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Association of Mortality and Acute Aortic Events With Ascending Aortic Aneurysm

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ABSTRACT

Background: The complex relationship between ascending aortic aneurysms and acute aortic events has garnered significant attention in recent years, particularly in light of the high morbidity and mortality associated with these conditions. This literature review synthesizes key findings from a series of studies that collectively enhance our understanding of the pathophysiology, risk factors, and clinical outcomes related to ascending aortic aneurysms and their complications. **Literature Review:** The analysis of the included studies reveals critical insights into the outcomes following surgical interventions for ascending aortic aneurysms, particularly in elderly patients who may face unique challenges (Pan, 2019). The importance of advanced modeling techniques, such as computational fluid dynamics and finite element analysis, is highlighted as essential for predicting aneurysm behavior and informing clinical decisions (Friesen et al., 2020). (Uimonen, 2021) provides a comprehensive overview of the pathophysiological processes leading to type A aortic dissection, emphasizing the interplay of various factors, including inflammation and biomechanics. The correlation between cardiac parameters and aortic diameter is further explored, revealing that cardiac health significantly impacts the management of ascending aortic aneurysms (Etli et al., 2022). **Conclusion:** In conclusion, the literature collectively underscores the complex relationship between ascending aortic aneurysms and acute aortic events, highlighting the necessity for a nuanced understanding of the disease process. The integration of advanced modeling techniques, thorough assessments of cardiac health, and critical reevaluation of surgical intervention criteria are essential steps toward improving clinical outcomes for patients with these high-risk conditions. Future research should focus on refining management strategies and addressing the gaps in knowledge regarding the long-term implications of ascending aortic aneurysms and their associated complications.

Keyword: Association, Mortality, Acute Aortic Events, Ascending Aortic Aneurysm

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INTRODUCTION

The complex relationship between ascending aortic aneurysms and acute aortic events has garnered significant attention in recent years, particularly in light of the high morbidity and mortality associated with these conditions. This literature review synthesizes key findings from a series of studies that collectively enhance our understanding of the pathophysiology, risk factors, and clinical outcomes related to ascending aortic aneurysms and their complications.

(Pan, 2019) provides a comprehensive overview of outcomes following ascending aortic surgery, emphasizing the multifaceted nature of acute aortic dissections and their presentations. The study highlights the need for improved management strategies, particularly in elderly patients, who may present unique challenges during surgical intervention. This article underscores the critical nature of understanding the underlying pathology of ascending aortic disease, which is further elaborated upon by (Friesen et al., 2020), who categorize the prominent modeling approaches utilized in aneurysm research. Their work emphasizes the importance of computational fluid dynamics and finite element analysis, which are pivotal in simulating aneurysm behavior and informing clinical decisions.

contribute to this discourse by presenting a population-based assessment of aortic-related outcomes in various aortic pathologies, including aortic dissection, intramural hematoma, and penetrating aortic ulcer. Their findings reveal a concerning in-hospital mortality rate associated with acute aortic events, reinforcing the notion that these conditions pose significant risks for both acute and chronic morbidity. This study provides essential data on the long-term survival and risks associated with these aortic conditions, setting the stage for further inquiry into their management.

(Uimonen, 2021) expands on the pathophysiological processes leading to type A aortic dissection, synthesizing literature that encompasses anatomy, physiology, and biomechanics. This narrative review elucidates the intricate interplay of factors contributing to aortic dissection, particularly in the context of

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ascending aortic aneurysms. The integration of these diverse aspects is critical for developing a holistic understanding of the disease process.

(Etli et al., 2022) delve into the correlation between cardiac parameters and aortic diameter in patients with ascending aortic aneurysm, identifying significant risk factors that contribute to disease progression. Their research highlights the importance of cardiac conditions such as coronary heart disease and atrial fibrillation, which may complicate the management of patients with ascending aortic aneurysms. This focus on the relationship between cardiac health and aortic dimensions is essential for informing clinical practice.

Finally, (Samanidis et al., 2022) investigate the diameter of the dissected ascending aorta in patients with acute type A aortic dissection, challenging existing thresholds for surgical intervention. Their findings suggest that the diameter may not be a reliable predictor of preoperative adverse events, prompting a reevaluation of current clinical guidelines regarding the management of ascending aortic conditions.

