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Review Article

COMPLICATIONS AND FOLLOW UP FOLLOWING A TOTAL KNEE REPLACEMENT; A REVIEW OF RECENT LITERATURE

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Abstract:

Introduction: Total knee surgical replacement is considered to be an extremely cost-effective surgery in the field of orthopedics. It is estimated that over four million patients in the United States have undergone a total knee replacement, and more than half a million patients undergo this operation annually.

Aim of work: In this review, we will discuss the risks of possible complications, methods for their prevention, and ideal follow up for patients who underwent total knee replacement surgery.

Methodology: We did a systematic search for prostatitis using PubMed search engine (<http://www.ncbi.nlm.nih.gov/>) and Google Scholar search engine (<https://scholar.google.com>). The terms used in the search were: total knee replacement, knee arthroplasty, complications, management and follow up.

Conclusions: Despite having an overall favorable safety profile, total knee replacement therapy can have associated morbidities. Overall mortality following a total knee replacement therapy is extremely low and is about 0.08%. Possible complications include cardiovascular events like arrhythmias, heart failure, myocardial infarction, deep venous thrombosis, pulmonary embolisms, and fat embolisms. Other more common complications are prosthetic infection, which is the most common early complication, and aseptic loosening, which is the most common late complications.

Keywords: knee replacement, surgical complications, orthopedic, knee arthroplasty

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INTRODUCTION:

Total knee surgical replacement, which can be also called knee arthroplasty, is considered to be an extremely cost-effective surgery in the field of orthopedics. However, despite its efficacy and relative safety, this surgery does still carry a risk of developing several complications and adverse events, which may sometime be severe and lead to significant morbidity. Knee arthroplasty is more usually performed on elderly patients who already could have other chronic comorbidities. This can put them at risk of developing several acute and late complications following the surgery. Moreover, these comorbidities can even sometimes lead to the failure of surgery. It is estimated that over four million patients in the United States have undergone a total knee replacement, and more than half a million patients undergo this operation annually [1]. With these numbers, even a minimal failure rate of the surgery is able to cause significant losses and costs.

In this review, we will discuss the risks of possible complications, methods for their prevention, and ideal follow up for patients who underwent total knee replacement surgery.

METHODOLOGY:

We did a systematic search for knee arthroplasty using PubMed search engine (<http://www.ncbi.nlm.nih.gov/>) and Google Scholar search engine (<https://scholar.google.com>). Our search also looked for complications and follow up following knee arthroplasty. All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: total knee replacement, knee arthroplasty, complications, management and follow up.

Failure of knee arthroplasty:

It has been estimated that about one fifth of patients who undergo a total knee replacement surgery can be not sufficiently satisfied with the outcomes of their surgery. However, this does not justify undergoing another surgery to attempt to improve outcomes. Instead, a revision surgery should only be indicated if there is a clear mechanism that explains the failure of the first surgery, and a proposed plan to correct the problem [2].

In the year 2012 alone, a report claimed that over 62,000 revision surgery were performed in the United States following a failed total knee replacement surgery. This number had significantly increased than previous years [3].

The 10-year survival rates for patients who undergo a total knee arthroplasty is higher than 90%. On the other hand, the 1-year and 5-year revision rates are 1.56% and 5.66% respectively [4]. Risks factors that predispose patients to failure of knee arthroplasty are many and include joint instability, aseptic loosening, and polyethylene wear with osteolysis, polyethylene wear without osteolysis, joint infection, and failure of the extensor mechanism [5].

Failure of knee arthroplasty can be classified as early, which occurs within the first two years following surgery, and late, which occurs after more than two years following surgery. Joint infection and joint instability are considered to be the most common causes of early failure [6]. On the other hand, aseptic loosening of the joint, and polyethylene wear are considered to be the most common causes for knee replacement late failure [6].

Assessment and follow up of factors associated with arthroplasty failure, like infections, instability or abnormal mechanics, depend mainly on radiology. On the other hand, some etiologies causing failure do not induce radiological changes. These include allergies, chronic pain syndrome, and tendinitis [2]

Postoperative Mortality:

Like any other major surgery in an elderly patient, knee arthroplasty can carry a risk of mortality. A report published in 2010 has estimated that the risk on mortality following a total knee replacement surgery could be about 0.08% [3]. Generally, hospitalization duration and mortality rates have both been decreasing recently [7].

Postoperative Morbidity:

A large cohort study was conducted on over four million patients who underwent knee arthroplasty between 1990 and 2004 has concluded that the rate of postoperative complications following knee arthroplasty was 8.4% [8]. The most common postoperative complication related to the surgical wound was seroma or hematoma. Another possible complication is the development of fat embolism that could embolize to the lungs [9]. Rarely, these fat embolisms can pass to the systemic circulation and embolize the brain or other vital organs leading to severe complications. Cardiac complications can also occur following knee arthroplasty, and examples include arrhythmias, myocardial infarction, and heart failure. A large observational study has found that up to 6.7% of patients developed a cardiac event within the first three months following total knee arthroplasty. The same study also concluded that about 5% of patients developed a pulmonary

embolism or a deep venous thrombosis following arthroplasty [10].

