ISSN 2572-9233

INTERNAL MEDICINE
Open Journal

Openventio PUBLISHERS

Case Report

Unraveling the Mysteries of Type-A Aortic Dissection Using POCUS/Echocardiography

Syeda Rukh, OMS-IV[1*]; Sathyanarayana Machani, MD, FACP[2]; Milind Awale, MD, MMM, FHM, FCR, CHCQM-PHYADV[2]

[1]*West Virginia School of Osteopathic Medicine (WVSOM), Lewisburg, WV 24901, USA*

[2]*Department of Internal Medicine, West Virginia University (WVU), Wheeling Hospital, Wheeling, WV 26003, USA*

[*]***Corresponding author***

Syeda Rukh, OMS-IV

West Virginia School of Osteopathic Medicine (WVSOM), Lewisburg, WV 24901, USA; E-mail: srukh@osteo.wvsom.edu

Article information

Received: June 4th, 2024; **Revised:** July 10th, 2024; **Accepted:** July 10th, 2024; **Published:** July 12th, 2024

Cite this article

Rukh S, Machani S, Awale M. Unraveling the mysteries of type-A aortic dissection uing POCUS/Echocardiography. [In press]. *Intern Med Open J*. 2024; 8(1): 8-12. doi: 10.17140/IMOJ-8-125

ABSTRACT

Introduction

Acute aortic syndrome (AAS), encompassing aortic dissection (AD), intramural hematoma (IMH), and penetrating aortic ulcer (PAU) occurs at an annual incidence of 50-150 cases per million, with AD comprising 80%, IMH 15%, and PAU five percent. Diagnosis relies on computed tomography (CT), despite limitations. Timely identification is critical due to the high mortality rate of AD, with nearly 40% resulting in immediate death and a subsequent 1-2% increase per untreated hour. Point-of-care ultrasound (POCUS) is emerging as an efficient tool for AD management.

Patient Description

A 70-year-old male presented to the emergency department (ED) with sudden-onset chest pain, radiating to the ears bilaterally, diaphoresis, and a globus sensation. Vital signs revealed elevated blood pressure.

Findings

An electrocardiogram (EKG) revealed inferolateral T-wave inversions, prompting a cardiology consultation for suspected acute coronary syndrome (ACS). Nitroglycerin and heparin drips were initiated. Troponins and chest X-rays (CXR) were unremarkable. A bedside transthoracic echocardiogram (TTE) revealed aortic dilation and a false lumen, facilitating diagnosis. Computed tomography angiography (CTA) showed type-A AD.

Treatment

An esmolol drip was started, followed by urgent surgical transfer.

Conclusion

AD presents with acute symptoms, often mistaken for a myocardial infarction (MI). POCUS offers bedside execution and aids in hemodynamically unstable patient management. TTE can be done using POCUS. A dilated aortic root (>4 centimeters, cm) strongly suggests AD, while an intimal flap is diagnostic. Cardiac surgery should be consulted upon this finding, as they may opt to forego CT and proceed directly to the operating room. POCUS streamlines patient management, facilitates early specialist consultations, and potentially reduces morbidity and mortality.

Keywords

Aortic dissection; Acute aortic syndrome; Clinical classification; Type A aortic dissection; Point of care ultrasound; POCUS; Case report; Patient management; Aortic dissection management; Early intervention; Expedited care; Patient outcomes; Diagnosis.

INTRODUCTION

Acute aortic syndrome (AAS) encompasses a spectrum of life-threatening conditions, including aortic dissection (AD), intramural hematoma (IMH), and penetrating aortic ulcer (PAU). AD alone comprises 80% of AAS cases, with IMH and PAU constituting 15% and 5%, respectively. This case report underscores the importance of maintaining a high index of suspicion for AAS, particularly in patients presenting with symptoms suggestive of acute coronary syndrome (ACS). While computed tomography (CT) remains the cornerstone of diagnosis, point-of-care ultrasound (POCUS) offers several advantages. It allows for bedside

execution, assists in the management of hemodynamically unstable patients, and has the potential to expedite specialist consultations and interventions. The integration of POCUS into the diagnostic algorithm for AAS has the potential to significantly impact patient outcomes by reducing time to diagnosis and subsequent morbidity and mortality.

CASE PRESENTATION

A 70-year-old male of Caucasian descent, with a past medical history of hyperlipidemia, hypertension, chronic kidney disease stage III, gout, and obesity, presented to the emergency department (ED) with the sudden onset of chest pain that commenced at rest. The pain was non-positional, non-pleuritic, unreproducible by palpation, and unrelated to food intake. It radiated to both ears and was accompanied by diaphoresis and a Globus sensation. No fever, nausea, vomiting, diarrhea, shortness of breath, syncopal events, or focal neurological deficits were reported.

