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Transthoracic echocardiography uses to diagnose proximal aortic dissections in the emergency department: A systematic review

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Abstract

Acute type A aortic dissection is among the most dangerous cardiovascular emergencies. Our goals were to gather the most up-to-date clinical data on TTE's diagnostic test accuracy and assess its potential application in the treatment of individuals with probable AD. This study followed the PRISMA guideline. Studies that employed TTE to examine type A or ascending dissection in people, whether randomized or non-randomized, were included because they met a clear reference standard. We searched, Embase, Scopus, MEDLINE, and Web of Science, the search was conducted without regard to language and includes studies published between 2014 and 2024. We found that patients with suspected type A AD can be triaged quickly using TTE as a first-line method. It provides emergency physicians with vital information to assist them make decisions about whether to transfer patients to specialized institutions or proceed swiftly to advanced aortic imaging procedures. TTE cannot be used as a stand-alone test to rule in and rule out type A AD, even when it is used in conjunction with the AD risk score classification. Preliminary findings indicate that TTE can rapidly provide critical diagnostic information in patients presenting with shock or hypotension, but more thorough investigation is required.

Keywords: Transthoracic Echocardiography; Diagnose Proximal Aortic Dissections; Emergency Department

1. Introduction

One of the most serious cardiovascular emergencies is acute type A aortic dissection (AD) [1,2]. However, non-specific symptoms might make diagnosis difficult. Certain aortic imaging techniques are necessary for an accurate and thorough depiction of aortic anatomy and problems. Tools like as computed tomography (CT), magnetic resonance imaging (MRI), transthoracic echocardiogram (TTE), and transesophageal echocardiography are essential in this process. The severity of the patient's illness, the availability of an imaging modality at the institution, and the presence of a skilled imaging specialist may all influence the choice of modality. Because of its widespread use and speedy production of high-resolution, crisp 3D pictures, CT scanners are the go-to option for assessing possible aortic problems and vascular treatments, particularly in emergency situations [3].

As a bedside diagnostic solution, TTE provides mobility and high availability. TTE is recommended as the initial imaging test for patients suspected of having AD by the European Cardiology Society and the European Echocardiography Association. This is especially advised when a patient's AD Risk Score indicates a low likelihood of AD [4]. Confirmatory imaging is necessary for patients with positive D-dimer test findings because of their high sensitivity and lack of specificity [5]. TTE has gained popularity as a screening method because of its accessibility, non-invasiveness, and lack

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of radiation [6]. To help identify direct and indirect indications of AD, TTE makes it possible to see the thoracic aorta, pericardium, and cardiac valves [7]. If the ascending aorta exhibits aortic wall thickening (diameter more than 5 mm) or an intimal flap separating two aortic lumens, the direct TTE sign is positive. An echocardiographic finding that indicates high-risk characteristics or consequences of AD, such as pericardial effusion or cardiac tamponade, aortic regurgitation, or dilatation of the thoracic aortic root (diameter more than 4 cm), is known as an indirect TTE sign [8]. We aimed to compile the most recent clinical data on the diagnostic test accuracy of TTE and evaluate its potential use in treating patients with suspected AD.

