CT Scan Negative Type A Aortic Dissection: A Case Series

Year: 2004-2021
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All patients had chest pain
*Seen in ER or by EMS*

CT Scan Findings
All patients had an ascending aortic aneurysm >5cm
Negative for Dissection

Intraoperative Findings

CTA is the imaging modality most frequently used in diagnosis of Type A aortic dissection. Although CTA has a high degree of accuracy, our case series demonstrates that false negative errors in diagnosis still occur. In patients with chest pain and an ascending aortic aneurysm, early operative intervention must be considered.

CTA - Computed Tomography Angiography, CT - Computed Tomography
Putative CT Scan Negative Type A Dissection

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Glossary of Abbreviations:

Computed tomography angiography – CTA, Computed tomography- CT, Transthoracic echocardiography TTE, Transesophageal echocardiography TEE, magnetic resonance imaging MRI, coronary artery disease CAD


Central Message: Despite a negative CT scan for a Type A dissection, in patients with chest pain and an ascending aortic aneurysm, early surgical intervention should be considered.

Perspective Statement: CTA is the imaging modality most frequently used in making a diagnosis of Type A aortic dissection. Although CTA has a high degree of sensitivity and specificity false negative errors in diagnosis can still occur. Our series emphasizes a need for a high index of suspicion and early operative intervention in patients presenting with chest pain and an ascending aortic aneurysm despite a negative CT scan for classical dissection.
Structured Abstract:

Objectives:

Computed Tomography Angiography (CTA) is the imaging modality most frequently used to diagnosis Type A aortic dissection for chest pain with a high degree of sensitivity and specificity. False negative and positive errors in diagnosis are infrequent. Despite initial negative imaging studies for dissection, surgeons must consider early operation in patients with recent onset chest pain in the presence of an ascending aortic aneurysm.

Methods:

We report four cases (2004-2021), mean age 51.25 years, (M: F=3:1) who presented with chest pain. Two had a history of syncope. On CTA all had an ascending aortic aneurysm and no dissection flap. Three had thickening of the ascending aorta and one a chronic type B dissection. On echocardiography, aortic regurgitation was moderate/severe in two patients, two had a pericardial effusion and none had a definitive dissection flap. All were operated on because of the surgeon’s concern for the association of chest pain and an ascending aortic aneurysm. The Institutional Review Board (IRB) at George Washington University Committee on Human Research, has determined that the research is exempt from IRB review under DHHS regulatory category 4 (#FWA00005945). The project as described in the application may proceed without further oversight by the OHR on 09/09/22.

Results:

The diagnosis of Type A aortic dissection was made at operation (three on median sternotomy and one after aortotomy). All patients did well. One patient who had peripheral cannulation (no malperfusion) and severe coagulopathy developed a
compartment syndrome and postoperatively required a below knee amputation.

Conclusions:

Surgeons must maintain a high index of suspicion for aortic dissection when patients present with chest pain and are found to have an ascending aortic aneurysm even in the absence of initial, classical, features of dissection on CT angiography. Improvements in imaging techniques and analysis are required.

Graphical Abstract / Figure 4:

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Keywords:

Aortic Dissection, Aortic Surgery, Diagnostic Imaging, Computed Tomography

Angiography, Computed Tomography
Introduction:

The diagnosis of acute ascending thoracic aortic dissection is associated with a high mortality of 1-2% per hour for the first twenty-four hours\(^1\) without surgical intervention which mandates urgent and accurate diagnosis.\(^2,3\) Improvements in imaging technology have resulted in highly sensitive and specific tools for making a diagnosis\(^4\). Even in operated patients the mortality is between 9-25%.\(^5\) The widespread use of CTA in evaluating patients with suspected thoracic aortic dissection has also increased the propensity for false positive results and unnecessary surgery.\(^6,7\) On the other hand, less well reported are patients who have a false negative CT scan leading to inappropriate delay in management with potential dire outcomes.\(^8,9\)

We describe our experience with four patients (Table 1) who presented with chest pain who on CTA had an ascending aortic aneurysm but no features of aortic dissection. Additional echocardiography (ECHO) also did not identify the aortic dissection. The patients were taken to the operating room because of chest pain in a patient with an ascending aortic aneurysm. The diagnosis of a Type A dissection was made after sternotomy in three and after aortotomy in one patient. All underwent successful replacement of the ascending aorta or a Bentall procedure.

