

Review Article



Thrombosed aneurysmal right coronary artery presenting as inferior STEMI: A comprehensive review and case report of diagnosis, imaging and management

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Summary

Coronary artery aneurysms (CAAs) are rare vascular disorders characterized by localized dilatation of a coronary artery segment, often leading to severe complications such as thrombosis, embolization, and rupture. This case report discusses a thrombosed aneurysmal right coronary artery (RCA) presenting as an inferior STEMI. A 61-year-old male presented with chest pain and diaphoresis. An ECG revealed inferior STEMI, and emergent coronary angiography (CAG) identified a large RCA aneurysm (2.14 x 1.4 cm) with significant thrombus and distal occlusion. PCI was performed, including aspiration thrombectomy and balloon angioplasty, followed by dual antiplatelet therapy (DAPT) and anticoagulation. Echocardiography confirmed the aneurysm and showed mildly reduced ejection fraction. Follow-up CAG demonstrated thrombus resolution, and the patient remained asymptomatic over 1.5 years. Thrombosed RCA aneurysms are challenging to diagnose due to varied presentations mimicking acute coronary syndromes. Imaging modalities such as echocardiography, cardiac CT, and CAG are crucial for accurate diagnosis and management. Treatment strategies include surgical resection, percutaneous interventions, and medical therapy, tailored to the patient's clinical and imaging findings. Thrombosed RCA aneurysms require prompt diagnosis and intervention. Advanced imaging and a tailored treatment approach are essential for optimal outcomes. This case highlights the importance of comprehensive management in patients with CAA-associated STEMI.

Keywords: Right Coronary artery aneurysm, ST-elevation myocardial infarction, Thrombosis

Received: January 15, 2025, Revised: February 21, 2025, Accepted: March 11, 2025, ePublished: April 1, 2025

Introduction

A coronary artery aneurysm (CAA) is a rare and potentially life-threatening vascular disorder characterized by a localized dilatation of a coronary artery segment, exceeding 1.5 times the diameter of the adjacent normal segment.^{1,2} This condition can be caused by various factors, including atherosclerosis, which is the most common cause, as well as congenital, mycotic, or systemic inflammatory diseases.² It is reported that CAA can lead to severe clinical sequelae, including thrombus formation, embolization, fistula formation, and rupture.³ The pathophysiology of CAAs is still not fully understood, and giant aneurysms are particularly rare.⁴ CAAs can involve any of the coronary arteries; however, anomalies of the left main stem are quite rare, occurring in approximately 0.1% of the population.⁵ Rarely, the aneurysm can become completely occluded by a thrombus.³ Thromboembolism is a recognized complication in patients predisposed to CAA who experience ST-elevation myocardial infarction (STEMI). In cases where a thrombus blocks the aneurysm, blood flow can be greatly reduced, resulting in a TIMI-I flow, which is marked by a large thrombus that almost completely blocks the distal part of the vessel. Additionally, the reduced flow in an enlarged aneurysmal

vessel encourages the formation of thrombus.⁶ Treatment options for CAAs include surgical correction, which is generally accepted as the preferred treatment,³ as well as thrombus aspiration and balloon dilation⁷; however, the management of patients presenting with STEMI secondary to CAA using primary coronary angioplasty can be challenging.⁸ It is essential to understand the pathophysiology, classification, clinical presentation, assessment, and management of CAAs to provide optimal care for patients with this condition.⁹

We describe the case of a 61-year-old individual with a right CAA and thrombus formation, who presented with an inferior STEMI. The patient initially underwent percutaneous coronary intervention (PCI) and was subsequently managed with intensification of anticoagulation therapy.

Case Presentation

A 61-year-old male with no prior medical history presented to the emergency department with a 24-hour history of left sternal chest pain radiating to his left arm, accompanied by diaphoresis. He denied any history of hypertension, diabetes mellitus, or tobacco use. On admission, his vital signs were stable, with a blood pressure of 130/80 mm Hg,



