Case Report

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Asymptomatic floating thrombus in the ascending aorta depicted on four-dimensional computed tomography

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Abstract

Aortic mural thrombi of the ascending aorta are rare. If an aortic mural thrombus is dislodged, it can cause various embolic complications, which can sometimes be fatal. Although contrast-enhanced computed tomography (CT) and transesophageal echography are useful for diagnosing aortic mural thrombi, four-dimensional CT (4D-CT) is one of the most useful modalities for both diagnosis and treatment selection in such cases. 4D-CT can be used to evaluate the morphology and mobility of thrombi. Furthermore, it is minimally invasive. To the best of our knowledge, there have not been any reports about 4D-CT being used to depict an asymptomatic ascending aortic thrombus. We report a very unusual case, involving an aortic mural thrombus of the ascending aorta.

Keywords

Four-dimensional computed tomography, floating thrombus, ascending aorta, fibrin thrombus

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Introduction

Aortic mural thrombi of the ascending aorta are rare.[1] If an aortic mural thrombus is dislodged, it can cause various embolic complications, for example, mesenteric, renal, or lower extremity ischemia, and some of these complications can be fatal, such as myocardial infarctions or strokes. There have been few reports about asymptomatic floating thrombi in the ascending aorta. Although contrast-enhanced computed tomography (CECT) and transesophageal echography (TEE) are useful for diagnosing such thrombi, four-dimensional CT (4D-CT) is also useful for evaluating the properties and mobility of thrombi. To the best of our knowledge, there have not been any reports about cases in which 4D-CT depicted an asymptomatic floating thrombus in the ascending aorta. We report a case, in which an asymptomatic floating thrombus in the ascending aorta was found incidentally on 4D-CT.

Case presentation

A 75-year-old male had a history of hypertension, diabetes mellitus, and smoking 20 cigarettes per day for 50 years. He had no history of atrial fibrillation. He underwent a medical checkup, and upper gastrointestinal endoscopy revealed middle thoracic esophageal squamous cell carcinoma. Since submucosal invasion by the cancer was suspected, surgery was planned after chemotherapy, and one course of FP therapy (5-fluorouracil, 800 mg/m^2/day, continuously for 5 days, and cisplatin, 80 mg/m^2, on day 1) was administered. Eleven days after the end of the first course of FP therapy, the patient underwent CECT to evaluate the effects and possible complications of the treatment. He was asymptomatic at that time, and his vital signs were unremarkable. Tests of the patient's coagulation status revealed a shortened activated partial thromboplastin time (21.2 s) and a high D-dimer level (1.6 μg/mL). CECT images obtained about 1 month earlier had not shown any abnormalities in the aorta (Figure 1); however, the new CT images incidentally revealed a floating

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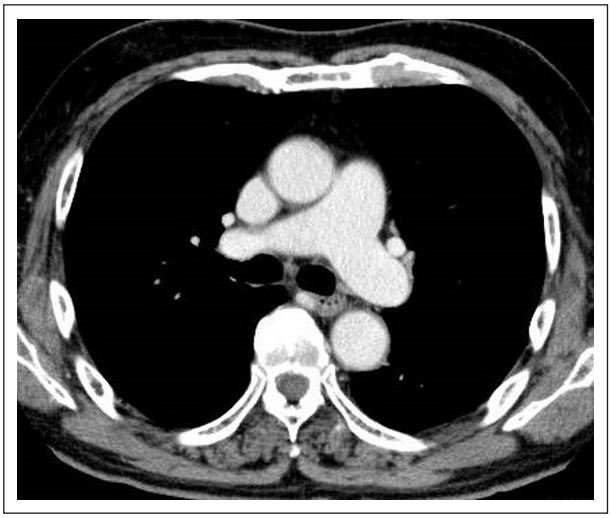

Figure 1. A contrast-enhanced computed tomography (CT) image obtained 1 month before the detection of the thrombus showed no abnormalities in the ascending aorta.

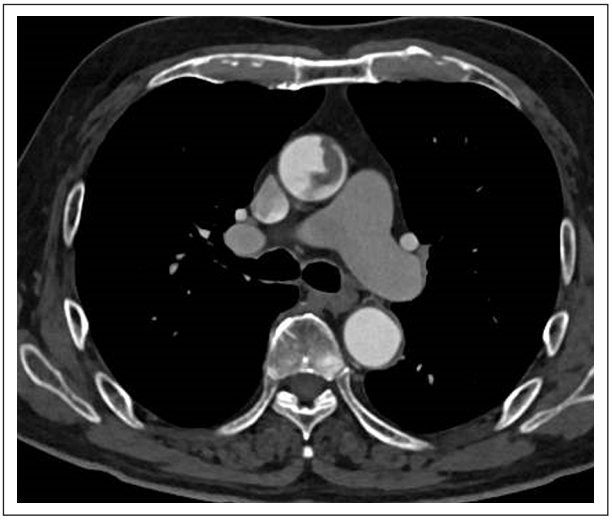

Figure 2. A contrast-enhanced CT image revealed a floating mass in the ascending aorta.

