**Clinical, Electrocardiographic, and Imaging Features of Acute Aortic Syndromes**

**Abstract:**

Acute aortic syndromes (AAS) relates to a range of different entities, including aortic dissection (AD), intramural haematoma (IMH), penetrating atherosclerotic ulcers (PAU) and traumatic or iatrogenic aortic dissection. They requires rapid diagnosis and a high level of clinical suspicion to identify thier symptoms. The aim of this study is to define the range of clinical presentations, electrocardiographic and imaging findings, in patients presenting with AAS.

**Materials and methods:**

This study is a retrospective study of clinical, electrocardiographic and imaging data in patients hospitalized for acute aortic syndromes from December 2021 to December 2024.Patients with traumatic or iatrogenic aortic dissection were excluded.

A total of 10 patients were included, with a mean age of 45 years, and 70% of patients were male.

The most frequent symptoms were chest pain alone (50%) or chest pain associated with back pain (40%). Classical “tearing” pain, often associated with aortic dissection, was less frequently reported. Differential blood pressure was observed in 30% of cases.

The electrocardiogram showed ST-segment depression in the apical, lateral and inferior leads, as well as ST-segment elevation in the AVR lead and T-wave changes, which were the most frequently observed abnormalities.

The most frequent diagnosis was type A aortic dissection (TAAD) (70%), followed by type B aortic dissection (TBAD) (20%) and intramural hematoma (IMH) (10%).

The initial diagnosis was made primarily by computed tomography angiography (CTA) in 70% of cases, and by transthoracic echocardiography (TTE) in 30%. Magnetic Resonance Imaging (MRI) was not performed any of these patients.

A diagnostic discordance was found between CTA and TTE in two patients, particularly in one patient with IMH and aortitis. In addition, one case of false positive of TAAD was identified.

**Conclusions:**

In conclusion, the diverse clinical presentations of AAS underline the importance of multimodal imaging for accurate diagnosis and management. Relying on classical signs may lead to misdiagnosis. A well-structured approach combining imaging techniques improves diagnostic accuracy, reduces errors and improves patient outcomes.

**KEYWORDS**: Acute Aortic Syndromes- Diagnosis- Multimodal Imaging

**Introduction**

Acute aortic syndromes (AAS) includes aortic dissection (AD), intramural hematoma (IMH), penetrating atherosclerotic ulcer (PAU) and Traumatic or iatrogenic aortic dissection.(1)These conditions represent a critical medico-surgical emergency with a high risk of mortality, requiring urgent diagnosis and management.

**Aortic Dissection** is characterized by the presence of an intimal flap separating the true from the false lumen and it’s the most common form of AAS(2). IMH is traditionally defined as a "dissection without an intimal tear,” it represents a non-communicating form of dissection. (3) IMH accounts for approximately 5% to 20% of AAS cases.(4) PAU represents around 7.5% of AAS cases, with a reported range between 2.3% and 11% .It is characterized by the ulceration of an atherosclerotic plaque that extends through the internal elastic lamina into the media layer of the aorta.(5)The clinical progression of patients with PAU varies. Many remain asymptomatic, but some develop AAS.

Several anatomical classifications have been developed to guide the management of AAS, with the Stanford and DeBakey systems being the most widely used. The Stanford classification categorizes AAS based on the involvement of the ascending aorta: Type A (TAAD) (corresponding to DeBakey Type I and II) includes dissections affecting the ascending aorta, while Type B (TBAD)(DeBakey Type IIIa and IIIb) involves only the descending aorta, regardless of the intimal tear's point of origin.(3)

To establish a correct diagnosis of AAS, an in-depth examination must be performed, which involves investigations allowing for the exclusion of several other conditions that are part of the differential diagnosis. The diagnosis of AAS is difficult due to three key factors: a modest prevalence, a lack of precise biomarkers and a highly varied clinical course.(6)

The aim of this study is to describe the spectrum of clinical symptoms, electrocardiographic abnormalities, and imaging findings in a consecutive series of patients presenting with acute aortic syndromes.

**Methods**

A retrospective analysis was conducted on the clinical data of AAS patients hospitalized at the cardiovascular surgery department of the hospital of Mohammed VI Marrakech MOROCCO from December 2021 to December 2024. AD was classified into Type A and Type B according to the Stanford classification.

Clinical variables were systematically documented on demographics, medical history, clinical presentations, physical examination findings and imaging results.

**Results**

**Baseline and clinical characteristics**

A total of 10 patients were included in this study, with male patients represents (70%). The most prevalent symptom was chest pain alone (n =5; 50 %) or chest pain in conjunction with back pain (n =4; 40%), characterized by abrupt onset and severe intensity. Classic “tearing” pain was infrequent symptom. Hypertension was the most frequent risk factor, observed in 40% of patients, followed by smoking, which was present in 10%.Takayasu arteritis, Marfan syndrome and a recent aortique manipulation were the high-risk conditions present in our series of patients.