heart rate of 88 beats per minute, and oxygen saturation of 98% on room air. Cardiac auscultation revealed no murmurs, rubs, or gallops. An ECG demonstrated ST-segment elevation in the inferior leads (II, III, and aVF), consistent with an acute inferior STEMI. Emergent coronary angiography (CAG) revealed a large aneurysm measuring 2.14×1.4 cm in the mid-distal segment of RCA, containing a significant thrombus. Distal to the aneurysm, a 100% occlusion was observed, likely due to embolization of thrombotic material from the aneurysm. Proximal left anterior descending artery (LAD) and left circumflex artery (LCX) were ecstatic. PCI was performed (Supplementary file 1, Video 1), starting with aspiration thrombectomy to remove the thrombus, followed by plain old balloon angioplasty (POBA) of the distal occlusion to restore coronary flow (Supplementary file 2, Video 2). Given the high thrombotic burden, eptifibatide, a glycoprotein IIb/IIIa inhibitor, was administered intracoronary during the procedure. Due to the extensive thrombus, deployment of a covered stent was deferred to mitigate the risk of further complications. The patient was admitted to the coronary care unit and started on dual antiplatelet therapy (DAPT) with aspirin and clopidogrel, along with enoxaparin 70 mg (BD) for anticoagulation. Intravenous infusion of eptifibatide was continued for 24 hours post-PCI. A departmental echocardiogram showed normal LV and RV size and mildly reduced ejection fraction (40%-45%) with akinetic base and mid-inferior wall segments. Moreover, echo free round shape structure in the right-side AV groove near to tricuspid annulus in favor of right CAA (15×14 mm) was seen on echocardiogram (Figure 1). A follow-up CAG conducted one week later demonstrated significant resolution of the thrombus within the aneurysm (Supplementary file 3, Video 3). The patient was subsequently discharged on a regimen of apixaban 5 mg (BD), and clopidogrel 75 mg (OD), to minimize the risk of recurrent thrombotic events. Throughout his hospitalization and subsequent 1.5-year

follow-up, the patient remained asymptomatic, with no recurrence of chest pain or thrombotic complications.

Topic analysis

Table 1 presents a series of 9 cases involving thrombosed RCA aneurysms,¹⁰⁻¹⁸ often associated with acute coronary syndromes such as Inferior STEMI^{11-13,15} or NSTEMI.¹⁴ Patients ranged in age from 31 to 81 years, with both males and females represented. The clinical presentation varies from acute chest pain,^{12-15,18} dyspnea,¹⁸ limb edema,^{10,17} decreased exercise tolerance¹⁶ to hospital referral for imaging due to suspicious ECG findings or progressive symptoms suggestive of CAD.¹⁸

Initial diagnosis

The initial diagnosis of thrombosed RCA aneurysms is often challenging due to their varied clinical presentations, which can mimic acute coronary syndromes or other cardiac pathologies. Echocardiography is typically the first-line imaging modality, providing a non-invasive and rapid assessment of cardiac structures. In many cases, echocardiography reveals a large, hypoechoic mass adjacent to the RV^{10,16} or within the RCA,^{12,17} often accompanied by signs of RV compression. In the studies by Teng et al¹⁶ and Tham et al,¹⁷ the initial suspicions were an intra-RV cardiac tumor and a right atrial RA mass, respectively. This initial finding raises suspicion of a thrombosed aneurysm and prompts further investigation.

Imaging

Cardiac CT and CAG are then employed to confirm the diagnosis and provide detailed anatomical information. Cardiac CT, with its ability to generate three-dimensional reconstructions, offers precise measurements of the aneurysm's size, location, and relationship to surrounding structures, while CAG allows for dynamic visualization of coronary blood flow, often revealing complete occlusion of the RCA with distal perfusion maintained via collaterals. In complex cases, MRI may be utilized to further characterize the aneurysm, particularly when thrombus formation or tissue composition needs to be assessed.¹⁸ The integration of these imaging modalities ensures an accurate and comprehensive diagnosis, guiding subsequent management decisions.

Management

Management strategies varied depending on the clinical scenario and imaging findings. Surgical resection of the aneurysm, often combined with CABG, was a common approach, particularly in cases with significant thrombus burden or compression of adjacent structures. Percutaneous interventions, including thrombectomy and stenting, were employed in select cases, while medical therapy with anticoagulants and antiplatelet agents was used either as adjunctive treatment or in cases where

