and venous thrombosis. Recombinant Tissue Plasminogen Activator (rtpa) is preferred because it has greater affinity for plasminogen in the presence of fibrin and a shorter infusion time than streptokinase or urokinase. Maron reported successful resolution of intra-cardiac adherent right atrial thrombus with tissue plasminogen activator administered by continuous infusion (2 mg/h) over

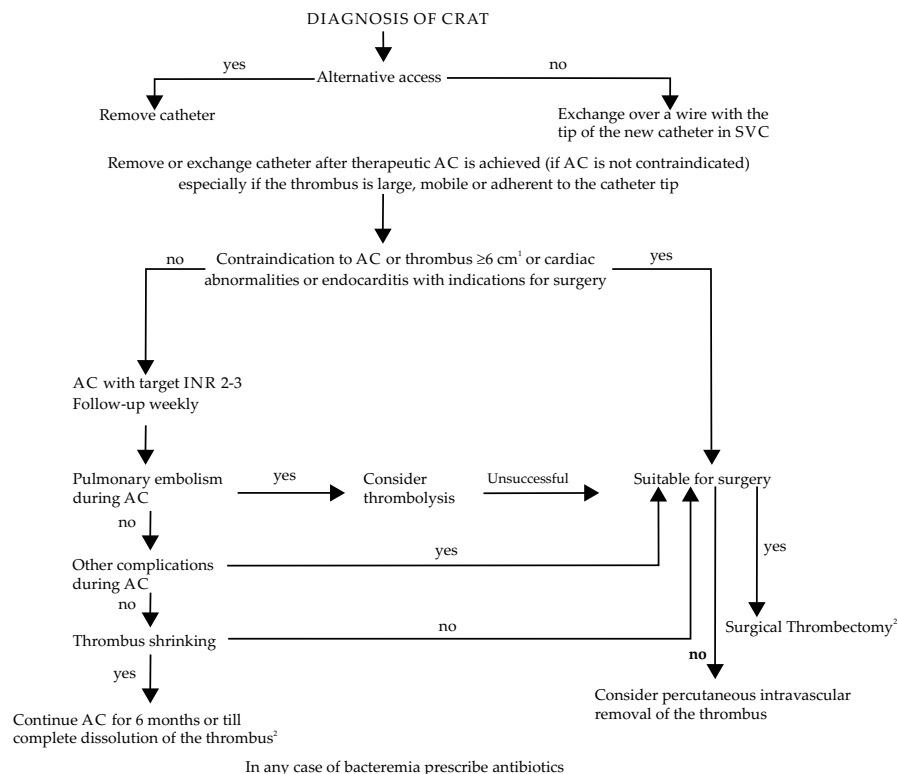


Fig. 8: Management algorithm in case of catheter-associated right atrial thrombus (CRAT) in haemodialysis patients. AC, anticoagulation; SVC, superior vena cava. If the thrombus is ≥ 6 cm but the patient is unsuitable for surgical thrombectomy, consider anticoagulation or thrombolysis treatment. Consider lifelong anticoagulation in case of hypercoagulable states, especially if the patient continues to receive dialysis through a catheter. (CRAT=Catheter related right atrial thrombi)

24 h via a 4F, 11 cm catheter placed fluoroscopically into the midsuperior vena cava, without major bleeding complications.¹⁵

The risks associated with thrombolysis include bleeding, hematoma formation at puncture sites, intracranial hemorrhage, and the potential for proximal clot dissolution and subsequent embolization.

Bereji reported successful percutaneous mechanical thrombectomy in two patients with right atrial thrombus. The author concluded that endovascular extraction of right atrial thrombi may represent a potential therapeutic alternative, particularly in patients with contraindications to thrombolysis and surgery.¹⁶

Angiovac aspiration system for right atrial thrombus: The AngioVac Cannula is intended for use as a venous drainage cannula during extracorporeal bypass for up to six hours and for removal of fresh, soft thrombi or emboli during extracorporeal bypass for up to six hours. It is used when thrombi is soft and patient is unfit for surgery or contraindications for thrombolysis. The

AngioVac Cannula is designed with a balloon-actuated, expandable funnel shaped distal tip. The proprietary funnel shaped tip enhances venous drainage flow when the balloon is inflated, prevents clogging of the cannula with commonly encountered soft, fresh thrombi or emboli, and facilitates en bloc removal of such extraneous material.

