HK25: When taking the culture of a joint, how many samples should be taken?

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Response/Recommendation:

When taking samples for routine culture from a hip or knee joint, it is recommended to obtain four to five samples. This number may be reduced to three when using blood culture bottles. However, there is limited evidence on the optimal number of samples required for culturing acid-fast bacilli or fungi from a hip or knee joint.

Level of Evidence: Moderate

Delegate Vote:

Rationale:

Regarding the identification of microorganisms in large joints, including hips and knees, earlier studies suggested that five or more (≥ five) samples should be collected[1, 2]. However, these studies lacked hypothesis-driven analyses to specifically support this recommendation. Recent studies have aimed to validate the optimal number of samples required to identify microorganisms in knee and hip joints[3-6].

Bémer et al. conducted a multicenter, prospective, cross-sectional study involving 215 patients who have periprosthetic joint infections (PJI) diagnosed using the IDSA criteria[7]. The overall positive culture rate was 89.3%. There were five intraoperative samples collected from each patient. Subsets of two, three, and four samples were randomly selected to assess agreement with the full microbiological dataset. Results demonstrated that four samples were sufficient to diagnose PJI, achieving a percentage of agreement of 98.1 and 99.7% with the bacteriological and overall IDSA criteria, respectively[4]. Gandhi et al. retrospectively analyzed 74 patients infected with total hip arthroplasty (THA) or total knee arthroplasty (TKA) diagnosed according to the MSIS criteria[8]. The overall positive culture rate was 85.1%. A receiver operating characteristic (ROC) curve analysis was performed to determine the optimal number of cultures required for a positive result. The analysis revealed an area under the curve (AUC) of 0.708 (95% confidence interval (CI): 0.554–0.861, $P = 0.019$). A threshold of four samples demonstrated an optimized sensitivity and specificity of 0.63 and 0.61, respectively. Notably, increasing the number of culture samples was associated with improved sensitivity[3]. Peel et al. retrospectively reviewed 499 patients who underwent revision total joint arthroplasty (TJA), of whom 22% (N= 111) met the MSIS criteria for PJI[9]. The majority of these cases involved revision TKA and THA procedures (83.2%, N= 415). The overall positive culture rate among PJI patients was 80.2%. For conventional culture techniques, including synovial and sonicate fluid cultures, Bayesian latent class modeling demonstrated the highest accuracy (95%) with a sensitivity of 97% and specificity of 91% when five samples were collected. When using blood culture bottles, the optimal number of samples decreased to three, achieving an accuracy of 93% (sensitivity: 92%, specificity: 93%)[6]. Kheir et al. conducted a single-center, retrospective study involving 622 PJI patients, with a total of 2,290 cultures collected from hips and knees. The diagnosis was made based on the MSIS criteria[10]. For

each patient, three to five tissue and fluid samples were generally collected for bacterial cultures. The overall positive culture rate was 62.6% (N = 1,433 out of 2,290 cultures). On average, four samples were required to obtain a minimum of two positive cultures, with variations observed among different microorganisms. Collecting five samples yielded the highest number of positive cultures, with a mean of 3.74 positive results, compared to other sample numbers, which ranged from one to more than nine[5].

The incidence of positive acid-fast bacilli or fungal cultures is very rare, ranging from 0 to 0.6% among 446 acid-fast bacilli and 486 fungal cultures performed during 253 orthopaedic procedures over a two-year study period, primarily involving TKA and THA procedures. Therefore, routine testing might not be necessary unless there is a high clinical suspicion[11]. Due to the rarity of such cases, most studies—typically case reports or small series—have not validated the number of cultures required to obtain positive results for acid-fast bacilli or fungi[12-18]. Repeated joint aspiration using selective culture media or molecular diagnostic techniques may improve the yield of organism detection for these types of pathogens[19].

Conclusion:

Current evidence recommends collecting four to five samples for bacterial cultures from a hip or knee joint to achieve a positive yield and diagnose PJI. When using blood culture bottles, this number might be reduced to three. However, evidence regarding the optimal number of samples needed to culture acid-fast bacilli or fungi from a hip or knee joint remains limited.

