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IMAGING

CASE REPORT: CLINICAL CASE

Coronary Artery Aneurysm Thrombosis in a Patient With Marfan Syndrome

Mohamed Ramzi Almajed, MD,[a] Abdulla Almajed, MD,[b] Shannon Antishin, DO,[a] Abdulmalik Saleem, MD,[a] Benjamin Wexler, MD,[a] Mustafa Mohammed, DO,[c] Thomas Keimig, MD,[d] Natesh Lingam, MD,[c] Khaled Abdul-Nour, MD,[c] Michael Hudson, MD[c]

ABSTRACT

Coronary artery aneurysm in adults is associated with connective tissue disorders, including Marfan syndrome. Coronary artery aneurysms are at risk for thrombosis, which obstructs coronary flow and thus results in myocardial infarction. We present a case of coronary artery aneurysm thrombosis in a patient with Marfan syndrome who presented with acute coronary syndrome. (JACC Case Rep. 2024;29:102538) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 56-year-old man with Marfan syndrome (MFS) presented to the hospital with chest pain for 3 hours that started after he exerted himself during an employment physical fitness assessment. His chest pain was substernal and radiated to his left arm, with a severity score of 8/10; it worsened with exertion and improved with rest.

TAKE-HOME MESSAGES

- ACS in patients with vasculitides and connective tissue disorders may represent thrombosis of a CAA.
- Identification of a CAA thrombosis should prompt a comprehensive evaluation of the role of antiplatelet therapy, anticoagulation therapy, and revascularization.

On evaluation, his vital signs were within normal limits. The cardiac physical examination was significant for a regular heart rate and rhythm with normal S_1 and S_2 sounds; there were no added heart sounds or murmurs. Jugular venous distention and lower limb swelling were not present.

PAST MEDICAL HISTORY

Our patient initially received a diagnosis of MFS 15 years before presentation, at which time he underwent an evaluation after his brother received a diagnosis of aortic dissection and was subsequently found to have MFS. Genetic testing revealed a fibrillin-1 mutation in our patient. Cardiac testing showed severe dilation of the ascending aortic root that was managed by valve-sparing surgical aortic root replacement; findings on serial imaging with yearly echocardiography and cardiac magnetic resonance at years 5 and 10 post-procedure were unremarkable.

From the [a]Department of Internal Medicine, Henry Ford Hospital, Detroit, Michigan, USA; [b]Department of Internal Medicine, College of Medicine and Medical Sciences, Arabian Gulf University, Manama, Bahrain; [c]Division of Cardiology, Henry Ford Hospital, Detroit, Michigan, USA; and the [d]Department of Radiology, Henry Ford Hospital, Detroit, Michigan, USA.

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ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome

CAA = coronary artery aneurysm

CTA = computed tomography angiography

DOAC = direct oral anticoagulant

MFS = Marfan syndrome

PLB = posterior lateral branch

RCA = right coronary artery

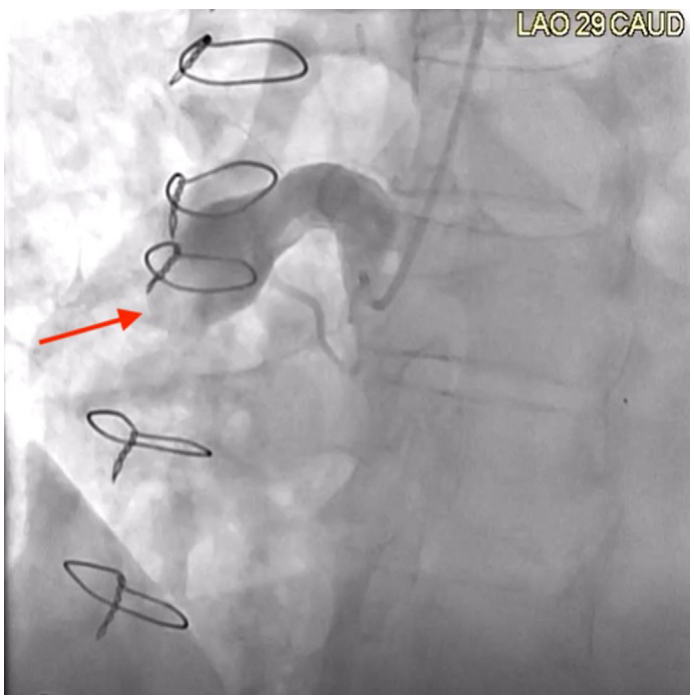
DIFFERENTIAL DIAGNOSIS

Our patient's presentation was most consistent with acute coronary syndrome (ACS). Causes include coronary artery occlusion, vasospasm, dissection, and aneurysm thrombosis. Other potential causes of his presentation included aortic dissection, acute aortic syndrome, pericarditis, myopericarditis, and pulmonary embolism.

