SH31. What is the role of semi-quantitative scoring of cultures and time to culture positivity in diagnosis? Should it still be included in the minor criteria? If so, what weighted score should it be given in the diagnostic criteria?

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Methodology: A comprehensive literature review was performed to identify all studies on culture positive prosthetic joint infection (PJI). Searches for the terms ("shoulder replacement" OR "shoulder arthroplasty") AND ("culture" OR "time to positive culture") was performed using the search engines PubMed and Google scholar which were searched through Jan 2025. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on culture positivity and time to culture positivity in revision joint arthroplasty and what it means for diagnosis of PJI. Exclusion criteria were non-English language articles, nonhuman studies, case reports, review papers, studies with less than <10 patients in the sample size, studies without clinical follow-up/infection rates, and technique papers without patient data. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. 20 articles met inclusion and exclusion criteria and were reviewed.

Response/recommendation: We recommend modifying scoring for single positive culture with low-virulent organism based on time to culture positivity as followed:

- single positive tissue culture with low-virulent organism weight
  - Growth ≤7 days 1 points
  - Growth >7 days 0 point

Strength of recommendation: **Moderate**

Rationale:

Current ICM criteria takes into account virulence of the organism and number of cultures into consideration for diagnosis of shoulder PJI. Two positive tissue cultures of the same virulent organism is one of the three major diagnostic criteria for definite PJI. Also, a single positive tissue cultures with a virulent organism (3 points) or two or more positive tissue cultures with a low-virulent organism (4 point) will lead to higher score as part of the minor criteria for PJI. Belay et al used the current ICM criteria to classify 43 patients who underwent revision shoulder arthroplasty at a single institution between 2013 and 2019 and showed patients with definite infection had the highest rate of reinfection (28.6%) at 1 year follow-up[1]. The significance of a single tissue culture with a low-virulent organism and the weight it needs to have in the scoring system is less clear.

C. acnes is the most common organism identified in revision total shoulder arthroplasty however it is also the most common contaminant of bacterial cultures growing in 13-20% of controls specimens [2]. There is growing evidence that time to culture positivity may be one way to differentiate between contaminants and true positive cultures. The optimum incubation period for recovery of low-virulent organisms including C. acnes has been established to be 13 days [3]. Frangiamore et al shows a significantly shorter time to positivity in a group of tissue culture categorized as ''true positives'' compared with a ''probable contaminant'' group (5 days vs. 9 days, P ¼ .002)[4]. Hsu et al. conducted a multicenter study on tissue specimens from revision shoulder arthroplasty that were labeled positive control (n=110) and negative control (n=22)[5]. The aim of the study was to establish the accuracy of tissue cultures for C. acnes as well as time to positivity

and strength of culture positivity. They showed that cultures were positive in 91% of positive controls and 14% of negative controls and the time to positivity was significantly shorter ($P < .001$) and the strength of positivity was significantly higher ($P < .001$) in positive controls. The average time to growth in positive controls were 4.0 ± 1.3 days and all positive samples grew by day 7. In another study, Toler et al studies host inflammatory reaction and time to C. acnes culture positivity in 1365 periprosthetic samples[6]. They assessed host inflammatory response based on ICM minor criteria scoring for synovial fluid CRP, Alpha-defensin, WBC and PMN%. They identified C. acnes in 94 tissue cultures and showed in this group, C. acnes antigen level had a positive correlation with inflammatory reaction ($r=0.6$, $p < 0.000$) and negative correlation with time to culture positivity ($r=-.04$, $p<0.0001$).

In summary, differentiation between contaminants versus true positive culture of low-virulent organisms in the setting of revision shoulder arthroplasty remains challenging. There is some evidence in the literature that lower time to culture positivity for C. acnes is associated with higher bacterial load and higher hot inflammatory reaction and it is an indicator of true infection. While there is no consensus on exact time to culture positivity, it seems 7 days would be a reasonable cut off based on two large studies. Therefore, we recommend modifying the scoring system and put less emphasis on single positive tissue culture with low-virulent organism that turn positive after 7 days.

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