ACUTE CARDIAC COMPLICATIONS AFTER TOTAL JOINT ARTHROPLASTY

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ABSTRACT Total joint arthroplasty (TJA) surgery should be a common procedure recently following the high incidence and prevalence of osteoarthritis (OA). However, the risk of cardiac events as one of the complications after TJA surgery may be a threatening condition. Many risk factors may affect the possibility of cardiac complications occurring in patients. We critically reviewed the cardiac events after TJA surgery, focused on myocardial infarct, cardiac arrest, and new onset of arrhythmia; we also reviewed its risk factors that may raise the possibilities of those complications present in the patient. Some risk factors have been identified, like age, gender, obesity, comorbid disease, and type of arthroplasty. Risks of cardiovascular events following the surgery are present even though the risk is lower as the recent approaches are improved. Some risk factors like age, gender, history of cardiac disease, hypertension, obesity, diabetes, and type of arthroplasty are significantly correlated with the postoperative cardiac complication. Therefore, comprehensive postoperative follow up is needed to prevent threatening conditions in patients who had undergone TJA surgery.

KEYWORDS Total joint arthroplasty, Total knee arthroplasty, Total hip arthroplasty, Cardiac complications, Myocardial infarction

1. Introduction

Osteoarthritis (OA) has been recently higher in both prevalence and incidence[1,2], as well as the increment of total knee arthroplasty (TKA) utilisation[3-5]. Since 2003, the incidence of TKA procedures in Australia has increased by more than 123%. A recent report in 2017 claimed that 55,000 primary TKA procedures had been done[3]. This trend of TKA procedure is expected to grow even higher in both Australia and other countries worldwide[6-8]. For example, the TKA procedure demand in the USA is likely to grow approximately 673% in 2030[8].

Hip fracture mostly occurs in older adults over 65-years-old[9] and has an incidence rate of 1 in 280,000 Americans every year[10]. Moreover, it is also one of the major reasons for a physician to refer a 65-year-old patient or more to the hospital in the USA[11]. By the end of 2040, the prevalence rate of hip fractures 65-year-old-or-more population is approximately raised significantly from 34.8 to 77.2 million. The incidence rate of this fracture may increase to over 500,000 in one year[12].

Consistent with the disease prevalence and incidence, both Total Hip Arthroplasty (THA) and TKA events are expected to grow higher approximately 174% and 673% in 2030, respectively, with an estimated 4 million of Total Joint Arthroplasty (TJA) are performed yearly in USA[13-15].

There are over one million people worldwide who undergo THA for osteoarthritis annually[16]. Unfortunately, when compared with other joint replacement surgery, this procedure is linked with high long-term inflammatory foreign-body tissue reaction incidence[17,18].

Studies reported that major cardiac complication after TJA is as low as 0.2 to 0.8% and are considered a relatively safe procedure with the precaution of the significantly increased risk if the substantial increase of projected arthroplasties is considered[19-23]. However, cardiac complication, as the major mortality and
morbidity caused after TJA procedure, plays a role in the higher rate of hospital mortality, noncardiac events, length of stay, and health expenditure[19,24-27]. Thus, there has been an important need to understand the contributing risks for THA-and-TKA-associated cardiac complications[28].

A study reported that early mortality after primary THA procedure in the 90-days range is at 17 of 1727 (1%) cases. Approximately 0.2% of the index was in patients under 70-years-old, 1.3% in patients between 70-80 years-old, and 2.5% in patients over 80-years-old. Some other causes for the mortality in this study were due to ischemic heart disease (n=7), cerebrovascular disorders (n=4), pulmonary embolism (n=2), and nonvascular etiologies (n=4)[29]. Ischemic heart disease is considered the most common cause of vascular death[30].

This review aims to describe the possibilities of acute cardiac complications in patients who have undergone total joint arthroplasty surgery. To achieve this, the authors describe cardiac events reported after total joint arthroplasty and describe risk factors affecting the cardiac event after the procedure.

2. Cardiac Events/Complications after Total Joint Arthroplasty Myocardial Infarction

Myocardial infarction (MI) is considered the most common cardiac adverse event after TJA surgery[30-32]. However, many surgeons have confidence in low MI risk and decide on early patient discharge due to improved surgical and anaesthetic approaches recently despite some simultaneous changes opposing this theory. Furthermore, there has been a significant survival rate of patients with high-risk coronary artery disease (CAD). However, at the same time, the number of patients that need surgery, like severe knee and hip osteoarthritis, is also increased. Therefore, the tendency for the lower length of stay is very appealing for both hospitals and patients. However, old patients with present comorbidities should be given more caution. The study reported that a 3-day delay in discharge following TJA surgery might identify cardiac attacks in 83% of the subjects[33]. The incidence and mortality outcomes of postoperative cardiac arrest episodes have become a concern for improving surgical patient outcomes. A study reported that three-quarters of 200 surgical patients had a postoperative cardiac arrest complication before or on the day of the surgery, and two-thirds of them died in the first 30 days postoperatively[34]. In addition, Pulidio et al. [35] and Basilico et al. [26] have reported cardiac complications, including cardiac arrest and arrhythmia, as one of the major systemic adverse effects following total joint arthroplasty (TJA), such as Total Knee Arthroplasty (TKA) or Total Hip Arthroplasty (THA).