The differential blood pressure and new aortic murmur were reported in 3patients (n=3;30%).

**Table 1:** Baseline characteristics, clinical presentation and examinations

|  |  |
| --- | --- |
| Clinical features | Overall |
| Age | 45.5 ans |
| Range | 9-73ans |
| Male | 70% |
| CARDIOVASCULAR RISK FACTORS AND MEDICAL PAST-HISTORY   * Diabetes * Hypertension * Coronaropathies * Smoking * Post-partum | 0  40%  0  10%  10% |
| HIGH RISK CONDITION   * Marfan syndrome * Family history of aortic disease * Known aortic valve disease * Recent aortique manipulation * Known aortic aneurysm * Takayasu arteritis | 10%  0  0  10%  0  10% |
| HIGH RISK PAIN FEATURE   * Chest pain * Chest pain +Back pain * Chest pain+ Abdominal pain * Abdominal pain * Abrupt onset * Severe intensity * Ripping /tearing | 50%  40%  20%  10%  80%  90%  30% |
| HIGH RISK FEATURE   * Hemodynamic instability(hypotension /schok) * Pulse deficit * Differential blood pressure * Focal neurologic deficit * New Aortic murmur | 0  10%  30%  0  30% |

**Initial investigations**

Electrocardiogram (EKG) findings showed ST segment depression in the apical lateral, inferior leads, as well as ST elevation in the AVR lead and T wave changes, which were the most common anomalies observed. These abnormalities was found especially in TAAD patients.

Chest radiography and D-dimer testing were not performed for the majority of patients.

**Diagnostic imaging**

All patients underwent transthoracic echocardiography (TTE) and computed tomography angiography (CTA).

Initial diagnosis was made primarily by CTA in 70% of cases, with TTE used in 30% of cases. MRI was not utilized for diagnosis in this study.

The most frequent diagnosis was Type A Aortic Dissection (TAAD) (70%), followed by Type B Aortic Dissection (TBAD) (20%) and Intramural Hematoma (IMH) (10%). Emergency department was the main site for initial diagnosis.

Aortic regurgitation was present in 50% of patient especially those with TAAD .Minimal pleural, pericardial effusions was present in 30% of patients.

**Table 2: Initial investigations and diagnostic imaging**

|  |  |
| --- | --- |
| Electrocardiogram findings   * AVR ST elevation * ST depression * T waves inversion * Sinus bradycardia * No significant abnormalities | 30%  30%  30%  10%  30% |
| Chest radiography findings   * Widened mediastinum * Not performed | **10%**  **90%** |
| D-dimer   * Not performed * Performed and significant | **80%**  **10%** |
| Initial modality   * Echocardiography * Computed tomography Angiography * Magnetic Resonance Imaging | **30%**  **70%**  **0%** |
| Diagnosis   * TAAD * TBAD * IMH * PAU | **70%**  **20%**  **10%**  **0%** |
| Initial diagnosis site   * Emergency department * Outside the hospital * Hospital service | **70%**  **20%**  **10%** |
| Complications at TTE\CTA   * Aortic regurgitation * Cardiac Tamponade * Minimal Pleural- Pericardial effusion * Minimal Peritoneal effusion * bladder hematoma | **50%**  **0**  **30%**  **10%**  **10%** |

**Discussion:**

Most acute aortic syndromes occur in older patients (in the fifth and sixth decade), with a male predominance, and in those with a history of hypertension. Patients with connective tissue disorders may present at a younger age without hypertension as can patients with vascular inflammatory diseases or trauma.(6) Chest pain is the most common presenting complaint for AAS (80%). Back (40%) and abdominal pain are not uncommon .(7) These findings concur with our results.

Our study highlights that the absence of ‘typical’ acute aortic syndrome symptoms—such as tearing or ripping pain, differential upper limb blood pressures, pulse deficit, or acute hypertension—does not reliably rule out the condition. The absence of these factors contribute to missed diagnoses, as demonstrated by Lovatt et al. (2022), who reviewed 12 studies involving 1,663 patients with acute aortic syndrome and reported a misdiagnosis rate of 33.8%.(8)

The present study demonstrated a high incidence of EKG changes in patients especially in patients with TAAD who presented to the hospital. Only 30 % showed a normal EKG. These observations were consistent with those of Hagan et al.(9) and Hirata et al.(10). Additionnally ST depression and T wave changes were observed in 34.0% and 21.4% cases, respectively.

