Vascular sequelae of aortic arch thrombo-emboli

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Date accepted for publication 22 October 2008

Abstract

An 88-year-old woman presented with thrombo-embolic disease of the left upper extremity manifested by the classical signs of pain, paresthesias, pallor, pulselessness, and poikilothermia. She was found to have a thrombo-embolus in the left distal brachial artery as well as two large thrombi in the aortic arch and proximal descending aorta. Initial surgical intervention included a left upper extremity embolectomy with subsequent restoration of blood flow to the left arm. Due to the patient’s advanced age, comorbidities, and availability of medical therapy, it was decided to treat her aortic thrombi through anti-coagulation with coumadin.

Keywords

Thrombus; emboli; aortic arch; thrombo-embolism.

Introduction

Sequelae of aortic thrombi are increasingly reported in the literature today compared to 10 years ago, perhaps due in part to the advent and widespread use of imaging modalities such as transesophageal echocardiography as well as increasing age and the prevalence of atherosclerosis in the general population. Although most embolic cases originate in the heart (~85%), the most common origin of non-cardiac emboli in the aorta are atherosclerotic lesions or abdominal aortic aneurysms[1,2]. It is known that 27% of patients with strokes or peripheral embolization have some form of aortic disease[3]. The majority of such cases are reported in adults with a history of disease such as atherosclerosis, dissection, trauma, malignancy, infection, or coagulopathy. In patients in whom thrombosis of the thoracic aorta is involved, 0.8-9% of patients will present with embolic disease involving the extremities[4]. We present a case of a woman with classical signs of acute arterial occlusion and was concurrently discovered to have thrombotic disease involving the aortic arch and descending thoracic aorta.
Case report

An 88-year-old woman presented to the emergency department with left-sided shoulder pain radiating to her fingertips associated with paresthesias, pallor, and poikilothermia. She was known to have coronary artery disease, hypertension, hypercholesterolemia, atrial fibrillation (successfully treated with cardioversion 3 months previously), and peripheral arterial disease. There was no history of diabetes mellitus or stroke. At admission, her brachial artery blood pressure was 142/74 mmHg in the left arm and 159/78 mmHg in the right arm. An EKG indicated normal sinus rhythm without any abnormalities. During evaluation, her whole left hand was duskier and appreciably cooler than the right; there was also decreased sensation and slow capillary refill (>3 s). On the side of concern, brachial and axillary pulses were palpable and a pulse was traceable by Doppler to the mid forearm, but radial and ulnar pulses were absent.

A computer tomographic angiogram (CTA) showed extensive ulcerative, non-calcified plaques with a series of small 1 x 1-mm thrombi at the takeoff of the subclavian artery as well as a 14 x 12-mm thrombus in the arch of the aorta and a free floating 4 x 4-mm thrombus in the distal descending aorta (Fig. 1a,b,c). CTA was inconclusive as to the patency of the arteries of the left extremity so a magnetic resonance angiogram (MRA) was performed. There was a 1.5-cm loss of flow signal at the distal brachial artery near its bifurcation (Fig. 2). The patient was taken to the operating room for a left brachial artery embolectomy with restoration of the left radial and ulnar pulses intraoperatively.

![Fig. 1.](image-url) (a) Coronal CT view of 12 x 14-mm thrombo-embolus in the arch of the aorta; (b) sagittal CT reconstruction showing thrombo-emboli in the aorta; (c) axial CT view of small thrombi in the aorta at the takeoff of the left subclavian artery.
Cardiac echocardiography performed on postoperative day one demonstrated no mural thrombus, vegetations, or regional wall motion abnormalities. Cardiac surgery determined the patient to be a poor candidate for surgical management of her aortic thrombi and thus she was placed on therapeutic heparin with a goal prothrombin time (PTT) of 60–80 s. She was then transitioned to lovenox as a bridge to coumadin which was subsequently started before discharge with an international normalized ratio (INR) goal of 2–3.

Discussion

The management of such patients with aortic arch thrombo-emboli remains controversial. This patient presented as an acute vascular emergency with sudden onset of severe pain in a limb that gradually became ischemic secondary to arterial occlusion. Most patients with aortic thrombi receive surgical management which usually includes a segmental resection of the involved aortic tissue through a thoracotomy. The reoccurrence of thrombosis after surgery as well as the duration of postoperative anticoagulation remains unclear. In a recent case series, it was found that the recurrence rate was due mainly to a short duration (1–4 months) of anticoagulation or antiplatelet therapies[4]. In many patients, recurrence of thrombo-embolic disease involved different sites from the original disease suggesting that diffuse aortic disease was the culprit. Half of thrombo-embolic disease reoccurrences are discovered during routine post-surgical surveillance. Thus, in this patient with diffuse atherosclerotic involvement of the aorta, regular clinical follow remains imperative. Common imaging modalities for aortic thrombo-emboli are computed tomography (CT), MRA, and transesophageal echocardiography (TEE) with the latter two having a higher reported sensitivity for detecting mobile aortic thrombi[5].