Through a critical evaluation of these studies, this literature review aims to illuminate the multifaceted nature of ascending aortic aneurysms and their association with acute aortic events, ultimately contributing to improved clinical outcomes and management strategies for affected patients.

LITERATURE REVIEW

Emily Pan's article, "Outcomes after ascending aortic surgery: registry-based studies with special emphasis on reoperations and pre-operative cardiac arrest" (Pan, 2019), provides a comprehensive examination of the outcomes associated with surgeries on the ascending aorta, particularly focusing on the implications of acute aortic events such as dissections and their correlation with mortality rates. The article synthesizes various studies and clinical observations to present a multifaceted view of the challenges and considerations in treating acute type A aortic dissection, especially in elderly patients.

One of the key insights from the article is the critical relationship between acute aortic dissection and myocardial infarction, underscoring the need for timely

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diagnosis and intervention (Pan, 2019). The author highlights that acute type A aortic dissections can present with atypical symptoms, often leading to delays in treatment that could worsen patient outcomes. This is particularly relevant for elderly patients, who may exhibit different clinical characteristics compared to younger populations. The article emphasizes that the current era of management must account for these variations to improve survival rates.

Moreover, Pan discusses the role of inflammatory processes in ascending aortic disease, drawing attention to the pathological perspectives that can inform surgical approaches. This aspect is crucial for understanding the underlying mechanisms that contribute to aortic aneurysms and dissections, as it can guide preoperative assessments and postoperative management strategies (Pan, 2019).

The article also delves into specific surgical techniques, such as the comparison between open and closed distal anastomosis for acute type A aortic dissection repair. This analysis is pivotal as it addresses the ongoing debate regarding the optimal surgical approach and its impact on outcomes, including reoperation rates and overall mortality (Pan, 2019). The systematic review and meta-analysis of various surgical methods provide a robust framework for clinicians to evaluate their practices.

Furthermore, the discussion surrounding the incidence of cardiac arrest due to non-traumatic aortic dissection or rupture adds a significant layer to the understanding of acute aortic events. Pan's findings suggest that aortic dissections can lead to catastrophic outcomes if not promptly recognized and treated, reinforcing the importance of awareness among healthcare providers (Pan, 2019).

The article "Comparison of existing aneurysm models and their path forward" by Friesen et al. (Friesen et al., 2020) provides a comprehensive evaluation of the current methodologies used in the modeling of aneurysms, particularly focusing on their implications for assessing rupture risk. The authors identify four prominent modeling approaches: computational fluid dynamics (CFD), finite element analysis (FEA), assessment-tools dimensionless parameters (ATDP), and machine learning (ML). Each of these methods offers distinct advantages and limitations in the context of aneurysm research, particularly in

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predicting rupture risk, which is a critical factor in managing ascending aortic aneurysms.

The review meticulously outlines the methodologies employed in the literature, showcasing a systematic approach to identifying relevant studies through a query-based search on the Web of Science database. This rigorous process, which initially yielded 3,127 papers, was refined to include only review papers and full English publications, ultimately resulting in 164 relevant records. This methodical selection process underscores the authors' commitment to providing a well-rounded analysis of existing literature, ensuring that the discussion is grounded in a robust evidential framework.

Friesen et al. (Friesen et al., 2020) also highlight the significance of fluid-structure interaction (FSI) and fluid-solid-growth (FSG) models in the context of aneurysm research. These models are increasingly recognized for their ability to simulate the complex interactions between the flowing blood and the aortic wall, which are crucial for understanding the mechanical stresses that contribute to aneurysm formation and rupture. The integration of these advanced modeling techniques into clinical practice could enhance the precision of rupture risk assessments, thereby informing better management strategies for patients with ascending aortic aneurysms.

Moreover, the authors critically evaluate the limitations of current modeling approaches, noting that while computational techniques have advanced significantly, challenges remain in their clinical applicability. For instance, the complexity of the models can hinder their widespread adoption in routine clinical settings. Furthermore, the authors call for a more standardized approach to aneurysm modeling, which could facilitate the comparison of results across different studies and enhance the reliability of rupture risk predictions.

