

Diagnosis of Thoracic Aortic Dissection in the Emergency Department



RCEM
Royal College
of Emergency
Medicine



The Royal College of Radiologists

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Summary of recommendations

1. All clinicians working in the emergency department should be made aware of the difficulties in making the diagnosis of Thoracic Aortic Dissection (TAD) and the need to be aware of local policies and resources to assist in this as part of their induction.
2. Clinicians should not use negative D-dimer alone to rule out TAD, the evidence is currently insufficient to support this.
3. Each emergency department must have agreed protocols between themselves and their radiology department regarding requests for CT Aortograms in cases of suspected thoracic aortic dissection.
4. Thoracic aortic dissection is a time critical emergency and provision must be available for the ED to rapidly access CT Aortograms throughout the whole 24hr period.
5. If the ED suspects a patient has a TAD it is the role of the ED to request the scan and act on the result. This responsibility should not be passed onto another clinical team.
6. All emergency departments should have a local protocol or pathway detailing the actions to be taken once a diagnosis of TAD has been made. This should include details of blood pressure management and local urgent referral pathways to specialist surgical centres, where appropriate.

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Scope

Acute Aortic Syndrome comprises aortic dissection, intramural haematoma and penetrating aortic ulcer and often patients can cross from one pathology to another, RCEM acknowledges that aortic syndrome is the overarching condition, but that dissection is the commonest and most risky presentation, so this guideline focusses mainly on this. The guideline focuses on the diagnosis of thoracic aortic dissection in adult patients attending the emergency department, rather than management.

Reason for development

The diagnosis of thoracic aortic dissection (TAD) is often difficult to establish in emergency department (ED) patients attending with chest pain. Key to making the diagnosis is the awareness amongst emergency clinicians (ECs) of the need to consider the diagnosis in patients presenting with chest pain. ECs should also have an awareness that TAD can present subtly or in young patients and that their pain may have migrated or dissipated by the time they are seen. Surveillance data suggests that opportunities to diagnose cases of TAD are being missed in the ED, often with catastrophic consequences. This guideline seeks to provide a consensus opinion with regards to which patients should be considered for CT scanning (the diagnostic modality of choice) whilst accepting that this is still an area of considerable controversy and concern.

Introduction

The incidence of TAD is estimated to be between 4.5 and 7 per 100,000 [1, 2]. TAD is a relatively uncommon cause of chest pain (acute coronary syndrome is 100-200 times more common) but can be catastrophic with an in-hospital mortality rate of 27% [3]. This makes deciding which patient to request a CT scan on particularly difficult. There are numerous examples of patients attending EDs with chest pain and being discharged without the diagnosis of TAD having been made (Appendix 2).

Risk factors for TAD are shown in box 1.

Box 1. Risk factors for TAD include:

- Hypertension
- Collagen disorders
- Marfan's, Ehler-Danlos
- Inflammatory vasculitis
- Giant cell arteritis, Takayasu arteritis, Rheumatoid arthritis)
- Instrumentation or structural abnormalities of the aorta
- Cardiac catheterisation, Bicuspid valve, Aortic coarctation, valve replacement
- Pregnancy
- Male
- Advancing age

A useful brief animation of the pathophysiology and resulting presentation of TAD can be found here <https://aorticdissectioncharitabletrust.org/>

The classical description of chest pain associated with TAD is said to be tearing pain in the inter-scapular region, however the most discriminating feature of the chest pain is that it is of sudden onset with its worst severity at onset [4]. The difficulty in diagnosing TAD is compounded by a relatively high number of atypical presentations. Of those patients who present with symptoms which might be suggestive of aortic dissection, only 0.3% have the diagnosis [5]. The chest pain associated with TAD may occur alone or in combination with back pain, syncope, or new onset neurological deficit. Patients may also present with complications from TAD see box 2. Clinical findings seen in TAD may include pulse deficits, aortic regurgitation, unequal blood pressure in both arms, unexplained hypotension or commonly no specific clinical signs.

