SH86: What is the treatment(if any) for unexpected positive cultures (UPCs) in revision shoulder arthroplasty without clinical or radiographic signs of infection?

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Response: There are no specific treatment recommendations for use and duration of antibiotics in unexpected positive cultures during revision shoulder arthroplasty without clinical or radiographic signs of infection.

Strength of Recommendation: Limited

Delegate Vote: 46 (100%) agree; 0 disagree; 0 abstain

Rationale: A comprehensive literature review was performed to identify all studies exploring treatment protocols for unexpected positive intraoperative cultures (UPCs). Searches for the terms "shoulder", "arthroplasty", "infection", "unexpected", "unexpected positive", and "unexpected positive intraoperative culture" were performed using the search engines PubMed and Embase which were searched through December 2024. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on treatment of UPC in shoulder surgery. UPC was defined as patients undergoing revision shoulder arthroplasty with no clinical or radiographic signs of infection who had one or more positive cultures taken from the shoulder at the time of revision. Exclusion criteria were non-English language articles, nonhuman studies, retracted papers, case reports, review papers, studies with less than <10 patients in the sample size, studies without clinical follow-up, and technique papers without patient data. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. Eight articles met inclusion and exclusion criteria and were reviewed.

Uncertainty in interpreting positive culture results in patients undergoing revision shoulder arthroplasty without clinical or radiographic signs of infection raises questions about the appropriate treatment for patients with UPC's. Despite this growing topic of concern, there remains a limited number of studies that evaluate the treatment of UPC's in shoulder surgery. In the studies reviewed, UPC rates ranged from 15-49% and of those positive cultures, 57.1-100% were C. acnes.[1–7]

Most studies that gave detailed accounts of their treatment protocol followed standard post-operative antibiotic regimens consisting of 24 hours of IV antibiotics. The remainder of the treatment protocol varied substantially between studies and even within each study in regard to type and duration of oral antibiotic treatment, addition of oral rifampin, and additional operative treatment. Studies reporting on treatment and outcomes of patients with UPCs is summarized in Table 1.

Padegimas et al. reported on a cohort of 108 patients who underwent revision arthroplasty, 28 of which had UPC's. The group of patients with UPC's was further divided into two groups. Group 1 had antibiotic therapy for 6 weeks, while the second group had 2 weeks of oral antibiotic therapy. One of the 10 patients who did not receive the additional 6-week antibiotic regimen experienced reinfection. Additionally, a higher percentage of patients with

UPCs underwent reoperation compared to those who did not have positive cultures (20.2% vs 7.1% respectively).[2]

Falstie-Jensen et al. Performed a retrospective cohort study of 124 patients who underwent revision surgery and found UPC's in 27 patients.[1] No additional treatment was initiated outside of the author's standard post-operative protocol. Using the Oxford Shoulder Score as their primary outcomes measure, this group found that the presence of UPCs did not impact short-term outcomes after standard revision shoulder arthroplasty, with patients experiencing improved function and reduced pain regardless of culture status at mean 2-year follow-up. While two patient's in the culture- negative group developed subsequent infection, none of the patient's treated with antibiotics developed reinfection during the study window. However, as the authors described, the short follow up period is a noted limitation of the study and it is possibly for these patient's to have developed infection after the study's conclusion.

Foruria et al. reported on 107 patients with UPCs. Persistent infection occurred in 10% of those with UPCs in this study, however the results were presented in aggregate and specific data on antibiotic regimen used for treatment of the patients who did experience persistent infection was not available. Antibiotic treatment varied, 34 patients were treated with oral antibiotic therapy with a wide range of duration (8-700 days), 19 with chronic suppression, and 54 did not receive any post-operative antibiotics. They found that antibiotic treatment duration was not associated with the presence of a second positive culture.[5] Grosso et al. demonstrated similar findings. In their study, 13 patients who underwent revision received tobramycin or gentamicin impregnated cement. All patients received IV antibiotics for 24 hours post-operatively with no additional antibiotic therapy. One out of 17 (5.9%) of patients with UPCs at the time of revision developed recurrent infection.[8]

The current comparative studies for treatment of UPCs are substantially underpowered, have high variability in antibiotic management and lack comparison of defined treatment protocols. At this time, no definitive conclusions can be drawn regarding the suitability of any particular antibiotic treatment algorithm for UPCs and what treatment option, if any, is most appropriate. A prospective randomized-controlled study comparing management of patients with UPC with no other evidence of infection at the time of revision surgery (standard post-op protocol with no additional antibiotic coverage vs addition of a standardized antibiotic treatment regimen) may help elucidate the most appropriate management of these patients.

