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PROSTHETIC JOINT INFECTION

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ABSTRACT

The number of cases handled by PJI is projected to rise in the coming years. The diagnosis of PJI relies on evaluating microbiology, inflammatory response, and pathology. However, the accuracy of the diagnosis is compromised by previous exposure to antimicrobial agents, the possibility of contamination, and the lack of specificity of inflammatory markers. Although new testing methods, such as molecular techniques, hold the potential for a swift diagnosis, they are constrained by the risk of contamination and the absence of susceptibility results. Interestingly, emerging synovial fluid markers exhibit promise as an additional tool in diagnosing PJI. The management of each PJI case, both in terms of surgery and antimicrobial treatment, requires an individualized assessment. It is imperative to conduct high-quality studies that aim to determine the most effective route and duration of antimicrobial treatment for each surgical approach. This review provides an overview of the diagnostic tests and treatment options for prosthetic joint infection, offering a practical approach to managing this complex clinical condition.

Keywords: Prosthetic joint infection.

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INTRODUCTION

In the upcoming years, it is anticipated that Prosthetic Joint Infection (PJI) will manage a higher total number of cases. Evaluation of the inflammatory response, pathology, and microbiology are necessary for diagnosis; however, the specificity of inflammatory markers, the possibility of contamination, and prior antimicrobial exposure all reduce diagnostic accuracy. Although they offer a speedy diagnosis, new testing modalities-such as molecular methods are constrained by possible contamination and a lack of susceptibility results. New markers found in synovial fluid exhibit potential as a useful tool for diagnosing pressure injuries. Every patient needs to have a customized assessment before beginning surgical or antibiotic treatment. High-quality research is required to determine the best course of action and length of antimicrobial therapy for every surgical technique (1).

The UK National Joint Registry 2023 report's data indicates that 5,464 revision knee arthroplasty procedures were carried out in 2022, and 6,258 revision hip arthroplasties also has been done in 2022 (2). It is projected that the number of primary total hip arthroplasties performed will reach 572,000 by 2030, an increase of 174%. It is anticipated that the number of primary total knee arthroplasties performed will increase to 3 point 48 million, a 673 percent increase. While the demand for knee revisions is anticipated to double by 2015, the demand for hip revision procedures is predicted to double by 2026. Even though knee revisions are currently performed more frequently than hip revisions, after 2007 it is anticipated that the demand for knee revisions will outpace the demand for hip revisions. Between 2005 and 2030, there is a projected growth of 137% for total hip revisions and 601% for total knee revisions (3).

The increased incidence of PJI in knee arthroplasties is expected to be a result of reduced protection from surrounding soft tissues and increased stress on the joint and soft tissues due to mobility. Unfortunately, there is limited research available to provide guidance on the risk of PJI following shoulder and elbow arthroplasty. However, based on the available studies, the risk of infection following shoulder arthroplasty appears to be comparable to, or potentially lower than, the risks associated with hip and knee surgery. It is worth noting, however, that a higher rate of PJIs has been reported in cases involving elbow arthroplasty, affecting up to 3.3% of patients (4,5).

In Indonesia, A study in 2023 found a cumulative sum of 1359 surgeries related to total hip/knee arthroplasty were conducted within the time frame of 2018 to 2020. Among this cohort, a total of 1031 procedures were dedicated to Total Knee Arthroplasty (TKA), whereas 321 surgeries were allocated to Total Hip Arthroplasty (THA). Correspondingly, during this identical timeframe, the institution treated a collective of 52 patients afflicted with prosthetic joint infection (PJI). Specifically, 31 of these individuals experienced knee PJI cases, accounting for approximately 59.61% of the infected, while the remaining 21 cases were attributed to hip PJI, constituting approximately 40.38% of the

affected population. The microbial culture as well as the pathological examination yielded results indicating the presence of gram-positive Staphylococcus species bacteria, which emerged as the prevailing causative pathogen responsible for PJI development. It is worth noting that a subset of 10 out of the 52 cases, or approximately 19.23% of the total, exhibited negative culture findings (6)

The risk factors associated with surgical procedures that may lead to PJI encompass various elements such as the specific site where arthroplasty is conducted, whether the surgery is a primary or revision procedure, the likelihood of successful soft tissue healing or the potential complications related to soft tissue, and ultimately the possibility of there being a subclinical infection present during prosthetic joint arthroplasty as a result of a previous infection affecting the joint (7).