Other studies conclude that myocardial infarction or cardiac arrest is the second-highest systemic complication post total joint arthroplasty[13,19]. Another study by Taberazam et al. [30] reports episodes of cardiac arrest in a 78-years-old patient who underwent a cemented arthroplasty. A better understanding of this complication is needed to improve careful observation in the intensive care room postoperatively. Most patients with total joint arthroplasty experienced the cardiac arrest episode within the first 3 days postoperatively[13,19].

The study concluded that patients with a total joint arthroplasty should be observed for at least 3 days following the procedure in the hospital. Waterman et al. [24] report an increase of postoperative cardiac arrest episodes in patients with age ≥ 80 years, history of hypertension, and history of cardiac diseases. (p<0.005). The study reports an increased odds of cardiac arrest episode by twofold for a history of hypertension and fourfold for age ≥ 80 years. Basilico et al. [26] also report similar findings that the history of cardiac diseases shows an increase of cardiac complications postoperatively. Another study by Shah et al. [19] demonstrates a significantly higher rate of cardiac arrest in total joint arthroplasty surgery than joint arthroscopy surgery.

Another common cardiac complication after arthroplasty surgery is arrhythmia. Feng et al. [15] reported arrhythmia as the highest cardiac complication after THA and TKA. Studies by Godoy et al. [36] and Urban et al. [37] also reported similar findings. Feng et al. [15] also concluded that the highest rate of arrhythmia occurs when the total joint arthroplasty is performed within 2 years after cardiac revascularization. In addition, long et al. [38] reported that a history of atrial fibrillation correlated with higher bleeding and cardiac complication rates after total joint arthroplasty.

A higher odd of cardiac complications like arrhythmia or myocardial infarction is shown among patients with diabetes mellitus, absence of Beta Blocker (β-blocker) use, heart rate ≥ 70/min, hypertension, and BMI > 25kg/m². In addition, a study by Urban et al. [37] reported higher postoperative cardiac complications on patients with elevated plasma troponin (cTnI) levels. Since increased odds of cardiac complications occurred among patients with a history of cardiac diseases and their risk factors, the postoperative condition should be given more care and attention.

3. Risk Factors of Cardiac Complication after Total Joint Arthroplasty

Total joint arthroplasty, including THA and TKA, is a common surgical procedure in the orthopaedic field involving high peri-operative risk related to the patient’s age and multiple associated diseases[28]. Some potential complications are known to occur during or following this procedure. Among all adverse outcomes, cardiovascular complications represent the principal cause of death[24]. Major cardiovascular complications associated with THA and TKA can be classified as myocardial infarction, cardiac arrest, thromboembolism, deep vein thrombosis, and pulmonary embolism[28]. Gill et al. reported that the death rate from cardiovascular complications is 0.2-0.29%. Age and history of cardiac disease were identified as two major risk factors in cardiac fatality[30]. Another study documented an incidence of cardiovascular complications ranging from 0.3-0.9% after total joint replacement surgery, and 30-day cardiac-related mortality was 0.35% for THA and 0.18% for TKA[24,37]. Among those patients with cardiac complications, 20.6% had increased plasma troponin I (cTnI) levels, which are more likely to have severe cardiac events. This serum is a specific marker and has a higher sensitivity to detect perioperative myocardial ischaemia than creatine phosphokinase (CPK)[30,37].

Factors identified as predictors of perioperative cardiac complications included age, gender, history of cardiac disease, obesity, hypertension, diabetes mellitus, type of arthroplasty, and chronic lung disease. Other conditions such as renal comorbidities, malnutrition, anaemia, alcohol use, cerebrovascular disease, higher ASA-class, and smoking have also been reported as the potential risk factors of cardiac complications, although known to a lesser extent. Recognizing these cardiac risk factors may improve awareness in preoperative plans and postoperative observations and thus reduce the incidence of cardiac events after surgery.
a. Age Advanced age has been identified as a traditional risk factor for cardiac complications. A study conducted by Waterman et al. reported that age more than 80 is a significant predictor of cardiac events after TKA and THA[24,28]. A previous study by Mantilla et al. documented the higher frequency of myocardial infarction in patients aged more than 70 years. The risk of cardiac events was four to nine times higher for patients over 70 years than patients less than 45 years[30].

b. Gender Menendez et al. reported that the male gender had 1.4 times higher odds of being diagnosed with myocardial infarction after TJA than the female gender[22]. Another study by Robinson et al. documented that the incidence of MI after THA and TKA in male patients was relatively high, 0.16% and 0.33%, respectively. The increased chances of MI in male patients could be partially due to the host’s previous conditions. On the contrary, the female gender was the protective factor for cardiac events in THA and TKA[28].