Cases with ST depression or T wave changes had higher incidence of shock (65.2% vs. 28.8%, p<0.001) and cardiac tamponade (51.2% vs. 15.0%, p<0.001) compared with those without changes.(11) These last two complications were not reported in our patients.

The strong clinical suspicion of acute aortic syndrome (AAS) explains the non-use of chest x-ray and D-Dimer by emergency physicians.Importantly, chest x-ray or EKG should not delay definitive imaging in patients in whom there is a high clinical suspicion (12).

our findings regarding the frequency of different AAS are in agreement with the results of the available literature.CTA is the most commonly used first-line imaging modality (63%), followed by echocardiography (32%), angiography (4%), and magnetic resonance imaging (1%). Currently, the latter two no longer play a significant role in the emergency diagnosis of this syndrome.(13) These results corresponds to the reported data.

CTA has a 100% sensitivity and 98% specificity for AAS (14) but motion artifact in the absence of pathology may mimic a dissection flap. Periaortic fibrosis,mediastinal tumors, and surrounding vascular structures can also be mistaken for TAD ((15)). This illustrates the diagnostic discrepancies observed in our series, highlighting the importance of a multimodal imaging approach to improve diagnostic accuracy in acute aortic syndromes.

**Conclusion**

In conclusion, the diverse clinical presentations of acute aortic syndromes underline the importance of multimodal imaging for accurate diagnosis and management. Relying on classical signs may lead to misdiagnosis. A well-structured approach combining imaging techniques improves diagnostic accuracy, reduces errors and improves patient outcomes

**References**

1. Banceu CM, Banceu DM, Kauvar DS, Popentiu A, Voth V, Liebrich M, et al. Acute Aortic Syndromes from Diagnosis to Treatment—A Comprehensive Review. J Clin Med. 2024 Jan;13(5):1231.

2. Bossone E, Eagle KA. Epidemiology and management of aortic disease: aortic aneurysms and acute aortic syndromes. Nat Rev Cardiol. 2021 May;18(5):331–48.

3. Leone O, Pacini D, Foà A, Corsini A, Agostini V, Corti B, et al. Redefining the histopathologic profile of acute aortic syndromes: Clinical and prognostic implications. 2018 [cited 2025 Feb 14]; Available from: https://cris.unibo.it/handle/11585/645408

4. Sundt TM. Intramural Hematoma and Penetrating Atherosclerotic Ulcer of the Aorta. Ann Thorac Surg. 2007 Feb;83(2):S835–41.

5. Vilacosta I, San Román JA, Aragoncillo P, Ferreirós J, Mendez R, Graupner C, et al. Penetrating atherosclerotic aortic ulcer: documentation by transesophageal echocardiography. J Am Coll Cardiol. 1998 Jul 1;32(1):83–9.

6. Population-Based Study of Incidence and Outcome of Acute Aortic Dissection and Premorbid Risk Factor Control | Circulation [Internet]. [cited 2025 Feb 13]. Available from: https://www.ahajournals.org/doi/10.1161/circulationaha.112.000483

7. 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases: Document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adultThe Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC). Eur Heart J. 2014 Nov 1;35(41):2873–926.

8. Lovatt S, Wong CW, Schwarz K, Borovac JA, Lo T, Gunning M, et al. Misdiagnosis of aortic dissection: A systematic review of the literature. Am J Emerg Med. 2022 Mar 1;53:16–22.

9. Hagan PG, Nienaber CA, Isselbacher EM, Bruckman D, Karavite DJ, Russman PL, et al. The International Registry of Acute Aortic Dissection (IRAD): New Insights Into an Old Disease. JAMA. 2000 Feb 16;283(7):897.

10. Hirata K, Wake M, Kyushima M, Takahashi T, Nakazato J, Mototake H, et al. Electrocardiographic changes in patients with type A acute aortic dissection. J Cardiol. 2010 Sep;56(2):147–53.

11. Hirata K, Wake M, Kyushima M, Takahashi T, Nakazato J, Mototake H, et al. Electrocardiographic changes in patients with type A acute aortic dissection. Incidence, patterns and underlying mechanisms in 159 cases. J Cardiol. 2010 Sep;56(2):147–53.

12. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease | Circulation [Internet]. [cited 2025 Feb 13]. Available from: https://www.ahajournals.org/doi/10.1161/cir.0b013e3181d4739e

13. Rousseau H, Chabbert V, Marcheix B, Hassar OE, Cron C, Lopez S, et al. Les syndromes aortiques aigus. 2009;21.

14. 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: systematic review and meta-analysis. Arch Intern Med. 2006 Jul 10;166(13):1350–6.

15. McMahon MA, Squirrell CA. Multidetector CT of Aortic Dissection: A Pictorial Review. Radiogr Rev Publ Radiol Soc N Am Inc. 2010 Mar;30(2):445–60.