

Case Report

Intraoperative Embolization of a Left Ventricular Apical Thrombus to the Innominate Artery during Coronary Artery Bypass Grafting Surgery: Diagnosis and Management

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Abstract

Left Ventricle Thrombus (LVT) is a known complication arising after acute myocardial infarction which can be attributable to wall hypokinesis or akinesis. It is most frequently seen with anterior wall MI. Embolization of these thrombi into the systemic circulation is possible and can result in devastating clinical outcomes. Removing the thrombus with an incision to a weak, infarcted myocardium can result in potentially fatal cardiac dysfunction or arrhythmias. In this case report, we describe successful and timely removal of thrombus from the innominate artery by suctioning it through an incision in aorta after achieving a temporary circulatory arrest. The thrombus was seen ejecting through the left ventricle on trans-esophageal echocardiogram during coronary artery bypass grafting.

Introduction

Left Ventricle (LV) thrombus is a complication arising after acute myocardial infarction and can lead to devastating outcomes if the thrombus embolizes to the systemic circulation [1]. Treatment options prior to embolization include left ventriculotomy with removal of the thrombus or non-operative management with anticoagulation. The decision for intervention depends upon the characteristics of the thrombus a mobile mass protruding into the LV cavity versus a flat lesion that is adherent to the endocardium. Occasionally, characteristics of the LV thrombus may be indeterminant and the decision to intervene is based on clinical judgment. The case described in this report features an LV thrombus that embolized after removal of the aortic cross-clamp following Coronary Artery Bypass Grafting (CABG). The discovery of the event required prompt intervention to prevent catastrophic cerebrovascular injury.

Case Presentation

A 59-year man presented with shortness of breath for several weeks prior to admission. He was found to have an Abnormal Electrocardiogram (EKG) and positive cardiac enzymes. He was

admitted and diagnosed with an acute anterior wall myocardial infarction. Cardiac catheterization demonstrated two-vessel coronary artery disease involving the Right Coronary Artery (RCA) and its Posterior Descending Artery (PDA) branch as well as critical disease in the Left Anterior Descending Artery (LAD). A preoperative Trans-Thoracic Echocardiogram (TTE) showed multiple regional wall motion abnormalities, normal valvular function, and an LV apical thrombus (Figure 1). The patient was scheduled for Coronary Artery Bypass Grafting (CABG). Intra-operatively, Trans-Esophageal Echocardiography (TEE) showed a well-organized mural based LV apical thrombus (Figure 2). The decision was made to proceed with the CABG surgery and manage the thrombus medically with postoperative anticoagulation. Standard aortic and right atrial cannulation was done to initiate Cardiopulmonary Bypass (CPB). The CABG technique was completed with aortic cross-clamping and cardioplegic arrest. Upon completion of the procedure, the cross-clamp was removed and cardiac contractility restored spontaneously. During this time, intraoperative TEE assessment captured embolization of the LV thrombus through the aortic valve. Simultaneously, the right radial arterial-line tracing was noted to flatten and the pressure curve on the monitor appeared dampened. An epi-aortic ultrasound revealed the thrombus lodged at the origin of the innominate artery (Figure 3). The patient was placed back on CPB and cardioplegic arrest was re-instituted. The patient was cooled and temporary hypothermic circulatory arrest initiated for seven minutes. During this time, a transverse aortotomy was done proximal to the innominate artery and the thrombus removed; the orifices of all arch vessels were thoroughly inspected and no additional clot was identified. The CPB was re-initiated and the patient re-warmed. The right radial A-line tracing returned to normal and a repeat epi-aortic ultrasound showed absence of clot with good blood flow into the innominate artery and the other arch vessels. The postoperative course was uneventful and the patient discharged in satisfactory condition. Surgical pathology reported the specimen as an organized thrombus measuring 2.0 cm x 1.8 cm x 1.1 cm.

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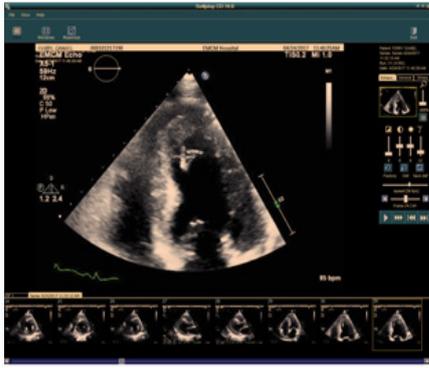


Figure 1: Pre-Operative Transthoracic Echocardiogram demonstrating LV apical Thrombus.



Figure 2: Intra-Operative Trans-Esophageal Echocardiogram demonstrating LV apical Thrombus.

