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Review Article

Mortality among patients undergoing orthopedic surgeries and admitted to the ICU

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ABSTRACT

Many postoperative complications have been associated with orthopedic surgeries, which require patients to be admitted to intensive care units. In this study, we reviewed previous studies that reported the mortality rates for patients undergoing orthopedic surgeries and have been admitted to the ICU, in addition to discussing the risk factors and complications for this event and the possible preventive measures. Studies showed that mortality rates in the ICU following orthopedic procedures are much lower than other procedures that are usually associated with higher rates of complications and deaths. However, serious efforts should be offered to decrease the development of complications that may increase the burdens of such cases. To achieve this, the identification of the possible risk factors is essential for decreasing this burden. We found that old age, the presence of comorbidities, the complexity of the procedure, and having large amounts of blood transfusion before the procedure might be significant factors for the development of severe complications and subsequent death. We have also discussed some complications like cardiovascular, cerebral, spinal, pulmonary, and renal disorders. Eliminating these disorders would require more effort for eliminating pain, applying appropriate doses of anesthetics, antibiotics, and beta-blockers.

Keywords: Mortality, Intensive care, Orthopedics

INTRODUCTION

Critical admission following surgeries accounts for a huge number of surgeries and is dependent on many factors. In the United Kingdom, 60-70% of critical admissions are attributable to surgical procedures.[1] Investigations showed that it is necessary to refer patients as early as possible to the intensive care unit (ICU) to decrease mortality rates during admissions and any other complications.[2] The burden of orthopedic surgeries has been recently increasing. For instance, it has been estimated that around 6% of the performed procedures in

the United States account for orthopedic surgeries with approximately 37 million procedures being performed.[3] In addition to patients' health concerns, orthopedic surgeries are attributable to another financial burden. For instance, it has been estimated that 30$ billion are the costs for hospitals attributable to total joint arthroplasty surgeries in the United States in 2006, and the number is said to be further expanding.[4]

Performing orthopedic surgeries can now be done in both the inpatient and outpatient settings to correct traumatic injuries, degenerative changes, malignant complications, congenital anomalies, and infectious pathogenesis.[5] Orthopedic surgeries are generally performed to eliminate pain and improve mobility and function. However, many complications have been reported with orthopedic surgeries.[6] These include complications that cause: airway affection, circulatory dysfunction, pulmonary compromise, acute or chronic pain and other manifestations that usually occur in the older population. It has been estimated that complications following joint replacement procedures are attributable to an incidence of 5-8.6% rate of complications while scoliosis surgeries have been associated with a 1-20% rate of serious complications in adults undergoing such surgeries.[7-9] These complications might be attributable to many factors bearing in mind that most of the orthopedic patients are from the elder population.[10] Additionally, medical advances in this field and the increased capacity in hospitals for such surgeries to meet the relatively huge demands have led to major reductions in the rates of complications.[11,12]

Although recent technologies in this field have led to huge reductions in the mortality rates among patients, many factors are to be considered when evaluating such rates. For instance, the elderly population and their relatively hazardous comorbidities may increase the risk of developing perioperative complications. In this study, we aim to review orthopedic complications, especially mortality, in ICU admissions and the related factors.

An extensive literature search of the Medline, Cochrane, and EMBASE databases was performed on 30 November 2020 using the medical subject headings (MeSH) or a combination of all possible related terms. Studies reporting the mortality rates for patients undergoing orthopedic surgeries and have been admitted to the ICU were screened for relevant information. We did not pose any limits on date, language, or publication type.

PREDICTORS FOR ICU ADMISSIONS FOLLOWING ORTHOPEDIC SURGERIES

ICU admissions following orthopedic surgeries can be expected especially in patients that suffer from the co-existence of other morbidities as pulmonary injuries, cardiac diseases, multi-level spine injury, diabetes, or hypertension. In addition to these factors, having airway edema or massive transfusion might be a significant factor for ICU admission. Courtney et al conducted a prospective analysis of 1,594 orthopedic patients to identify the relevant predictors for ICU admissions following total knee or hip arthroplasty.[10] The authors reported that having chronic obstructive pulmonary disease (COPD), coronary artery disease, congestive heart failure, have lost more than 1000 ml of blood perioperatively, or was administered intraoperative vasopressors were significantly associated with ICU admission in the previously mentioned population. These results were supported by previous studies in the literature. For instance, Lee et al expressed that patients that underwent orthopedic surgeries and suffering from COPD develop severe complications as the need for blood transfusion, septic shock, and anemia which usually require postoperative ICU admission.[13] Klasan et al also supported those same findings in a patient-matched study of lower-limb orthopedics.[14] Friedman et al also reported that having benign heart murmurs was an independent significant factor for predicting ICU admissions after orthopedic surgeries.[15] Similar results were reported by Courtney et al which has also identified an increased body mass index (BMI) (> 35 kg/m^2) as a significant risk factor for ICU admission.[16] High BMI, obesity, and obstructive sleep apnea have been reportedly associated with severe postoperative complications that require ICU admission by several studies.[17,18] Another study by AbdelSalam et al also identified other risk factors as old age, high BMI, blood transfusion, smoking, and general anesthesia as significant predictors for ICU admissions following orthopedic surgeries.[19]