INVESTIGATIONS

The electrocardiogram showed a normal sinus rhythm with T-wave inversions in leads II, II, and aVF without ST-segment changes. His high-sensitivity troponin I value was 15,537 ng/L on presentation and peaked at 16,211 ng/L (reference range, <19 ng/L) within 3 hours. His B-type natriuretic peptide value was 177 pg/mL (reference range, <50 pg/mL). Basic metabolic profile, hepatic function panel, coagulation profile, and complete blood count findings were unremarkable.

FIGURE 1 Invasive Coronary Angiography of the Right Coronary Artery



Left anterior oblique (LAO) caudal (CAUD) view demonstrating aneurysmal disease involving the right coronary system with incomplete filling of the right coronary artery (arrow).

A transthoracic echocardiogram revealed normal biventricular size and systolic function without regional wall motion abnormalities. Valvular evaluation was notable for mild aortic and mitral regurgitation without significant stenosis.

Our patient was medically managed for ACS; he received therapeutic anticoagulation with a heparin infusion, antiplatelet therapy with aspirin, a beta-blocker, and a statin. He underwent urgent invasive coronary angiography, which showed severe aneurysmal disease involving all coronary arteries with diffusely slow coronary flow. The distal right coronary artery (RCA) was poorly visualized, with contrast material pooling in the aneurysmal middle RCA, suggestive of aneurysm thrombosis causing coronary occlusion (**Figures 1 and 2**, Videos 1 and 2). Percutaneous coronary intervention was not performed.

Coronary computed tomography angiography (CTA) confirmed aneurysmal disease of the coronary arteries with severe involvement of the RCA, with dilation up to 25 mm in the distal portion with a thrombosed fusiform aneurysm of the posterior lateral branch (PLB) (**Figures 3 to 6**). The remainder of the evaluation showed no obstructive coronary artery disease, with a total coronary artery calcium score of 105, placing him between the 75th and 90th percentiles for age and sex.

On review of our patient's previous imaging performed to monitor the aortic root, the presence of aneurysmal disease involving the coronary arteries could be appreciated. He had not previously undergone dedicated advanced imaging of the coronary arteries or functional testing for myocardial ischemia.

MANAGEMENT

Our patient's angina resolved after medical management; therefore, his presentation did not warrant percutaneous or surgical revascularization. Occlusion of the RCA was deemed the likely culprit for his clinical presentation, for which he was prescribed lifelong therapeutic anticoagulation with a vitamin K antagonist to reduce the risk of coronary artery aneurysm (CAA) thrombosis. He was referred to outpatient cardiologists and cardiac surgeons specialized in MFS and associated diseases of the aorta.

OUTCOME AND FOLLOW-UP

Our patient received maintenance anticoagulation therapy with a vitamin K antagonist without further episodes of angina. Three months after his presentation, he was found to have aortic valve infective

endocarditis resulting in severe insufficiency with valve destruction. He was managed with antibiotics and underwent surgical replacement of the aortic valve with a mechanical valve. Given his known myocardial infarction in the setting of ischemia at the PLB, he underwent concurrent coronary artery bypass grafting with a saphenous vein graft to the posterior descending artery.

DISCUSSION

Our patient's clinical presentation was consistent with ACS secondary to CAA thrombosis. His history of MFS likely predisposed him to the development of extensive CAAs, which are prone to complications, including thrombosis, embolization, rupture, and vasospasm.