mass in the ascending aorta (Figure 2). The mass exhibited uniform low density, but did not display enhancement. On the same day, 4D-CT was performed for further examination. The patient received 100 mL of 300 mg/mL iodinated contrast medium for the CECT and 65 mL of 370 mg/mL iodinated contrast medium for the 4D-CT; however, his renal function did not deteriorate. 4D-CT images showed that the mass was attached to the anterior wall of the ascending aorta along a region measuring about 18 mm in length. A 36-mm-long part of the mass was moving up and down, and the movement was synchronized with the patient's heartbeat (Figure 3(a), (b) and Video 1, 2). Since the appearance of the floating mass suggested that it was soft, we suspected a

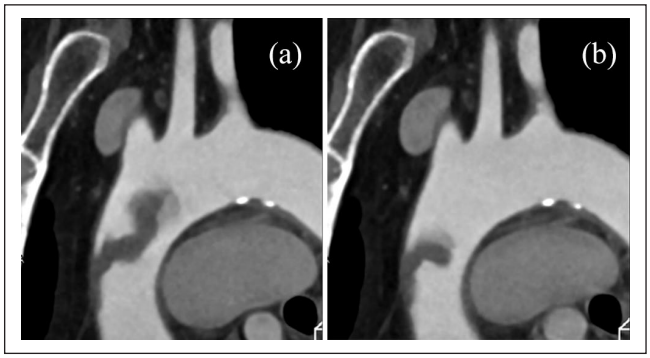

Figure 3. Four-dimensional CT images showed that the mass was attached to the anterior wall of the ascending aorta and moved up and down in sync with the patient's heartbeat: (a) systolic phase; (b) diastolic phase.

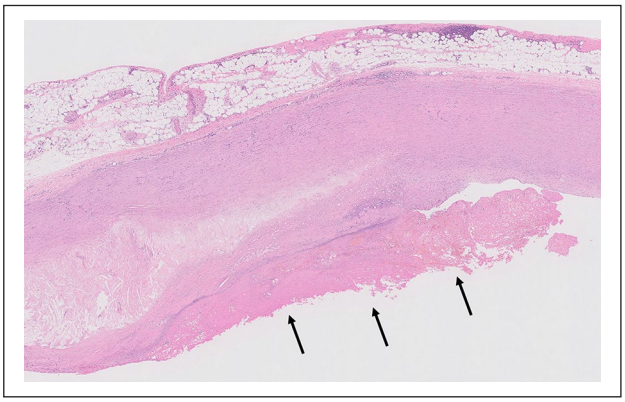

Figure 4. A hematoxylin-eosin stained specimen showed that the mass was a fibrin thrombus (arrows). The attachment site exhibited atherosclerosis; however, no continuity was found between the thrombus and tunica intima (1×).

thrombus or benign tumor. Moreover, it seemed that the mass could become dislodged at any moment, which could have resulted in serious embolic complications. Therefore, the patient underwent emergency surgery the next day. Since malignancy could not be completely ruled out, replacement of the ascending aorta was performed. During the operation, the mobile mass was found to be attached to the anterior wall of the ascending aorta. A microscopic examination revealed that the mass was a fibrin thrombus, which was attached to the aortic wall. The aortic wall exhibited evidence of atherosclerosis; however, no continuity was found between the thrombus and tunica intima (Figure 4). The patient received heparin (5000 units) for 11 days postoperatively. His postoperative course was uneventful, and he was given an ambulatory discharge at 15 postoperative days. About 2 months after the discharge, he underwent surgery for esophageal cancer. He took 30 mg edoxaban as an oral anticoagulant for 188 days until his D-dimer level normalized, and the thrombus had not recurred after about a year.

Discussion

Aortic thrombi are often seen in the presence of aortic dissection or aortic aneurysms; however, they rarely occur in relatively normal aortas. Machleder et al.[2] reported that in 10,671 consecutive autopsies, 0.45% of thoracoabdominal aortas without aneurysms contained a thrombus. Aortic thrombi are often found as a result of a systemic arterial embolism; therefore, asymptomatic cases are rare. To the best of our knowledge, there is no evidence that floating thrombi are more likely to cause embolisms than immobile thrombi; however, we speculate that floating thrombi could be susceptible to resistance from blood flow, and thus, more likely to become dislodged. The abdominal aorta is the most common site of occurrence (64%), followed by the descending aorta (27%). Aortic thrombi rarely occur in the ascending aorta or the aortic arch (8%).[1] Multiple causes of aortic thrombi have been described, including blood disorders (e.g. protein S or protein C deficiency or anti-phospholipid antibody syndrome), tumors, aortitis, collagen disease, aortic structural abnormalities (e.g. aortic aneurysms), intra-aortic atheromas, hormone therapy, steroid use, and atrial fibrillation.[3] Laperche et al.[4] reported that dyslipidemia and smoking are also risk factors for thrombus formation. Among chemotherapies, cisplatin is known to be a risk factor for thrombus formation, and it has been reported that vascular events occurred in about 45% of cisplatin-treated patients within the first 2 courses.[5] Cisplatin seems to promote thrombus formation by causing vascular endothelial damage. The present patient was also treated with cisplatin, and a thrombus formed after just 1 course of treatment. In addition, he had some other risk factors, such as cancer, hypercoagulability, and a history of smoking. Although the exact etiology of his thrombus cannot be determined, given the presence of atherosclerotic changes at the thrombus attachment site, it might have formed through an interaction between hypercoagulability and atherosclerosis.