During the episode, the patient took aspirin, which helped reduce the pain from 9/10 to 6/10. In the ED, vital signs revealed an elevated blood pressure of 129/86 mm Hg, a pulse of 56 beats/min, an oxygen saturation of 95%, and a temperature of 97.16 F. Sublingual nitroglycerin relieved the pain but prompted an abrupt decrease in systolic blood pressure to the 70s, which responded well to fluid resuscitation.

On physical examination, the patient had a regular heart rate and rhythm, no murmurs or gallops, and +2/4 pulses in all extremities bilaterally. Lungs were clear to auscultation bilaterally, the abdomen was soft and non-distended without guarding or rigidity, and bowel sounds were present. The electrocardiogram (EKG) showed sinus rhythm at 55 bpm with T-wave inversions in the inferolateral leads. Cardiology was consulted due to EKG changes, leading to concerns about ACS and the initiation of nitroglycerin and heparin drips. His home blood pressure medications were continued due to a history of hypertension.

Subsequent troponins, lipid panel, and chest X-ray (Figure 1) were unremarkable. Despite interventions, the patient experienced worsening chest pain and intermittent epigastric discomfort. On day 2, morphine was administered for pain control, and the nitroglycerin drip was escalated. Oxygen supplementation began due to declining saturation levels of 89-90%. Coronary angiography, intended for coronary anatomy assessment, was unsuccessful, but it did reveal a false lumen observed during the femoral approach (Figure 2).

A bedside transthoracic echocardiogram (TTE) facilitated the diagnosis, uncovering aortic pathology with findings of moderate dilation of the ascending aorta, a dilated aortic arch and the presence of an intimal flap (Figure 3). CT imaging identified an aortic aneurysm, culminating in a dedicated computed tomography angiography (CTA) revealing a type A AD (A-AD) extending from the ascending thoracic aorta through the abdominal aorta to the right common iliac artery (Figure 4).

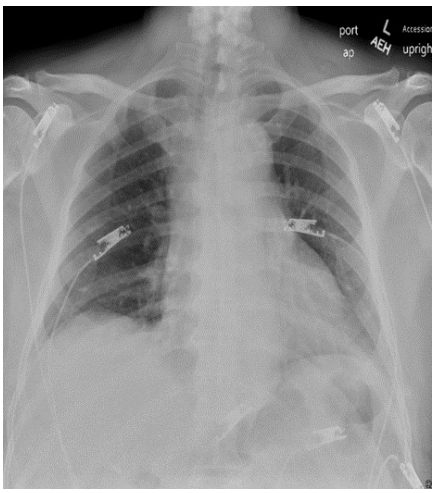
The patient was transferred to the intensive care unit (ICU) and an esmolol drip was initiated for blood pressure control. Urgent arrangements were orchestrated for transfer to a tertiary center for surgical intervention.

DISCUSSION

Acute aortic syndrome (AAS) encompasses a spectrum of interconnected conditions resulting from the disruption of the medial layer of the aortic wall. These conditions include AD, IMH and PAU. The annual incidence of AAS is approximately 50-150 cases per million, with 80% being dissections, 15% IMHs, and 5% PAUs.[2]

The diagnosis of AD relies on detecting an intimal flap that divides the aorta into true and false lumina. There are two classifications according to the extent of aortic involvement: the DeBakey and Stanford classifications. The Stanford classification

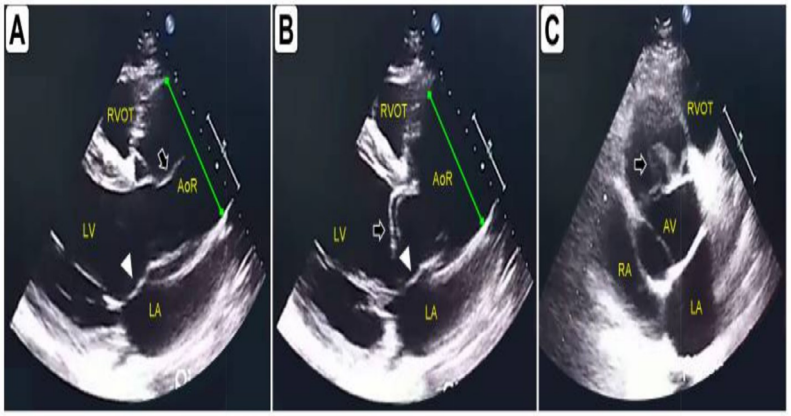
Figure 1. *Initial Chest Radiograph Antero-posterior Mobile*