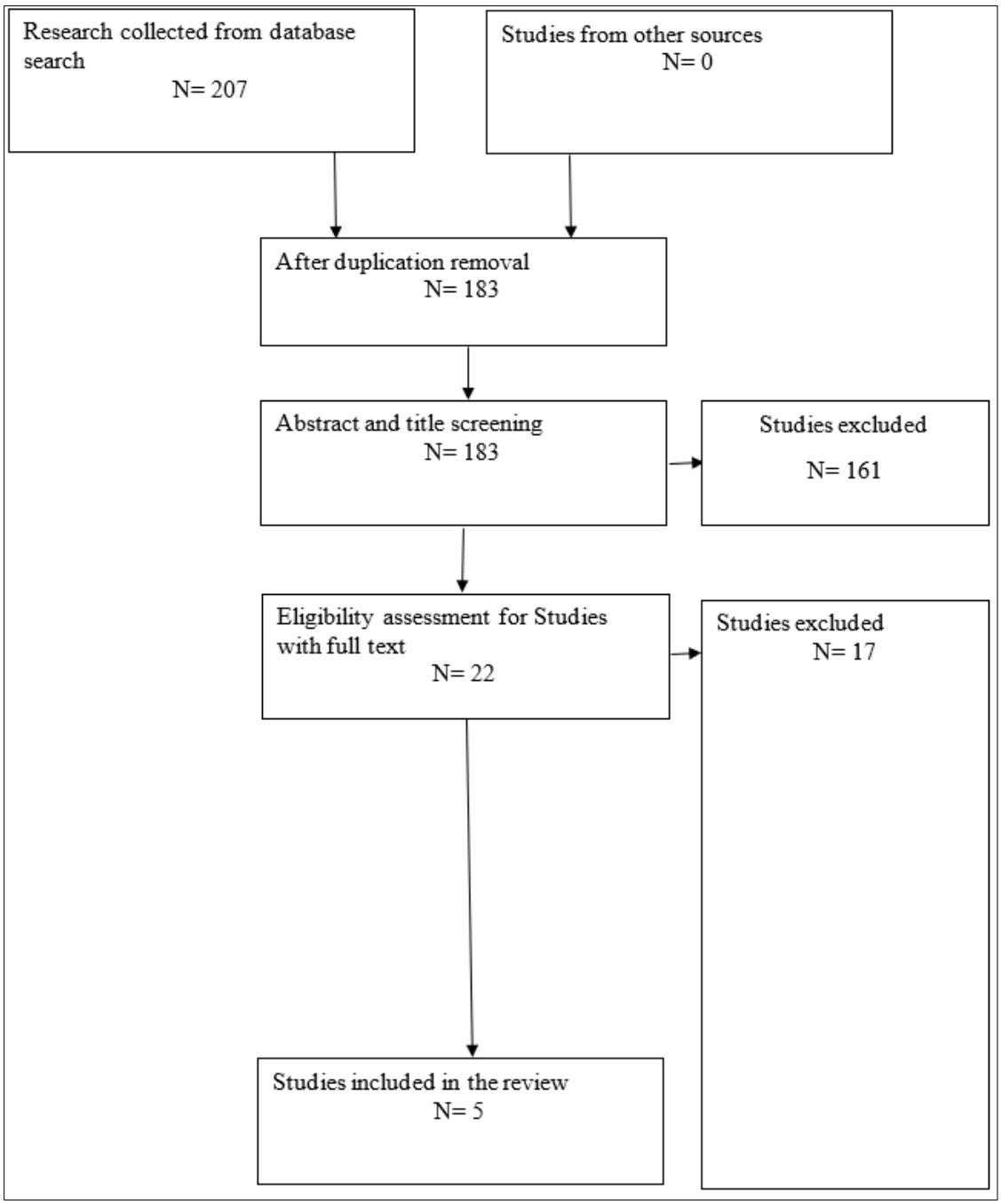

Figure 1 PRISMA consort chart of studies selection

2. Method

We conducted a comprehensive analysis of research comparing TTE's effectiveness in evaluating type A AD. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was adhered to in this investigation. We included studies with a well-defined reference standard that used TTE to investigate type A or ascending dissection in humans, whether randomized or non-randomized. Studies that were prospective or retrospective were acceptable. Animal experiments, reviews, criticism, and case reports were not included.

The following search keywords were used in a systematic search across Embase, Scopus, MEDLINE, and Web of Science: echocardiography, sonography, ultrasound, type A aortic disection, proximal, ascending. Studies published between 2014 and 2024 were included in the search, with no language constraints.

Based on the previously mentioned criteria, two writers independently reviewed and chose papers; differences were settled by consensus with a third author. Following screening, studies found in various databases were de-duplicated. The whole text of the articles that made it beyond the first screening was examined (Fig 1). Results from the reference standard were used to determine outcomes in cases when only incomplete information was available. Datasets were ostensibly grouped according to sonographic results based on the presentation of findings in the included research. The population, study design, study goal, key findings, conclusion, and reference standard were all retrieved.

