INTERNATIONAL SEVEN JOURNAL
OF MULTIDISCIPLINARY
ISSN: 2764-9547

AORTIC DISSECTION: THERAPEUTIC STRATEGIES AND MODERN GUIDELINES

DISSECÇÃO DE AORTA: ESTRATÉGIAS TERAPÊUTICAS E DIRETRIZES MODERNAS

DISECCIÓN DE AORTA: ESTRATEGIAS TERAPÉUTICAS Y DIRECTRICES MODERNAS

https://doi.org/10.56238/isevmjv4n6-020

Receipt of originals: 11/29/2025 **Acceptance for publication:** 12/29/2025

Ryan Rafael Barros de Macedo[1], Juliana de Jesus Santos[2], Karen L Morais Figueiredo de Mendonça[3], Matheus Pires da Conceição do Carmo[4], Rafael Cardoso Louzada[5], Adria Amanda Carvalho Jacinto[6], Sintya Roberta Siilva de Paulo[7], Eduardo da Silva Horta[8], Amanda Carolina Milan[9], Fernanda Iara Rodrigues Oliveira[10]

ABSTRACT

Aortic dissection is a cardiovascular emergency with high morbidity and mortality, whose early diagnosis remains challenging due to its variable and often nonspecific clinical presentation. This article aims to critically review contemporary evidence on aortic dissection, with emphasis on diagnostic challenges, emerging pathophysiological mechanisms, and current therapeutic strategies. This is a narrative literature review based on articles published over the past five years and selected from the PubMed database. The findings highlight the relevance of clinical suspicion combined with the timely use of computed tomography angiography, as well as the complementary role of biomarkers and risk stratification tools. Recent advances have expanded the understanding of the disease's pathophysiology, demonstrating the involvement of inflammatory, immunological, and genetic pathways, in addition to new clinical scenarios, such as aortic changes associated with prolonged use of left ventricular assist devices. It is concluded that the integration of early diagnosis, advanced pathophysiological understanding, and individualized management is essential to reduce mortality and improve the care of patients with aortic dissection.

Keywords: Aortic Dissection. Acute Aortic Syndrome. Diagnosis. Pathophysiology. Treatment.

[1] Medical student. Centro Universitário do Planalto Central Apparecido dos Santos (UNICEPLAC).
[2] Medical student. Instituto de Educação Médica (IDOMED).
[3] Assistant physician in Intensive Care Unit. Universidade de São Paulo (HCFMUSP).
[4] Graduated in Medicine. Universidade Estadual Paulista (UNESP).
[5] Graduated in Medicine. Universidade Federal de Santa Maria (UFSM).
[6] Graduated in Veterinary Medicine. Centro Universitário Mais (UniMais).
[7] Physiotherapist. Centro Universitário Mais (UniMais).
[8] Graduated in Nursing. Universidade Nove de Julho (UNINOVE).
[9] Medical student. Universidade do Sul de Santa Catarina (UNISUL).
[10] Medical student. Faculdade de Medicina de Juazeiro do Norte (IDOMED FMJ).

INTERNATIONAL SEVEN JOURNAL
OF MULTIDISCIPLINARY
ISSN: 2764-9547

RESUMO
A dissecção aórtica constitui uma emergência cardiovascular de elevada morbimortalidade, cujo diagnóstico precoce permanece desafiador devido à apresentação clínica variável e frequentemente inespecífica. Este artigo tem como objetivo revisar criticamente as evidências contemporâneas acerca da dissecção aórtica, com ênfase nos desafios diagnósticos, nos mecanismos fisiopatológicos emergentes e nas estratégias terapêuticas atuais. Trata-se de uma revisão narrativa da literatura, realizada a partir de artigos publicados nos últimos cinco anos, selecionados na base de dados PubMed. Os achados destacam a relevância da suspeição clínica associada ao uso oportuno da angiotomografia computadorizada, bem como o papel complementar de biomarcadores e ferramentas de estratificação de risco. Avanços recentes ampliaram a compreensão da fisiopatologia da doença, evidenciando a participação de vias inflamatórias, imunológicas e genéticas, além de novos cenários clínicos, como alterações aórticas associadas ao uso prolongado de dispositivos de assistência ventricular esquerda. Conclui-se que a integração entre diagnóstico precoce, compreensão fisiopatológica avançada e manejo individualizado é fundamental para a redução da mortalidade e para o aprimoramento do cuidado ao paciente com dissecção aórtica.