CAA is defined as coronary artery dilation with a diameter that is 50% greater than that of normal adjacent segments. Giant CAA is defined as dilation that is >8 mm in diameter or is 400% greater than that of normal adjacent segments.[1,2] CAAs rarely occur in the general population and are identified incidentally among 0.5% to 4.9% of patients who undergo invasive coronary angiography.[3,4] Giant CAA have an incidence of 0.02% and most commonly involve the RCA.[5] CAAs are more prevalent among patients with MFS compared with the general population.[6] In MFS, fibrillin gene mutations disrupt the architecture of the arterial wall and result in a weakened structure that is at higher risk of CAA formation.[7]

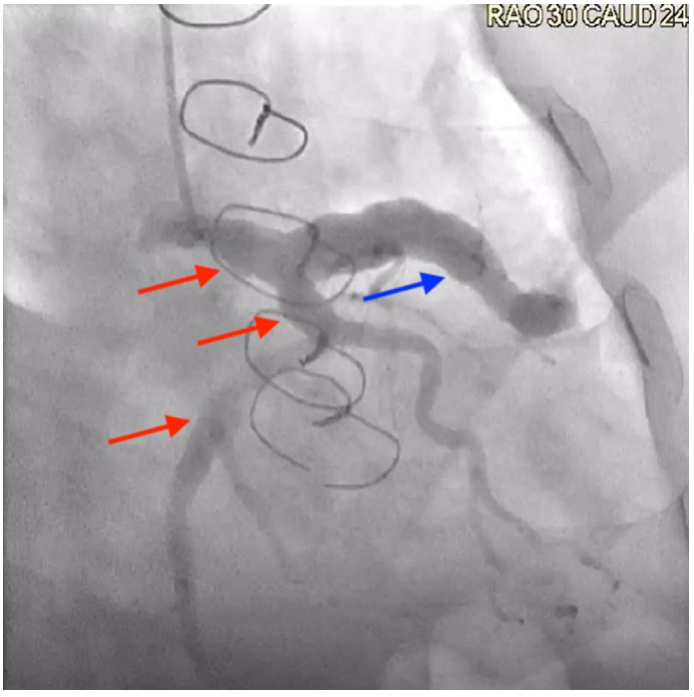
Management of CAA in adults is driven by expert opinion and extrapolated from clinical practice guidelines of similar conditions, such as those involving pediatric patients with CAA and patients with Kawasaki disease who develop CAA thrombosis. The literature regarding the use of medications such as direct oral anticoagulant (DOAC) agents, novel coronary stents, and advanced revascularization techniques is limited.

In patients presenting with ACS and a CAA thrombosis culprit lesion, medical management with antiplatelet and anticoagulation therapy is vital and aims to reduce the risk of thrombosis and rupture.[2,8] Patients at low risk of thrombosis, such as those with small and isolated aneurysms, are managed with single antiplatelet therapy consisting of aspirin, 81 mg daily.[1] Patients at moderate risk of thrombosis, such as those with moderately sized and multiple aneurysms, are managed with dual antiplatelet therapy consisting of aspirin, 81 mg daily, and clopidogrel, 75mg daily.[1]

In patients at high risk of thrombosis, such as those with giant aneurysms or significant predisposing risk factors, therapeutic anticoagulation with a vitamin K antagonist such as warfarin to a target international normalized ratio of 2.0 to 3.0 is recommended in addition to antiplatelet therapy with aspirin.[2,9] DOAC agents may be considered for anticoagulation therapy because they have been used in patients with CAA in the setting of Kawasaki disease and coronary ectasia with comparable efficacy and safety.[10-12] Medical therapy, however, does not entirely mitigate the morbidity and mortality conferred by the risk of complications involving existing CAAs.

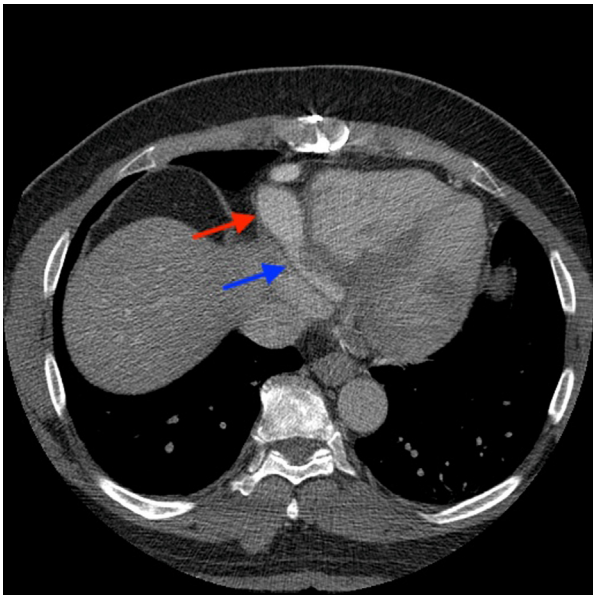
Patients with high-risk presentations, including refractory angina, arrhythmias, and hemodynamic