Materials and methods:

Table 1 outlines the relevant details of the four cases.

Case 1

The patient was a 49-year-old-male with no significant past medical history.

He presented to an outside hospital with central chest pain and a tentative diagnosis of acute coronary syndrome was made. There was no EKG or
enzyme evidence of a myocardial infarction and he was treated as a patient with unstable angina. A CT scan was done and this showed an enlarged ascending aorta, 5.6 cm and the ECHO showed moderate to severe aortic incompetence (AI). He was treated with Plavix and antihypertensive agents. He was seen at the outside hospital and transferred to our facility for further evaluation. The chest pain continued and the patient was taken to the cath. laboratory for a coronary angiogram which did not show an aortic dissection, but there was severe aortic incompetence. Because of the constellation of findings, the patient was taken to the operating room. The transesophageal ECHO (TEE) showed moderate severe aortic regurgitation, an enlarged root but no dissection. At median sternotomy, a classical Type A ascending aorta was noted that extended down to the annulus. A Bentall operation using a St Jude valve conduit and additional coronary artery bypass grafting was performed. Because of the prior use of Plavix there was a coagulopathy requiring delayed closure of the sternum. Postoperatively, he developed a compartment syndrome that required a below knee amputation. The patient remains alive 18 years later.

**Case 2.**

A 43-year-old African American male had severe chest pain and syncope and was brought to an outside hospital. He was severely hypertensive on admission and awake with no residual neurological sequelae. A CT scan showed the presence of an enlarged ascending aorta, no dissection and a pericardial effusion. He was transferred to our hospital for drainage of the
pericardial effusion. An ECHO confirmed a pericardial effusion but no dissection was seen. Despite the absence of a dissection the surgeon was suspicious because of the presence of an enlarged ascending aorta, severe chest pain and a pericardial effusion in the presence of an ascending aortic aneurysm.

Again, in the OR, TEE did not show an aortic dissection. With full capability for cardiopulmonary bypass on standby in the OR, a median sternotomy approach was used. On immediately opening the sternum, the presence of a hemopericardium was obvious. On opening the pericardium, a classical Type A dissection was present. This patient underwent a successful bio-Bentall procedure and is alive 8 years later.

**Case 3.**

A 43-year-old African American male presented with moderate to severe bouts of increasing chest pain. The CT scan showed evidence of a chronic Type B dissection and in addition he had an ascending aortic aneurysm 5.5 cm and associated moderate aortic regurgitation. A cardiac catheterization was done and he had no evidence of significant CAD. Intraoperative TEE confirmed moderate AI and an ascending aortic aneurysm. An unexpected finding on making the aortotomy in the aneurysmal ascending aorta was the presence of a linear tear above the sinotubular junction near the left coronary cusp. He underwent a Bentall procedure and he had a benign postoperative course. He had a further operation to manage his iliac artery aneurysm and he is alive six years after his Bentall procedure.
Case 4:

A 70-year-old Hispanic lady developed severe chest pain and collapsed whilst shopping. She had no prior cardiac history. EMS found her hypotensive and she had recovered from her syncopal episode. She was given fluids and taken to another hospital. Now the patient was hypertensive and tachycardic. Her white count was elevated 21k. A CT scan showed an enlarged ascending aorta 5.2 cm but no evidence of aortic dissection and a pericardial effusion (Hounsfield units 35 Figure 1A). She was treated with antibiotics and transferred to our ICU for drainage of her pericardial effusion. There was no evidence of an MI. The TTE confirmed the presence of a moderate pericardial effusion, an enlarged ascending aorta and mild aortic incompetence. We planned to a median sternotomy instead of a pericardial window because of the presence of an aneurysm and chest pain.