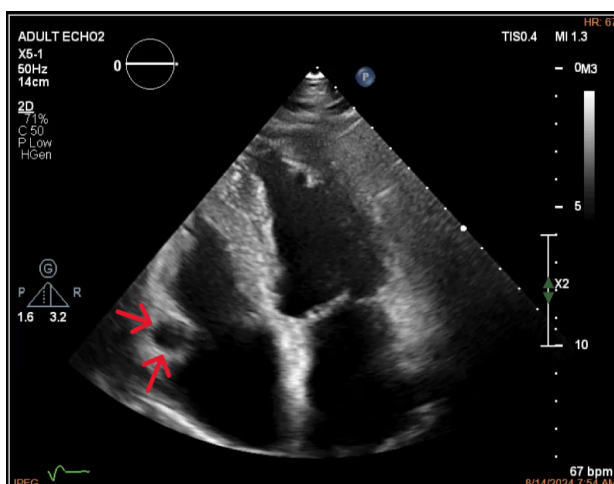


Figure 1. Echocardiogram (four-chamber view) with red arrows indicating the location of the right coronary artery

Table 1. Case reports of thrombosed RCA aneurysm

First author, year	Patients Gender and Age	Past Medical History	Presentation, initial diagnosis	Imaging for first Diagnosis of Aneurysm	Characteristics of Aneurysm (CAG)	Management and Follow-Up
Wang et al, 2024 ¹⁰	Female, 56 years old	Lower limbs Edema	Referred to hospital with chest congestion and limb edema ● Heavy ball mass adjacent to the RV accompanied (Echo-detected)	Echocardiography on admission: a large circular occupying lesion, resembling a bulky hypoechoic ball originating from RCA causing compression on RV. ECG-gated cardiac-CT and 3D reconstruction further confirmed the mass as a hypodense shadow.	One aneurysm measuring 6.3 cm × 5.4 cm (proximal RCA) with thrombosis	●Surgical resection and repair ●Post-operation: Not reported
Ishida et al, 2024 ¹¹	Male, 52 years old	HTN, dyslipidemia	Transient ischemic attack ● Anterior and Inferior STEMI	CTA: A giant CAA at the RCA (50mm), completely occluded by a thrombus ¹ .	RCA was occluded at proximal to the CAA, and the CAA did not show contrast. however, the artery distal to the CAA showed contrast via a collateral artery from the LCX.	●At first, IV heparin started. 4 days later, CTA and CAG were performed again. They showed slight contrast in the CAA and the distal coronary artery. Then, CABG (right gastroepiploic artery–RCA distal to the CAA) and CAA was resected. ●Post-operation: Not reported ●Conservative medical treatment.
Steenbergen et al, 2024 ¹²	Female, 81-year-old	None	Progressive, non-exertional chest pain ● Inferior STEMI	Emergent CAG: Giant saccular aneurysm in the proximal RCA with significant thrombus Cardiac CT: Aneurysm was 5cm in size.	Giant saccular aneurysm in proximal RCA with thrombosis	Low-dose rivaroxaban was added to existing antiplatelet therapy. (Attempts to enter into the RCA were unsuccessful) ●Post-operatopn: Not reported ●Administration of two boluses of a glycoprotein IIb/IIIa inhibitor (tirofiban) during CAG, followed by a tirofiban infusion (12.5 mg) for six hours. + ●DAPT (aspirin + clopidogrel) + enoxaparin during hospitalization ●Discharged with clopidogrel 75 mg (OD) rivaroxaban 20 mg (OD).
Khan et al, 2024 ¹³	Male, 31 years old	None	Sudden-onset chest pain ● Inferior STEMI	Emergent CAG: RCA ostial aneurysm of about 8 mm in size with heavy thrombus formation + an occluded distal PDA	RCA ostial aneurysm of about 8 mm in size with heavy thrombus formation + an occluded distal PDA	●CABG (Vein graft was used to bypass the distal RCA), thrombectomy. ●Post-operation: Not reported
Jalalzai et al, 2023 ¹⁴	Male, 56 years old	None	Retrosternal chest and, left arm pain of sudden onset, chest tightness, and shortness of breath. ● NSTEMI	CAG: two aneurysms measuring 52 × 45 mm and 22 × 20 mm	Two aneurysms measuring 52 × 45 mm, 22 × 20 mm (Middle and proximal segments)	●CABG (Vein graft was used to bypass the distal RCA), thrombectomy. ●Post-operation: Not reported
Al Hennawi et al, 2022 ¹⁵	Male, 40 years old	Gout	Acute onset of severe chest pain, sweating, pain radiation to the left arm with a tingling sensation, and concurrent acute-onset diarrhea. ● STEMI	CAG: Mid-RCA aneurysm, and mid-distal thrombotic occlusion of the RCA.	Mid-RCA aneurysm, and mid-distal thrombotic occlusion of the RCA.	●PCI: POBA on RCA. Distal occlusion was stented with Resolute Onyx. ●No postoperative complication. Discharged on DAPT for one year.
Teng et al, 2020 ¹⁶	Female, 53 years old	None	Decreased exercise tolerance and lower extremity edema for 3 months, elevated eosinophil cell number. ● Intra-RV mass suspicious for cardiac tumor.	Surgical view ² and IHC study confirmed the diagnosis of CAA with CD34, CD31 positive and D2–40 negative.	Intra-ventricular mass 3.5 × 2.5 cm in size locating at the right ventricle below the tricuspid annulus.	●Aneurysm was surgically resected. No CABG was performed. ●3 months later: A dilated RCA with the proximal diameter of 6.1 mm and a fistula between RCA and RV with a diameter of 2.3 mm was seen on TTE.