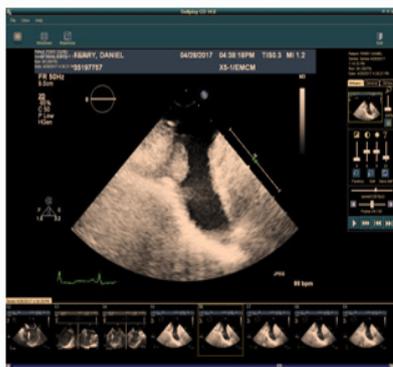


Figure 3: Intra-Operative Epi-Aortic Ultrasound showing thrombus within innominate Artery.

Discussion

Left ventricular thrombi are reported to occur in up to 30%-45% of patients after acute anterior wall myocardial infarction [2]. In most cases, these infarcts occur in the distribution of left anterior descending artery [3]. The majority of thrombi occur in the apex and are associated with an abnormality of ventricular wall motion such as akinesia or dyskinesia promoting blood stasis and clot formation. Thrombi usually appear within the first 10 days of myocardial infarction and 96% of the thrombi appear within the first two weeks [4]. Embolization of these thrombi into the systemic circulation which can occur in up to 10% of cases can lead to fatal consequences such as stroke and other vital organ damage [5]. Embolization is more likely to occur with protruding or mobile thrombi than with laminar

thrombi [6,7]. Risk factors for embolization include advanced age, thrombus size, prior history of embolization, diffuse LV dilatation with systolic dysfunction, LV aneurysm and atrial fibrillation [8,9]. Echocardiographic evaluation following an acute MI is a useful tool in detecting the presence of LV thrombus. Two-dimensional TTE is the technique most commonly used for assessing presence, shape and size of LV mural thrombi and provides excellent specificity (85%-90%) and sensitivity (95%) [10]. Trans-Esophageal Echocardiography (TEE) is the diagnostic test of choice for detecting atrial masses or thrombi in the left atrial appendage, but its value is limited in detecting LV thrombus as the apex is often not well visualized [9]. However, vertical scans such as mid-esophageal 4 chamber, midesophageal 2 chamber and deep trans-gastric views generally provide a good assessment of LV apex [11]. Intraoperative embolization of LV thrombus is not very probable, but early detection using TEE can prevent disastrous outcomes. The decision to surgically remove an LV thrombus versus medical management with anticoagulation depends on clinical and technical factors as well as the natural history of this disorder. Approximately 30%-76% of all the LV thrombi spontaneously resolve within a time period of two-years after the initial infarction [2]. In the pre-anticoagulation era, treatment mainly focused on surgical removal of the thrombus via an incision to the ventricle but this can potentially lead to cardiac dysfunction and fatal arrhythmias. In addition, placing sutures on a fragile myocardium can result in uncontrolled bleeding. Anti-coagulation therapy following myocardial infarction has shown a significant decrease in embolic risk and currently the 2013 American College of Cardiology Foundation/American Heart Association ST Segment Elevation MI (STEMI) guidelines recommend anticoagulation for patients with acute MI and asymptomatic LV mural thrombus (Class IIa, Level of Evidence, LOE: C) [12]. Given the increased risk of bleeding with anticoagulant and dual anti-platelet therapy, these guidelines also suggest lower INR ratio goals (2.0-2.5) in this clinical setting. However, there is limited data on the optimal anti-thrombotic therapy for preventing embolism while minimizing bleeding events in patients with Acute Myocardial Infarction (AMI) complicated by left ventricular thrombus. Patients who have anterior MI with risk factors for mural thrombus formation the role of anticoagulation is still controversial. For example, the 2013 American College of Cardiology Foundation/American Heart Association STEMI guidelines state that anticoagulation therapy may be considered with STEMI and anterior apical akinesia or dyskinesia (Class IIb, LOE: C) [12]. However, this recommendation is based on older studies and it is unknown if the benefits of anticoagulation outweigh the known bleeding risks. Currently, there are no studies available to determine the best strategy to treat LV thrombi. In one study measuring the long-term outcome of treatment strategies, the overall risk of systemic thromboembolism was higher in those treated with anticoagulation versus those that underwent surgical resection (17.7% versus 0%) [13]. Moreover, there are no specific guidelines for well-organized clots that have been dislodged into the systemic circulation each case requires an individualized approach. In our patient, the thrombus was seen dislodging through the LV on TEE and its location was confirmed in the innominate artery using epi-aortic ultrasound. The presence of thrombus into arterial circulation warranted immediate surgical removal owing to the likelihood of a devastating cerebrovascular accident. Although LV thrombectomy was not considered at the onset of the CABG procedure, surgeons must be prepared to modify the operation in the event of an unexpected intraoperative event. Use of TEE and epi-aortic ultrasonography, as well as the acute change in the right radial arterial line, allowed

for a rapid diagnosis and treatment of an otherwise devastating complication.

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