CECT and TEE are useful for diagnosing aortic thrombi, and 4D-CT is also useful for such purposes. 4D-CT is a technique that reproduces the cardiac cycle by continuously replaying reconstructed 3D-CT images derived from multiple phases. It has many advantages, for example, it makes it possible to understand the location and extent of a mass' attachment and to understand how the mass moves in time with the patient's heartbeat. In the current case, the attachment site and properties of the mass could not be assessed in detail using conventional CECT; however, 4D-CT provided detailed information about these factors, which highlighted the need for early surgery. It is difficult to assess the risk of an embolism occurring. However, the smaller the attachment between a thrombus and a blood vessel the more likely the thrombus is to become dislodged. In the present case, the way the mass floated in the bloodstream indicated that it was soft, which led us to suspect a thrombus or benign tumor. 4D-CT images can also be of great benefit when explaining situations to patients and their families, as they make it easy to see how dangerous a condition is. Another major advantage of 4D-CT is that, unlike TEE, it is minimally invasive. TEE requires a probe to be pressed against the esophageal wall, and there is a chance that a probe scan could cause a floating thrombus to become dislodged. Considering this risk, 4D-CT might be more appropriate for assessing floating thrombi, especially in asymptomatic cases.

In addition to a thrombus, malignant tumors, such as sarcomas (leiomyosarcoma, angiosarcoma, or fibrosarcoma), and benign tumors, such as myxoma or lipoma, were differential diagnoses in the current case.[6] Images alone are of limited use for differentiating among such conditions, and a biopsy is the only way to make a definitive diagnosis. However, performing a biopsy preoperatively is almost impossible in such cases; therefore, treatment is performed at the same time as diagnosis.

We propose that all floating thrombi should be treated because of their potentially fatal complications. There are two main types of treatment for floating thrombi: anticoagulation therapy and surgery. Anticoagulation therapy is often employed first, and there was a report about a case in which this resulted in the thrombus disappearing.[1] However, if a thrombus is larger than 1 cm, administering anticoagulation therapy alone could result in a fatal embolism occurring.[7] Therefore, it is desirable to operate as soon as possible. There are two major types of surgery that can be performed in such cases: tumor resection and aortic replacement. Which method should be chosen is a difficult question. For example, in one case it was reported that aortic replacement was conducted because malignancy could not be ruled out,[8] while in another case tumor resection alone was performed because examinations of frozen sections did not reveal any malignant findings.[9] There are no established indications for surgery in such cases. We consider that if malignancy cannot be ruled out, aortic replacement could be one of the best methods. In addition, it was reported that a stent graft was inserted in a case in which a thrombus extended from the aortic arch to the descending aorta.[10] Although stent graft procedures are minimally invasive, stent grafts cannot be inserted in some cases, depending on the location of the thrombus or the degree of arteriosclerosis. The inability to definitively diagnose a mass is also a problem. In recent years, thrombus aspiration has been used to remove some aortic thrombi, and it could be the first-choice treatment in cases in which the patient is unable to tolerate surgery.[11] However, thrombus aspiration carries a risk of embolization and injury to the aortic wall; therefore, we did not perform it. Thrombectomy also carries a risk of recurrence, and we could not rule out malignancy, and hence, we finally chose to replace the ascending aorta.

Since aortic thrombi sometimes cause fatal complications, early treatment is important as soon as they are detected. However, there are no treatment guidelines for such cases at this time. It is necessary to choose the best treatment method for each patient.

Conclusion

We reported a case involving an asymptomatic floating thrombus in the ascending aorta, which was successfully depicted using 4D-CT. In such cases, the early initiation of treatment is desirable because floating thrombi can cause fatal embolic complications. 4D-CT can be used to identify the location and properties of a thrombus; therefore, it is one of the most useful modalities not only for diagnosing thrombi, but also for aiding decisions regarding their treatment.

Declaration of conflicting interests

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Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

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Informed consent

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Supplemental material

Supplemental material for this article is available online.

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