

## CASE REPORT

## INTERMEDIATE

## CLINICAL CASE

# Aortic Thrombosis and Subsequent Myocardial Infarction in a Previously Healthy 12-Year-Old Male



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## ABSTRACT

Aortic thrombus formation in children is uncommon, particularly in an otherwise healthy pediatric patient. Thromboembolism of such thrombi resulting in subsequent ST-segment elevation myocardial infarction is, thus, exceedingly rare. **(Level of Difficulty: Intermediate.)** (J Am Coll Cardiol Case Rep 2023;25:102049) © 2023 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 12-year-old athletic boy who presented to an outside emergency department with a 1-day history of nausea and vomiting followed by a severe sharp chest pain that started on the day of presentation. The chest pain was midsternal in location without radiation. He did not have any obvious illness in the prior few months. He also recalled he had a hockey puck injury to the lower neck a few weeks before presentation.

## LEARNING OBJECTIVES

- To list the differential diagnoses of chest pain in a pediatric patient.
- To recognize a rare but lethal condition in an otherwise previously healthy pediatric patient with chest pain.

## PAST MEDICAL HISTORY

There is no significant past medical history.

## DIFFERENTIAL DIAGNOSIS

The differential diagnosis of chest pain in a previously asymptomatic pediatric patient encompasses various etiologies, namely: 1) musculoskeletal etiologies encompassing conditions like costochondritis and muscle strain; 2) gastrointestinal origins involving gastroesophageal reflux and gastritis; 3) respiratory factors comprising pneumonia, pneumothorax, and pulmonary embolism; 4) cardiac underpinnings encompassing pericarditis, myocarditis, aortic or pulmonary stenosis, and hypertrophic cardiomyopathy; and 5) blunt chest injury.

## INVESTIGATIONS

He was transferred to our institution for a concern of acute perimyocarditis with diffuse ST-segment

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Manuscript received June 14, 2023; revised manuscript received September 8, 2023, accepted September 12, 2023.

## ABBREVIATIONS AND ACRONYMS

**IABP** = intra-aortic balloon pump

**LAD** = left anterior descending

**LCA** = left coronary artery

**LV** = left ventricle

elevation noted on electrocardiogram (Figure 1). Troponin I at the emergency department was elevated at 1.07 ng/mL (normal range: <0.045 ng/mL) and elevated to 186 ng/mL (normal range: <0.05 ng/mL) upon arrival at our hospital. Echocardiogram showed intraluminal aortic mass attached at the posterior sinotubular junction with apical wall motion abnormality and septal hypokinesis (Figure 2). He was therefore urgently taken to the computed tomography angiography, which confirmed the intraluminal aortic mass and possible occlusion of the left coronary artery (LCA) (Figures 3 to 5). Subsequently, he was taken directly to the operating room for emergent thrombectomy surgery as well as coronary angioplasty.