Male patients, as well as patients diagnosed with seropositive rheumatoid arthritis or those who have experienced a history of around the knee fracture, as well as patients with certain types of prostheses such as constrained or hinged, were found to have elevated rates of infection following primary arthroplasty. It was observed that complications related to the wound served to increase the risk of developing a deep infection. Interestingly, the rate of septic failure following epicondylar primary knee arthroplasty was lower in comparison to total condylar primary knee arthroplasty; however, it is worth noting that this difference was not statistically significant.

Remarkably, the implementation of combining parenteral antibiotic prophylaxis and antibiotic-impregnated cement used as prosthetic fixation acted as a protective measure against septic failure, particularly in the context of revision knee arthroplasty. Strikingly, following revision total knee arthroplasty, it was discovered that neither the diagnosis of the patient nor the type of prosthesis had any impact on the likelihood of septic failure. However, it is crucial to highlight that previous revision surgeries conducted to address infection and wound-healing issues were found to predispose patients to subsequent revision surgeries specifically for the purpose of treating infection (8).

Histories of diabetes, rheumatoid arthritis, depression, steroid use, and previous joint surgery were also correlated with an elevated susceptibility to prosthetic joint infection (PJI), thus demonstrating a noteworthy association between these medical conditions and the increased risk of acquiring PJI (9). The risk of Periprosthetic Joint Infection (PJI) is significantly increased when there is a history of infection, whether it is located at the operation site or at different sites during the time of arthroplasty. Infection occurring at sites distant from the joint arthroplasty is particularly concerning as it is likely to raise the risk of PJI by introducing transient bacteremia and subsequently seeding the joint. It is well-documented that hematogenous infection in the presence of a prosthetic joint is a known risk factor for the development of PJI, with staphylococcal hematogenous infections showing the highest rate of infection.

In fact, studies have indicated that up to 25% to 34% of staphylococcal

hematogenous infections in the presence of joint arthroplasty can progress to become infected, further highlighting the importance of addressing any existing infections prior to arthroplasty. The implications of these findings emphasize the need for appropriate preoperative screening and management of infections to minimize the risk of PJI and improve patient outcomes. Consequently, meticulous attention should be given to identifying and treating any existing infections, both at the surgical site and other potential sources, to mitigate the risk of PJI and optimize the success of arthroplasty procedures (10,11).

Generating a microbiologic diagnosis in PJI is crucial for determining the most effective treatment plan, encompassing both surgical options and the optimization of antimicrobial therapy with the most targeted and potent agent. The assessment of the organism's virulence and the selection of intravenous antimicrobial therapy and the suitable following oral antimicrobial therapy for long-term suppression of the organism are important factors that inform the overall surgical plan. However, the microbiologic diagnosis poses challenges due to various factors, including the biofilm formation at the interface between bacteria and the prosthesis, as well as the extensive use of antimicrobials, which can lead to falsely negative culture results. The formation of biofilm is primarily responsible for the inability to eradicate PJIs solely through antimicrobial therapy, necessitating surgical intervention to undertake the formed biofilm. Even when employing a surgical approach to PJI management, the use of antibiofilm agents remains paramount, particularly in cases of staphylococcal PJI (1).

The exact point at which pathogens enter the prosthetic joint infection is still uncertain in most cases. Contamination of the surgical site during the operation can happen either through airborne sources or from the skin flora located at the periphery of the wound. Even though the introduced organism may include with low virulence microorganism, such as S. epidermidis, it was observed that S. epidermidis was the prevailing pathogen, even in cases of late-stage infections (12).

