an incidence of joint dysfunction of 74% (128 of 172) in the knees compared to 85% (126 of 148) in the hips.

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QUESTION 6: Should intraoperative purulence be considered as a definitive sign of a periprosthetic joint infection (PJI)?

RECOMMENDATION: Intraoperative purulence should not be considered a definitive sign of a PJI. The definition of purulence is subjective and is neither a sensitive, nor specific, diagnostic marker of a PJI. A validated, objective definition for purulence due to infection is required to set purulence as a diagnostic criterion for PJIs.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 75%, Disagree: 22%, Abstain: 3% (Super Majority, Strong Consensus)

RATIONALE

Purulence, defined as the presence of pus, has conventionally been considered a definitive sign of PJI and many studies have used intraoperative purulence as a single criterion to diagnose PJIs [1–4]. The Infectious Diseases Society of America (IDSA) in a Clinical Practice Guidelines for diagnosis and management of PJI, indicates that the presence of purulence without another known etiology surrounding the prosthesis is a definitive evidence of PJI (B-III) [5]. However, considering purulence around the implant as a definitive sign of infection seems to have several drawbacks.

First of all, the determination of purulence is based on the subjective interpretation of the surgeon. Although most surgeons might agree on frank pus, they would have different thresholds for considering cloudy or turbid fluid as purulence. Therefore, the definition of purulence is subjective and assessment and classification of what constitutes purulence are based on surgeons' training, experience and other factors. Failure to use objective criteria to diagnose PJIs has been shown to substantially increase the reported infection rates [6,7].

Secondly, the presence of purulent-appearing or turbid synovial fluid has been reported in both non-infected native and prosthetic joints [8–12]. Turbid, yellowish-white fluid may represent the neutrophil-rich liquid that develops as part of an inflammatory reaction in response to an infection [13], but it may also be seen in non-infectious problems such as crystalline deposition diseases [14,15]. Although contemporary biomaterials are relatively inert, they may still release particles that provoke an inflammatory reaction in some patients [16]. In addition, purulence can exist in patients with failure of metal-on-metal (MoM) bearing surfaces [8–10] or failure due to corrosion at the trunnion of the femoral stem [11], but that does not represent a PJI. Moreover, concomitant infection and failed MoM arthroplasty have also been reported with indistinguishable appearance of the periprosthetic fluid or tissue from non- infected failed MoM implants [17,18].

Thirdly, it was shown that purulence had an acceptable sensitivity of 0.82 and PPV of 0.91 but the specificity and NPV were exceedingly low (0.32 and 0.17, respectively). The sensitivity of purulence was significantly higher in acute hematogenous and late PJIs (0.92 and 0.89, respectively), compared with early postoperative PJIs (0.66) [19], but it is still low to be a definitive sign of PJIs.

Fourth, in the early postoperative period, the synovial fluid is usually blood-contaminated and evaluation of purulence in this time period is very difficult [19].

Fifth, studies showed that there is no correlation between the intensity of systemic inflammatory response and the presence of purulence in the affected joint. Alijanpour et al. [19] showed no correlation between erythrocyte sedimentation rate and C-reactive protein levels and the percentage of synovial neutrophils and the presence of purulence in their series of 467 patients. However, they showed an association between the mean number of synovial neutrophil count, which is concordant with the concept that puru-

lence represents a local inflammatory reaction consisting of a high synovial white blood cell count.

Therefore, in the absence of an objective definition, it is difficult to consider purulence as a simple dichotomous variable. Subjective opinion of the surgeon regarding periprosthetic fluid can vary based on their clinical impression or concerns regarding the consequences of misdiagnosing PJIs. Moreover, PJI has a serious impact on patients' health and quality of life because patients may be subjected to additional surgical procedures and long-term antibiotic treatment. Therefore, surgeons should be cautious in applying subjective criteria for ruling in or ruling out PJIs in suspected patients.

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QUESTION 7: Is aseptic loosening (AL) associated with an undiagnosed periprosthetic joint infections (PJIs)?

RECOMMENDATION: Some percentage of AL is due to culture-negative infection, since up to 10% of culture-negative cases contain bacteria when screened by molecular methods. Whether this correlates to an undiagnosed infection causing AL remains unclear. Understanding this issue is limited by the ability of bacterial culture to function as an effective gold standard for detecting infection. The role of molecular techniques such as next generation sequencing in this setting needs to be explored.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 90%, Disagree: 8%, Abstain: 2% (Super Majority, Strong Consensus)

RATIONALE

Loosening is one of the most common indications for total joint arthroplasty revision. Differentiating between PJI and AL is important in determining appropriate treatment. Loosening is considered aseptic when the radiographic or clinical findings associated with loosening are present in the absence of clinical or laboratory evidence of infection. Radiographic determination of loosening has an excellent specificity and positive predictive value, however, a poor sensitivity and negative predicative value, and thus should not be used to exclude loosening [1].

There is the possibility that microorganisms live on or around implants without signs or symptoms of infection, which can lead to AL. Several prospective and retrospective studies have supported that at least a fraction of cases with AL have been associated with higher rates of bacterial growth. The reported prevalence of unexpected positive cultures (UPC) in presumed aseptic revision arthroplasty varies from 5.9 to 23.9% [2–14]. This major variation might be due to small sample size, different culturing protocols (detection of bacteriologic 16S ribosomal RNA by polymerase chain reaction, sonication fluid cultures and conventional techniques of fluid and soft tissue cultures), laboratory contamination rates, as well as the heterogeneity of patients included in each study (i.e., revisions for isolated polyethylene wear, dislocation, fracture and implant loosening) [2,5]. Kempthorne et al. reported a case-control prospective study comparing AL patients (cases) and patients undergoing revision surgery for other causes (control) with a positive culture rate of 15% [2].