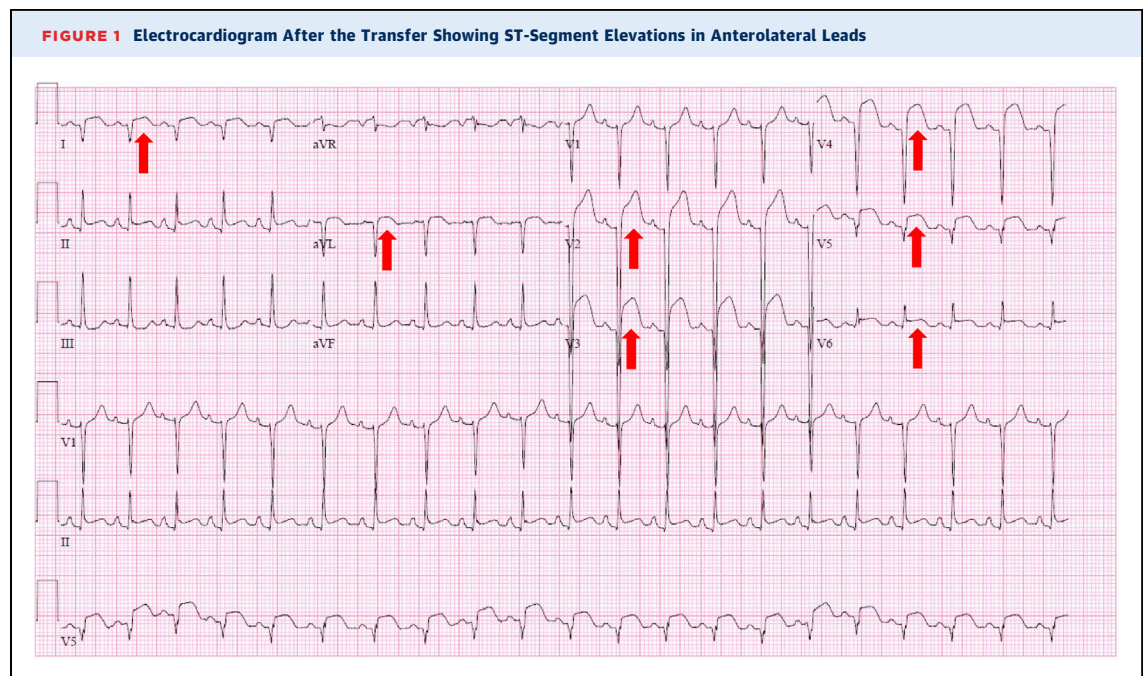
## MANAGEMENT

After he was placed on bypass, the ascending aorta was opened, followed by direct infusion of cardioplegia into both coronary arteries. An organized, whitish thrombus of 2 cm by 2 cm was noted to be just above the orifice of the LCA (Figure 6). It was removed with no obvious intimal injury at the site of its attachment. Intraoperative LCA angiography showed a large thrombus completely obstructing the left anterior descending coronary artery (LAD) completely

(Figure 7). Intracoronary tissue plasminogen activator was slowly administered, with the subsequent angiogram demonstrating flow into the LAD, but the thrombus was still present. Subsequently, the balloon thrombectomy of the LAD was performed multiple times through a sheath (Figure 8). The following angiogram still showed a thrombus in a branch of the LAD; therefore, tissue plasminogen activator injection was repeated followed by nitroglycerin administration (Figure 9). The angiogram then showed patency of the diagonal branch with some obstruction at the distal (Figure 10). At the end of the case, transesophageal echocardiogram showed severe left ventricle (LV) dysfunction. Intra-aortic balloon pump (IABP) was placed to optimize the coronary blood flow, and he was brought to the cardiac intensive care unit. He was then transferred to the cardiac intensive care unit on the IABP, in addition to vasoactive support of epinephrine 0.1 µg/kg/min, norepinephrine 0.1 µg/kg/min, and dopamine 10 µg/kg/min.

The postoperative course was complicated by malignant hyperthermia requiring 2 doses of dantrolene. IABP was gradually weaned and eventually removed on postoperative day 4. He had significant LV dysfunction postoperatively and was discharged home approximately 1 month after the surgery on oral guideline-directed medical therapy (metoprolol, spironolactone, sacubitril/valsartan) for heart failure

**FIGURE 1** Electrocardiogram After the Transfer Showing ST-Segment Elevations in Anterolateral Leads



with reduced ejection fraction and triple antithrombotic therapy (aspirin, apixaban, and clopidogrel). The discharge electrocardiogram continued to show some ST segment changes (Figure 11).