In a study conducted in Indonesia in the year 2023, it was found that the primary causative agent responsible for PJI was Staphylococcus aureus, followed by coagulase negative Staphylococcus. The pathogen known as Methicillin-Resistant Staphylococcus Aureus (MRSA) was found to account for approximately 9.62% of the cases. Additionally, there was a notable proportion of cases where the presence of bacteria could not be identified through culture, accounting for 19.23% of the total. Furthermore, within this study, it was observed that there were four instances of mycobacteria infections that yielded negative culture results, as well as one case of mycobacteria infection in conjunction with Pseudomonas sp. as a concomitant causative agent (6).

When assessing the possible microbiologic causes of PJI, it is important to consider the time elapsed between the arthroplasty procedure and the development of infection. This timeline may provide necessary information for the microbiologic

differential diagnosis. Table 1 provides a breakdown of the commonest bacterial causes of PJI based on the timing of infection, with early-onset infections occurring within the first 3 months, delayed-onset infections occurring between 3 months and 1 year, and late onset infections occurring after 1 year or 2 years. Different types of bacteria are associated with each time frame, with early infections typically involving more virulent organisms and late infections often resulting from hematogenous seeding (1,13).

Table 1. Description of prosthetic joint infection by time from arthroplasty.

	Early PJI	**Delayed (3-12 mo)**	**Late**
Synovial fluid			
White blood cell count (cell/uL)	>10000	>3000	>3000
PMN (%)	>90	>80	>80
Serum CRP (mg/L)	>100	>10	>10
Serum ESR (mm/h)	Not useful	>30	>30
Clinical presentation	Acute onset wound drainage, fever, erythema, joint pain	Subacute joint pain, possible sinus tract formation, which diminishes pain	Systemic symptoms more likely with concomitant bacteremia, pain
Microbiologic differential	Virulent organisms Saureus aerobic gram negative polymicrobial Anaerobic	Less virulent coagulase-negative staphylococci enterococcus cutibacterium	S aureus B-hemolytic streptococci gram-negative bacilli
Etiology	Acquired during arthroplasty	Acquire during arthroplasty, early postoperative	Hematogenous from other infectious focus
Histopathology	More than 5 PMNs per High-power field in 5 hifh-power fields		

Note: PJI (Prosthetic Joint Infection), mo (Month).

The laboratory values derived from the International Consensus definition do not meet the criteria for low virulence organisms, but there is still evidence of PJI (1,13).

When approaching the microbiologic differential diagnosis, it is crucial to consider another significant factor, which is the type and location of joint arthroplasty. In the case of shoulder arthroplasties, the incidence of infection is notably high, primarily caused by Cut bacterium (formerly known as Propionic bacterium)-with Cut bacterium acnes being the most encountered pathogen, whereas it is less likely to be found in other arthroplasty infections. This discrepancy is believed to be due to anaerobic bacteria exposure, which presumably present during the initial arthroplasty procedure, given the proximity to the axilla, the normal site of the bacteria. Considering this factor is crucial as it can potentially impact the available diagnostic and treatment options. Propionibacterium acnes, a Gram-positive anaerobic bacillus, can pose challenges in isolation whenever appropriate anaerobic cultures could not be obtained (1).

Several fungal species have the potential to induce PJI, with Candida species being responsible for approximately 80% of

cases. Nevertheless, the identification of a fungus as the primary causative agent does not preclude the presence of bacteria. Coexisting bacterial infection has been observed in 15%–20% of fungal PJI cases (14). In the year 2020, an investigation was conducted which also revealed that Candida species were the predominant fungal pathogens that were identified, accounting for approximately 85% of the cases. Furthermore, it was observed that 30% of the cases had a simultaneous bacterial infection (15).