Factors that were not related to the patients can be also good predictors for severe complications and ICU admissions. Nahtomi-Shick et al said that patients undergoing complex surgeries and receiving large amounts of fluids intraoperatively are more prone to be admitted to the ICU.[20] This is logical as such surgeries are usually associated with huge amounts of blood loss and resuscitation which may lead to an imbalance between the body fluids, and increasing incidence of edema which makes it difficult to manage the underlying pain and complications. Nahtomi-Shick et al also reported that the American society of anesthesiology status, patients' age, type and techniques of surgery, and administration of large amounts of fluids were associated with the ICU length of stay following orthopedic surgeries.[20] The evidence that patients undergoing surgical procedures are more prone to develop severe complications secondary to events like fluid loss and subsequent fluid administration was also supported by this study. On the other hand, a large cohort study supported this evidence. Conducted between 1986 and 1992, Weis et al studied the prevalence of perioperative complications following spine surgeries and reported that no significant association was reported between perioperative complications and Cobb angle, and the surgical approach being whether anterior or posterior.[21] Moreover, the authors reported that smoking did not possess a significant impact on the development of severe or minor pulmonary complications. It is worth

mentioning that associated morbidities as cancer might increase the incidence of infections, pulmonary toxicity and effusion, and myocardial toxicity from associated chemotherapy. Besides, malignant lesions might lead to hypercalcemia, syndrome of inappropriate anti-diuretic hormone, and are usually associated with the development of small cell bronchogenic carcinoma. In the same context, such patients usually suffer from chronic pain that is usually provoked by any surgical insults.[22] Therefore, all of the previously mentioned factors should be considered when operating for patients with orthopedic lesions for better control and prevention of subsequent complications.

CONCERNS AND CHALLENGES OF CRITICAL CARE IN ORTHOPEDIC SURGERIES

Many concerns have been aroused regarding the critical care of orthopedic patients undergoing surgeries. These include cardiac and circulatory, patent airways, and pain management concerns. Although many cardiac complications may arouse during such surgeries, some complications have been identified as unique ones to orthopedic surgeries. Autonomic dysfunction may result from surgeries involving the spinal cord in addition to cardiac dysfunction that may result from embolic complications. Besides, old age and the presence of severe comorbidities might exacerbate such complications. Therefore, it is necessary to maintain adequate perfusion pressure for maintenance of cardiac, renal, and cerebral in addition to spinal tissue perfusion. Following total hip arthroplasty, cardiac complications have a prevalence rate of 2-10% while following non-cardiac surgeries, in general, the occurrence of myocardial infarction accounts for 70%.[23,24] Additionally, the development of thromboembolic events is very common in these patients and can lead to elevated pulmonary pressure and subsequent complications.[25] A 20% rate for changes in the electrocardiogram for orthopedic patients in the ICU has been previously reported, however, no significance was associated with these changes. Arrhythmias are also common events in these patients with a prevalence rate of 4.8% for supraventricular tachycardia which may be attributable to old age and the history of cardiac diseases.[26] Therefore, it is highly recommended that these patients should receive appropriate perioperative care for preventing the occurrence of any serious complications. For instance, beta-blockers have been prescribed to reduce myocardial ischemia.[27] Adrenal insufficiency should be also looked after as orthopedic patients are prone to adrenocortical insufficiency that is attributable to the concomitant use of corticosteroids and anti-inflammatory agents for the management of arthritis.[28] Another challenge is the management of any possible spinal trauma that can lead to spinal shock affecting the injured segment and the segments below the lesion leading to disturbing motor, sensory and autonomic functions.[22] Managing pain might also be challenging in orthopedic patients requiring critical care as these patients are usually prone to develop acute and chronic perioperative painful events.[29] Opiates are usually used for the management of this pain. Sedation and pain relief can be achieved by intravenous infusion supply of opiates intra and postoperatively.[30] Pain management has several benefits as it can intervene against the development of pain pathways responsible for chronic pain in addition to normalizing the levels of catecholamines, blood glucose, and inflammation together with the promotion of the process of tissue healing.[30] On the other hand, many complications have been reported with the continuous use of analgesics in patients requiring mechanical ventilation. These events include; gastrointestinal tract hemorrhage, pneumonia, sinusitis, barotrauma, cholestasis, bacteremia and thromboembolic diseases.[31] For reducing ICU complications for orthopedic patients, many approaches have been proposed. Although these measures are not specific to the orthopedic care, they have been reported to reduce the postoperative complications. For instance, preoperative application of beta blockers has shown favorable results in reducing complications and reducing the risks for cardiovascular risks.[32,33]