c. History of cardiac disease A history of cardiac diseases such as arrhythmia, coronary artery disease, myocardial infarct, congestive heart failure, or valvular disease was correlated with a higher risk of perioperative cardiovascular complications. Most studies have shown that the patients with previous cardiac disease were at a 1.5 times higher risk of suffering cardiac events following TKA and THA[26]. A patient with a history of cardiac diseases added by several conditions such as ASA class III and IV will significantly increase the cardiac event’s risk by 4.4 times. The previous thromboembolic disease also increases the risk by 3.2 times[30].

d. Obesity Obesity is abnormal or excessive body fat accumulation presented as a body mass index (BMI) score over 30. The study conducted by Feng et al. concluded that obese patients showed a tendency of increased cardiac complication risks after surgery compared to normal-weight patients[28]. However, other studies by Anoushiravani et al. and Thornqvist et al.; reported a possible association between underweight patients and cardiac complications after total joint replacement. Thus, patients who are underweight and obese may therefore be at the same risk of cardiac complications. Fu et al. also reported similar findings that malnutrition has a higher risk of cardiac complication after THA and TKA[28].

e. Hypertension A study by Belmont Jr. et al. identified that hypertension requiring medication was one of the most significant predictors for the development of postoperative cardiac events[13]. This finding is also in line with the study by Waterman et al., which reported that a history of hypertension increased the odds of myocardial infarction and cardiac arrest by a factor of two[24]. Dy et al. also documented similar findings that hypertension increased the risk of cardiac complications by 1.56 times after THA and TKA surgery[30].

f. Diabetes A study by Martinez-Huedo et al. reported an increase of total joint arthroplasty (TJA) among Type 2 Diabetes Mellitus (T2DM) patient[39]. This correlates with an increase in the number of T2DM patients and arthritis; therefore, the number of T2DM patients that underwent TJA is likely to increase. In a study by Belmont Jr. et al., diabetes was correlated with increased cardiac complications in T2DM patients who undergo a TJA operation[13]. Both complicated and uncomplicated diabetes showed a relation between the incidence of diabetes and an increased risk of cardiac complications[28]. This finding is consistent with several previous studies[13,40,41]. Dy et al. revealed an increase of the cardiac complications following TKA and THA in patients with T2DM by 1.55 times[30]. Despite similar findings from other studies, Bolognesi et al. report a lower frequency of myocardial infarction among the T2DM patients that undergo a TJA operation[42].

g. Type of arthroplasty Based on the study by Shah et al., TKA and THA had a 1.94 to 2.5 times greater risk of cardiac events than a lesser invasive procedure, including knee arthroscopy[19]. Another study by Menendez et al. reported that primary THA was associated with a higher risk of AMI than primary TKA[22]. Martin et al. found that bilateral metal-on-metal (MoM) THA may result in cardiac failure due to cobalt toxicity. In addition, the elevated cobalt levels may present severe systemic side effects, including cardiomyopathy, polycythaemia, hypothyroidism, and neuropathy complications[43].

h. Others Many other conditions are related to cardiac complications following joint replacement surgery. Feng et al. investigated that simultaneous bilateral TJA surgery has a higher risk of cardiac events than unilateral TJA surgery. This higher risk of cardiac events is assumed due to the extensive invasive procedure and longer operation time[15]. Patient with previous acute renal failure was also associated with increased cardiac complications following TKA and THA[22]. Other prevalent comorbid conditions, including cerebrovascular and chronic pulmonary diseases, were discovered as significant risk factors for cardiac complications after TJA surgery[13]. Previous cerebrovascular disease and chronic pulmonary disease associated with AMI were reported with an odds ratio of 2.3 and 0.8, respectively[22]. Shah et al. identified smoking as a significant risk factor associated with cardiac complications after TJA surgery[19]. Corticosteroid use for patients who underwent TKA and THA has also been reported to increase perioperative complications, including cardiac complications[44].

4. Conclusion

TJA surgery becomes more often as the prevalence and incidence of osteoarthritis are increased. The risk of cardiovascular events following the surgery like myocardial infarct, cardiac arrest, and new onset of arrhythmia is present even though some surgeons believe that the risk is getting lower as the recent surgery approaches are improved. Some factors are the significant cause of the cardiac event presented after TJA surgery, like age, gender, history of cardiac disease, hypertension, obesity, diabetes, and type of arthroplasty done in the patient. Present renal, cerebrovascular, and chronic pulmonary disease also play a role in presenting the cardiac events after TJA surgery.

Declarations

**Ethics approval and consent to participate**

All consents have been taken.
Consent for publication
Informed consent has been taken.

Competing interests
The authors declare that they have no competing interests.

Author’s contribution
Panji Sananta: Conceptualization, Data curation, Methodology, Formal analysis, Interpretation, Supervision, Validation, Writing - original draft, Writing - review & editing. Felix Cendikiawan: Conceptualization, Formal analysis, Interpretation, Writing - original draft, Writing - review & editing. Alva Pribadi: Conceptualization, Formal analysis, Interpretation, Writing - original draft, Writing - review & editing. Muhammad Abduh: Conceptualization, Formal analysis, Interpretation, Writing - original draft, Writing - review & editing. Panji Sananta: Conceptualization, Data curation, Methodology, Formal analysis, Interpretation, Supervision, Validation, Writing - original draft, Writing - review & editing.

Funding
This work did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

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