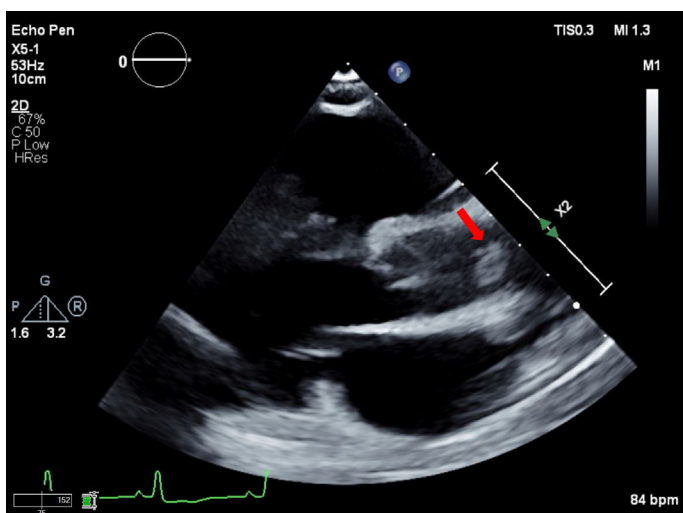
## DISCUSSION

Formation of a thrombus in the aorta is a rare condition in any age group, let alone in a previously healthy pediatric patient with no known comorbidities, such as coagulopathy or malignancy. In a study of 10,671 autopsies, aortic thrombus without an aneurysm or dissection occurred with incidence rate of about 0.45% (48 cases).<sup>1</sup> The aortic isthmus, descending thoracic aorta, and lower abdominal aorta are the most common sites of the aortic thrombus, whereas the ascending aorta is the rarest place for the thrombus formation.<sup>2</sup> Bowdish et al<sup>3</sup> also reported the similar demographic of aortic thrombus locations in a study series of 78 patients: 64% were in the abdominal aorta, 28% were in the descending aorta, and the ascending and aortic arch accounted for only 8%.

There are several risk factors for thrombus formation in the aorta, which include coagulopathies such as protein S or C deficiency and anti-phospholipid antibody syndrome, malignancies, aortitis, collagen disease, aortic structural abnormalities, trauma, intra-aortic atheroma, hormone therapy, steroid use, substance abuse, and atrial fibrillation.<sup>4-6</sup> Our patient did not have any of the risk factors listed, and all results of the coagulation workup that was done after the admission had been negative, except that he had an elevated result on the factor VIII assay, which was first obtained 6 days after the initial surgery. As previously mentioned, the patient had a hockey puck injury to his left neck that happened a few weeks before the initial presentation; however, it is unclear whether this event was related to thrombus formation, considering no blunt trauma injury was found inside of the chest.

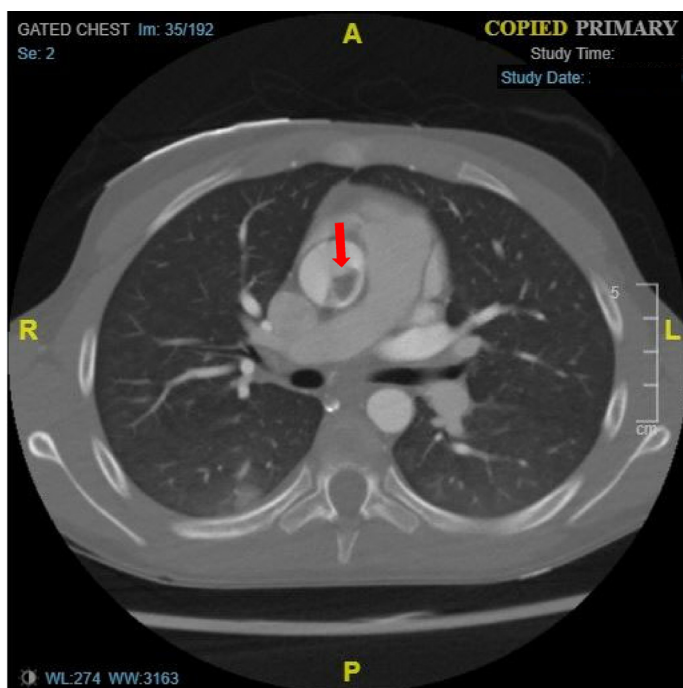
Interestingly, the age demographics of aortic thrombosis or free-floating aortic thrombus seem to be almost biphasic—in the neonatal period, related to umbilical lines or other foreign material,<sup>7</sup> and in older populations, related to the risk factors listed earlier—whereas our patient is a previously healthy 12-year-old boy. Moreover, there is no report of the aortic thrombus causing acute myocardial ischemia in a 12-year-old healthy boy. Lemaire et al<sup>8</sup> reported a case of a thrombus in the proximal aorta embolizing into a coronary artery and causing myocardial infarction in a young female smoker. They reported that myocardial infarction secondary to free-floating aortic thrombus is more common in young female smokers;