Palavras-chave: Dissecção Aórtica. Síndrome Aórtica Aguda. Diagnóstico. Fisiopatologia. Tratamento.

RESUMEN
La disección aórtica constituye una emergencia cardiovascular de alta morbimortalidad, cuyo diagnóstico precoz continúa siendo un desafío debido a su presentación clínica variable y frecuentemente inespecífica. Este artículo tiene como objetivo revisar críticamente la evidencia contemporánea sobre la disección aórtica, con énfasis en los desafíos diagnósticos, los mecanismos fisiopatológicos emergentes y las estrategias terapéuticas actuales. Se trata de una revisión narrativa de la literatura, basada en artículos publicados en los últimos cinco años y seleccionados en la base de datos PubMed. Los hallazgos destacan la relevancia de la sospecha clínica asociada al uso oportuno de la angiotomografía computarizada, así como el papel complementario de los biomarcadores y las herramientas de estratificación del riesgo. Los avances recientes han ampliado la comprensión de la fisiopatología de la enfermedad, evidenciando la participación de vías inflamatorias, inmunológicas y genéticas, además de nuevos escenarios clínicos, como las alteraciones aórticas asociadas al uso prolongado de dispositivos de asistencia ventricular izquierda. Se concluye que la integración entre el diagnóstico precoz, la comprensión fisiopatológica avanzada y el manejo individualizado es fundamental para reducir la mortalidad y mejorar la atención del paciente con disección aórtica.

Palabras clave: Disección Aórtica. Síndrome Aórtico Agudo. Diagnóstico. Fisiopatología. Tratamiento.

1 INTRODUCTION

Aortic disease, encompassing both aneurysm (AA) and aortic dissection (AD), represents a clinical condition of high morbidity and mortality, requiring a deep understanding of its pathophysiology and management (Dreher et al., 2025). Acute aortic dissection is characterized by the separation of the layers of the aortic wall, allowing blood to flow through an intimal rupture into the medial layer, creating a false lumen that can lead to poor organ perfusion, aortic rupture, and death (Reed, 2024).

Despite advances in cardiovascular medicine, early diagnosis remains a significant challenge in emergency departments, as the clinical presentation is often atypical and mimics other acute thoracic pathologies (Reed, 2024). In addition to traditional cardiovascular risk factors, such as hypertension, the etiology of aortic disease is multifactorial, involving genetic predisposition and complex inflammatory mechanisms. Syndromic conditions, such as Marfan Syndrome, illustrate the importance of mutations in fibrillin-1 and dysregulation of transforming growth factor beta (TGF-β) and angiotensin II signaling pathways in the progression of aortic dilation (Asano et al., 2022).

Recently, new pathophysiological frontiers have been explored, highlighting the role of the complement system and innate immunity in vascular wall degeneration. Activation of complement pathways and release of anaphylatoxins (C3a, C5a) have been associated with vascular inflammation, extracellular matrix degradation, and immune cell recruitment, suggesting new therapeutic targets for precision medicine (Dreher et al., 2025). Additionally, the management of patients with advanced heart failure using left ventricular assist (LVAD) devices has introduced new scenarios of complexity, where non-physiological continuous flow can induce structural changes in the aorta, predisposing to aneurysms and dissections (Chaubey et al., 2024).

Despite advances in imaging methods and cardiovascular management, aortic dissection continues to be associated with high mortality rates, particularly due to diagnostic delay or error in emergency departments. Studies have shown that a significant proportion of patients do not receive the correct diagnosis at initial admission, which significantly compromises the prognosis, considering that mortality increases progressively with each hour of delay in recognizing the disease. This scenario shows that aortic dissection remains a relevant clinical challenge, requiring greater integration between clinical suspicion, risk stratification, and early decision-making (REED, 2024).

