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Aortic Aneurysms, an Angiological Overview

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ABSTRACT

Aortic aneurysms represent a critical cardiovascular condition characterized by a localized, abnormal dilation of the aorta, presenting a significant risk of rupture and subsequent morbidity and mortality. This review article explores the angiological approach to aortic aneurysms, encompassing epidemiology, classifications, risk factors, complications, and the nuances of angiological management. Through an in-depth examination of these elements, this review aims to provide comprehensive insights into the management of aortic aneurysms, highlighting key considerations and strategies in clinical practice.

KEYWORDS: Aortic Aneurysm, Abdominal; Vascular Disease; Aortic Diseases.

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INTRODUCTION

Aortic aneurysms, both thoracic and abdominal, stand as a significant cause of concern within the spectrum of cardiovascular diseases [1]. Their prevalence among the adult population is notable, with abdominal aortic aneurysms (AAAs) being more prevalent compared to thoracic aortic aneurysms (TAAs) [2]. Among those aged over 65, the prevalence of AAAs is approximately 1.7%, while TAAs are relatively rarer, but pose equally significant risks due to their association with catastrophic complications if ruptured. The incidence rates show a notable male predominance, with the prevalence rising with age, especially after the fifth decade of life [3].

The clinical significance of aortic aneurysms lies in their potential for rupture, a devastating event associated with high mortality rates. The natural history of aortic aneurysms includes a silent progression, often asymptomatic until a life-threatening event such as rupture or dissection occurs. Thus, early detection, risk stratification, and appropriate management play a vital role in altering the disease's course, potentially preventing fatal outcomes. The mortality rate due to aortic aneurysm rupture remains high, emphasizing the urgent need for effective surveillance, risk stratification, and timely intervention [4].

Advancements in diagnostic imaging techniques have significantly contributed to the early detection and surveillance of aortic aneurysms. Non-invasive imaging modalities such as ultrasound, CT angiography, and MRI play a crucial role in the accurate diagnosis, measurement, and monitoring of aneurysmal growth, aiding in risk stratification and informing clinical decision-making [5].

Moreover, with the rising utilization of screening programs for high-risk individuals, there has been an increased identification of asymptomatic aneurysms, allowing for timely interventions and preventive measures to mitigate the risks of catastrophic events. This proactive approach underscores the importance of preventive medicine in reducing mortality associated with aortic aneurysms [6].

Definition: Aortic aneurysms are characterized by a localized, abnormal dilatation of the aortic wall, often attributed to degenerative processes involving the vessel's structural components, leading to a loss of integrity and increased vulnerability to dilation and eventual rupture. The condition's multifactorial nature involves genetic predisposition, hemodynamic stress, and atherosclerotic changes collectively weakening the aortic wall [7].

Classification

Table 1. Classification

Classification Type	**Description**
Size-Based Classification	
Small Aneurysms	Less than 3 cm in diameter.
Medium Aneurysms	Between 3 and 5.5 cm in diameter.

Large Aneurysms	Greater than 5.5 cm in diameter.
Morphological Classification	
Fusiform Aneurysms	Symmetrical dilation causing a tubular-shaped enlargement.
Saccular Aneurysms	Asymmetrical outpouching protruding from one side of the aortic wall.
Location-Based Classification	
Infrarenal Aneurysms	Located below the renal arteries.
Juxtarenal Aneurysms	Involve (or are adjacent to) the renal arteries.
Suprarenal Aneurysms	Extend beyond the renal arteries towards the upper abdominal aorta.
Pararenal Aneurysms	Encircle the renal arteries without involving their origins.
Aneurysm Shape	
Cylindrical Aneurysms	Uniformly dilated along the aortic diameter.
Conical Aneurysms	Tapering configuration, broader at one end and narrow at the other.
Irregular Aneurysms	Non-uniform dilatation or bulging in the aortic wall.
Aortic Segments Involved	
Infrarenal Aneurysms (Type IV)	Located only below the renal arteries.
Juxtarenal Aneurysms (Type III)	Involve the renal arteries.
Suprarenal Aneurysms (Type II)	Extend beyond the renal arteries towards the upper abdominal aorta.
Pararenal Aneurysms (Type I)	Encircle the renal arteries without involving their origins.

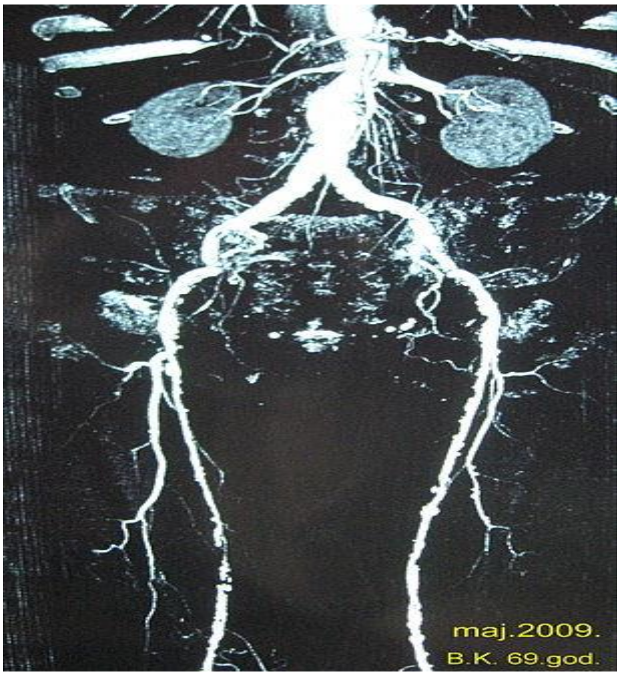

Figure 1. AAA, diameter 34 mm, with occlusion of the right femoral artery and severe atherosclerotic changes in the arteries of the lower extremities. Author: Dr. M. Dimić, Niš, June 2009. [8]

