SH44: Should cultures be sent routinely at the time of revision shoulder arthroplasty regardless of indication for revision, presence of acute mechanical failure (acute periprosthetic fracture, instability, poor implant positioning), or clinical suspicion of PJI?

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Response: If there is clinical suspicion for PJI, cultures should be sent routinely. If there is a traumatic/acute mechanism of injury or PJI is not suspected, cultures do not need to be sent routinely.

Strength of Recommendation: Limited

Delegate Vote: 47 (89%) agree; 1 (2%) disagree; 5 (9%) abstain

Rationale: A thorough review was performed to identify all pertinent studies reporting on culture results after revision shoulder arthroplasty. Searches for the terms "revision shoulder arthroplasty", "unexpected cultures", "shoulder", and "shoulder replacement" were performed using the search engines PubMed and MEDLINE which were searched through 2024. Inclusion criteria for the systematic review were all English studies (Level I-IV evidence) that reported on postoperative cultures with revision shoulder arthroplasty. Exclusion criteria were non-English language articles, nonhuman studies, retracted papers, case reports, studies with less than <10 patients in the sample size, studies without clinical follow-up, studies without culture results and technique papers without patient data.

Periprosthetic joint infection (PJI) is a devastating complication of shoulder arthroplasty with rates reported up to 5% in primary cases and up to 15% in revision cases.[1] Positive cultures have been noted to be as high as 59% in revision cases.[2] Proper identification of pathogenic organisms during revision shoulder arthroplasty can improve patient outcomes by allowing for more appropriate antibiotic treatment regimens. Coste et al reported 30% residual infection when infected shoulder arthroplasty was treated with resection arthroplasty alone and 60% residual infection with antibiotic treatment alone.[4] Therefore, appropriate antibiotic regimens in addition to proper surgical debridement is vital in eradication of PJI. It is important to remember that even 2-staged treatments for infected shoulder arthroplasty can result in residual infection in 10.1-22% of cases after implant explantation, debridement, placement of an antibiotic spacer and intravenous antibiotics administered for 6 weeks.[1,3,14,16,17] One possible reason for this treatment failure is inaccurate diagnoses of the offending pathogen and the possibility of polymicrobial infections. Even in the presence of known infection, alternative organisms can be cultured at the time of revision which may influence postoperative treatment regimens.[18] Culture data is typically monomicrobial so the use of next-generation sequencing, which typically results in polymicrobial results, may improve these outcomes but this is still an area of active research.[18] In light of reports of positive cultures from shoulders without prior surgery and no clinical signs of infection to be as high as 45%, the utility of intraoperative tissue cultures in patients undergoing primary shoulder arthroplasty without a history of prior surgery is unclear.[5] Unexpected positive cultures (UPC), defined as a situation with no pre- or perioperative

suspicion of infection, can be as high as 50% during revision shoulder arthroplasty.[6,9,11] The significance of these UPC clinically remains to be determined.

Cutibacterium acnes, a common indolent shoulder pathogen, is isolated in up to 79.4% of revision shoulder arthroplasties when clinical suspicion for PJI was low.[2,10,11] *Cutibacterium acnes* has been isolated in the deep layer of the dermis in 18.8% of patients undergoing primary reverse TSA.[7] Studies have shown that the *C. acnes* present in the skin at the beginning of surgery is genetically the same as those found in the deep tissues at the end of surgery.[12,13] *C. acnes*-positive culture rate can range from 9.3-41.8% of patients undergoing primary shoulder arthroplasty.[8,15] Furthermore, *C. acnes* has also been surprisingly isolated from sterile inanimate objects (gauze sponges and air swabs) further complicating an UPC.[11,21,22] As the significance of UPCs remains unclear and the presentation of shoulder PJI can commonly be indolent due to *C. acnes* or other low virulence organisms, cultures should be obtained in all revision shoulder arthroplasties when PJI is possible to try to better understand and diagnose these different clinical scenarios and lead to more well defined treatments. The recommended ICM culture protocol should be utilized, including the number and type of specimens obtained and the culture technique performed on the specimens, in order to minimize difficulty in interpreting positive culture result(s). This recommended culture protocol includes obtaining 5 deep tissue specimens from different areas of the shoulder at revision shoulder arthroplasty and culturing of the tissue samples using aerobic and anaerobic conditions with 14 day culture hold (diagnostic accuracy may be improved with additional use of enrichment media/broth).

Instability is commonly associated with hematoma formation and postoperative hematoma is a potential risk factor for shoulder PJI. Hematoma formation was associated with positive intraoperative cultures in a retrospective review of 3541 primary and 606 revision shoulder arthroplasty cases.[20] Furthermore, instability is commonly associated with poor implant positioning. Poor implant positioning may result from inexperience due to poor exposure or prolonged operative time. Although data is lacking in regards to these specific issues in relation to positive intraoperative cultures, one may extrapolate that both these issues from inexperience will increase the chance of PJI and therefore cultures may be helpful in the management of these patients as well.

The only conceivable situation where routine cultures may not be indicated is when a known acute, mechanical failure occurs and is the obvious reason for revision. A patient who has a successful postoperative outcome after shoulder arthroplasty that then sustains an acute, mechanical failure (e.g., fall or trauma resulting in a periprosthetic fracture or acute instability event) may not benefit from cultures being obtained intraoperatively as false positives may result in unnecessary and/or harmful post-operative antibiotic use. However, concerns for PJI may still exist in more chronic scenarios of mechanical failure.

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