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QUESTION 3: What tests are useful to investigate a possible infection of total ankle arthroplasty (TAA)? What are their thresholds?

RECOMMENDATION: Overall, the approach to a potentially infected TAA does not change compared to other periprosthetic joint infections (PJIs). There are no novel or unique diagnostic procedures for TAA infection, specifically. Joint aspiration or intraoperative tissue/synovial biopsies with microbiological cultures are the most important diagnostic tests for suspected TAA infections. In the absence of specific data related to TAA, the threshold for these tests should be derived from the hip and knee PJI literature.

LEVEL OF EVIDENCE: Strong

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The literature lacks information regarding a specific diagnostic work-up for infected TAA compared to PJI of other joints. Clinically, persistent pain with or without loosening of the components is believed to be a potential presentation for PJI of TAA [1–3]. According to some authors, the pain localization can hint at one diagnosis versus another; anteromedial pain is commonly caused by gutter impingement or medial ankle stress reaction, whereas more diffuse pain is usually associated with stiffness, loosening or infection [3]. A prior history of delayed surgical wound healing is often reported in patients with infection [4]. The presence of a sinus tract is definitive evidence of infection but is infrequently seen [4].

Ankle swelling and pain progressing to incisional discharge then dehiscence and rapid loosening are strongly suggestive of infection. In these cases, a joint aspiration or intraoperative tissue/synovial biopsies and microbiological work-up, remains the preferred method for diagnosis of TAA infections [2–7]. The microbiological techniques (culture, polymerase chain reaction) are not specific for TAA infections. In infected TAA literature that identifies the causative pathogen, there is a trend towards TAA PJI being affected by a higher proportion of gram-positive microorganisms compared to other PJIs and a smaller proportion of gram-negative bacteria [4,5]. Of note, the microbiological evaluation in one study found no single gram-negative bacteria among 19 cases of infected TAA [7]. Intra-articular leukocyte differentiation, leukocyte esterase, intra-articular C-reactive protein, or alpha-defensin immunoassays of prosthetic joint samples have not yet been sufficiently validated for TAA PJI [8]. Other than during the initial work-up to rule out infection, systemic serum inflammatory markers are practically of no additional advantage. Many authors do not dogmatically recommend their use [3]. Likewise, imaging techniques do not prove infection but may show the localization of abscesses or may confirm implant loosening [1]. Hsu et al. suggested that more than 10 leukocytes per high-power microscopic field in the synovial biopsies would be suggestive of infection [1]. Other groups have reported that >5 leukocytes per high power field in frozen section microscopy may be indicative of PJI [5,7]. However, these approaches are not shared with the majority of author groups and convincing data in favor of microscopic leukocyte counting for TAA specifically are lacking.

Ultimately, there is little consensus regarding the work-up for TAA PJI. Many diagnostic tools are used based on provider preference, with only aspiration and fluid analyses being universally endorsed in the literature.

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QUESTION 4: What are the indications for aspiration of a possibly infected total ankle arthroplasty (TAA)?

RECOMMENDATION: Whenever a periprosthetic joint infection (PJI) of a TAA is clinically possible or suspected, especially when elevated erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) levels exist, and in correspondence to the literature on PJI in total hip and knee arthroplasties, joint aspiration is indicated.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

We performed a systematic review of the literature regarding the research question found above as recommended: A PubMed Search for the MeSH Terms ("arthrocentesis"[MeSH Terms] OR "arthrocentesis"[All Fields] OR ("joint"[All Fields] AND "aspiration"[All Fields]) OR "joint aspiration"[All Fields]) AND ("arthroplasty, replacement, ankle"[MeSH Terms] OR ("arthroplasty"[All Fields] AND "replacement"[All Fields] AND "ankle"[All Fields]) OR "ankle replacement arthroplasty"[All Fields] OR ("total"[All Fields] AND "ankle"[All Fields] AND "arthroplasty"[All Fields]) OR "total ankle arthroplasty"[All Fields]) was performed on February 16, 2018. A total of n = 10 results were found.

Additionally a PubMed Search for the MeSH Terms ("infection"[MeSH Terms] OR "infection"[All Fields]) AND ("arthroplasty, replacement, ankle"[MeSH Terms] OR ("arthroplasty"[All Fields] AND "replacement"[All Fields] AND "ankle"[All Fields]) OR "ankle replacement arthroplasty"[All Fields] OR ("total"[All Fields] AND "ankle"[All Fields] AND "arthroplasty"[All Fields]) OR "total ankle arthroplasty"[All Fields]) was performed on February 17th, 2018. A total of n = 200 results were found. After exclusion of irrelevant manuscripts or duplicates, only four publications remained that can be considered a "match" regarding a specific answer to the research question.

Investigation of a prosthetic joint for possible infection, including the ankle, commences with detailed history-taking, physical examination and ordering a series of laboratory tests. There is no gold standard for diagnosis of PJI and because of this, we must rely on a combination of diagnostic techniques to reach or refute the diagnosis of PJI. The serum laboratory tests that should be ordered include ESR, CRP and potentially other tests, such as D-dimer levels. If these laboratory tests are elevated or with normal serological tests and high clinical suspicion for infection, the next line of investigation is believed to be joint aspiration.

The synovial fluid obtained, if any, should be sent for analyses that include total white blood cell count, neutrophil count and the percentage of neutrophils, as well as analyses for biomarkers, such as leukocyte esterase and alpha-defensin. The joint aspirate is also cultured to identify the potential infecting pathogen.

Although the algorithm for investigation of PJI in hip and knee arthroplasty has been well studied and the optimal threshold for parameters, such as cell count and neutrophil differential, determined, there is little data related to PJI of TAA. In the absence of such data, we believe that TAA should also be investigated in a similar fashion to hip and knee arthroplasty. In fact, our search determined that most studies related to TAA use the MusculoSkeletal Infection Society criteria and extrapolate data published in total hip and knee arthroplasty literature to TAA [1]. In one study, Alrashidi et al. recommended that aspiration for synovial fluid analysis should be considered if the ESR and CRP are elevated [2]. This has been corroborated by other studies in recent years, confirming the utility of aspiration to help gauge the presence of inflammation or infection around a TAA [3–5].

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QUESTION 5: What is the best technique for performing aspiration of patients with total ankle arthroplasty (TAA)?

RECOMMENDATION: In the absence of evidence, we recommend that ankle joint aspiration to evaluate for periprosthetic joint infection (PJI) be performed under sterile conditions via the anteromedial approach. Ultrasound guidance may be used if available but is not necessary to obtain an acceptable synovial fluid sample.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

In the setting of suspected ankle PJI based on preoperative history, physical, laboratory values and imaging modalities, preoperative aspiration can be useful and may reveal an organism in 50 to 60% of cases [1]. Landmark-based aspiration using a sterile technique via an anteromedial approach performed in the office is most commonly performed in order to obtain ankle synovial fluid for analysis. Imaging guidance via computed tomography or ultrasound is not usually necessary since the ankle joint is relatively simple to aspirate [2]. Ultrasound guidance may provide higher accuracy if available based on cadaver studies evaluating injections, which suggested 85% accuracy without ultrasound and 100% accuracy with ultrasound [3,4]. However, another study demonstrated 100% accuracy in ankle joint needle insertion in a cadaver study using palpation technique only [5]. In the setting of infection, there is typically excess fluid resulting in simpler access to the ankle joint for aspiration. Thus, aspiration can be performed without necessarily using ultrasound guidance.

The ankle can be accessed via several approaches. The most common approach is the anteromedial approach, which is just medial to the tibialis anterior tendon at the level of the ankle joint.