Interpreted as negative chest by the radiologist

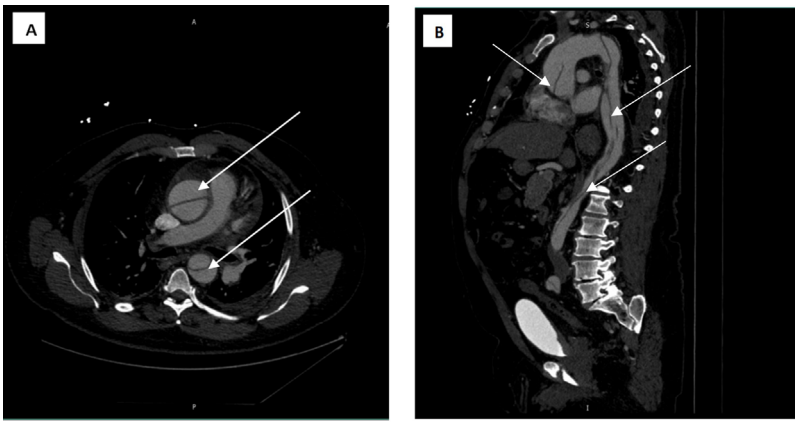
Figure 2. *A False Lumen Observed During an Unsuccessful Femoral Catheterization Attempt*

Figure 3. *Cardiac Point-of-Care Ultrasound (POCUS)*



Cardiac POCUS showing signs of type A-AD. A. Parasternal long axis (PLAX) view in a systolic frame. B. PLAX view in a diastolic frame. C. Parasternal short-axis view. The arrow indicates the intimal flap, while the continuous green line indicates the aortic root dilation. The arrowhead is pointing to the anterior leaflet of the mitral valve. LV: left ventricle; LA: left atrium; RVOT: right ventricular outflow tract; RA: right atrium; AoR: aortic root; AV: aortic valve. Reprinted with permission from López and Blanco, licensed under CC BY 4.0.[1]

Figure 4. *Computed Tomography Angiography Chest Abdomen Pelvis with Intravenous Contrast*



Contrast-enhanced CT image demonstrating an intimal flap (arrows) consistent with a Stanford type A aortic dissection. The dissection flap extends through the length of the abdominal aorta.

system categorizes the involvement as ascending aorta (type A) or localized to the descending aorta (type B). The DeBakey criteria classify dissections as originating in the ascending and involving the entire aorta (type I), only the ascending aorta (type II), or solely the descending aorta (type III). Comprising around 62% of all dissections, type A dissections commonly extend into the descending aorta. With a higher in-hospital mortality rate (20-30%) than type B dissections (~5-10%), type A dissections typically require surgical intervention. In contrast, type B dissections exhibit notably higher long-term survival rates and are frequently manageable through medical approaches.[3]

If left unaddressed, AD has the potential to lead to a fatal aortic rupture, resulting in massive internal hemorrhage, mal-perfusion syndromes, and cardiac tamponade. The incidence of acute aortic dissection in the general population is estimated to range from 2.6 to 3.5 per 100,000 person-years.[4] Nearly 40% of individuals experiencing AD succumb almost immediately, and the risk of death escalates by 1-2% for every hour the condition remains untreated.[5] AD carries a significant mortality rate, emphasizing the critical importance of early medical and surgical intervention. Rapid and accurate diagnostic methods applicable to critically ill patients are paramount.

CT serves as the gold-standard imaging technique for identifying and confirming the presence and extent of AD. However, it comes with drawbacks such as intravenous dye use which can pose challenges for patients with limited IV access or renal impairment unsuitable for contrast administration, high costs, radiation exposure, and the inability to be conducted at the bed-

side. These limitations may lead to delays in AD diagnosis and subsequent treatment. POCUS emerges as a valuable alternative, supporting the diagnosis of AD and potentially guiding immediate surgical intervention, rather than necessitating a referral for a CT scan of the aorta.

This case review explores the use of echocardiography as an alternative imaging modality for diagnosing AD in patients presenting with initial signs of ACS.