Table 1. Continued.

First author, year	Patients Gender and Age	Past Medical History	Presentation, initial diagnosis	Imaging for first Diagnosis of Aneurysm	Characteristics of Aneurysm (CAG)	Management and Follow-Up
Tham et al, 2019 ¹⁷	Male, 80 years old	CABG, repaired abdominal artery aneurysm and repaired bilateral iliac arteries aneurysms	None. ● Non-obstructive atrial mass proximal to the tricuspid valve at the right AV junction (Echo-detected)	CTA revealed a large calcified and thrombosed RCA aneurysm compressing the RA externally.	Not reported	● Aneurysmal mass was surgically resected + CABG (Femoral-popliteal bypass) ● Post-operation: Not reported
Arcinas et al, 2018 ¹⁸	Female, 54 years old	None	Progressive dyspnea following an episode of severe chest pain (For 3 weeks). Previous inferior MI (ECG-revealed). ● Referred for CTA based on ECG findings, suspicious for CAD.	TTE: A 7 x 5 cm circumscribed intrapericardial mass in the right AV groove. Cardiac CT: Confirmed mass with peripheral calcification, external to AV groove. CMRI: No gadolinium enhancement, suggestive of thrombosis in the mass	Giant dense mass 8 cm x 5 cm in the right AV groove.	● Aneurysmal mass was surgically resected. + CABG ● Post-operation: Not reported

¹ After posterior leaflet of tricuspid was detached from annulus, it was confirmed as a thrombosed right CAA.

² Normal views in echocardiography, CTA showed an irregular mass with internal contrast enhancement locating below the tricuspid annulus.

invasive procedures were not feasible.

Management algorithm for CAA with associated STEMI

Figure 2 represents the complex management of patients with STEMI related to a CAA.¹⁹

The management of a CAA associated with STEMI focuses on relieving the thrombotic burden to achieve TIMI II-III anterograde flow. Initial interventions may include aspiration thrombectomy, balloon angioplasty, thrombectomy, or direct catheter aspiration, with consideration given to adjuvant intracoronary fibrinolytics or antiplatelet agents. A thorough etiologic workup, utilizing angiography and intravascular ultrasound (IVUS), is essential to evaluate the aneurysm and identify any associated conditions, such as coronary stenosis or ruptured plaque. In cases where stenosis or plaque rupture is present, treatment options include the use of a self-expanding stent for vessels < 5 mm or a drug-eluting stent (DES) for vessels ≥ 5 mm, accompanied by anticoagulant and antiplatelet therapy in line with PCI and atrial fibrillation guidelines. Additionally, addressing the underlying cause of the aneurysm is critical. In the absence of associated stenosis, management varies based on thrombus burden: low thrombus burden may be managed with standard therapy, while high thrombus burden may necessitate the use of IIb/IIIa inhibitors and heparin perfusion, with consideration of a staged procedure. A covered stent may be employed in the absence of significant tortuosity, calcification, or side branch involvement. This approach underscores the importance of a tailored strategy, guided by thrombus