Box 2. Complication of TAD may include:

- Myocardial ischaemia
- Haemopericardium
- Renal failure
- Aortic rupture
- Stroke
- Heart failure
- Haemothorax
- Mesenteric infarction
- Limb ischaemia
- Paraplegia

Diagnostic tests

Chest X-Ray - Box 3 describes some of the abnormalities that may be present on a chest X-ray (CXR), HOWEVER 15% of patients with TAD have a normal CXR. A normal PA CXR does not exclude or confirm TAD. The main use of a CXR is to exclude alternative causes of chest pain such as pneumonia. It is important that performing a CXR does not delay definitive diagnosis.

Box 3. Chest radiograph changes suggestive of TAD:

- Widened mediastinum >8cm
- Obscuration of the aortic knob.
- 'Ring sign' (displacement of the aorta >5 mm past the calcified aortic intima).
- Pleural effusion.
- Pleural cap (fluid in the apex of the hemi-thorax).
- Deviation of the trachea & left main bronchus.

Electrocardiogram (ECG) - 30% of patients also have a normal ECG [3].

D-dimer - A recent meta-analysis has shown when using a 500ng/mL cut-off (Fibrinogen equivalent units; FEU), D-dimer has high sensitivity (96.5%) but only modest specificity (56.5%). Unselective use especially in patients with very low clinical probability is likely to lead to a high false positive rate and therefore over investigation with advanced imaging [6].

Echocardiography - may sometimes have a role in diagnosis of TAD; however transthoracic echo (TTE) will miss 30% of cases, transoesophageal echo is more sensitive than TTE (NPV 99%) [4].

CTA - The diagnostic modality of choice is the Computed Tomography Aortogram (CTA), which has high diagnostic accuracy in discriminating the various components of TAD [7].

Initial non-contrast acquisition should form part of the scanning protocol for its value in assessment of intramural haematoma. A post contrast CT of the aorta delineates the full extent of dissection and involvement of branch vessels.

Arterial phase acquisition should routinely be performed with ECG synchronisation (ECG-gated scan) with the aim of producing motion-free images of the aortic root [8]. Radiological prospective triggering should be used where possible to reduce radiation dose.

CT thoracic aorta is reasonable in the first instance for lower risk patients who have no abdominal or lower limb symptoms, this will limit the radiation dose. If dissection is found to involve the upper abdominal aorta, completion imaging will be required of the whole aorta.

CT Whole aorta is necessary in high-risk patients (see table 1) or those with known aortic disease.

ED access to CT scans is key to the rapid diagnosis and appropriate management. Local protocols should be in place to ensure urgent CT scan requests meet the appropriate criteria. Centres that have successfully addressed their TAD missed diagnosis rate by awareness raising programmes and increased access to CTA have reported a 10% pickup rate for TAD [5] and 42% pickup rate for alternative diagnoses [9,10]. The diagnostic yield of other tests for significant diagnoses is equally low – CTPA for Pulmonary Embolus varies from 4.7 to 31% [11] and lesion on CT head in patients with minor head injury (NICE indications) needing neurosurgical intervention is only 3% [12].

TAD is a time critical emergency and CTA with timely reporting must be available for the ED 24/7.

Recommendations for clinicians

- All clinicians working in the ED should be made aware of the difficulties in making the diagnosis of TAD and the need to be made aware of local policies and resources at induction
- Teaching about the pitfalls of presentation and diagnosis, along with regular shop floor discussion (board rounds etc.) are key to raising awareness.
- Patients presenting with a 'classical' history for TAD with abrupt onset of severe "ripping" or "tearing" pain, especially with cardiovascular compromise, should proceed directly to CT.
- For patients where the diagnosis of TAD is considered possible, in the absence of a firm alternative diagnosis (e.g. acute myocardial infarction, pneumothorax), if patients have chest pain and any high-risk features listed in table 1 (below) they should have a CT scan.
- In some cases, clinical judgement will need to be exercised with regards recurrent presentations and exposure to ionising radiation.
- In cases where dissection has been excluded by CT, the patient should be reviewed, other imaging may be required if alternative chest or abdominal diagnoses are being considered.

Table 1. High Risks for Thoracic Aortic Dissection

High Risk CONDITIONS	• Marfan syndrome • Connective tissue disease • Family history aortic disease • Known aortic valve disease • Recent aortic manipulation • Known thoracic aortic aneurysm
High Risk PAIN FEATURES	Chest, back or abdominal pain described as: • ABRUPT in onset / severe in intensity Or • Ripping / tearing / sharp or stabbing quality radiating to back.
High Risk CLINICAL FINDINGS	• Pulse deficit • Systolic BP differential (>20mmHg) • Focal neurological deficit (in conjunction with pain) • Aortic regurgitation murmur (new or not known and with pain)

If the ED suspects a patient has a TAD it is the role of the ED to request the scan and act on the result, this responsibility should not be passed onto another clinical team.