References:

1. DeHaan A, Huff T, Schabel K, Doung YC, Hayden J, Barnes P. Multiple cultures and extended incubation for hip and knee arthroplasty revision: impact on clinical care. J Arthroplasty. 2013 Sep;28(8 Suppl):59-65. Epub 2013/07/28.
2. Atkins BL, Bowler IC. The diagnosis of large joint sepsis. J Hosp Infect. 1998 Dec;40(4):263-74. Epub 1998/12/30.
3. Gandhi R, Silverman E, Courtney PM, Lee GC. How Many Cultures Are Necessary to Identify Pathogens in the Management of Total Hip and Knee Arthroplasty Infections? J Arthroplasty. 2017 Sep;32(9):2825-8. Epub 2017/05/10.
4. Bemer P, Leger J, Tande D, Plouzeau C, Valentin AS, Jolivet-Gougeon A, et al. How Many Samples and How Many Culture Media To Diagnose a Prosthetic Joint Infection: a Clinical and Microbiological Prospective Multicenter Study. J Clin Microbiol. 2016 Feb;54(2):385-91. Epub 2015/12/08.
5. Kheir MM, Tan TL, Ackerman CT, Modi R, Foltz C, Parvizi J. Culturing Periprosthetic Joint Infection: Number of Samples, Growth Duration, and Organisms. J Arthroplasty. 2018 Nov;33(11):3531-6 e1. Epub 2018/08/11.
6. Peel TN, Spelman T, Dylla BL, Hughes JG, Greenwood-Quaintance KE, Cheng AC, et al. Optimal Periprosthetic Tissue Specimen Number for Diagnosis of Prosthetic Joint Infection. J Clin Microbiol. 2017 Jan;55(1):234-43. Epub 2016/11/04.
7. Osmon DR, Berbari EF, Berendt AR, Lew D, Zimmerli W, Steckelberg JM, et al. Diagnosis and management of prosthetic joint infection: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2013 Jan;56(1):e1-e25. Epub 2012/12/12.
8. Parvizi J, Gehrke T, Chen AF. Proceedings of the International Consensus on Periprosthetic Joint Infection. Bone Joint J. 2013 Nov;95-B(11):1450-2. Epub 2013/10/24.

9. Parvizi J, Gehrke T, International Consensus Group on Periprosthetic Joint I. Definition of periprosthetic joint infection. J Arthroplasty. 2014 Jul;29(7):1331. Epub 2014/04/29.
10. Parvizi J, Zmistowski B, Berbari EF, Bauer TW, Springer BD, Della Valle CJ, et al. New definition for periprosthetic joint infection: from the Workgroup of the Musculoskeletal Infection Society. Clin Orthop Relat Res. 2011 Nov;469(11):2992-4. Epub 2011/09/23.
11. Wadey VM, Huddleston JI, Goodman SB, Schurman DJ, Maloney WJ, Baron EJ. Use and cost-effectiveness of intraoperative acid-fast bacilli and fungal cultures in assessing infection of joint arthroplasties. J Arthroplasty. 2010 Dec;25(8):1231-4. Epub 2009/11/03.
12. Kim SJ, Lee DW, Lee C, Kim JH. Mycobacterium avium complex prosthetic joint infection: A systematic review of the literature and pooled analysis. J Orthop Surg (Hong Kong). 2023 Sep-Dec;31(3):10225536231199392. Epub 2023/10/25.
13. Lee YR, Kim HJ, Lee EJ, Sohn JW, Kim MJ, Yoon YK. Prosthetic Joint Infections Caused by Candida Species: A Systematic Review and a Case Series. Mycopathologia. 2019 Feb;184(1):23-33. Epub 2018/07/28.
14. Yang HY, Shin HH, Kim JW, Seon JK. The fate of fungal periprosthetic joint infection after total knee arthroplasty. Int Orthop. 2023 Nov;47(11):2727-35. Epub 2023/08/06.
15. Wiwattanawarang N. Fungal periprosthetic joint infection after total knee arthroplasty. J Med Assoc Thai. 2014 Dec;97(12):1358-63. Epub 2015/03/15.
16. Cobo F, Rodriguez-Granger J, Lopez EM, Jimenez G, Sampedro A, Aliaga-Martinez L, et al. Candida-induced prosthetic joint infection. A literature review including 72 cases and a case report. Infect Dis (Lond). 2017 Feb;49(2):81-94. Epub 2016/09/03.
17. Guan Y, Zheng H, Zeng Z, Tu Y. Surgical procedures for the treatment of fungal periprosthetic infection following hip arthroplasty: a systematic scoping review. Ann Med Surg (Lond). 2024 May;86(5):2786-93. Epub 2024/05/02.
18. Wang D, Sun XT, Zhang CF, Fang XY, Huang ZD, Zheng QC, et al. Total Knee Arthroplasty in Patients with Unsuspected Tuberculosis of the Joint: A Report of Four Cases and a Systematic Review of the Literature. Orthop Surg. 2020 Dec;12(6):1900-12. Epub 2020/11/05.
19. Nace J, Siddiqi A, Talmo CT, Chen AF. Diagnosis and Management of Fungal Periprosthetic Joint Infections. J Am Acad Orthop Surg. 2019 Sep 15;27(18):e804-e18. Epub 2018/12/07.