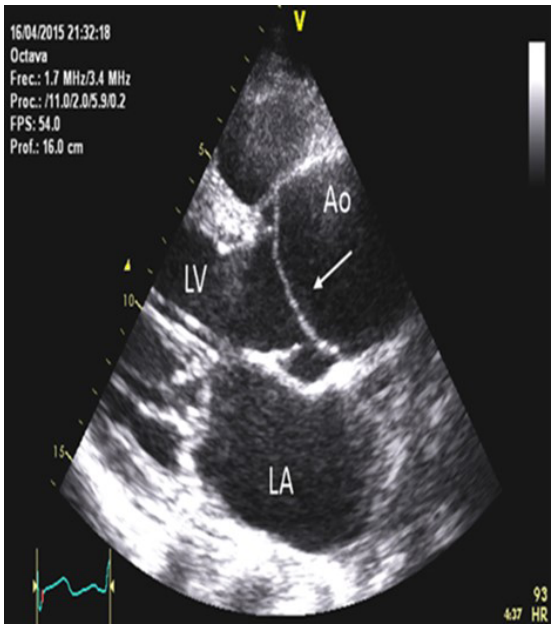
Rates of misdiagnosis for aortic dissection range from 14-38%.[3] Patients experiencing AD typically manifest acute symptoms, including chest and back pain, frequently leading to misdiagnosis akin to an acute myocardial infarction (MI), as illustrated in this case report. When a diagnostic suspicion of AD arises, it is essential to begin by thoroughly eliciting a detailed pain history. Chest and back pain are prevalent symptoms, reported by 85-95% of individuals, often characterized by an abrupt onset (85%) and severe intensity (90%). Approximately half of individuals may experience tearing or ripping pain, presenting a positive likelihood ratio (+LHR) 1.2-10.8. Additionally, sharp pain is reported in around 65% of cases.[3] A study by Ohle et al[3] found that a focused pain history led to fewer missed cases. Risk factors for AD include thoracic or abdominal aortic aneurysm, Marfan's syndrome, bicuspid aortic valve, family history of AD, and recent aortic surgery or catheterization.

AD predominantly impacts males, representing around 2/3 of cases, and manifests at an average age of approximately 63.5. Patients under 40 years of age comprise 5-10% of all dissections, with Marfan's syndrome identified in approximately half of this demographic. New neurologic deficits and chest/back pain are the most concerning findings during the physical examination, occurring in 17-40% of type A dissections. An aortic regurgitation murmur is present in 30-50% of type A dissections, the presence of new murmurs exhibits a robust positive likelihood ratio (+LHR) of 5. A widened mediastinum on chest X-ray (CXR), detected in 60-90% of cases, is strongly associated with a positive likelihood ratio (+LHR) 1.1-3.4.[3]

Point-of-care ultrasound (POCUS) revolutionizes clinical practice by providing real-time, bedside imaging of internal structures, facilitating swift and precise diagnosis. This portable, non-invasive technique is particularly transformative in emergency medicine, critical care, and primary care settings. POCUS serves diverse purposes, from evaluating cardiac function to identifying abdominal pathology, guiding procedures, and diagnosing musculoskeletal injuries. Its adaptability and accessibility render it invaluable in resource-limited environments and critical scenarios, where timely diagnosis is paramount. POCUS should be the initial imaging modality in suspected AD, especially in unstable patients. By enabling bedside imaging, POCUS obviates the need for potentially risky patient transfers, making it pivotal in emergency AD cases.

TTE can be done using POCUS. A dilated aortic root (> 4 cms, cm with clinical correlation) on TTE is strongly indicative of AD. The finding that is diagnostic for AD on TTE is the identification of an intimal flap (Figure 5). Cardiac surgery should be promptly consulted upon discovering this finding, as they may choose to forego CT and proceed directly to the operating room, preceded by pre-operative transesophageal echocardiography (TEE). Trained operators can effectively detect AD using TTE, with a higher performance for type A dissections.

Figure 5. *Transthoracic Echocardiography*



The arrow shows the intimal flap in the aortic root. Ao, Aorta; LA, left atrium; LV, left ventricle. Reprinted with permission from Evangelista et al[2] licensed under CC BY-NC-ND 4.0.

During TTE examinations for acute chest pain, particular emphasis should be placed on detecting aortic root dilatation, aortic regurgitation, and pericardial effusion. These findings are indicative of AAS and warrant heightened attention. The integration of harmonic imaging and contrast enhancement has notably heightened the sensitivity and specificity of TTE for diagnosing AD. All scanning planes should be utilized, including the left and right parasternal long-axis views, the suprasternal, two-chamber, and subcostal views. TTE facilitates the evaluation of critical parameters such as the intimal flap in the proximal ascending aorta and identifies complications commonly associated with AD, such as pericardial effusion/tamponade, significant aortic regurgitation, and left ventricular function. Aortic regurgitation is a prevalent finding in patients with type A AD, occurring in 40-76% of cases.[2] The precise diagnosis and quantification of aortic regurgitation play a crucial role in assisting surgeons in determining whether aortic valve replacement or repair is warranted.