Hospital readmission following knee arthroplasty is a significant issue that led to high costs. Causes of hospital readmissions following the surgery can be decreased joints motion (in about 18% of readmissions), wound-related complications (in about 14% of readmissions), bleeding (in about 9.9% of readmissions), surgical wound infection (in about 9.9% of readmissions), and thromboembolic events (in less than 4% of readmissions) [11].

Periprosthetic Infection:

A deep joint infection is considered one of the most serious and concerning complications of knee arthroplasty, with a postoperative prevalence that can reach about 2%¹². Many organisms can cause periprosthetic infection, these include *Staphylococcus aureus*, which is responsible for more than half of the cases, and *Staphylococcus epidermidis*, which can be responsible for up to 30% of cases. Acute periprosthetic Infection following knee arthroplasty usually occurs within the first two months following knee replacement. Typical presentations include erythema of the knee, swelling of the knee, and a continuous draining from the joint, that lasts for more than a week. On the other hand, an intermediate periprosthetic Infection usually occurs after more than two months following the surgery but less than two years. Finally, late periprosthetic Infection after a knee arthroplasty occurs after more than two years of the surgery. Most infections spread through the blood to reach the joint [13].

Regardless of the time of onset, periprosthetic infections manifest clinically as pain, warmth, stiffness, swelling, and tenderness of the joint. The first step when suspecting an infection must always be radiographical imaging. However, it has been found that radiological findings have low sensitivity and low specificity for detecting infections in the joint. Along with radiological investigations, ESR and C-RP levels should be measured in the blood to determine the presence of an inflammation¹². If all these investigations reveal no abnormal findings, a joint infection is ruled out, and the physician must start looking for other causes of the clinical presentations. On the other hand, if abnormal findings are found, an aspiration of the joint is indicated and must be immediately performed to establish the diagnosis. aspiration of the joint has sensitivity, specificity, and accuracy that can reach 100%. However, these sensitivity, specificity, and accuracy will significantly decrease if the patient has been taking any antibiotics within the last four weeks

before aspiration⁵. Analysis of joint aspirate usually includes counting cells with differentiating their types. This will help detect leukocytes and determine their numbers and percentages. A diagnosis of infection is made when the joint aspirate analysis reveals a leucocytic count of more than 1100/ul, with at least 60% of aspirate cells being neutrophils [12]. Another diagnostic modality is the measurement of interleukin 6 levels in blood. In fact, this modality has been found to have high sensitivity for detecting periprosthetic infections [14]. Despite the presence of several new techniques for the identification and diagnosis of joint infections following total joint replacement surgery, imaging and joint aspiration continue to be the standard diagnostic tests in the work up for joint infections [15].

Generally, the findings of radiographic imaging can range from being totally normal to showing complete destruction of the bones. In fact, some time it is challenging to distinguish between a joint infection and an aseptic loosening with imaging only. Imaging showing gas in joints is a rare finding but has a high specificity for joint infection [15].

^{99m}Tc triplephase bone scan can also be used in these cases to detect the presence/absence of infections. An infected joint will show on bone scan an increase in the uptake during the three phases of the procedure. Therefore, the absence of increases in the uptake could lead to ruling out the presence of an infected joint and indicates looking for other possible diagnoses [16].

Treatment of a prosthetic joint infection following total knee arthroplasty includes the retention of the prosthetic joint. This can be achieved with complete debridement along with exchange of polyethylene liner, and primary prosthetic, or salvage procedures like amputation, resection or arthrodesis. Along with performing all these measurements, the administration of intravenous antibiotics is important for at least four weeks. The exact duration of antibiotics treatment depends mainly on the severity of the disease, duration of the infection, and the type of the causative organism [12].

In conclusion, the diagnoses, assessment, management, and treatment of a prosthetic joint infection following a knee arthroplasty all depend on clinical experience, serologic testing results, joint aspirate analyses, and imaging findings [17].

Aseptic Loosening:

Aseptic loosening is considered to be the most common complication leading to late failure of knee

arthroplasty. It is thought to be a result of accumulating mechanical stress, weak stocking of bone, and particle debris that cause osteolysis. To establish a diagnosis of aseptic loosening, radiographic findings should show expanding radiolucency that is wide at the site of the cement-bone, or metal-bone interface. Other radiological findings include fractures of the cement and migration of components [18]. However, these radiological findings can also be detected in asymptomatic and nonprogressive cases. It is also normal to detect stress shielding on radiology, which occurs as a result of reducing the mechanical loading of the bone leading to decreased mineralization of the bone and atrophy [19].

Generally, stress shielding happens within two years following undergoing total knee replacement surgery. It is typically found under the posterior and anterior femoral flanges, or under the tray of the tibia. However, it usually stays stable and appears normal on follow up [20].

