Diagnosis of Prosthetic Joint Infection

Cultures, Biomarker and Criteria

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KEYWORDS

• Prosthetic joint infection • Arthroplasty • Diagnosis

KEY POINTS

- In patients undergoing revision arthroplasty, infections should always be considered and excluded prior to or at the time of surgery.
- No single diagnostic test has enough accuracy for the detection of prosthetic joint infection; therefore, a combination of preoperative and intraoperative tests is needed for the diagnosis of arthroplasty infection.
- Serologic inflammatory markers are useful tests in selecting patients who would benefit from more invasive procedures such as arthrocentesis.
- The optimization of traditional tissue culture and biofilm-dislodging techniques has improved the identification of the causative agent.
- Synovial fluid measurement of cytokines are promising new emerging tests.

INTRODUCTION

Total joint arthroplasty is a highly successful treatment modality that improves joint function, relieves pain, and increases the overall quality of life.[1] Prosthetic joint infection (PJI) is one of the most dreaded complications of arthroplasties that has been reported in 0.5% to 0.8% of patients undergoing primary total knee and hip arthroplasties.[2] With a projected increase in the number of primary arthroplasties, even at a steady infection rate, more infectious complications are expected in the next decades. The cost of treatment of a PJI is 3 to 4 times the cost of a primary implantation,[3] which imposes a great burden to the health care system. Despite the abilities of curing and/or controlling PJI with current treatment regimens, patients with PJI

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have inferior functional results compared with patients who undergo revisions for aseptic joint failure.[4]

Even though infection is the most common cause of knee arthroplasty revision and the third most common cause of hip arthroplasty revision[5] in the United States, discriminating between aseptic joint failure and chronic PJI can still be a challenging task. An accurate diagnosis is important, as the therapeutic approach differs between PJI and aseptic failure. Failing to identify a PJI will lead to placement of prosthesis in an infected joint space, which could compromise the outcome of the arthroplasty. On the other hand, misdiagnosis of PJI can lead to unnecessary antimicrobial use and surgical procedures with an increased morbidity and cost to the health care system.

PJIs are biofilm-related infections in which bacteria attach to the inert surface of the prosthesis forming communities embedded within an extracellular polymeric matrix.[6] This biofilm leads to a persistent infection that is maintained by a relative antimicrobial resistance and tolerance to the host defenses (immune reaction). Currently, the presence of PJI is evaluated by detecting the invading organisms (ie, cultures) or by assessing the host immune response to the infection (ie, serologic tests and inflammatory cell counts). Biofilm-related infections are difficult to diagnose, as traditional microbiological tests are optimized to detect free-floating bacteria (planktonic) but not bacteria within the biofilm (sessile). In addition, arthroplasty infections caused by low virulence organisms may fail to illicit a systemic inflammatory response detectable by clinical symptoms or serologic tests.

Several tests with different levels of complexity have been evaluated for the detection of PJI, and none of them have shown an adequate diagnostic accuracy to be used as a stand-alone test. The accuracy of any given test can only be measured by comparing the results of the test to a clearly established definition of disease (gold standard). Such a gold-standard definition of PJI does not currently exist. Different definitions have been used among studies evaluating diagnostic tests for detection of PJI that could compromise the validity and comparability of results. In an effort to standardize the definition of PJI, multiple medical societies and working groups have proposed different definitions. In 2011, the Musculoskeletal Infectious Society (MSIS) proposed a set of criteria for the diagnosis of PJI that was later revised by the International Consensus Meeting on PJI (**Table 1**).[7,8] In 2012, the Infectious Diseases Society of America (IDSA) published a set of criteria for the definition of PJI.[9] These definitions have only minor differences in determining the presence of infection.[6]

CLINICAL PRESENTATION

Clinical presentation of PJI is dependent on the time of onset from prosthesis placement, mechanism of infection, virulence of the pathogen, and host immune response (**Table 2**). History and physical examination can improve the accuracy of diagnostic tests. By carefully selecting patients who would obtain the most benefit from a diagnostic test, one can minimize the false-positive and false-negative results. Numerous tests are currently available to aid physicians in the evaluation of PJI. However, the selection of these tests and the interpretation of their results should be made in conjunction with the likelihood of infection based on history and physical examination.

Joint pain is the most common presentation of PJI and aseptic failure. Joint erythema and systemic signs such as chills and fever are highly specific for infection but are rarely seen except in acute hematogenous PJI or early postoperative infections.[10–14] Other conditions, such as gout, may have a similar presentation with local signs of inflammation in the affected prosthesis. A sinus tract communicating with the

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