FIGURE 2 Invasive Coronary Angiography of the Left Anterior Descending Artery



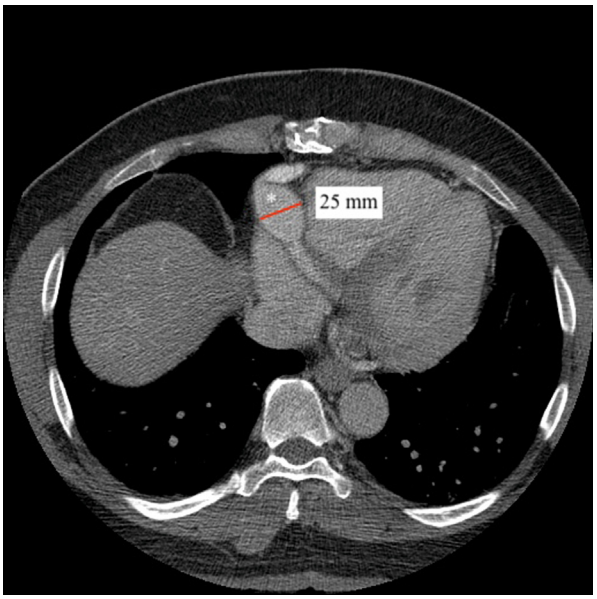
Right anterior oblique (RAO) caudal (CAUD) view demonstrating aneurysmal disease involving the left coronary system (red arrows) most prominent in the left anterior descending LAD artery (blue arrow).

FIGURE 3 Coronary Computed Tomography Angiography of the Right Coronary Artery



Axial view of a right coronary artery fusiform aneurysm (red arrow), with a filling defect in the distal right coronary artery (blue arrow).

FIGURE 4 Coronary Computed Tomography Angiography of the Right Coronary Artery



Axial view of a right coronary artery fusiform aneurysm measuring 25 mm in diameter (star).

instability, warrant urgent revascularization. Revascularization is difficult because the anatomy and high thrombus burden of aneurysms pose a high risk of failure, embolization, and repeat thrombosis.[13] Percutaneous interventions include thrombolytic administration, aspiration thrombectomy, and stent placement.[14] Intervention on saccular and small pseudoaneurysms not involving a major side branch consists of covered stent exclusion, whereas intervention on saccular and fusiform aneurysms involving a major side branch consists of stent-assisted coil embolization.[15] The absence of coronary stents designed for the treatment of CAA poses a significant limitation because clinically significant aneurysms are often larger in diameter than most available stents. The advent of coronary stents with greater dimensions, tapered coronary stents, and purpose-specific devices may offer better procedural outcomes.[16] Surgical revascularization consists of coronary artery bypass, often with aneurysm resection.[2]

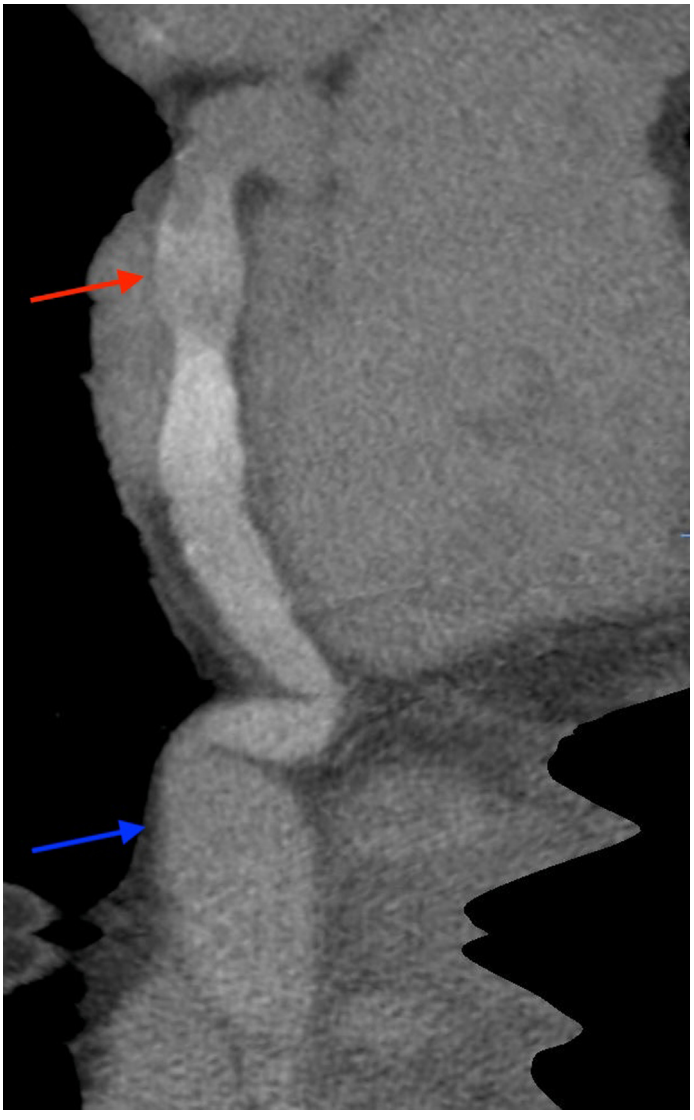
Multimodal imaging has the potential to prevent complications of CAA in high-risk patients such as those with MFS through early detection and risk factor modification. Surveillance is typically performed after surgical repair of the aortic root in patients with routine CTA and magnetic resonance angiography. These imaging modalities can identify patients with high-risk CAA, and that would offer opportunities for early intervention.[5] Retrospective review of previous imaging in patients who have a diagnosis of CAA thrombosis often reveals the presence of CAA before symptom onset.