Table 1. Summary of Studies reporting on treatment and outcomes of patients with UPCs

Author	UPC (n)	UPC that were P. acnes (n)	Treatment Protocol	Outcomes
Dodson et al.	6	6	IV Cefazolin for 36 hours -5 patients received oral ampicillin for mean 9 weeks (range:8-10), and used ESR/CRP value normalization to determine when to discontinue -1 patient remained on chronic suppressive abx for 24 months	NR
Falstie-Jensen et al.	27	18	Culture positive at postop day 4? -2 weeks IV abx, followed by 4 weeks oral abx Culture positive at postop day 14? -additional 4 weeks of oral abx Abx of choice based on ID recommendations	No patient's in UPC treated with abx developed reinfection. However, as the authors described, the short follow up period is a noted limitation of the study.
Foruria et al.	107	68	53 patients treated with postop abx -19 patients treated with chronic abx suppression -34 patients treated for mean of 120 days (range:8-700 days) Exact abx and route of administration unclear	Results reported in aggregate. Most notably, 11 patients had later positive cultures with the same microorganism as was the intial culture, however it is unclear if these patients were among those treated with abx.
Grosso et al.	17	10	Other than routine 24h IV abx, no additional IV or oral abx were administered	1 patient present with subsequent superficial wound infection at 6 weeks postop
Hsu et al.	27	27	Patient's with "high index of suspicion" -IV Ceftriaxone for a minimum of 3 weeks Patient's with "low index of suspicion" -Oral Augmentin for a minimum of 3 weeks If 2 or more cultures became positive, patients were switched to IV ceftriaxone +/- vancomycin with oral rifampin for 6 weeks. This was followed with oral Augmentin or doxycycline for minimum 6 (months/weeks?)	3 required reoperation for infection, however none had positive cultures at time of re-revision
Kelly and Hobgood	8	6	7 patients were not treated 1 patient treated with 4 weeks of Doxycyline for unrelated superficial wound infection at the ilia crest	2 patients presented with subsequent infection at 12-14 months postoperatively
Padegimas et al.	28	15	10 patients treated but discontinued after 2 weeks 18 patients treated for 6 weeks -12 with IV abx (Vancomycin, Penicillin, Metronidazole, Ampicillin, Daptomycin, Clindamcycin) -6 with oral abx (Cephalexin, Doxycycline, TMP-SMZ)	1 patient treated for recurrent infection in UPC group
Topolski et al.	75	45	Unspecified, highly variable treatment course -14 treated with unspecified abx for 1-6 weeks -7 treated with oral unspecified abx -remaining 54 were not treated	10 patients required reoperation for pain or loss of function at mean 2.5 years

1. Falstie-Jensen T, Lange J, Daugaard H, Sørensen AKB, Ovesen J, Søballe K, et al. Unexpected positive cultures after revision shoulder arthroplasty: does it affect outcome? J Shoulder Elbow Surg. 2021 Jun;30(6):1299–308.

2. Padegimas EM, Lawrence C, Narzikul AC, Zmistowski BM, Abboud JA, Williams GR, et al. Future surgery after revision shoulder arthroplasty: the impact of unexpected positive cultures. J Shoulder Elbow Surg. 2017 Jun;26(6):975–81.

3. Kelly JD, Hobgood ER. Positive culture rate in revision shoulder arthroplasty. Clin Orthop. 2009 Sep;467(9):2343–8.

4. Topolski MS, Chin PYK, Sperling JW, Cofield RH. Revision shoulder arthroplasty with positive intraoperative cultures: The value of preoperative studies and intraoperative histology. J Shoulder Elbow Surg. 2006 Jul 1;15(4):402–6.

5. Foruria AM, Fox TJ, Sperling JW, Cofield RH. Clinical meaning of unexpected positive cultures (UPC) in revision shoulder arthroplasty. J Shoulder Elbow Surg. 2013 May;22(5):620–7.

6. Hsu JE, Gorbaty JD, Whitney IJ, Matsen FA. Single-Stage Revision Is Effective for Failed Shoulder Arthroplasty with Positive Cultures for Propionibacterium. J Bone Jt Surg. 2016 Dec 21;98(24):2047–51.

7. Dodson CC, Craig EV, Cordasco FA, Dines DM, Dines JS, DiCarlo E, et al. Propionibacterium acnes infection after shoulder arthroplasty: A diagnostic challenge. J Shoulder Elbow Surg. 2010 Mar;19(2):303–7.

8. Grosso MJ, Sabesan VJ, Ho JC, Ricchetti ET, Iannotti JP. Reinfection rates after 1-stage revision shoulder arthroplasty for patients with unexpected positive intraoperative cultures. J Shoulder Elbow Surg. 2012 Jun;21(6):754–8.