The advancement of scientific knowledge has revealed that aortic dissection cannot be understood only as a consequence of isolated hemodynamic factors, but as a result of a complex interaction between structural alterations of the vascular wall, genetic predisposition, and inflammatory processes. Evidence indicates that the disorganization of the extracellular matrix, endothelial dysfunction and inadequate activation of specific molecular pathways contribute decisively to the loss of aortic integrity. Thus, the integrated understanding of these mechanisms becomes essential to explain the clinical heterogeneity of the disease and its unpredictable evolution (ASANO et al., 2022; DREHER et al., 2025).

In addition to the classical mechanisms, the incorporation of new clinical and biomolecular scenarios has increased the complexity of the management of aortic dissection. The identification of the role of the complement system in the pathogenesis of the disease and the observation of aortic changes associated with the prolonged use of left ventricular assist devices reinforce the need for updated and individualized approaches. In this context, it is essential to critically review the available contemporary evidence, integrating diagnostic, pathophysiological, and therapeutic findings, in order to offer a comprehensive view that contributes to the improvement of current clinical management (DREHER et al., 2025; CHAUBEY et al., 2024).

The aim of this study is to review the current evidence on aortic dissection, covering everything from diagnostic challenges and emerging molecular mechanisms to contemporary therapeutic strategies.

Aortic dissection (AD) is defined as the rupture of the aortic media layer due to intramural hemorrhage, which causes the separation of the layers of the aortic wall and results in the formation of a true lumen and a false lumen, a process that can progressively evolve to aortic rupture if the integrity of the adventitious layer is also compromised. (Dreher et al., 2025).

Acute aortic dissection presents high diagnostic difficulty and, in most cases, is identified mistakenly or late, mainly due to its atypical clinical manifestations and the similarity of its diagnostic picture with that of other diseases, with highly inconclusive and dynamic clinical characteristics, since its symptoms can appear and disappear, since its symptoms can appear and disappear throughout the evolution of the condition. (Reed, 2024).

The incorrect diagnosis of acute aortic dissection is relatively frequent and requires specific tests, such as computed tomography angiography (CTA), to confirm the

diagnosis, and, from this perspective, it is essential to be effective in early diagnosis in order to improve the prognosis of patients after emergency care. (Reed, 2024).

Aortic dissection remains a condition of high clinical and pathophysiological complexity, marked by complex diagnostic challenges and new molecular and structural discoveries that expand the understanding of the disease. Therefore, this study aims to systematically review the contemporary evidence related to aortic dissection, addressing the main obstacles to an efficient and correct diagnosis, as well as the emerging pathophysiological mechanisms — including inflammatory, immunological, and genetic pathways — and the therapeutic strategies currently employed, with the aim of integrating recent knowledge and guiding perspectives for modern clinical management.

2 METHODOLOGY

This study is a narrative literature review, elaborated with the aim of compiling and critically analyzing the current scientific evidence regarding aortic dissection and its therapeutic approaches. The bibliographic search was conducted in the PubMed database, using the descriptors "Aortic Aneurysm Dissecting" and "Treatment", interconnected by the Boolean operators AND and OR, in accordance with the vocabulary of the Medical Subject Headings (MeSH). The inclusion criterion included articles published in the last five years, accessible in full and written in English or Portuguese, which dealt directly with the proposed theme. Studies without direct relevance to the object of study, duplicates, and studies with inaccurate methodology were discarded. The screening initially occurred by reading titles and abstracts, advancing to the complete analysis of the selected texts to ensure their relevance, and the extracted data was systematized in a descriptive manner.

