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1.2. PREVENTION: RISK MITIGATION

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QUESTION 1: What preoperative screening for infections should be performed in patients undergoing revision hip or knee arthroplasty because of presumed aseptic failure?

RECOMMENDATION: In addition to taking a thorough history, obtaining radiographic imaging and performing a physical examination, all patients with a failed hip or knee arthroplasty awaiting revision surgery should have their serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) measured. Patients with high index of suspicion for infection should be considered for further workup.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 96%, Disagree: 4%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

While there are many etiologies that can cause pain and failure following total joint arthroplasty (TJA), infection is the most common cause of failure in total knee arthroplasty (TKA) and the third most common cause of failure in total hip arthroplasty (THA) [1,2]. The evaluation of patients with a painful TJA begins with a thorough history, physical examination and joint-specific radiographic imaging.

Patients with recent bacteremia, prolonged drainage after surgery, multiple surgeries on the same joint, history of prior periprosthetic joint infections (PJIs), history of surgical site infections of the same joint, comorbidities resulting in an immunocompromised state (i.e., diabetes mellitus, inflammatory arthropathy, etc.) or patients with increased risks of skin barrier penetrations (i.e., intravenous drug abuse, skin ulceration, chronic venous stasis, etc.) should be considered at higher risk for PJIs [3]. Physical exam findings suggestive of PJIs include joint erythema, warmth or large atraumatic effusion.

Plain radiographs should be obtained for all patients presenting with a painful TJA. It is useful to compare serial radiographs. Plain radiographic findings that should increase suspicions of PJIs include signs of early loosening, early osteolysis, periosteal elevation and transcortical sinus tract [4,5]. However, it is important to note that radiographs are rarely diagnostic of PJIs, and can often be normal in the setting of infection.

Infection can be an occult cause of pain following TJA. Therefore, screening for PJIs should be performed in every patient with a painful hip or knee arthroplasty. A successful screening test should have high sensitivity, be widely available and cost-effective. Serum inflammatory markers have been a cornerstone for screening for PJIs in the painful TJA [3–9]. Obtaining an ESR and CRP have proven to be effective screening tools for PJIs due to their high sensitivity, wide availability and cost-effectiveness [10–18]. Using ESR and CRP in combination improves sensitivity and negative predictive values [10,13,14,17–20].

It is important to note that ESR and CRP levels below established thresholds do not definitively exclude the possibility of PJIs [10,13,20]. This is especially true of patients with slow growing organisms such as *Cutibacterium acnes* (*C. acnes*) [21]. It is also true that patients with elevated serological markers do not definitely have PJIs. It is recommended that in the presence of elevated serology and/or high, clinical suspicion for PJIs, even in the presence of normal serology, joint aspiration be performed [3,5,7].

There are some additional limitations to screening using inflammatory markers. ESR, especially, and CRP are normally elevated in the early postoperative periods. Patients with elevated metal ion levels can also present with elevated ESR and CRP levels creating a clouded diagnostic picture [9]. In an effort to overcome these shortcomings, other serum biomarkers have been studied for the diagnosis of PJIs. Interleukin-6 (IL-6) is a cytokine produced by activated monocytes, macrophages and T-cells and has been shown to be a highly-sensitive and specific biomarker for PJIs. However, selection bias, cofounding variables and small study sizes have limited its wide spread adoption [11,22–24]. In a recent study, Shahi et al. evaluated serum D-dimer (fibrinolytic by-product) as a marker of PJIs. In their study, D-Dimer outperformed both ESR and CRP individually and when combined in terms of sensitivity and specificity for diagnosis of PJIs [20]. While promising, this was the first study to analyze the role of D-dimer in diagnosing PJIs.

It is clear that there is a need for more specific and accurate serological screening tests in order to diagnose PJIs. The future holds

promise as the role of new serological markers are being evaluated. Until a more accurate serum marker is introduced, we recommend that any patient with suspected diagnosis of PJI be screened using serological tests for inflammation, namely, CRP and ESR. Consideration should also be given to testing D-dimer as a potential supplementary serological test.

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QUESTION 2: Does prior septic arthritis (aerobic, anaerobic, fungal, tuberculosis) of a native joint predispose the patients to an increased risk of subsequent periprosthetic joint infection (PJI) in the same joint receiving arthroplasty? If yes, how soon after a prior septic arthritis can elective arthroplasty be performed in the same joint?

RECOMMENDATION: Yes. A prior septic arthritis in a joint does predispose the same joint to subsequent PJI after arthroplasty. In the absence of concrete evidence, we recommend that arthroplasty be delayed at least until completion of antibiotic treatment and resolution of clinical signs of infection, but no earlier than three months from the inciting event.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 87%, Disagree: 9%, Abstain: 4% (Super Majority, Strong Consensus)

RATIONALE

The role of total joint arthroplasty (TJA) in patients with prior septic arthritis is not clearly defined. The number of variables involved in such cases have made all current, cohort-based studies difficult to statistically compare. These variables include, age of onset of septic arthritis (child vs. adult), septic joint with or without osteomyelitis involvement, type of joint infected (knee vs. hip), operation performed (one-stage vs. two-stage), time between septic joint and TJA or time between stages for two-stage procedures, and the initial organism causing septic arthritis (tuberculosis vs. bacterial). These variables, among others, are important because they contribute to substantial heterogeneity between patients being treated under the blanket term of having prior septic arthritis.

Previous studies have often grouped patients with differing amounts of these variables together and have reported low-powered and inconclusive results. We performed a systematic review of the literature [1–51] including studies that have directly compared this patient population to those undergoing primary TJA at the same institution by the same surgeons to assess whether or not patients