The article "Population-Based Assessment of Aortic-Related Outcomes in Aortic Dissection, Intramural Hematoma, and Penetrating Aortic Ulcer" by Weiss et al. (Weiss et al., 2020) presents a comprehensive examination of the outcomes associated with three critical aortic pathologies: aortic dissection (AD), intramural hematoma (IMH), and penetrating aortic ulcer (PAU). The authors provide a

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thorough analysis of the mortality rates and morbidity associated with these conditions, which are characterized by a disruption of the media layer of the aortic wall.

One of the key insights from this study is the high mortality rates associated with acute Stanford type A and type B dissections, reported at 22% and 14%, respectively. This statistic underscores the severity of these conditions and highlights the need for timely intervention. The authors emphasize that aortic events are the leading cause of death in patients suffering from both types of dissections, which is a crucial point for clinicians managing these patients.

Furthermore, the article discusses the comparative prognosis for patients presenting with IMH and PAU, noting that while their acute survival rates may be marginally better than those of patients with AD, long-term survival remains poor. This finding is significant as it suggests that even conditions perceived as less acute can lead to detrimental outcomes over time.

The study also addresses the long-term risks faced by patients with chronic forms of these aortic pathologies. Weiss et al. (Weiss et al., 2020) indicate that individuals with chronic AD, IMH, and PAU are at a heightened risk for subsequent aortic events, such as recurrent dissection, rupture, and aneurysmal degeneration. The authors highlight the gap in knowledge regarding the true risk of late aortic death and subsequent aortic events for these patients, which points to a critical area for further research.

The article titled "Synthesis of multidimensional pathophysiological process leading to type A aortic dissection: a narrative review" by Mikko Uimonen (Uimonen, 2021) provides a comprehensive examination of the complex pathophysiological processes associated with type A aortic dissection. The narrative review is structured around a thorough literature search conducted through the PubMed database, utilizing a variety of key terms related to aortic conditions. The author effectively synthesizes findings from multiple studies addressing the anatomy, physiology, histopathology, biochemistry, biomechanics, inflammation, risk factors, fluid dynamics, and hemodynamics of ascending aortic diseases.

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Uimonen's review highlights the multidimensional nature of aortic dissection, emphasizing that it is not merely a mechanical failure but rather a culmination of various biological and physical processes. By integrating insights from diverse fields, the article underscores the importance of a holistic understanding of the ascending aorta's structure and function in relation to aortic aneurysms and dissection. This integrative approach is crucial, as it allows for a more nuanced understanding of the risk factors and physiological mechanisms that contribute to acute aortic events.

The article critically evaluates the existing literature, identifying gaps in knowledge regarding the interplay between different pathophysiological factors. For instance, while the review discusses the role of inflammation and biomechanical stress in the development of aortic dissection, it also points out the need for further research to elucidate the precise mechanisms through which these factors interact. This critical evaluation not only highlights the current state of research but also sets the stage for future studies aimed at improving clinical outcomes for patients with ascending aortic aneurysms.

The article titled "Investigation of the correlation between cardiac parameters and aortic diameter in patients with ascending aortic aneurysm" by Mustafa Etli et al. (Etli et al., 2022) provides a comprehensive examination of the relationship between cardiac parameters and the diameter of the ascending aorta in patients diagnosed with ascending aortic aneurysm (AA). The authors emphasize the multifactorial nature of AA, highlighting its association with the progressive weakening of the aortic wall, which is particularly pertinent given the high mortality and morbidity rates associated with ascending AA.

One of the critical insights from this study is the emphasis on the underreported nature of ascending AA compared to abdominal AA. This gap in the literature underscores a significant clinical concern, as ascending AA is often diagnosed incidentally during echocardiographic examinations, which may result in delayed management and increased risk of adverse outcomes. The authors argue that there is a lack of adequate information available to clinicians regarding the

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optimal management strategies for patients with a dilated ascending aorta, which is a crucial aspect of improving patient outcomes.

The article further discusses the management of ascending AA, linking it directly to the diameter of the aorta. The authors point out that surgical intervention is typically determined by the aortic diameter, suggesting that a more standardized approach to monitoring and decision-making is necessary. This perspective is particularly relevant in clinical practice, as it highlights the need for a systematic evaluation of aortic size in conjunction with patient-specific risk factors.