3 RESULTS AND DISCUSSION

3.1 DIAGNOSTIC CHALLENGES AND CLINICAL PRESENTATION

The identification of acute aortic dissection in the emergency setting is critical and often hampered by the variability of symptoms. It is estimated that in the United Kingdom, there are about 4,000 cases annually, with a rate of incorrect or late diagnoses that significantly affects prognosis (Reed, 2024). Although sudden and severe chest pain is the classic symptom, it is present in most patients, but the absence of typical signs, such as pulse deficit or blood pressure difference between the limbs, does not exclude the

disease. Acute aortic syndrome (ASS) encompasses not only classic dissection, but also intramural hematoma and penetrating ulcer, requiring a high index of clinical suspicion. Computed tomography angiography (CTA) remains the imaging modality of choice due to its high sensitivity and specificity, and should be promptly requested in cases of abrupt pain or "the worst pain of life" (Reed, 2024).

Although chest X-rays have limited sensitivity, they remain relevant as an initial screening tool in the evaluation of patients with suspected aortic dissection in the emergency room. The finding of mediastinal enlargement, associated or not with tracheal deviation, effacement of the aortic contour, or presence of left pleural effusion, has been described as an important warning sign for acute aortic syndromes. Recent guidelines and reviews emphasize that, in the face of a suggestive clinical picture, the identification of these radiographic alterations should accelerate the indication of highly accurate confirmatory tests, particularly computed tomography angiography, avoiding potentially fatal diagnostic delays. Thus, chest X-ray remains useful as an initial complementary test, especially in scenarios of limited resources or hemodynamic instability, as long as it does not replace CTA as the definitive diagnostic method (REED, 2024; ERBEL et al., 2019; NISHIMURA et al., 2022)

In recent years, accumulated evidence indicates that D-dimer is frequently elevated in acute aortic syndrome, presenting high diagnostic sensitivity, although with moderate specificity, so that "altered" values should increase clinical suspicion, but do not confirm the disease in isolation. Recent meta-analyses demonstrate high overall sensitivity of D-dimer for acute aortic syndrome, and combined strategies that integrate the ADD-RS clinical score with D-dimer (often using the cut-off point of 500 ng/mL in FEU) show adequate performance for screening and selection of patients who should be promptly submitted to computed tomography angiography, reducing potentially fatal diagnostic delays (ESSAT et al., 2024; REN et al., 2024)

3.2 PATHOPHYSIOLOGICAL MECHANISMS AND INFLAMMATION

The molecular understanding of aortic disease has advanced beyond simple hemodynamics. Recent studies indicate that the complement system, an essential part of innate immunity, is activated in the three main pathways (classical, lectin, and alternative) during the pathogenesis of aortic aneurysms and dissections (Dreher et al., 2025). The presence of anaphylatoxins (C3a and C5a) and membrane attack complex

(MAC) formation contribute to vascular inflammation, smooth muscle cell apoptosis, and matrix degradation via metalloproteinases (MMPs). The elevation of biomarkers such as C5a and C2 in plasma has been shown to correlate with disease progression, suggesting that pharmacological inhibition of complement may represent a promising avenue for personalized therapies in the future (Dreher et al., 2025).

In the context of connective tissue diseases such as Marfan Syndrome, fibrillin-1 deficiency leads to a failure of tissue homeostasis. Experimental models have shown that exacerbated angiotensin II receptor 1 (AT1r) signaling and dysregulation of the TGF-β pathway are central drivers of the pathology (Asano et al., 2022). In addition, endothelial dysfunction, characterized by impaired nitric oxide (NO) production and increased oxidative stress, precedes and aggravates the formation of aneurysms, highlighting the complexity of the interaction between the vascular wall and molecular signals (Asano et al., 2022).

3.3 THERAPEUTIC STRATEGIES AND CLINICAL MANAGEMENT

The therapeutic management of aortic dissection is guided by the Stanford classification into type A and type B (DAILY et al., 1970).". For Type A dissections (involving the ascending aorta), immediate surgical intervention is mandatory due to the risk of tamponade and rupture. For Type B (descending aorta), the initial management is preferably medical, focused on strict control of blood pressure and heart rate, using intravenous beta-blockers such as labetalol or esmolol (Reed, 2024). Anti-impulse therapy aims to reduce stress on the aortic wall, with adequate analgesia with opioids being key to avoiding reflex tachycardia (Reed, 2024).