Fungal PJI poses a significant challenge as it requires intricate diagnosis, management, and eradication, necessitating a systematic treatment approach. It is crucial to enhance awareness regarding this condition, particularly when patients with immunosuppression, substantial comorbidities, multiple surgeries, and a history of drug use present with painful Total Joint Arthroplasty (TJA). To promptly identify any suspected fungal PJI, it is imperative to utilize easily accessible serum and synovial fluid markers for diagnostic purposes (16).

Mycobacteria constitutes a small proportion of PJIs. Nevertheless, the Mycobacterium tuberculosis complex is considered as a potential cause in patients who have a past medical record of active tuberculosis or latent tuberculosis. The diagnosis of this complex can be considerably postponed, spanning several months or even years following the initial presentation (17). It has been observed that most of the Mycobacterium tuberculosis PJI cases arise due to a pre-existing Mycobacterium tuberculosis infection in the native joint prior to the placement of arthroplasty. In the case of the wrist, up to 31% of such incidents have been reported (18).

PJI caused by nontuberculous mycobacterial infections is a rare occurrence and has primarily been documented through individual case reports and case series. These infections often present with delayed diagnoses. In individuals with a healthy immune system, nontuberculous mycobacteria are typically introduced during surgery; however, in immunocompromised individuals, this complication may also arise from a dissemination of infectious process. Additionally, there have been several reported cases of PJI caused by Mycobacterium bovids following intravehicular treatment with Bacillus Calmette-Gue´Rin (BCG) (19).

In a study conducted in 2007, researchers examined 897 cases of Prosthetic Joint Infection (PJI) that occurred between January 1990 and December 1999. Out of these cases, 60 (7%) were identified as culture-negative PJI, meaning that no microorganisms were detected in the cultures. Culture-negative PJIs are often associated with prior exposure to antimicrobial agents. Therefore, if a microbiological diagnosis is crucial for effective management, it may be necessary to repeat testing after discontinuing antimicrobial therapy, if feasible (20, 21).

Apart from the common pathogens that may be influenced from previous antimicrobial treatment, culture-negative PJI can also be caused by uncommon and

difficult-to-culture organisms. These may cover rarely reported bacteria such as Q fever, Brucella, Bartonella, and mycoplasma, as well as mycobacterial and fungal infections. In cases where aerobic/anaerobic bacterial cultures yield negative results, it is recommended to perform mycobacterial and fungal cultures (20, 21). Furthermore, advancements in microbiological techniques, such as the use of broad-range Polymerase Chain Reaction (PCR) and metagenomics shotgun sequencing, may enable the identification of novel causes of PJI that were previously challenging to detect. With these innovative approaches, researchers hope to expand our understanding of the diverse range of microorganisms that can contribute to PJI (20, 21).

Efforts to eliminate bacteria and prevent the formation of biofilms in the area surrounding the implant are hindered by the suppression of the local immune response. This compromises the effectiveness of preventive measures taken during surgery. To address this issue, the prevention of PJI should focus on several key targets. Firstly, identifying patients who are at a higher risk of developing PJI is crucial. Secondly, reducing the bacterial load in the perioperative period is essential. Thirdly, creating an environment at the surgical site that is antibacterial and prevents biofilm formation is important. Lastly, stimulating the local immune response is necessary.

Despite advancements in research, there is still a significant gap between proposed preventive strategies and their implementation in clinical practice. The most effective approach to combating infections lies in combining all preventive measures into a comprehensive "clinical pack" that is consistently applied in all settings where prosthetic joint implantation takes place. Additionally, the use of "anti-infective" implants may be a suitable option for patients at a higher risk of PJI. However, further progress in preventing PJI is dependent on the utilization of quality improvement tools and continuous data analysis to assess the efficacy of the preventive strategy in specific clinical settings (22).

The prevention of Surgical Site Infection (SSI) and PJI is a complex process that requires a comprehensive approach involving multiple disciplines. With the continuous advancements in technology, it becomes crucial to validate the effectiveness of these preventive strategies. However, this article presents a concise overview of a well-established ten-step approach for preventing SSI and PJI. It is worth mentioning that optimizing the host before surgery, administering prophylactic antibiotics, utilizing antiseptic irrigation solutions, and ensuring proper wound management are among the key preventive measures currently employed in this field (23).