A repeat CTA was done 11.5 hours after the first study. Again, no dissection flap was seen and presence of some aortic wall thickening was noted between the ascending aorta and the pulmonary artery (Fig 1B). A TEE did not show a dissection flap (Video 1 and 2). However, some thickening of ascending aortic wall was noted.

Upon opening the sternum, hemopericardium was present. Some adventitial hemorrhage was noted on the antero-lateral aspect of the ascending aorta on draining the pericardial blood. (Figure 3). This was not in the region of the thickening noted on the CT scan. After aortotomy, a deep tear was noted posteriorly, around the sinotubular junction (Figure 2, Case 4, Video 3 and 4). She
underwent an ascending aorta and hemi-arch repair using circulatory arrest via a graft to the innominate artery. Her postoperative course was benign and she is doing well at ten months post-intervention.

Discussion:

Improvement in surgical techniques and cerebral protection for managing type A aortic dissection have resulted in a decrease in morbidity and mortality even in patients without associated malperfusion.¹⁰ In order to improve survival, it is mandatory to make an early correct diagnosis. In this regard, the commonest modality used to confirm the clinical suspicion is CT angiography due to its availability, speed of imaging of the entire aorta and ability to detect alternative diagnoses. The sensitivity and specificity of CTA for aortic dissection range from 94%–100% and 77%–100% respectively.³,⁴ Other imaging modalities include magnetic resonance imaging (MRI) and TEE and they offer comparable sensitivities and specificities for making the diagnosis of aortic dissection and can be used as secondary tests when the diagnosis is uncertain.¹¹ Diagnostic features of aortic dissection on CTA include the presence of an intimal flap, presence of a true and false double lumen, and dilatation of the ascending aorta. An added advantage of CT scanning is that it assists the surgeon with operative planning as it can visualize the extent of the dissection flap, including valve or branch vessel involvement or other distal complications. Disadvantages of CTA include radiation exposure and use of iodinated contrast. In the series presented, on pre-operative CTA, all cases had an ascending aortic aneurysm but no dissection flap. In our series of patients,
dissection flap was not seen on echocardiography. In two patients, there was moderate to severe aortic regurgitation and in two there was evidence of pericardial effusion and in two cases aortic wall thickening.

Although CTA, TTE, and MRI are all highly accurate, false negative and positive studies do occur.\textsuperscript{6,7,8,9} False negative CTA studies for aortic dissection can be due to inadequate contrast opacification or where the presence of peripheral calcification in a chronic dissection simulates an atherosclerotic aneurysm. However, CTA is generally a very sensitive test and false negative findings are luckily rare. There were two case reports from Yale of ascending aortic aneurysm with pain who were operated on despite CTA negative for aortic dissection. Intraoperatively aortic dissection was detected. They emphasized that the size criteria for replacing ascending aortic aneurysms pertain to asymptomatic patients, and symptomatic patients with aneurysm require resection regardless of size.\textsuperscript{8,9} DeWeert et al describe a case of a patient on PCP who presented with an acute aortic syndrome. There was no evidence of ascending aortic dissection on CTA, but a flap was seen on TEE and the patient underwent a root and aortic valve replacement.\textsuperscript{8}

False positive CTA are more common and can result in unnecessary surgery. They can be due to curvilinear artifacts in the aortic root and proximal ascending aorta. These are often caused by aortic wall motion and can be reduced by using ECG-gating.\textsuperscript{13} In our series, none of the patients had ECG-gated CT scans. This later
modality improves visualization of the aortic root and helps correct for motion artefacts. However, EKG gated CT scans requires the presence of trained technicians, advanced generation scanner and radiologists who can read cardiac images. Most centers do not offer this service on a 24/7 basis.

The other variants of the aortic syndrome complex, such as intramural hematomas (IMH) are detected on non-contrast CT scans. In three (cases 1,3,4) of the four patients where non-contrast scans were performed, IMH was not identified. In case four where a second CT scan study was performed 11.5 hours after the first scan, some thickness of the ascending aorta was noted (Fig 1B).

The true incidence of false negative CTA for AD will require autopsies to be performed in patients who die with acute aortic syndrome and sudden death.