Risk factors for aortic aneurysms:
Genetics: There is a notable genetic predisposition for aortic aneurysms, especially in familial cases or hereditary conditions such as Marfan syndrome, Ehlers-Danlos syndrome, and Loeys-Dietz syndrome [8].
Atherosclerosis: Often linked to the development of abdominal aortic aneurysms (AAAs), atherosclerosis plays a crucial role, particularly in the weakening of the aortic wall [7, 10].
Age and gender: Advancing age and male gender are prominent risk factors, with the prevalence of aortic aneurysms rising significantly in individuals over the age of 65 and being more prevalent in males [7].
Hypertension and smoking: Both hypertension and tobacco use are identified as significant modifiable risk factors contributing to the development and progression of aortic aneurysms [7].
Complications and mortality:
Rupture: The most critical complication of aortic aneurysms is rupture, leading to high mortality rates. Mortality following rupture is exceptionally high, with reported rates of approximately 80-90%, underscoring the urgency for intervention [11].
Dissection and thromboembolism: Dissections can lead to life-threatening complications, affecting various vital organs. Additionally, thromboembolic events originating from aneurysmal thrombi or mural thrombus can cause severe complications [11].
Complications following surgery: Mortality rates associated with aortic aneurysm repair, both open surgical and endovascular, are contingent on various factors such as patient age, comorbidities, and the urgency of intervention. Mortality rates have improved significantly, particularly in elective cases, with open surgical repair mortality ranging from 2-5% and endovascular repair showing lower rates around 1-3% [12].
Angiological surgical management
Criteria for intervention: The decision for intervention is multifaceted, considering aneurysm size, morphology, growth rate, symptoms, patient comorbidities, and life expectancy. Generally, intervention is recommended for aneurysms >5.5 cm in diameter or those exhibiting rapid growth, symptomatic cases, and in high-risk patients with smaller aneurysms [13].
Surgical techniques: Open surgical repair involves replacement of the diseased aorta with a prosthetic graft, using various approaches such as the traditional midline sternotomy or lateral thoracotomy. It's crucial in cases involving the ascending aorta and aortic arch. Newer techniques, like valve-sparing aortic root replacement, offer an option for certain anatomical considerations [12, 13].

Endovascular repair: Endovascular aneurysm repair (EVAR) or thoracic endovascular aneurysm repair (TEVAR) involves the deployment of stent grafts within the aneurysmal sac, a less invasive alternative. It has seen significant advancements in treating infrarenal AAAs and Type B thoracic aortic aneurysms [12, 13].

Hybrid procedures: These combine elements of both open and endovascular approaches, allowing for complex repair, especially in cases involving the aortic arch or juxtarenal aneurysms [14].

DISCUSSION

Advancements in endovascular repair: The evolution of endovascular repair techniques, including the development of fenestrated and branched endografts, has significantly broadened the applicability of endovascular interventions. These advancements allow for the treatment of complex anatomies and previously deemed high-risk patients, providing a minimally invasive alternative to traditional open surgical repair. However, challenges such as endoleaks, device migration, and the need for long-term surveillance persist, warranting continuous refinement and innovation in endovascular technology [12, 13].

Open surgical repair: Despite the rise of endovascular approaches, open surgical repair remains a crucial option, particularly in complex cases involving anatomical challenges or patients unsuitable for endovascular techniques. Advances in surgical techniques, including aortic arch surgery, hybrid procedures, and aortic valve-sparing operations, continue to improve outcomes in select cases [12, 13].

Patient selection criteria: The selection of the optimal treatment strategy, be it endovascular or open repair, relies heavily on rigorous patient assessment. Factors such as aneurysm size, location, morphology, patient comorbidities, age, and life expectancy contribute to the decision-making process. Balancing the risks and benefits of each approach is crucial in tailoring the treatment to individual patient needs [11-13].

Rupture risk assessment: Accurate prediction of rupture risk is critical in deciding the timing and modality of intervention. While aneurysm size has traditionally been a key determinant, other factors, such as growth rate, anatomical features, and biomarkers, are increasingly considered. Understanding and integrating these multifactorial risk assessments aid in better stratification of patients for surveillance or intervention [10].

Role of surveillance: Continuous monitoring and surveillance play a pivotal role in the management of aortic aneurysms. Serial imaging studies, including ultrasound, CT angiography, or MRI, are essential for tracking aneurysm growth, detecting potential complications, and informing timely interventions [10].

Integrating technology and Innovation: Technological advancements, including computational modeling, artificial intelligence, and novel imaging modalities, have the potential to revolutionize risk stratification, treatment planning, and long-term surveillance. These innovations may refine rupture risk assessments, treatment strategies, and follow-up protocols, contributing to more personalized and effective patient care [5].

Future directions: As the field continues to evolve, areas for improvement include refining risk stratification models, optimizing endovascular techniques, reducing complications, and exploring novel medical therapies to stabilize or regress aneurysm growth.

CONCLUSION

The management of aortic aneurysms demands a meticulous and individualized approach. Advancements in endovascular technology, open surgical techniques, patient selection criteria, and the integration of innovative technologies continue to reshape the landscape of aortic aneurysm care, offering hope for improved outcomes and reduced mortality rates. Continuing research, technological innovations, and multidisciplinary collaboration are key to further advancements in managing this critical cardiovascular condition.

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