3. Result

We included 5 articles in this systematic review (Fig 1), the articles assessed the use of TTE in detection of acute AD in emergency department, authors used CT, CT angiography and autopsy as reference standards tests when compare TTE to other modalities. Hui et al. (2022) reported that 33.0% of the patients had a type A AD diagnosis. The sensitivity and specificity for Type A AD were 43.0% and 97.0%, respectively, when direct TTE signals were present, and 97.0% and 78.0%, respectively, when any TTE indication was present. The additive advantage of TTE was greatest in those with a low clinical risk of Type A AD. When there were no direct symptoms of TTE and the risk score was less than 1, the sensitivity of the Type A AD rule-out was 98.4%. When compared to CT angiography, emergency physician TTE showed a sensitivity of 86.4% and a specificity of 100.0% (Wang et al., 2020). The door-to-diagnosis time for the TTE group was 10.5 minutes, while it was 79.0 minutes for the control group. The door-to-CT angiography, examination, and door-to-targeted-treatment timings did not differ between the TTE and control groups. The TTE group had a 4.2% in-hospital death rate and a 25.0% 3-month post-discharge mortality rate, compared to 9.1% and 20.8% for the control group. Main characteristics of the included studies were presented in (Table 1).

According to Sobczyk et al. study there is no appreciable differences between CT and TTE in terms of diagnosing proximal AD. Patients with aortic valve abnormalities were more likely to have a composite transplant, whereas patients with normal aortic valve images were more likely to receive valve sparing surgery (50.8%). According to the R-Spearman statistics, there is a strong positive correlation between the maximum diameter of the ascending aorta as assessed by TTE and CT, as well as between TTE and intraoperative measurement.

Table 1 study design, aim and main findings of the includes studies

Citation	Study design	Study aim	Main findings
Nazerian et al., 2014 [9]	Multicenter prospective	To assess the diagnostic efficacy of TTE conducted by emergency doctors in suspected type A AD, both by itself and in conjunction with the AD detection risk score.	The sensitivity for diagnosing type A AD was 88% when any TTE indication of AD was detected. Diagnostic sensitivity was raised to 96% in the presence of any FOCUS indication or an AD detection risk score greater than 0. Direct FOCUS sign identification showed a 94% specificity, whereas direct TTE sign detection combined with an ADD risk score > 1 had a 98% specificity.
Hui et al., 2022 [10]	Retrospective observational study	To assess TTE's effectiveness in type A AD screening in individuals who have had an ST-segment raised myocardial infarction.	33.0% were diagnosed with type A AD. For Type A AD, the sensitivity and specificity were 43.0% and 97.0%, respectively, for the presence of direct TTE signals and 97.0% and 78.0%, respectively, for the presence of any TTE sign. In individuals with a low clinical likelihood of Type A AD, the additive benefit of TTE

			was most noticeable. The sensitivity of the Type A AD rule-out was 98.4% when the risk score was ≤1 and there were no direct TTE symptoms.
Wang et al., 2020 [6]	Single center prospective	To investigate how emergency physicians' use of TTE affects AD patients' diagnosis, care, and safety in emergency situations.	In the TTE group, emergency physician TTE had a sensitivity of 86.4% and a specificity of 100.0% when compared to CT angiography. The TTE group's door-to-diagnosis time was 10.5 minutes, whereas the control group's was 79.0 minutes. There were no differences between the TTE and control groups in the door-to-CT angiography, examination, or door-to-targeted-treatment times. The TTE group saw an in-hospital death rate of 4.2% and a 3-month post-discharge mortality rate of 25.0%, while the control group experienced rates of 9.1% and 20.8%.
Tokuda et al., 2018 [11]	Single center retrospective	To evaluate the predictive values for AD markers in stroke or transient ischemic attack patients.	Patients with AD had substantially greater initial D-dimer concentrations, systolic blood pressure laterality, and more often pericardial effusion on echocardiography and common carotid artery dissection on TTE than patients without AD. AD on TTE has adequate sensitivity and seems to be the most disease-specific result.
Sobczyk et al., 2015 [12]	Comparative study	The purpose of the study was to determine if TTE is more accurate than CT in diagnosing acute type A AD.	There were no discernible differences between CT and TTE in terms of detecting proximal AD, according to statistical analysis. A composite graft was the preferred method for individuals with anomalies of the aortic valve, whereas the valve sparing surgery was more likely to be performed on patients with normal aortic valve images (50,88%). The maximal diameter of the ascending aorta as determined by TTE and CT, as well as TTE and intraoperative measurement, have a high positive connection, according to the R-Spearman statistics.