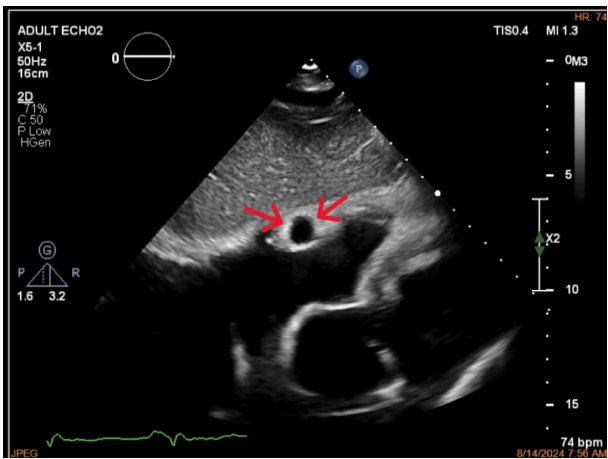


Figure 2. Echocardiogram (subxiphoid view) with red arrows indicating the location of the right coronary artery

burden, vessel characteristics, and associated pathology, to optimize outcomes in patients with CAAs and STEMI.⁹ PCI of an aneurysmatic culprit vessel has been shown to have a limited success rate, accompanied by a significantly high incidence of stent thrombosis (> 15%) at the 1-year follow-up mark.¹⁹ Consequently, the preferred revascularization strategy should prioritize the restoration of anterograde flow, with stent implantation being considered a secondary consideration (Figure 3).

Conclusion

In conclusion, thrombosed RCA aneurysms represent a challenging clinical entity, often presenting with acute coronary syndromes and requiring prompt diagnosis and

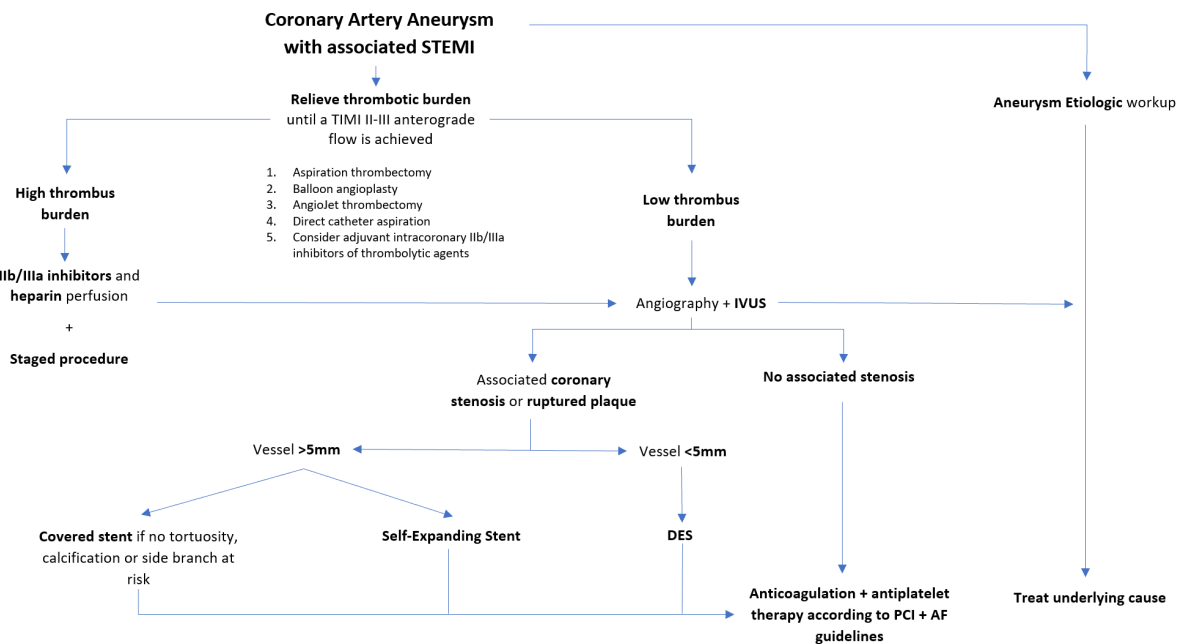


Figure 3. Management algorithm of CAA associated with STEMI

intervention. Advanced imaging techniques, including echocardiography, cardiac CT, CAG, and MRI, play a critical role in the initial diagnosis, characterization, and management of these aneurysms. A tailored approach to treatment, guided by imaging findings and clinical context, is essential for optimizing outcomes in these patients.

Authors' Contribution

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Competing Interests

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval

Written informed consent was obtained from the participant for anonymized patient information to be published in this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Supplementary Files

Supplementary file 1, Video 1 (PCI before thrombus aspiration)

Supplementary file 2, Video 2 (Thrombus aspiration POBA on distal RCA)

Supplementary file 3, Video 3 (Follow-up CAG, 1 week post-PCI, significant resolution of thrombus)

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