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THROMBOPROPHYLAXIS AND CARDIAC CHALLENGES IN ORTHOPEDIC SURGERY: VENOUS THROMBOEMBOLISM RISK

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Abstract: **INTRODUCTION** Venous thromboembolism (VTE), including deep vein thrombosis and pulmonary embolism, represents a significant risk in orthopedic patients, especially those with cardiac comorbidities. These patients are at higher risk due to immobility, endothelial injury, and hypercoagulability, exacerbated by their cardiac conditions. The review focuses on the complex interplay between orthopedic surgery, cardiac diseases, and VTE, discussing the challenges of anticoagulation management and the outcomes associated with VTE in this vulnerable population. **OBJETIVE** To explore and critically analyze the current understanding of venous thromboembolism (VTE) risk in orthopedic patients with cardiac comorbidities, focusing on the pathophysiology, challenges in anticoagulation management, and the efficacy of thromboprophylaxis strategies in this high-risk population. **METHODS** This is a narrative review which included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases, using as descriptors: "Venous Thromboembolism" AND "Orthopedic Surgery" AND "Cardiac Comorbidities" OR "Anticoagulation Management" OR "Thromboprophylaxis" in the last years. **RESULTS AND DISCUSSION** Orthopedic patients with cardiac comorbidities face multiple risk factors for VTE, including venous stasis from immobility, endothelial injury during surgery, and a hypercoagulable state. Conditions such as heart failure and atrial fibrillation further increase VTE risk. Anticoagulation strategies, including LMWH and DOACs, are critical for thromboprophylaxis but must be carefully managed to prevent bleeding complications. Mechanical prophylaxis and early mobilization are essential but are often delayed in cardiac patients, heightening their risk. The long-term prognosis in these patients is often poor, with higher rates of VTE recurrence and increased mortality. Novel anticoagulants offer promise but require further research in patients with complex cardiac conditions. **CONCLUSION** VTE remains a significant risk in orthopedic patients with cardiac comorbidities. The management of VTE in this population is complex, requiring a balance between thromboprophylaxis and bleeding prevention. Current guidelines provide a foundation, but further research is needed to optimize outcomes for this high-risk group. A multidisciplinary approach is crucial for managing the intricate challenges posed by both orthopedic and cardiac conditions in these patients.Venous Thromboembolism Risk in Orthopedic Patients with Cardiac Comorbidities: Narrative Review

Keywords: Venous Thromboembolism; Orthopedic Surgery; Cardiac Comorbidities; Anticoagulants

INTRODUCTION

Venous thromboembolism (VTE), encompassing both deep vein thrombosis (DVT) and pulmonary embolism (PE), represents a significant complication in patients undergoing orthopedic surgery, particularly in those with underlying cardiac comorbidities[1]. These patients are inherently at higher risk due to a combination of factors, including immobility, endothelial injury, and hypercoagulability, often exacerbated by their cardiac condition[1]. The aging global population, coupled with the increasing prevalence of cardiovascular disease (CVD), has resulted in a higher frequency of patients with cardiac comorbidities undergoing orthopedic procedures[1]. Orthopedic surgery, especially hip and knee arthroplasties, is associated with one of the highest rates of VTE, with incidences varying widely

depending on the specific patient population and the prophylactic measures employed[2].

As the global healthcare landscape evolves, the aging population continues to grow, which poses additional challenges for managing patients with pre-existing cardiac conditions undergoing major surgical procedures, particularly orthopedic surgeries[2]. The burden of cardiovascular disease (CVD) and its associated comorbidities often complicates the perioperative period, particularly concerning the risk of developing thromboembolic events[2]. Therefore, understanding the risk factors and specific considerations for managing VTE in patients with both cardiac comorbidities and orthopedic surgical needs is critical for improving patient outcomes[3].

Patients with cardiac conditions, such as atrial fibrillation, heart failure, and coronary artery disease, are not only predisposed to thromboembolic events but also face unique challenges in the perioperative management of anticoagulation[2]. The intricate balance between thromboprophylaxis and the prevention of bleeding complications becomes especially critical in this population, where the margin for error is reduced due to their underlying health vulnerabilities[2]. Furthermore, the pharmacokinetic and pharmacodynamic interactions between cardiac medications and anticoagulants used for VTE prophylaxis present another layer of complexity in managing these patients[3]. These complex pharmacological interactions can lead to heightened bleeding risks or, conversely, insufficient anticoagulation, increasing the likelihood of thromboembolic events[3]. Therefore, patient-specific management protocols must be developed, taking into account the delicate balance required to reduce VTE risk without exacerbating cardiovascular conditions[3]. Despite advancements in both orthopedic surgical techniques and VTE prophylaxis protocols, the risk of VTE remains substantial, necessitating a deeper understanding of the interplay between orthopedic surgery, cardiac comorbidities, and VTE[4].