Surgical embolectomy with exploration of the right chambers and the pulmonary arteries under full cardiopulmonary bypass is the classic treatment. It has two drawbacks: It is not readily available in all medical centres, and it is sometimes associated with an extremely high mortality rate.¹⁷

Following is treatment guideline for Catheter related right atrial thrombi (CRAT) which is the most common cause of right atrial thrombi.¹⁸

Prophylaxis

Current guidelines, based on the evidence available, do not recommend anticoagulation for the routine prevention of CRTs although most of the critical care patients will receive

LMWH prophylaxis as standard care.¹⁹ Low molecular weight heparin is in general preferred to unfractionated heparin because it is convenient, overall less expensive, eliminates the need for aPTT monitoring, avoid the problem of intravenous site infections and give superior results. Previously, low-dose warfarin (1 mg/day) had been used for patients with indwelling catheters and malignancy but subsequent trials disproved its benefit. The largest contemporary trial, WARP (Warfarin thromboprophylaxis in cancer patients with CVCs) compared the use of adjusted dose warfarin (INR 1.5–2.0), low-dose warfarin (1 mg/day) and no anticoagulation in the prevention of CRT in cancer patients.²⁰ The data from this trial did find a benefit in CRT reduction in the dose adjusted arm but this was offset by increased bleeding risk. There was no significant benefit in taking low-dose warfarin. However patient with atrial fibrillation and hypercoagulable states (non CRAT) should be prescribed anticoagulant therapy. Newer anticoagulants used in non valvar atrial fibrillation have many advantages over conventional warfarin viz INR monitoring and drug interactions. Despite the discovery and application of many parenteral (unfractionated and low-molecular-weight heparins) and oral anticoagulant vitamin K antagonist (VKA) drugs, the prevention and treatment of venous and arterial thrombotic phenomena remain major medical challenges. Furthermore, VKAs are the only oral anticoagulants used during the past 60 years. NOACs are novel direct-acting medications that are selective for one specific coagulation factor, either thrombin (IIa) or activated factor X (Xa). Several NOACs, such as dabigatran (a direct inhibitor of FIIa) and rivaroxaban, apixaban and edoxaban (direct inhibitors of factor Xa), have been used for at least 5 years but possibly 10 years. Unlike traditional VKAs, which prevent the coagulation process by suppressing the synthesis of vitamin K-dependent factors, NOACs

directly inhibit key proteases (factors IIa and Xa). The important indications of these drugs are the prevention and treatment of deep vein thrombosis and pulmonary embolisms, and the prevention of atherothrombotic events in the heart and brain of patients with acute coronary syndrome and atrial fibrillation. They are not fixed, and dose-various strengths are available. Most studies have reported that more advantages than disadvantages for NOACs when compared with VKAs, with the most important advantages of NOACs including safety issues (ie, a lower incidence of major bleeding), convenience of use, minor drug and food interactions, a wide therapeutic window, and no need for laboratory monitoring.

Challenging areas in right atrial thrombus

Majority of patients with right atrial thrombus are asymptomatic. Most of them get detected on routine cardiac evaluation. The lack of incorporation of an algorithmic approach toward right heart thrombus, especially in high risk patients, both by Chest and the European Society of Cardiology are due to the lack of evidence-based guidelines and randomized control studies. There is still debate over treatment options surgical v/s thrombolysis. No evidence based guidelines for prophylaxis in indwelling catheters.

Concluding Remarks

The presence of thrombus in RA is rare and an indication of potentially fatal pulmonary embolism. Thus keep a high index of suspicion for the thromboembolic complications in patients with thrombogenic states, implanted devices and underlying malignancy and do serial echocardiography even if patients are asymptomatic.

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