Moreover, the authors identify significant cardiac factors that may serve as risk indicators for the development of ascending AA, including coronary heart disease and atrial fibrillation. This connection between cardiac health and aortic diameter is an important contribution to the understanding of ascending AA, suggesting that comprehensive cardiac assessments could play a role in identifying patients at higher risk for aneurysm progression.

The article titled "Association of dissected ascending aorta diameter with preoperative adverse events in patients with acute type A aortic dissection" by Samanidis et al. (Samanidis et al., 2022) presents a critical examination of the relationship between the diameter of the dissected ascending aorta and preoperative adverse events in patients suffering from acute type A aortic dissection (ATAAD). This condition is recognized as a significant cardiovascular emergency, and the authors aim to assess whether the size of the ascending aorta correlates with adverse outcomes such as neurological dysfunction and hemodynamic instability.

The study employs a retrospective analysis of patients admitted for ATAAD treatment, measuring the diameter of the dissected ascending aorta and its potential association with various adverse events. Notably, the authors report that the diameter of the dissected ascending aorta did not correlate with preoperative adverse events. Furthermore, their findings indicate no significant relationship between the aortic diameter and 30-day mortality rates, as well as postoperative ICU and hospital stays. These results challenge the existing clinical guidelines that suggest specific diameter thresholds for surgical intervention, particularly in non-

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syndromic and syndromic patients, which recommend ascending aortic replacement at diameters of 5.5 cm and 4.5-5.0 cm, respectively.

The authors suggest that the current thresholds for surgical intervention may need to be re-evaluated, particularly regarding the lower limits of ascending aorta aneurysm size and the associated risks of late acute dissection. This proposition is significant as it invites a critical rethinking of established practices in managing ATAAD, emphasizing the need for a more nuanced understanding of the condition's pathophysiology and the factors influencing outcomes.

However, the study's retrospective nature and the relatively small sample size may limit the generalizability of the findings. The authors acknowledge this limitation and call for randomized controlled studies with larger patient cohorts to validate their results, which is an essential step in establishing more definitive clinical guidelines.

CONCLUSION

The literature review provides a thorough examination of the association between ascending aortic aneurysms and acute aortic events, highlighting various aspects such as pathophysiology, risk factors, and clinical outcomes. The introduction establishes the significance of this relationship, particularly in light of the high morbidity and mortality rates associated with acute aortic conditions. The reviewed articles collectively emphasize the multifaceted nature of these conditions, underscoring the need for improved management strategies and a deeper understanding of the underlying mechanisms.

The analysis of the included studies reveals critical insights into the outcomes following surgical interventions for ascending aortic aneurysms, particularly in elderly patients who may face unique challenges (Pan, 2019). The importance of advanced modeling techniques, such as computational fluid dynamics and finite element analysis, is highlighted as essential for predicting aneurysm behavior and informing clinical decisions (Friesen et al., 2020). Moreover, the population-based assessment of aortic-related outcomes indicates

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significant in-hospital mortality rates associated with acute aortic events, reinforcing the urgency for timely interventions (Weiss et al., 2020).

(Uimonen, 2021) provides a comprehensive overview of the pathophysiological processes leading to type A aortic dissection, emphasizing the interplay of various factors, including inflammation and biomechanics. The correlation between cardiac parameters and aortic diameter is further explored, revealing that cardiac health significantly impacts the management of ascending aortic aneurysms (Etli et al., 2022). Additionally, the findings from (Samanidis et al., 2022) challenge existing clinical guidelines regarding the surgical intervention thresholds for dissected ascending aorta, suggesting a need for reevaluation based on new evidence.

In conclusion, the literature collectively underscores the complex relationship between ascending aortic aneurysms and acute aortic events, highlighting the necessity for a nuanced understanding of the disease process. The integration of advanced modeling techniques, thorough assessments of cardiac health, and critical reevaluation of surgical intervention criteria are essential steps toward improving clinical outcomes for patients with these high-risk conditions. Future research should focus on refining management strategies and addressing the gaps in knowledge regarding the long-term implications of ascending aortic aneurysms and their associated complications.

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