



## Culture positivity in primary total shoulder arthroplasty



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**Background:** The clinical significance of positive cultures in shoulder surgery remains unclear. This study determined the rate and characteristics of positive intraoperative cultures in a cohort of patients undergoing primary shoulder arthroplasty.

**Methods:** From February 2015 to March 2016, 94 patients, without prior surgery, underwent primary shoulder arthroplasty. Before surgery, all shoulders were prospectively enrolled and consented to obtain standardized intraoperative cultures. All patients received standard preoperative antibiotic prophylaxis. Standardized fluid and tissue locations were sampled and sent for aerobic and anaerobic cultures and held for 13 days. Patients and surgeon were blinded to the culture results.

**Results:** Average age at surgery was 70.5 years (range, 50–91 years), and 41 patients (47%) were male. At least 1 positive culture was found in 33 shoulders (38%), with 17 patients (19%) having  $\geq 2$  positive cultures. *Cutibacterium* (formerly *Propionibacterium*) *acnes* was the most common organism (67%), followed by coagulase-negative *Staphylococcus* (21%), *Staphylococcus aureus* (3%), and other organisms (18%). The rate of positive culture was higher in men (51%) than in women (26%,  $P = .016$ ). *Cutibacterium acnes* was more common in men with positive cultures (95% vs. 17%,  $P < .001$ ) and coagulase-negative *Staphylococcus* and *Staphylococcus epidermidis* were more common in women with positive cultures (42% vs. 10%,  $P = .071$ ).

**Conclusion:** Positive deep tissue cultures develop in a high percentage of patients undergoing primary shoulder arthroplasty despite antibiotic prophylaxis. The long-term clinical implication of this finding requires further study, especially with regard to the risk of late failures of shoulder arthroplasty.

The Thomas Jefferson University Hospital Institutional Review Board approved this study (IRB No. 14D.294).

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**Level of evidence:** Level III; Cross-Sectional Design; Epidemiology Study

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Unexpected positive cultures at the time of revision shoulder arthroplasty surgery remain a diagnostic and therapeutic treatment dilemma. In many of these cases, revision surgery is performed for pain, stiffness, or component loosening where deep infection is not clinically suspected.<sup>3,5,7,12,15,17</sup> Surgeons continue to debate the clinical significance of these positive cultures and whether patients require further treatment with antibiotics or repeat surgery. The most common organism identified in these instances is *Cutibacterium* (formerly *Propionibacterium*) *acnes*, a slow-growing gram-positive anaerobic bacillus commonly found as normal flora in the skin.<sup>1,2,10,14,16</sup>

Although not traditionally considered virulent, *Cutibacterium acnes* has been isolated in cultures in 25% to 60% of patients at the time of revision shoulder surgery and has therefore been implicated as a potential cause of shoulder arthroplasty failure or persistent pain after nonarthroplasty shoulder surgery in patients without clinically suspected infection.<sup>6,8,10,12,15,17</sup> However, presumed clinical reinfection rates in cases of revision shoulder arthroplasty where infection was not initially suspected but a positive culture was found have varied widely from 6% to 25%.<sup>3,5,7,17</sup>

Grosso et al<sup>5</sup> reported a series of 17 patients who underwent single-stage revision arthroplasty and had 1 or more cultures unexpectedly positive for *Cutibacterium acnes*, *Staphylococcus epidermidis*, or other bacteria. Despite their patients not receiving postoperative antibiotic treatment for their positive culture results, the clinical reinfection rate was only 6%.<sup>5</sup> This low reinfection rate when contrasted against the high prevalence of an organism such as *Cutibacterium acnes* in the surgical site at the time of revision shoulder surgery has raised the question of whether many of the positive cultures at the time of revision shoulder surgery represent true infection.

One method of further evaluating the clinical relevance of positive cultures at the time of revision shoulder arthroplasty has been to evaluate the incidence of positive cultures at the time of primary shoulder arthroplasty. Several studies have investigated the rate of culture positivity at the time of primary shoulder arthroplasty and showed the presence of *Cutibacterium acnes* in deep synovial fluid or tissue cultures in 9% to 41% of patients.<sup>8,9,11,13</sup>

The high prevalence of *Cutibacterium acnes* in deep cultures taken during the exposure for primary shoulder surgery cultures has lent support to theories that the bacteria may merely be a commensal organism in the skin, possibly a contaminant from surgical exposure, or an etiologic factor in the development of shoulder arthritis as opposed to a true pathogen. Whether the presence of *Cutibacterium acnes* at the time of primary shoulder arthroplasty poses a risk of failure at long-

term follow-up is unclear. However, the answer to this question may provide some perspective on the clinical significance of identifying *Cutibacterium acnes* in the setting of revision shoulder surgery where infection is not suspected.

The primary purpose of our study was to determine the rate of positive cultures in a series of patients undergoing primary shoulder arthroplasty with no history of prior shoulder surgery or suspicion of underlying infection. Secondly, we sought to identify patient risk factors associated with the risk of a positive culture and to determine the short-term clinical significance of a positive culture.

## Materials and methods

The study was designed to be a prospective observational study with both the surgeon and patient blinded to the culture results. The study enrolled 94 patients undergoing primary anatomic or reverse total shoulder arthroplasty between February 2015 and March 2016. Inclusion criteria were adult patients with end-stage arthropathy of the glenohumeral joint. The preoperative diagnosis was recorded as osteoarthritis, cuff tear arthropathy, or “other.” “Other” forms of arthritis included rheumatoid arthritis, post-traumatic arthritis, and avascular necrosis of the humeral head. We excluded patients who had any previous arthroscopic or open surgery on the involved shoulder or a history of any shoulder infection. Insufficient culture data resulted in 6 of the 94 patients being removed from the review, leaving a cohort of 88 patients.

Demographic data included patient age, sex, height, weight, preoperative diagnosis, and prior steroid injection into the involved shoulder. On the day of surgery, all patients had laboratory analysis to measure erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). All operations were performed by 1 of 6 fellowship-trained shoulder surgeons.

## Surgical protocol

Preoperative antibiotics were administered according to Joint Commission, Surgical Care Improvement Project guidelines. First-line antibiotic prophylaxis was cefazolin, administered within 60 minutes of surgical incision. Patients with a  $\beta$ -lactam allergy were administered clindamycin or vancomycin, based on a facility-specific antibiogram.

All surgeons used a similar chlorhexidine-based skin preparation (ChlorPrep; Becton Dickinson and Company, Franklin Lakes, NJ, USA) and draping protocol that included iodophor-impregnated surgical drapes (Ioban; 3M, St. Paul, MN, USA). Shoulder arthroplasty implants were used at the discretion of the treating surgeon. All surgeons routinely used space suit surgical attire for the procedure.

As part of the surgical exposure, 3 to 4 cultures specimens were obtained and standardized to include (1) an attempted synovial fluid aspiration through the subscapularis tendon, and tissue culture of

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