**FIGURE 2** Echocardiogram From the Parasternal Long-Axis View Showing an Intraluminal Aortic Mass Attached Posterior to the Sinotubular Junction



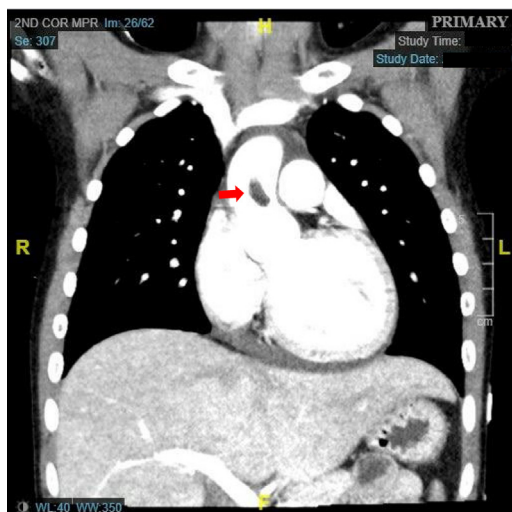
including their patient that they reported and among the 18 cases they identified, 72% were female, with mean age of 45 years, and 57% had a history of cigarette smoking.<sup>8</sup>

**FIGURE 3** Intraluminal Aortic Mass (Computed Tomography Axial View)



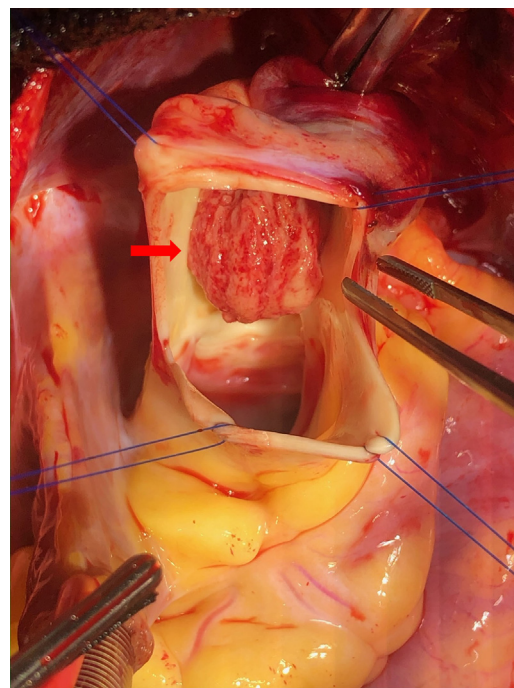


**FIGURE 4** Intraluminal Aortic Mass (Computed Tomography Coronal View)



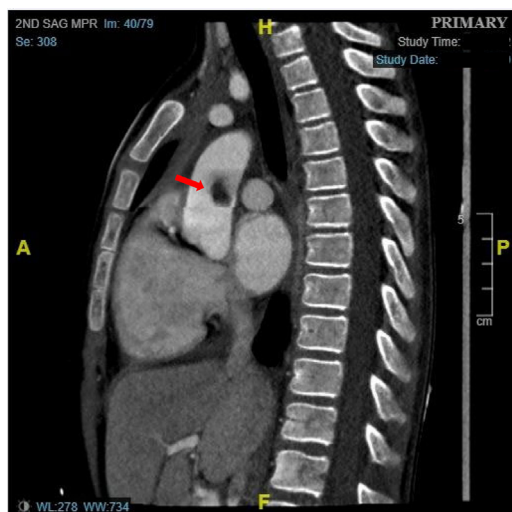
There are several topics for discussion from this case. First, cold selective antegrade cardioplegia was administered to this patient, but given the involvement of coronary artery that was suggested by computed tomography angiography, retrograde cardioplegia may have reduced the ischemic injury and have had better recovery of myocardial function.<sup>9</sup> Second, a hybrid operating room could have enabled the operators to perform the coronary artery angiography and thrombectomy simultaneously following

**FIGURE 6** Intraoperative Finding of a Whitish Thrombus Just Above the Orifice of the LCA

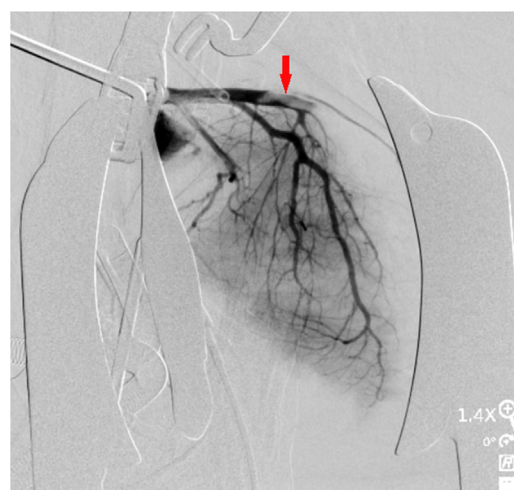


aortic wall thrombus removal. In the case of unsuccessful thrombectomy, coronary artery bypass graft could have been an option. It is important to consider such alternatives and whether these may have