The low negative predictive value (NPV) of TTE does not allow for the exclusion of dissection and additional imaging like CT or TEE should be considered if clinical suspicion remains high. POCUS has limitations, including lower detail and accuracy compared to MRI or CT scans, a restricted field of view potential-

ly missing critical details, challenges in evaluating complex conditions like heart valve intricacies or aortic dissections, and susceptibility to factors such as obesity or intestinal gas affecting image quality. It primarily provides 2D images, which may not suffice for comprehensive heart evaluations, and its availability varies across healthcare settings. TEE overcomes the limitations of TTE in thoracic aorta assessment. TTE can detect dissection flaps within the first 4 to 8 mm of the ascending aorta and a brief section of the descending aorta, but its sensitivity for all dissections in the descending aorta is limited (31-55%).[6] However, TTE expedites the transfer of patients with clear evidence of AD for prompt surgical intervention, improving preoperative outcomes.

CONCLUSION

AD, a potentially fatal aortic syndrome, often mimics acute MI. The advantages of POCUS lie in its capability to offer real-time visualization of the aortic valve and ascending aortic structure at the bedside, aiding in ruling out the presence of AD. During TTE examinations for acute chest pain, particular emphasis should be placed on detecting aortic root dilatation, aortic regurgitation, and pericardial effusion. These findings are indicative of AAS and warrant heightened attention. In suspected acute MI patients, especially in PPCI centers, introducing POCUS before coronary revascularization can minimize treatment delays for those with AD. We recognize that although POCUS should not substitute advanced imaging crucial for cardiothoracic surgical planning, its integration can streamline patient management and facilitate early consultations with specialists, contributing to a reduction in morbidity and mortality. Research exploring the algorithmic integration of POCUS, Aortic Dissection Detection Risk Score, and D-dimer as decision tools shows promise and has the potential to enhance current ED practices. The European Heart Association endorses the use of D-dimer, aortic dissection detection risk score (ADD-RS) and POCUS, which can achieve a sensitivity of 100%. A 2015 study found that the time to intervention and time to CT scan were significantly lower for individuals who underwent an ultrasound compared to those who did not.[7] Currently, our approach should prioritize thorough pain history assessment, identification of high-risk patient characteristics, and examination findings. Additionally, the use of POCUS can assist in determining the necessity of a computed tomography angiography (CTA) for assessing AD.

CONSENT

The authors have received written informed consent from the patient.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. López VC, Blanco P. Acute type a aortic dissection diagnosed by POCUS in a 29-year-old man. *POCUS J.* 2023; 8(2): 118-120. doi: 10.24908/pocus.v8i2.16533

2. Evangelista A, Maldonado G, Gruosso D, et al. The current role of echocardiography in acute aortic syndrome. *Echo Res Pract.* 2019; 6(2): R53-R63. doi: 10.1530/ERP-18-0058

3. Wells S, King P. Aortic dissection - A needle in a haystack. EMOttawa Blog. Website. https://emottawablog.com/2020/10/aortic-dissection-a-needle-in-a-haystack/. Retrived October 22, 2020. Accessed December 12, 2023.

4. Kim HJ, Lee HK, Cho B. A case of acute aortic dissection presenting with chest pain relieved by sublingual nitroglycerin. *Korean J Fam Med.* 2013; 34(6): 429-433. doi: 10.4082/kjfm.2013.34.6.429

5. Cleveland Clinic. Aortic dissection. 2019. Website. https://my.clevelandclinic.org/health/diseases/16743-aortic-dissection. Accessed December 12, 2023.

6. Broadstock A, Desai S, Dowd R, Bundy L, Freudenberger J. POCUS for the win: Aortic dissection. Emra.org. Website. https://www.emra.org/emresident/article/pocus-ftw-aortic-dissection. Published November 21, 2022. Accessed December 12, 2023.

7. MetroHealth Emergency Ultrasound. POCUS for aortic dissection: The evidence. www.youtube.com. July 7, 2021. https://www.youtube.com/watch?v=tP9ENdtj4MM&t=557s. Accessed December 12, 2023.