Infection can be categorized as 'early' if it occurs within three months of prosthesis implantation, 'delayed' if it presents between three and 24 months, and 'late' if it occurs beyond two years. However, various authors have recently proposed more intricate classification systems for PJI that consider factors such as host status, presence of bony defect, and anatomy-pathological features. Additionally,

Romano et al. have developed a comprehensive seven-point classification system that can be applied to any bone and joint infection. This classification system includes information on etiopathogenesis, responsible microorganisms, as well as infection, callus, and stability data when considering PJI. The symptoms experienced by patients with PJI can range from acute, characterized by sudden joint pain, swelling, and wound purulence, with or without systemic signs of infection, to chronic, which may manifest as persistent discomfort, limited range of motion, and/or the formation of sinus tracts with discharge. This spectrum of symptoms can be effectively represented using a simple 2 × 2 (Table 2.) (24,25).

Table 2. 2 × 2 table displaying the spectrum of clinical presentation of PJI.

Early acute Less than three months after implantation Acutely warm, swollen, pain, erythematous joint often with features of systemic sepsis.	**Early chronic** Less than tree months after implanation Presistent wound drainage.
Delayed/late acute More than three months after implanation Acutely warm, swollen, pain, erythematous joint often with features of systemic sepsis.	**Delayed/late Chronic** More than three months after implanation. Chronic pain ± Sinus, Loosening may be apparent on X-rays.

To accurately diagnose PJI, a proper definition is necessary. The Musculoskeletal Infection Society (MSIS) and the Infectious Diseases Society collaborated in 2011 to establish criteria that standardized the definition of PJI, leading to enhanced diagnostic confidence and research cooperation. However, the prior definitions were based on consensus rather than evidence-based algorithms, which prompted the introduction of new diagnostic criteria in 2018 to address their limitations. The 2018 system, which incorporates recently developed diagnostic tests, boasts a sensitivity of 97.7% and specificity of 99.5%, compared to the 86.9% sensitivity and 79.3% specificity of the 2011 MSIS criteria. Although there is no universally accepted definition of PJI, the implementation of the new criteria and novel tests has significantly improved diagnostic accuracy (Table 3.) (26- 28).

Table 3. Criteria to diagnose Prosthetic Joint Infection

	Score	Decision
Major criteria (at lest one of the folloeing)		
Two Positive cultures of the same ofanism		Infected
Sinus tract with evidence of communication to the joint or visualization of the prosthesis		
Minor Criteria (preoperative)		
Elevated CRP or D-dimer (serum)	2	≥ 6 Infected
Elevated ESR (serum)	1	
Elevated synovial WBC count or LE (synovial	3	2-5 Possibly infected
Positive alpha-defensin (synovial)	3	
Elevated synovial PMN (%) (synovial)	2	0-1 Not infected
Elevated synovial CRP (synovial)	1	
Intraoperative diagnosis		
Preopetaive score	-	≥ 6 infected
Positive histology	3	
Positive purulence	3	4-5 inconclusive
Single posisive culture	2	≤ 3 Not infected

Various definitions of PJI exist, however, most of these scoring systems do not

incorporate the use of imaging techniques. Currently X-ray examinations are considered as a general screening tool for patients with joint replacement, with MRI and nuclear imaging techniques to be more focused for the work up to determine the differential diagnosis of PJI. According to the available literature, these are highly sensitive investigations, such as three-phase bone scans, WBC scans, and FDG-PET scans. If these scans yield negative results, they can reliably be used as criteria to exclude PJI.

Additionally, a positive WBC scan (possibly combined with a bone marrow scan) can be considered a confirmatory criterion for PJI. In the case of FDG-PET/CT, it is necessary to establish clear and standardized interpretation criteria for differentiation between infection and non-infectious pathologies, particularly aseptic loosening. Lastly, although MRI shows promise due to its preliminary results, easy accessibility, and lack of ionizing radiation, further studies are needed to confirm its accuracy in diagnosing PJI. If its accuracy is confirmed, MRI may become another important imaging modality to be included in future PJI definitions (29,30).