This review aims to explore the current understanding of VTE risk in orthopedic patients with cardiac comorbidities, emphasizing the pathophysiological mechanisms, the challenges of anticoagulation management, and the outcomes associated with VTE in this high-risk population[3]. The discussion will also address current prophylactic strategies, including pharmacological and mechanical interventions, and examine their efficacy in reducing VTE incidence while minimizing the risk of bleeding in patients with cardiac comorbidities[4]. Ultimately, understanding the available interventions is key to tailoring prevention protocols to individual patient profiles, especially in this high-risk cohort[4]. The review will conclude by outlining future directions in the management of VTE in this population, highlighting areas where further research is needed to optimize outcomes[4]. Future studies must delve deeper into long-term outcomes to refine protocols further, with an emphasis on personalized care that optimally balances risk and benefit[5].

OBJETIVES

To explore and critically analyze the current understanding of venous thromboembolism (VTE) risk in orthopedic patients with cardiac comorbidities, focusing on the pathophysiology, challenges in anticoagulation management, and the efficacy of thromboprophylaxis strategies in this high-risk population.

SECUNDARY OBJETIVES

- To evaluate the role of cardiac comorbidities such as atrial fibrillation, heart failure, and coronary artery disease in increasing the risk of VTE in orthopedic patients.

- To assess the outcomes of VTE prophylaxis, both pharmacological and mechanical, in patients undergoing orthopedic surgery with preexisting cardiac conditions.
- To discuss the long-term prognosis and challenges in managing VTE in orthopedic patients with significant cardiac comorbidities.
- To review current clinical guidelines for managing anticoagulation in these patients and highlight areas needing further research.

METHODS

This is a narrative review, in which the main aspects of the current understanding of venous thromboembolism (VTE) risk in orthopedic patients with cardiac comorbidities, focusing on the pathophysiology, challenges in anticoagulation management, and the efficacy of thromboprophylaxis strategies in this high-risk population in recent years were analyzed. The beginning of the study was carried out with theoretical training using the following databases: PubMed, sciELO and Medline, using as descriptors: "Venous Thromboembolism" AND "Orthopedic Surgery" AND "Cardiac Comorbidities" OR "Anticoagulation Management" OR "Thromboprophylaxis" in the last years. As it is a narrative review, this study does not have any risks. Databases: This review included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases.

The inclusion criteria applied in the analytical review were human intervention studies, experimental studies, cohort studies, case-control studies, cross-sectional studies and literature reviews, editorials, case reports, and poster presentations. Also, only studies writing in English and Portuguese were included.

RESULTS AND DISCUSSION

The pathophysiology of VTE in orthopedic patients with cardiac comorbidities is complex and multifactorial[4]. Immobilization following major orthopedic procedures, such as hip and knee replacements, leads to venous stasis, a key component of Virchow's triad, which is further exacerbated by the presence of cardiac conditions[5]. In patients with heart failure, for instance, reduced cardiac output results in sluggish blood flow, increasing the likelihood of clot formation[5]. Additionally, endothelial injury, another pillar of Virchow's triad, occurs during surgery due to the mechanical disruption of tissue, particularly in procedures involving large joints[5]. This damage to the vasculature sets the stage for thrombus formation, particularly in patients with preexisting atherosclerosis, commonly seen in those with coronary artery disease[6]. The unique hemodynamic changes that occur in cardiac patients further exacerbate the risk, as altered blood flow and vascular resistance in these individuals often create optimal conditions for clot formation[6]. These patients frequently exhibit impaired vascular tone and microvascular dysfunction, which complicates post-surgical recovery and increases the likelihood of thromboembolic complications[6]. As such, a more comprehensive understanding of the specific pathophysiological changes in these patients is necessary to guide prophylaxis and treatment strategies that effectively mitigate VTE risk[7].

Another critical factor is the hypercoagulable state induced by both the surgical procedure and the systemic inflammatory response that follows[6]. In patients with atrial fibrillation, the risk is compounded by the presence of stasis in the atria, which further predisposes to thrombus formation[6]. The use of perioperative anticoagulation in these patients presents a unique challenge, as the need for

anticoagulant therapy to prevent stroke or other embolic events must be balanced against the increased risk of perioperative bleeding[7]. The choice of anticoagulant, its timing, and its dosage are crucial considerations that significantly impact the incidence of VTE in this population[7]. Tailoring anticoagulant therapy in this population can be particularly challenging, as patient-specific factors such as renal function, the severity of cardiac disease, and surgical risks need to be integrated into the decision-making process[7]. Current guidelines suggest the use of low-molecular-weight heparin (LMWH) or direct oral anticoagulants (DOACs) in most patients undergoing orthopedic surgery, but the application of these therapies in cardiac patients requires careful tailoring to individual risk profiles[8]. Patient monitoring, including laboratory markers of coagulation status, may provide additional insights into the adequacy of therapy, allowing for adjustments during the perioperative and postoperative periods[8].