In patients who have severe atherosclerosis, a number of interventions have been shown to be effective in ameliorating endothelial dysfunction such as lipid-lowering therapy, angiotensin converting enzyme (ACE) inhibitors, hyperglycemia reduction, and diet and exercise. For patients such as the women presented here, medical management primarily involves artificially manipulating normal endothelial functions by controlling thrombogenesis and/or fibrinolysis with anticoagulation as well as antiplatelet agents. Previous studies have shown that resolution of

Fig. 2. MRA showing the absence of signal due to an embolism near the bifurcation of the brachial artery in the left limb with collateralization of vessels restoring distal flow.
aortic thrombi with medical treatment alone can be effective\textsuperscript{[6,7]}. Using TEE, one group has documented the resolution of aortic thrombi of between 0.5 and 3 cm with anticoagulant therapy\textsuperscript{[8]}. A small case series following patients over a 2-year period who had surgical or medical interventions showed the two groups had comparable results\textsuperscript{[4]}. However, neither antiplatelet agents nor coumadin have been shown to effectively prevent recurrent embolic episodes from aortic atheromas\textsuperscript{[9]}. Indeed, therapeutic anticoagulation may paradoxically induce further embolic events by causing plaque hemorrhage or lysis of the pedicles attaching thrombi to vessels.

Perhaps lessons from interventional approaches to prevent pulmonary emboli can be creatively or theoretically applied to this problem. After all, the need for mechanical prophylaxis will continue as long as there is demand from patients who have a strong medical contraindication for more traditional therapies. The possibility of adapting current inferior vena cava (IVC) filter designs (Titanium Greenfield filter, Venatech low profile filter, TrapEase filter) for use in the aorta or adapting endovascular stent grafts to include the function of filtering atherosclerotic thrombo-emboli may very well revolutionize the future management of these patients.

Also on the frontier from the surgical standpoint are endovascular approaches such as transesophageal echocardiography-guided balloon thrombectomy. These minimally invasive procedures are becoming increasingly popular for the management of aortic thrombi\textsuperscript{[10]}. As of now, there are few reports of recorded accidental embolization during the thrombus dislodgement, but the concern of iatrogenic embolization leading to such adverse outcomes such as stroke or mesenteric ischemia does remain a major concern.

Until larger, multicenter, perhaps even randomized clinical trials can be done, there is little evidence to definitively recommend one modality of treatment over another when it comes to the management of aortic thrombi. Traditional surgical approaches involving the aortic structures involves the use of cardiopulmonary bypass and treatment options for patients like these should be reserved for impending life or limb threatening pathologies. In our era of sophisticated three-dimensional dynamic imaging, a more definitive set of guidelines may be established based on the ability to predict higher risk thrombi that may require more aggressive intervention. Different thrombi, depending on their size, protrusion, and mobility from the lumen of the aorta, may have predictable rates of future embolic events. In the field of molecular imaging, biomarkers at the cellular level are starting to be used to predict higher risk thrombi; for example, studies have documented increased amounts of the enzyme myeloperoxidase in eroded or ruptured plaques compared to stable fatty streaks. Perhaps with the use of predictive risk models and/or novel endovascular approaches we may be able to monitor patients earlier and effect treatments tailored to patients and their individual risk profiles.

**Teaching points**

- Although there are many unanswered questions remaining regarding the best clinical management of aortic thrombi, with the increased usage of imaging modalities it is likely we will discover that more cases of aortic thrombi exist than previously thought.
- As of now, the current literature mainly involves a few case reports and series, and there remains little evidence upon which to make broad reaching recommendations about the management of patients with proximal aortic or arch thrombi.
- At this point, therapeutic anticoagulation is recommended routinely for the patient in whom the risks of complex aortic intervention may outweigh the benefits. These patients may have significant co-morbidities such as extensive coronary heart disease, obstructive lung disease, or obesity.
- With the increasing popularity of minimally invasive surgical techniques, more surgeons are considering procedures such as transesophageal echocardiography guided balloon thrombectomy for the management of aortic thrombi, and there may be a subset of patients with aortic thrombi who might greatly benefit from these interventions.

**References**