Debridement, Antibiotic Therapy, Irrigation, and Retention The initial strategy encompasses the utilization of DAIR, which stands for Debridement, Antibiotics, Implant Retention. Individuals who derive benefits from this approach must fulfill several criteria, including symptoms lasting for a short duration of less than three weeks, the absence of sinus tract, adequate soft tissue coverage, stable joint, and the availability of oral antimicrobial therapy to target the identified pathogen. Patients who fail to meet these criteria tend to have poorer outcomes. In such cases, an alternative approach, such as a Two-Stage Exchange (TSE), should be considered as the preferred option over DAIR. The DAIR procedure involves an open arthrotomy, irrigation, and thorough removal of any infected material, followed by the exchange of the polyethylene liner (31).

Patients who are most likely to benefit from this approach are either early cases of PJI with symptoms present for less than 3 weeks or delayed/late infections that occur after the joint is infected through hematogenous spread, with symptoms lasting for a brief period. After surgery, the broad-spectrum antibiotic treatment is changed to a specific antibiotic treatment for the identified pathogen and is usually given intravenously for the first 2 to 6 weeks of therapy. Most patients then transition to oral antibiotic therapy, although the ideal duration of this therapy is not well-defined and longer regiment is generally used for infections in total knee replacements. For infections in total knee replacements, a combination of oral rifampin and antibiotics is recommended for 6 months, while for staphylococcal infections in the hip, shoulder, and elbow, a combination of oral rifampin and antibiotics is recommended for 3 months. In cases where highly effective oral antibiotics are available, such as the combination of fluoroquinolone and rifampin for staphylococcal infections, successful reports have shown that intravenous antibiotic therapy can be avoided altogether. Patients with staphylococcal PJI

who undergo Debridement, Antibiotics, And Implant Retention (DAIR) and are unable to tolerate rifampin as part of their combination therapy tend to have worse outcome, necessitating indefinite oral antibiotic suppression. Microbiology also plays a role in the outcome after DAIR, with PJIs caused by Staphylococci, particularly S. aureus, vancomycin resistant Enterococci, and fluoroquinolone-resistant Gram-negative bacteria having worse outcomes compared to other organisms. Cases with negative cultures also tend to have worse outcomes with the DAIR approach, likely due to the difficulty in choosing the most effective antibiotic regimen. If DAIR fails, the next proper option is to convert to a TSE approach, which occurs in up to 72% of failures. Salvage options other than repeat TSE include joint resection without reimplantation, arthrodesis, and amputation (31-35).

The One-Stage Exchange method is a surgical procedure in which a single operation is performed to complete an open arthrotomy. This is followed by the completely removing the prosthesis and any previous cement, thorough irrigation, and debridement. Subsequently, a new arthroplasty is implanted using antimicrobial loaded cement that has been selected based on its effectiveness against the infective organism. This approach is less commonly utilized in the United States. Generally, it is reserved for cases of THA infections in which intravenous and oral antimicrobials are known to be available prior to the operation. The duration and specific courses of antimicrobial treatment after OSE can also vary. Like the DAIR method, an initial two to six-week intravenous antimicrobial treatment is administered, unless there are highly bioavailable oral agents available that can be combined with rifampin for staphylococcal infections. While the Infectious Diseases Society of America (IDSA) guidelines recommend indefinite chronic suppression for these cases, there is still some variation in actual practice. The success rates of the One-Stage Exchange method are reported to be comparable to those of TSE hip and knee arthroplasty infections, although the One-Stage Exchange method is more commonly used for THA infections (31,36).