Other findings that raise the suspicion of the presence of an underlying aseptic loosening include increase width of the radiolucency of the joint, the presence of radiolucency foci that are bigger than 22 mm, and the migration of components¹⁸. However, these findings could also be present in a septic loosening, and this cannot be distinguished based on imaging only. Therefore, physicians must always run the workup for infection, and rule out its presence, when findings of loosening are present. A grading system was formed by the Knee Society to help physicians clinically assess these cases and estimate the risk of having either septic or aseptic loosening based on radiologic findings. The term 'subsidence' is usually used to indicate losing bone substance under a component leading to settlement of the component into the bone. It is usually found in the tibia in cases where the tray of the tibia sinks through the plateau of the tibia [20].

Polyethylene Wear:

This complication usually occurs late after the knee replacement surgery. It mainly occurs in patients who have metal prostheses that do not have congruent articular surfaces. Risk factors that predispose patients to develop polyethylene wear include the weight of the patient, the physical activity, the molecular weight of the polyethylene along with its thickness, its alignment with femoral components, and the presence of irregularities in the condylar component surface [21].

Since their introduction for the use in total knee arthroplasty, metal backings have also led to an increase in the rate of polyethylene wear. The reason behind this is that they led to the development of micromotions between the modular polyethylene and the metal tray of the tibia [22].

Clinically, the clinical presentation of a polyethylene wear includes a joint effusion that could be either painless or painful. Evaluation should start with lateral and anteroposterior radiographs. However, when the polyethylene wear is present in the patella, it is challenging to detect it using lateral radiographs, but easier with axial radiographs. In the presence of asymmetric wear, it is also common to find a concomitant valgus or varus deformity. Mild wear cases can only be detected after comparing current images with previous ones [21].

Osteolysis:

Osteolysis, which is also called aggressive granulomatosis and particle disease, is a result of a biological process that is cell-mediated and started by the macrophages phagocytosing particle debris. This will lead to the development of an aseptic granulomatous reaction of the foreign body, with filling the osteolysis regions with granulation tissue and phagocytosed debris. These reactions have also been found to include bone cement particles, metal particles, ceramic particles, and polyethylene particles [23].

Osteolysis is considered to be one of the most common causes for requiring another surgery following the knee arthroplasty. It has been found to follow the use of cemented knee replacements and cementless knee replacements. However, cemented knee replacements have been associated with significantly less rates of developing osteolysis than cementless, 16% vs. 30% risk of osteolysis, respectively. In addition, the overall incidence rate of developing osteolysis following a total knee replacement surgery is significantly less than the overall incidence rate of developing osteolysis following total hip replacement surgery [22].

Although osteolysis can develop in any site around the prosthetic joint, it is more common in the femoral condylar region, near the femoral collateral ligaments attachment, along the component periphery, and along the channels that access the tibial cancellous bone²². In addition, the presence of incomplete porous coating in the prosthetic joint, screw holes, or incomplete ingrowth of the bone can all predispose to the development of near osteolysis in a cementless knee prosthetic joint [13].

Most patients can remain asymptomatic for a long period following the development of osteolysis. However, as the pathology progresses, almost all patients will have pain around the joint that is associated with swelling of the joint and possibly acute synovitis. Therefore, it is crucial for all patients who underwent total knee replacement therapy to do serial follow up radiographs to detect osteolysis as early as possible, and to evaluate the progression of the pathology. Continuous obtaining of radiographs will allow for accurate comparisons over time, with the detection of extension of the pathology if present [24].

It is also possible to detect and assess osteolysis using CT and MRI imaging, especially in assessing osteolysis extension. Several studies have suggested that the use of MRI can help detect both granulomatous tissue and synovitis early and before the progression to a destructive disease [25].

Metallosis:

All types of knee replacements that are approved to be used in the United States have no metal-on-metal bearings, which is different than hip replacements. Therefore, it is more likely for polyethylene failure to develop before metal scraping. However, if this occurs, this will lead to the release of metallic material into the prosthetic joint space causing inflammation and staining of the joint and stimulating a foreign body immunity response. In these cases, radiographing imaging will show metallic density that is distributed along the synovial periphery. The thickness of this density is usually proportionate to the amount of metallic material that have accumulated in the joint area. If the physician performs a joint aspirate analysis, the aspirate fluid will most likely be dark [26].

CONCLUSIONS:

Total knee replacement surgery is the definitive treatment for severe knee osteoarthritis and is considered a common surgery among the elderly population. More than half a million elderly patients undergo this surgery annually due to its efficacy, cost-effectiveness, and safety. Despite having an overall favorable safety profile, total knee replacement therapy can have associated morbidities and long-term complications. Overall mortality following a total knee replacement therapy is extremely low and is about 0.08%. However, long term complications and morbidities have relatively higher rates. This could be attributed to the popularity of this surgery among elderly who already have several comorbidities. Possible complications include

cardiovascular events like arrhythmia, heart failure, myocardial infarction, deep venous thrombosis, pulmonary embolisms, and fat embolisms. Other more common complications are prosthetic infection, which is the most common early complication, and aseptic loosening, which is the most common late complications. Several other late complications can occur as well. Due to the high number of patients undergoing total knee replacement surgery every year, proper addressing and treatment of these complications will significantly improve quality of life and decrease costs of treatment.

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