4. Discussion

The purpose of this study was to assess TTE's ability to diagnose proximal AD by identifying certain sonographic features. We found that, given its low likelihood ratio, strong diagnostic odds ratio, low sensitivity, and low number needed to treat, the systematic evaluation of each sonographic characteristic may help reduce suspicion for proximal AD. The identification of a specific group combined with negative ultrasound results after the methodical evaluation of any sonographic feature can effectively and confidently rule out proximal AD.

In contrast to Nazerian et al. [9] findings for emergency doctors performed TTE, which showed sensitivity of 88% and specificity of 96%, Wang et al. [6] study revealed that the sensitivity of TTE for type A AD was 90.9% and the specificity was 100%. The discrepancy suggests that specialized training and expertise have a significant impact on the test's sensitivity and specificity. A longer training period and a more uniform picture gathering procedure may also help to enhance the outcome. For the first 48 hours, the patient death rate for type A AD rises by 1% to 2% every hour [13]. Therefore, for this kind of patient, reducing the diagnostic time is essential. In Wang et al.'s study, the emergency doctors performed TTE examination was conducted concurrently with the patient's standard diagnostic and therapeutic procedures, and it did not lengthen those times. This extra evaluation had no effect on the therapeutic plan because the attending physician on duty was blinded to the test results.

TTE has so far demonstrated varying degrees of sensitivity and specificity for the identification of typical type A AD when conducted by experienced cardiologists in various clinical situations [7,14]. The sensitivity of direct sonographic signs of AD was significantly higher in a study by Cecconi and colleagues [7] evaluating the diagnostic performance of TTE performed by skilled cardiologists with extensive experience in 270 patients with suspected type A AD in the intensive care unit or emergency department. This suggests that specific training and experience in TTE significantly affect the sensitivity of this technique [7].

TTE cannot, however, be utilized as a stand-alone test to rule in or rule out type A AD in all individuals, as demonstrated by earlier research. For example, in Nazerian et al. [9] cohort, if the decision to send patients to immediate surgery had been based solely on the detection of a "normal TTE," six potentially life-saving operations would have been missed, and 14 inappropriate interventions would have been generated if the decision had been based on the diagnosis of intimal flap/intramural hematoma at TTE examination. Advanced aortic imaging investigations like CT angiography, TEE, or MRI must be used to compare the poor accuracy of TTE with 95–100% sensitivity and 94–100% specificity [15–17].

List of abbreviations

- TTE, Transthoracic echocardiography
- AD, Aortic dissection
- MRI, magnetic resonance imaging
- CT, computed tomography
- PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses

5. Conclusion

TTE can be used as a quick first-line tool to triage patients with suspected type A AD. It gives emergency physicians crucial information to help decide whether to move quickly to advanced aortic imaging tests or to transfer patients to specialized facilities. Even when performed in conjunction with the AD risk score categorization, TTE cannot be utilized as a stand-alone test to rule in and rule out type A AD. Although more extensive research is necessary, preliminary results show that TTE can quickly give vital diagnostic information in patients presenting with shock or hypotension.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Bossone E, LaBounty TM, Eagle KA. Acute aortic syndromes: diagnosis and management, an update. Eur Heart J. 2018 Mar 1;39(9):739-749d. doi: 10.1093/eurheartj/ehx319

[2] Tsai TT, Nienaber CA, Eagle KA. Acute Aortic Syndromes. Circulation. 2005 Dec 13;112(24):3802–13. doi: 10.1161/CIRCULATIONAHA.105.534198

[3] Correction to: 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation. 2022 May 3;145(18). doi: 10.1161/CIR.0000000000001073

[4] Evangelista A, Flachskampf FA, Erbel R, Antonini-Canterin F, Vlachopoulos C, Rocchi G, et al. Echocardiography in aortic diseases: EAE recommendations for clinical practice. Eur J Echocardiogr. 2010 Sep 1;11(8):645–58. doi: 10.1093/ejechocard/jeq056