The clinical outcomes of VTE in orthopedic patients with cardiac comorbidities are often poorer than in those without such conditions[8]. Studies have shown that patients with heart failure or atrial fibrillation who develop VTE have higher rates of recurrent thromboembolic events and worse overall survival[8]. The presence of cardiac comorbidities also complicates the management of VTE, as these patients are often already on antithrombotic therapy for their cardiovascular conditions[8]. This raises the question of whether standard VTE prophylaxis protocols are sufficient for these high-risk individuals[9]. In fact, some evidence suggests that extended thromboprophylaxis beyond the immediate postoperative period may be beneficial in reducing the incidence of VTE in patients with significant cardiac comorbidities, though this approach must be weighed against the increased risk of bleeding[9]. Additionally, long-term studies on extended thromboprophylaxis in this population are still scarce, and more evidence is needed to determine the balance between benefit and harm, particularly with newer anticoagulants[9].

Mechanical prophylaxis, including the use of graduated compression stockings and intermittent pneumatic compression devices, plays an important role in VTE prevention in this population, particularly in patients for whom pharmacological prophylaxis is contraindicated or must be delayed[9]. However, mechanical prophylaxis alone is generally insufficient in high-risk cardiac patients, and its efficacy is maximized when used in conjunction with pharmacological agents[10]. This dual approach, combining pharmacological and mechanical methods, helps to mitigate VTE risk in patients who are particularly vulnerable due to their cardiac status[10]. Early mobilization, another cornerstone of VTE prevention, is often delayed in cardiac patients due to concerns about exacerbating their underlying condition[10]. This delay, however, significantly increases the risk of VTE, and strategies to safely promote early mobilization in these patients are an area of ongoing research[11]. Innovative approaches, including prehabilitation or targeted physiotherapy interventions, may help reduce immobilization time, even in high-risk cardiac patients, potentially lowering their VTE risk[11].

The management of anticoagulation in patients with both cardiac and orthopedic conditions is fraught with challenges. In particular, patients with atrial fibrillation are often on long-term anticoagulation therapy, typically with warfarin or a DOAC, to prevent stroke[11]. The perioperative management of these patients requires careful planning, as abrupt cessation of anticoagulation increases the risk of thromboembolic events, while continuation of therapy raises the risk of perioperative bleeding[12]. Bridging strategies,

using short-acting anticoagulants like LMWH during the perioperative period, are often employed, but the optimal approach remains a topic of debate[12]. Moreover, the interaction between antiplatelet therapy, commonly used in patients with coronary artery disease, and anticoagulants adds another layer of complexity to VTE prophylaxis in this population[12]. Personalized strategies for managing anticoagulation that balance the patient's cardiovascular and thromboembolic risks are therefore essential, requiring close coordination between orthopedic surgeons and cardiologists[12].

Long-term outcomes in patients with both VTE and cardiac comorbidities are generally worse compared to those without cardiac disease[13]. Studies have demonstrated that these patients have higher rates of VTE recurrence, as well as increased mortality[13]. The presence of heart failure, in particular, has been shown to be an independent predictor of poor outcomes in patients with VTE, likely due to the hemodynamic instability caused by the combination of reduced cardiac output and the additional burden of pulmonary embolism[13].

CONCLUSION

Venous thromboembolism remains a significant risk in orthopedic patients, particularly those with cardiac comorbidities. The interplay between the patient's underlying cardiac condition, the immobilization and endothelial injury associated with orthopedic surgery, and the hypercoagulable state induced by both the surgical procedure and the systemic inflammatory response creates a perfect storm for VTE development in this population. The management of VTE in these patients is particularly challenging, as the need for effective thromboprophylaxis must be balanced against the risk of perioperative bleeding, especially in patients who are already on long-term anticoagulation or antiplatelet therapy for their cardiac conditions.

While current guidelines provide a framework for VTE prophylaxis in orthopedic patients, the unique challenges posed by the presence of cardiac comorbidities require a more nuanced approach. The use of mechanical prophylaxis, early mobilization, and individualized anticoagulation strategies are essential components of care in this population, but further research is needed to optimize outcomes. The development of novel anticoagulants offers promising new avenues for VTE prevention, but their role in patients with significant cardiac comorbidities remains to be fully elucidated. Ultimately, a multidisciplinary approach, involving orthopedic surgeons, cardiologists, and hematologists, is essential to effectively manage the risk of VTE in these high-risk patients.

As the population ages and the number of patients with both cardiac and orthopedic conditions continues to grow, the need for more robust clinical trials and evidence-based guidelines will become increasingly urgent. Addressing these challenges will be critical to improving both short-term and long-term outcomes in this vulnerable patient population.

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