In a Japanese study 7% of patients with sudden death on postmortem CT autopsy had an aortic dissection. Similarly, a Mayo Clinic report showed approximately 30% of cases of aortic dissection remained undiagnosed until postmortem examination.

Although it is frequently performed, bedside, point-of-care transthoracic echocardiography (TTE) is not very accurate. The sensitivity and specificity of formal TTE for AD range from 77%–80% and 93%–96%, respectively, for the ascending aorta. It may detect a flap in the parasternal long axis view of the aortic root. However, emergency department transthoracic echocardiography
(TTE) does have value in evaluating patients who are hemodynamically unstable, have heart failure, pericardial tamponade, aortic insufficiency, have wall motion abnormality etc.

Much has been written about the early operation in patients with symptomatic ascending aortic aneurysms. The surgical decision to operate in our case series was predicated on the presence of an ascending aortic aneurysm and recent onset of severe chest pain. All patients were hypertensive and there was no evidence of a myocardial infarct. Because of our favorable experience with urgent replacement of symptomatic ascending aortic aneurysms that had false negative CTA findings for aortic dissection, we would encourage other centers to use this approach as surgical delay increases morbidity and mortality. We have not used, nor suggest, this approach in the absence of an ascending aortic aneurysm.

**Conclusion:**

Our report suggests no single historical feature, physical examination finding, or laboratory test or imaging study can safely rule out aortic dissection. Although the CTA is usually the initial imaging test with a high sensitivity and specificity, false negatives findings can occur. In patients with chest pain and an ascending aortic aneurysm on CTA, consideration must be given to early operative intervention, even in the absence of classic features of Type A dissection.
References:


17. Elefteriades JA. Thoracic aortic aneurysm: reading the enemy's playbook.

Curr Probl Cardiol. 2008;33(5): 203-77
Legends:

**Table 1:** In all cases, a standard CTA was performed. The pre-operative CT scan, intra-operative TEE, operative photographs and image of the deep tear in the ascending aorta that was not seen on the CTA, and post-op CT scan are shown in Fig 1-3 and Videos 1-4. The same surgeon was involved in the care and operative procedures of all four patients.

**Figure 1A:** CT (Case 4) with and without contrast. This shows an aneurysmal ascending aorta (5.18 cm diameter). There were no features of an aortic dissection and an intramural hematoma was not seen on the non-contrast images.

**Figure 1B:** Repeat CT of case 4 with and without contrast 11.5 hours after first CT. There were no features of aortic dissection. However, now there is some thickness of the ascending aorta near the pulmonary artery.

**Figure 2:** A deep intimal-medial tear is seen in the wall of the ascending aorta.

**Figure 3:** Ascending aorta with adventitial hemorrhage after drainage of bloody pericardial effusion.

**Figure 4:** Graphical abstract providing an overview of the case series.

**Video 1:** Intraoperative TEE. There is a pericardial effusion present.

**Video 2:** Intraoperative TEE. There is no evidence of a dissection flap. There is some thickness noted of the aortic wall.

**Video 3:** Intraoperative Video: On opening the pericardium, bloody effusion and clot is seen.

**Video 4:** Intraoperative Video: On aortotomy, a deep linear intimal-medial
tissue tear is seen posteriorly.
Figure 1A

CT (Case 4) with and without contrast. This shows an aneurysmal ascending aorta (5.18cm diameter). There were no features of an aortic dissection and an intramural hematoma was not seen on the non-contrast images.
Figure 1B

Repeat CT of case 4 with and without contrast 11.5 hours after first CT. There were no features of aortic dissection. However, now there is some thickness of the ascending aorta near the pulmonary artery.
Figure 2/Central Picture: Intraoperative Finding: deep intimal-medial tear in the wall of the ascending aorta.
Figure 3: Ascending aorta with adventitial hemorrhage after drainage of bloody pericardial effusion
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<th>Case number</th>
<th>Age/Sex</th>
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<th>Pericardial Effusion</th>
<th>Chest Pain</th>
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<td>Mild</td>
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