Advances in drug therapy to prevent aortic dilation in syndromic patients have been explored. While the use of angiotensin receptor blockers (ARBs) such as losartan has shown promising results in animal models by modulating the TGF-β pathway and improving nitric oxide signaling, human clinical trials have shown heterogeneous results when compared to traditional beta-blockers (Asano et al., 2022).

The management of aortic dissection does not end in the acute phase, and longitudinal follow-up is an essential component of care. Serial imaging is recommended, preferably by computed tomography angiography or magnetic resonance imaging, at regular intervals—typically at 1, 6, and 12 months after the initial event, and annually thereafter—to monitor aortic stability, false lumen evolution, and the development of late

aneurysms. Tight control of blood pressure, adherence to anti-impulse therapy, and modification of cardiovascular risk factors are key to reducing disease progression and the need for future reinterventions. (ERBEL et al., 2019; DREHER et al., 2025)

3.4 COMPLEX SCENARIOS: VENTRICULAR ASSIST DEVICES

The increasing use of continuous flow left ventricular assist (LVAD) devices for end-stage heart failure has introduced new aortic complications. The non-pulsatile flow generated by devices such as the HeartMate 3 can induce aortic wall fibrosis and dysregulation of the extracellular matrix (Chaubey et al., 2024). Case reports demonstrate that patients with no prior history of significant aortic disease may develop severe aneurysms and dissections after implantation, requiring high-risk surgical reinterventions that combine open and endovascular repair. This underscores the need for vigilant monitoring of the aorta in patients with long-term mechanical circulatory support (Chaubey et al., 2024).

4 CONCLUSION

Aortic dissection remains a highly complex and high-risk clinical condition, in which the diagnostic delay has a direct impact on the prognosis. Recent literature reinforces that the heterogeneous clinical presentation requires a high degree of suspicion in emergency services, combined with the rational and early use of highly accurate imaging methods.

Advances in the understanding of pathophysiological mechanisms demonstrate that the disease results from a multifactorial interaction, involving structural alterations of the aortic wall, genetic predisposition, and activation of inflammatory and immunological pathways. The identification of the role of the complement system and of new associated clinical conditions, such as long-acting mechanical circulatory support, broadens the prospects for more targeted and personalized therapeutic approaches.

In view of this, it is evident that there is a need for integrated strategies that combine early diagnosis, appropriate treatment according to the classification of the dissection, and rigorous longitudinal follow-up. The incorporation of recent scientific knowledge into clinical practice represents an essential step towards reducing mortality and optimizing the management of aortic dissection in the context of contemporary medicine

REFERENCES

Asano, K., & et al. (2022). Pathophysiology and therapeutics of thoracic aortic aneurysm in Marfan syndrome. Biomolecules, 12(1), Article 128.

Chaubey, S., & et al. (2024). Repair of dissecting aortic aneurysm in post-LVAD patient. Methodist DeBakey Cardiovascular Journal, 20(1), 45–48.

Daily, P. O., & et al. (1970). The management of acute aortic dissections. Annals of Thoracic Surgery, 10(3), 237–247.

Dreher, L., & et al. (2025). Aortic aneurysm and dissection: Complement and precision medicine in aortic disease. American Journal of Physiology – Heart and Circulatory Physiology, 328, H814–H829.

Erbel, R., & et al. (2019). 2019 ESC guidelines for the diagnosis and management of aortic diseases. European Heart Journal, 41(36), 363–398.

Essat, M., & et al. (2024). Diagnostic accuracy of D-dimer for acute aortic syndromes.

Nishimura, R. A., & et al. (2022). 2022 AHA/ACC guideline for the diagnosis and management of aortic disease. Circulation, 146(15), e334–e482.

Reed, M. J. (2024). Diagnosis and management of acute aortic dissection in the emergency department. British Journal of Hospital Medicine, 85(1), 1–9.

Ren, S., & et al. (2024). Diagnostic accuracy of the aortic dissection detection risk score alone or with D-dimer for acute aortic syndromes: Systematic review and meta-analysis. PLOS ONE.