All emergency departments should have a local protocol or pathway detailing the actions to be taken once a diagnosis of TAD has been made. This should include details of blood pressure management and local urgent referral pathways to specialist surgical centres, where appropriate.

Consensus standards have been published for the inter-hospital transfer of patients with AAS [13].

Emerging Evidence

For patients presenting with chest pain in whom the diagnosis of TAD is felt to be a reasonable possibility, then evidence is emerging [14,15] that a diagnostic strategy using the Aortic Dissection Detection Risk Score (ADD-RS, appendix 1) is likely to be safe and cost effective. An ADD-RS of more than 1 or an ADD-RS equal to 1 AND a D-dimer >500ng/mL should prompt an ECG gated CTA. Prospective studies are still required to fully validate this diagnostic strategy. The ADD-RS should NOT be applied to all patients with chest pain, only those in whom it is felt TAD is a possible diagnosis. It is important to be aware of the units of measurement of D-dimer; Fibrinogen equivalent units (FEU) is the more standard reporting figure with an upper limit of normal of 500 ng/ml, however, some laboratories report D Dimer units (DDU) with an upper limit of normal of 250 ng/ml.

About this document

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Review

Usually within three years or sooner if important information becomes available.

Conflicts of Interest

ER is a non-paid medical advisor to the charity Aortic Dissection Awareness

Disclaimers

The College recognises that patients, their situations, Emergency Departments and staff all vary. This guideline cannot cover all possible scenarios. The ultimate responsibility for the interpretation and application of this guideline, the use of current information and a patient's overall care and wellbeing resides with the treating clinician.

Research Recommendations

NCEPOD should undertake a national review of all TAD deaths.

The role of D-dimer as a screening test for TAD in ED patients presenting with chest pain and ECG finding not consistent with infarction or ischaemia.

Validation of the diagnostic strategy utilising the Aortic Dissection Detection Risk Score combined with D-dimer as described in this guidance.

Incidence of pulse deficits and unequal blood pressure in non-chest pain population.

Impact of urgent / emergency CT scanning on stable patients with a normal chest X-ray who present with chest pain and a positive D-dimer.

Audit standards

80% of patients who undergo CT scanning for possible aortic dissection / acute aortic syndrome should have clinical notes which document the presence or absence of the high-risk CLINICAL features listed in table 1.

Key words for search

Thoracic aortic dissection, acute aortic syndrome, aortic dissection

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Appendix 1

Aortic Dissection Detection Risk Score (ADD-RS)

High Risk CONDITIONS	• Marfan syndrome • Family history aortic disease • Known aortic valve disease • Recent aortic manipulation • Known thoracic aortic aneurysm	1 point if any present
High Risk Pain FEATURES	Chest, back or abdominal pain described as: • Abrupt in onset • Severe in intensity • Ripping or tearing.	1 point if any present
High Risk CLINICAL FINDINGS	• Evidence of perfusion deficit -Pulse deficit -Systolic BP differential -Focal neurological deficit (in conjunction with pain) • Murmur of aortic Insufficiency (new or not known to be old and in conjunction with pain) • Hypotension or shock state	1 point if any present

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Appendix 2 – Case Examples

Examples of selected cases of Missed Thoracic Aortic Dissection in the Emergency Department.

Case #1

39yr man, known hypertension and smoker presented to the ED with chest pain. His pain was severe, sharp, central and radiated to the left side of his chest, left shoulder and half way down his left bicep. His pain was noted to have been exacerbated by movement or left arm straining, and he was discharged home with a diagnosis of musculoskeletal injury with a plan for analgesia and instructions to return if his symptoms worsened. Normal ECGs, negative D-dimer and Troponin.