Patients with CAA who are managed with medical therapy or revascularization require close follow-up and a multidisciplinary heart team approach to their care. These patients could benefit from surveillance imaging with advanced imaging modalities and functional testing for inducible myocardial ischemia; the interval of follow-up should be tailored to each patient's individual risk of complications. In the absence of defined imaging protocols and clinical practice guidelines, further research is necessary to clarify the role of screening and surveillance for CAA in at-risk patients.

CONCLUSIONS

CAA is a lesser-known complication of MFS. It confers high morbidity and mortality because of the risk of aneurysm thrombosis. Dedicated imaging to screen for and monitor CAAs in these patients could be useful to prevent complications.

FIGURE 5 Coronary Computed Tomography Angiography of the Right Coronary Artery



Coronal view of a right coronary artery fusiform aneurysm (blue arrow), with a filling defect in the distal right coronary artery (red arrow).

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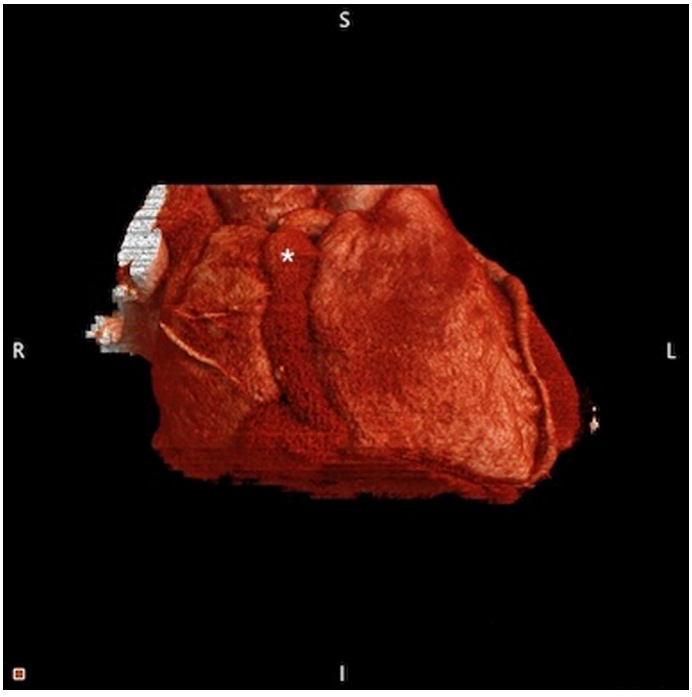
ADDRESS FOR CORRESPONDENCE: Dr Michael P Hudson, Division of Cardiology, Henry Ford Hospital, 2799 West Grand Boulevard, Detroit, Michigan 48202, USA. E-mail: mhudson1@hfhs.org.

FIGURE 6 Coronary Computed Tomography Angiography With 3-Dimensional Reconstruction of the Right Coronary Artery



Diffuse aneurysmal disease of the right coronary artery (star).

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KEY WORDS acute coronary syndrome, coronary artery aneurysm thrombosis, Marfan syndrome

APPENDIX For supplemental videos, please see the online version of this paper.