[5] Bima P, Pivetta E, Nazerian P, Toyofuku M, Gorla R, Bossone E, et al. Systematic Review of Aortic Dissection Detection Risk Score Plus D-dimer for Diagnostic Rule-out Of Suspected Acute Aortic Syndromes. Carpenter CR, editor. Acad Emerg Med. 2020 Oct 21;27(10):1013–27. doi: 10.1111/acem.13969

[6] Wang Y, Yu H, Cao Y, Wan Z. Early Screening for Aortic Dissection With Point-of-Care Ultrasound by Emergency Physicians. J Ultrasound Med. 2020 Jul 23;39(7):1309–15. doi: 10.1002/jum.15223

[7] Cecconi M, Chirillo F, Costantini C, Iacobone G, Lopez E, Zanoli R, et al. The role of transthoracic echocardiography in the diagnosis and management of acute type A aortic syndrome. Am Heart J. 2012 Jan;163(1):112–8. doi: 10.1016/j.ahj.2011.09.022

[8] 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases. Eur Heart J. 2014 Nov 1;35(41):2873–926. doi: 10.1093/eurheartj/ehu281

[9] Nazerian P, Vanni S, Castelli M, Morello F, Tozzetti C, Zagli G, et al. Diagnostic performance of emergency transthoracic focus cardiac ultrasound in suspected acute type A aortic dissection. Intern Emerg Med. 2014 Sep 29;9(6):665–70. doi: 10.1111/echo.14980

[10] Hui L, Wang D, Liu T, Liu B, Wang Y, Liu B. Diagnostic performance of transthoracic echocardiography in screening acute type A aortic dissection from ST-segment elevated myocardial infarction. Cardiovasc Diagn Ther. 2022 Oct;12(5):603–13. doi: 10.21037/cdt-22-59

[11] Tokuda N, Koga M, Ohara T, Minatoya K, Tahara Y, Higashi M, et al. Urgent Detection of Acute Type A Aortic Dissection in Hyperacute Ischemic Stroke or Transient Ischemic Attack. J Stroke Cerebrovasc Dis. 2018 Aug;27(8):2112–7. doi: 10.1016/j.jstrokecerebrovasdis.2018.03.010

[12] Sobczyk D, Nycz K. Feasibility and accuracy of bedside transthoracic echocardiography in diagnosis of acute proximal aortic dissection. Cardiovasc Ultrasound. 2015 Dec 25;13(1):15. doi: 10.1186/s12947-015-0008-5

[13] Harris KM, Strauss CE, Eagle KA, Hirsch AT, Isselbacher EM, Tsai TT, et al. Correlates of Delayed Recognition and Treatment of Acute Type A Aortic Dissection. Circulation. 2011 Nov;124(18):1911–8. doi: 10.1161/CIRCULATIONAHA.110.006320

[14] Evangelista A, Avegliano G, Aguilar R, Cuellar H, Igual A, Gonzalez-Alujas T, et al. Impact of contrast-enhanced echocardiography on the diagnostic algorithm of acute aortic dissection. Eur Heart J. 2010 Feb 2;31(4):472–9. doi: 10.1093/eurheartj/ehp505

[15] Shiga T, Wajima Z, Apfel CC, Inoue T, Ohe Y. Diagnostic Accuracy of Transesophageal Echocardiography, Helical Computed Tomography, and Magnetic Resonance Imaging for Suspected Thoracic Aortic Dissection. Arch Intern Med. 2006 Jul 10;166(13):1350. doi: 10.1001/archinte.166.13.1350

[16] Hiratzka LF, Bakris GL, Beckman JA, Bersin RM, Carr VF, Casey DE, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease. Circulation. 2010 Apr 6;121(13). doi: 10.1161/CIR.0b013e3181d4739e

[17] Baliga RR, Nienaber CA, Bossone E, Oh JK, Isselbacher EM, Sechtem U, et al. The Role of Imaging in Aortic Dissection and Related Syndromes. JACC Cardiovasc Imaging. 2014 Apr;7(4):406–24. doi: 10.1016/j.jcmg.2013.10.015