He returned 5 days later, the Emergency Department junior resident recorded that he complained of sudden onset chest pain, which radiated through to his back, whilst lying on his sofa. The pain was described as severe and constant, and he had vomited 3 times. A diagnosis of gastritis or pericarditis was made by the ED and the patient treated with morphine, omeprazole and IV fluids. Patient referred to the medical team, normal amylase and troponin. Seen by medical team, thought differential diagnosis not unreasonable but noted Bilateral BPs as 174/109 mmHg (left arm), and 147/107 mmHg (right arm). Discharged home, returned 1 day later in cardiac arrest and was unable to be resuscitated.

Case #2

49-year-old presented to the ED with non-radiating, stabbing chest pain and was 8/10 in severity at the onset. He reported that his vision went cloudy and he felt SOB but was not sweaty or clammy. The severity of the pain was 3/10 after receiving IV morphine, aspirin and GTN. He smoked 20 cigarettes per day but there was no other medical or drug history. He scored zero on NEWS 2 and his two high sensitive troponin levels were 9.4ng/L and 9.7ng/L (no significant change between the two samples taken 3 hours apart). The ECG was NSR with T- wave inversion in Lead 1, AVL, V4, V5 and V6. The blood results were normal except that his WCC was 12.5 and D-Dimer was 1592. Chest X-ray was clear. He was referred to the medical team with a diagnosis of possible pulmonary embolism (PE) and treated with enoxaparin. The case was discussed with the Medical Registrar and the patient was discharged with a plan to return the next day for a CTPA via the Ambulatory Emergency care pathway. NEWS2 score zero for the preceding 3 hours. Ten minutes after discharge he suffered a cardiac arrest and was unable to be resuscitated.

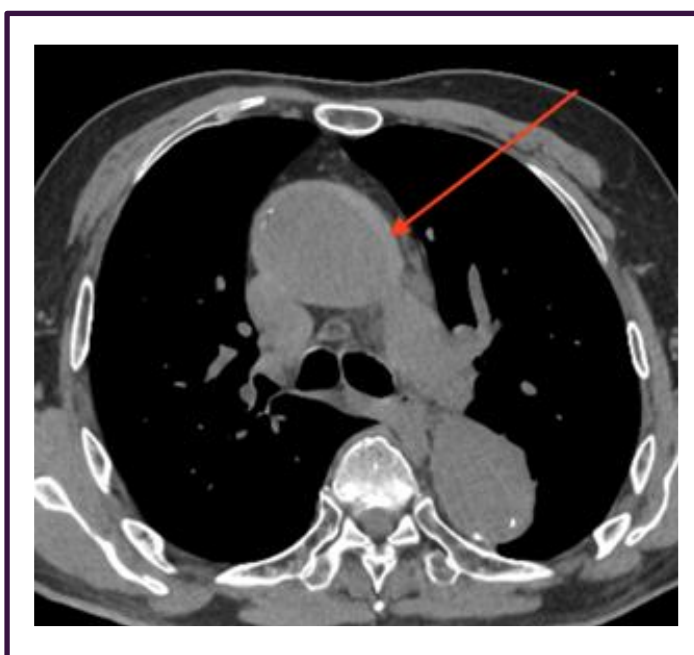
Appendix 3 - Examples of CT findings in thoracic aortic dissection



Post contrast CT Aorta showing descending thoracic aortic dissection.



Post contrast CT Aorta showing ascending and descending thoracic aortic dissection.



Non-contrast CT image showing high density intramural haematoma in the wall of the ascending aorta (arrow)

Appendix 4

Aortic Dissection Awareness UK

Unexplained Severe Pain?

**THINK
AORTA**

Aortic Dissection is an emergency
that is often fatal when missed

**CT Scan for a definitive
diagnosis**

Symptoms

- Pain is the #1 symptom
- Neck, back, chest or abdomen
- Numbness or weakness in any limbs
- History of collapse

Pain characteristics can be:

- Maximal in seconds
- Migratory & transient
- Pain can be sharp, tearing, ripping

Patient Risk Factors

- Hypertension
- Aortic aneurysm
- Bicuspid aortic valve
- Familial aortic disease
- Marfans and other connective tissue disorders

Physical Examination

- Pulse deficit or vascular signs
- Neurological signs of stroke or paraplegia

Diagnostic Warning

- Chest x-ray, ECG, ultrasound & blood tests can be normal

Aortic Dissection Awareness UK in collaboration with:

Heart Research UK
Society for Cardiothoracic Surgery in Great Britain and Ireland
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