**FIGURE 5** Intraluminal Aortic Mass (Computed Tomography Sagittal View)



**FIGURE 7** Intraoperative Left Coronary Artery Angiography Showing a Complete Occlusion of the Left Anterior Descending Coronary Artery

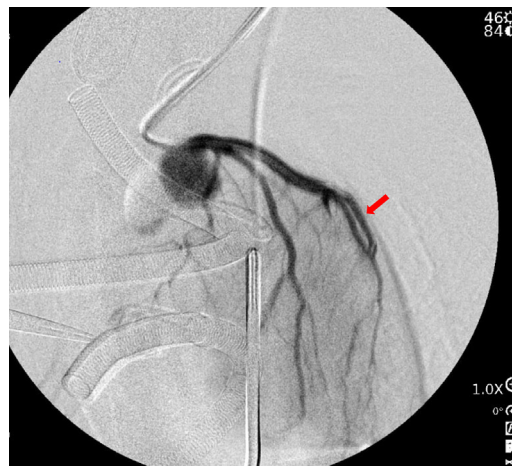


**FIGURE 8** LCA Angiography After Tissue Plasminogen Activator Administration Showing Improvement of Flow in the LAD But No Flow Going Into the Branch of the LAD and Attempting Intervention



LAD = left anterior descending coronary artery; LCA = left coronary artery.

**FIGURE 10** Angiogram at the End Showing Opening of the Branch Coronary Artery of the Left Anterior Descending Coronary Artery



shortened the total ischemic time and potentially preserved ventricular function.

## FOLLOW-UP

Despite guideline-directed medical therapy, the patient continued to have persistent cardiac function with limited activity and significant LV fibrosis on cardiac magnetic resonance, and he was therefore

listed for heart transplantation, which he received 5 months after the initial presentation. Almost 3 weeks following transplantation, while only on aspirin, he was found to have an intracardiac thrombus, requiring surgical thrombectomy. Post-thrombectomy, he was restarted on triple antithrombotic therapy. Almost 2 years post-thrombectomy, he remains on triple therapy without thrombosis recurrence and has normal cardiac function.