The most definitive therapeutic surgical method for PJI encompasses a two-stage exchange TSE procedure. This approach commences with removing the infected tissue through debridement, extraction of the old prosthesis, collection of cultures, elimination of old cement, and placement of a cement spacer containing antibiotics into the joint space. The objective is to administer high-dose local antimicrobial therapy and provide structural support. Either static or articulating cement spacer can be adopted, to ensure continuous mechanical support while the arthroplasty is removed and administration of local high-level antimicrobial therapy.

Concurrently, the patient usually undergoes a 4-week to 6-week course of intravenous antimicrobial therapy alongside the local antibiotic therapy in the joint. After the completion of intravenous antimicrobial therapy, the patient is closely monitored without antimicrobial therapy for a period ranging from 2 weeks to 6 weeks,

prior to proceeding with the second surgical stage. During this observation period, clinical evaluation and laboratory work, including assessment of inflammatory markers, are conducted to identify patients who may benefit from repeat debridement. In the second surgical stage, there is an additional opportunity to ensure eradication of infection during the reimplantation surgery by conducting intraoperative examination of the joint, sending histopathology samples for analysis, including frozen section, collecting cultures, removing the spacer, and finally, implanting a new prosthesis, if there are no concerns regarding ongoing infection (1).

This approach is also recommended for cases of fungal prosthetic PJI. Systematic reviews report success rates of greater than 85% with Two-Stage Exchange (37,38). However, certain factors such as the presence of sinus tract and prior joint revision history are associated with higher failure rates. It is worth noting that many failures are due to new infections rather than a relapse of the known organism. Although there is limited evidence, it suggests that high-risk patients undergoing TSE may benefit from a short course (ranging from 28 days to 3 months) of antimicrobial therapy even with negative reimplantation cultures. This approach may help decrease the risk of future infections, especially in patients with multiple previous revision surgeries and ongoing risk factors (39, 40).

Salvage Surgical Options In specific instances of PJI, when the likelihood of surgical intervention yielding an improved level of function is low, such as in patients who are completely no ambulatory due to lower extremity PJI, there are potential surgical options to consider. These options include complete hardware removal without reimplantation, arthrodesis, and even amputation. These approaches are also applicable to cases where patients have undergone multiple standard TSE procedures without success and lack effective suppression options. When considering amputation as an option for PJI treatment, it is generally advisable to seek a second opinion. Patients who undergo resection arthroplasty and arthrodesis still require a period of 4 to 6 weeks of pathogen-directed therapy. Depending on the level of amputation, if there is persistent proximal intramedullary osteomyelitis, patients may also require post-surgery treatment for osteomyelitis (1).

Nonsurgical Although it is not recommended to pursue a nonsurgical approach for the treatment of PJI, there are certain circumstances where this course of action becomes necessary. This is particularly applicable to patients who are deemed unsuitable candidates for surgical intervention. This may be the case when considering factors such as the patient's overall medical condition and the approach to managing their infection in a palliative manner. In such instances, a targeted antimicrobial therapy strategy can be employed, which is guided by the aspiration of the joint and subsequent culturing. It is crucial, however, that the patient is provided with appropriate counseling regarding this treatment plan. It is important to note that these patients are at

a heightened risk of experiencing a relapse of the infection. Consequently, they often require indefinite oral antimicrobial suppression to manage their condition effectively (1).

CONCLUSION

The total number of cases managed by PJI is expected to increase in the upcoming years. The diagnosis of PJI relies on the assessment of microbiology, inflammatory response, and pathology. However, the accuracy of the diagnosis is compromised by previous exposure to antimicrobial agents, the possibility of contamination, and the lack of specificity of inflammatory markers. Although new testing methods, such as molecular techniques, offer the promise of a rapid diagnosis, they are limited by the potential for contamination and the absence of susceptibility results. Excitingly, novel synovial fluid markers show potential as an additional tool in the diagnosis of PJI. The management of each PJI case, both surgically and with antimicrobial agents, necessitates a personalized evaluation. It is crucial to conduct high-quality studies that aim to identify the optimal route and duration of antimicrobial treatment for each surgical approach.

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