MORTALITY FOLLOWING ORTHOPEDIC SURGERIES

In general, the mortality rates among orthopedic patients have been estimated to below. The National hospital discharge survey reported a mortality rate of 0.92% for inpatient mortality and a rate of 0.49% if the rate of mortality from acute hip fractures were not included in this rate. The survey also showed that these rates were significantly much lower than the rate of mortality from general surgeries (2.7%).[34] A big study of 528,495 patients undergoing total hip and knee arthroplasty in 400 hospitals in the United States was conducted to evaluate the outcomes of these patients after the surgery and the effect of critical care on these outcomes. The authors estimated the 30 day mortality rate in patients receiving critical care services to be 2.5% and the rate of in-hospital deaths to be 2.2% which was significantly higher than patients that were not receiving critical care services.[35] Memtsoudis et al conducted another study on lumbar spine fusion surgeries and recruited 95,434 patients from 400 US hospitals. The authors reported that the in-hospital total mortality rate for this population was found to be 1.02% for patients receiving critical care services while the total 30 day mortality rate for the same patients was found to be 1.14% and both rates were significantly higher in patients receiving the ordinary care.[36] These relatively low rates (than the hip and knee surgeries rates) are probably due to the difference in both populations and the difference in surgeries which we previously mentioned might be a significant factor in the determination of the severity of complications and the prognosis of the condition. The rate of ICU mortality following orthopedic surgeries significantly increases with age. For patients over the age of 70 years old, a mortality rate of 4.8% has been reported.[3] Mortality rates are mostly attributable to the complications that hugely

affect the general condition of these patients. Bhattacharyya et al reported that among the patients that developed myocardial infarction, 19% died, among patients that developed acute renal failure, 27.6%, and among patients with pulmonary embolism, 19.3% died. In the same context, stroke, pneumonia, tumors, and infections led to the death of 8.0%, 8.6%, 5.2%, and 1.6% of patients suffering from these conditions.[3] A risk of 1% mortality rate has been projected for patients undergoing an elective total hip replacement surgery by the US National Institute of Health. Previous studies also showed a range of 0.6-24% mortality rates have been associated following acute hip traumas.[26] A retrospective analysis by the National surgical quality improvement program was conducted to evaluate the ability of the modified frailty index to predict mortality and postoperative complications in patients undergoing total shoulder arthroplasty and reported that an increased score of this index was significantly associated with mortality and other complications following the procedure.[37] For reducing mortality rates, previous studies expressed the need to apply more strict approaches for management and prevention of complications that may lead to mortality. Besides beta-blockers for cardiovascular complications, van den Berghe et al said that insulin therapy reduces postoperative mortality rates by 4% in critically ill patients. Antibiotic administration before the surgery might be also effective in reducing infection complications and enhancing the prognosis.[38-40]

CONCLUSION

In this study, we reviewed previous studies that reported the mortality rates for patients undergoing orthopedic surgeries and have been admitted to the ICU, in addition to discussing the risk factors and complications for this event and the possible preventive measures. Although the mortality rates in orthopedic patients that are being in the ICU are low, serious efforts should be offered to decrease the development of complications that may increase the burdens of such cases. We found that old age, the presence of comorbidities, the complexity of the procedure, and having large amounts of blood transfusion before the procedure might be significant factors for the development of severe complications and subsequent death. We have also discussed some complications like cardiovascular, cerebral, spinal, pulmonary, and renal disorders. Eliminating these disorders would require more effort for eliminating pain, applying appropriate doses of anesthetics, antibiotics, and beta-blockers.

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