## CONCLUSION

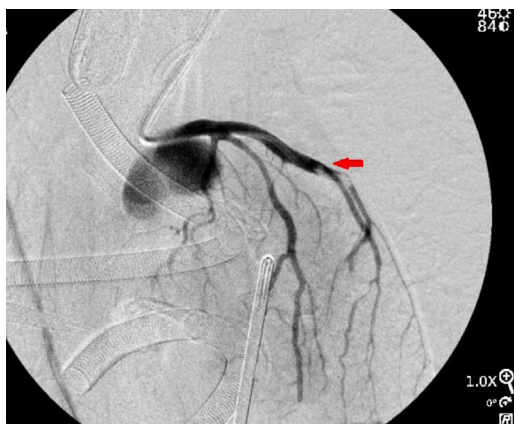
Aortic thrombus formation in a previously healthy pediatric patient is an extremely rare condition, and it is even more rare that it results in ST-segment elevation myocardial infarction. Multiple risk factors have been reported, but there may not be an identifiable risk in all patients. Prompt identification and initiation of management of such thrombi are crucial and require rapid organization and response by a skilled multidisciplinary team.

## FUNDING SUPPORT AND AUTHOR DISCLOSURES

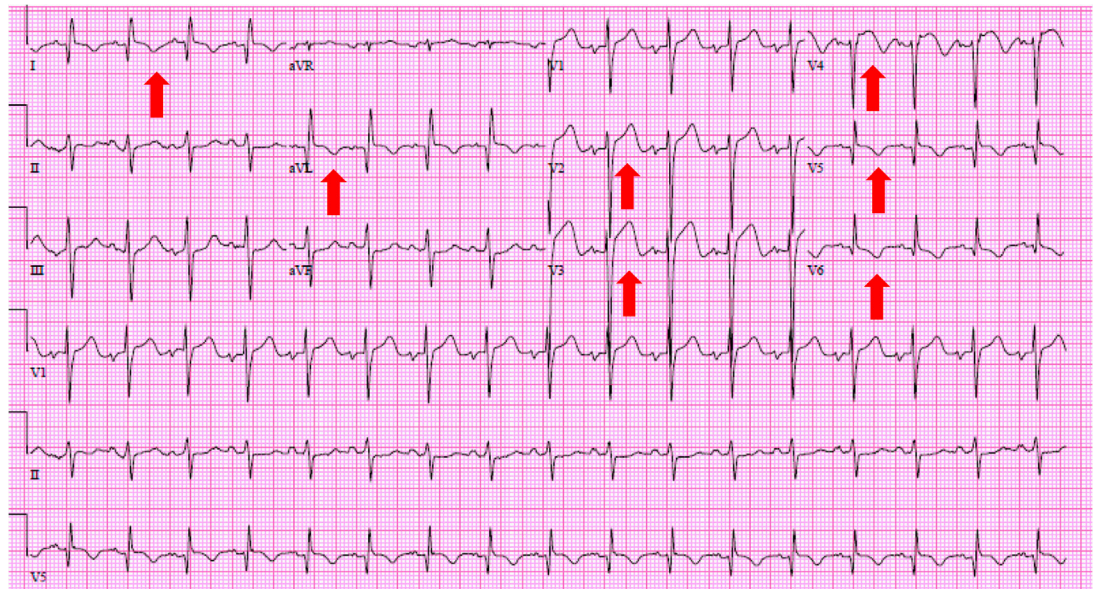
The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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**FIGURE 9** Angiogram Still Showing a Thrombus in a Branch of the Left Anterior Descending Coronary Artery



**FIGURE 11** Discharge Electrocardiogram Continued to Show ST-Segment Elevations in Leads V<sub>2</sub> to V<sub>4</sub> and Inverted T-Wave Replaced in the Lateral Leads



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**KEY WORDS** acute coronary syndrome, acute heart failure, myocardial ischemia, pediatric surgery, thrombus