SH34: Is cloudy fluid important in the diagnosis of PJI? 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 evaluating the use of cloudy fluid in the diagnosis of shoulder PJI. Searches for the terms "shoulder replacement", "cloudy fluid", "ICM", and "shoulder arthroplasty" were performed using the search engines PubMed and Google Scholar which were searched through October 2024. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on the use of the "cloudy fluid" as a diagnostic marker used for defining shoulder arthroplasty PJI. 2 articles met inclusion and exclusion criteria and were reviewed.

Answer: Unknown. There is only a single study which looks at the sensitivity and specificity of cloudy fluid comparing gold standard positive for PJI (sinus tract/purulence) vs. gold standard negative for PJI (no major/minor criteria with only 1 low virulent positive culture). Specificity and sensitivity are lower than all other minor criteria which would support not including cloudy fluid as one of the minor criteria.

Strength of Recommendation: Limited

Rationale:

The original citation for the importance of cloudy fluid comes from the study of Pottinger et al (JBJS 2012). In this study, the surgeons performed revision arthroplasty with no clear evidence of infection and obtained cultures at the time of revision surgery. Multiple clinical and radiographic factors were evaluated with regards to their association with a single positive culture for either P. Acnes or another organism other than P. Acnes. The authors determined that the odds ratio of one of the cultures to be positive for P. Acnes was 10.68 if cloudy fluid was present on aspiration. There was no significant finding for cloudy fluid and other organisms besides P. Acnes. Based upon this study, cloudy fluid was considered important in determining if P. Acnes was present at the time of revision shoulder arthroplasty.

Since this publication, the ICM 2018 criteria used cloudy fluid as minor criteria weighted at 2 points. The only subsequent publication to evaluate the importance of this minor criteria in identifying infection was published by Patel et al in JSES 2021. These authors evaluated a group of patients who were considered infected and undergoing a first stage of a two stage revision. 87 first stage revisions were performed and these were categorized based upon the ICM criteria: 30% definite, 21.8% probable, 6.9% possible, 48.3% unlikely. The authors looked at each of the minor criteria and determined sensitivity, specificity, accuracy, PPV and NPV when comparing gold standard PJI group (sinus, purulence) versus gold standard negative PJI group (no major or minor criteria or 1 positive culture with low virulent organism. The results of the sensitivity, specificity,

accuracy, PPV and NPV were 73.9%, 65%, 69.5%, 70.8% and 40.6% for cloudy fluid. These were the lowest of any of the minor criteria.
There is currently unpublished data from Klifto et al presented at the ASES 2024 Annual meeting supporting cloudy fluid was not predictive of any criteria of PJI.

Based upon the limited data to support its inclusion as a minor criteria from the Pottinger study alone and the low values obtained from the Patel study, the data supports not including this as a minor criteria in the future.

References:

1. Saper D, Capiro N, Ma R, Li X. Management of Propionibacterium acnes infection after shoulder surgery. Curr Rev Musculoskelet Med. 2015 Mar;8(1):67-74. doi: 10.1007/s12178-014-9256-5. PMID: 25596729; PMCID: PMC4596189.

2. Pottinger P, Butler-Wu S, Neradilek MB, Merritt A, Bertelsen A, Jette JL, Warme WJ, Matsen FA 3rd. Prognostic factors for bacterial cultures positive for Propionibacterium acnes and other organisms in a large series of revision shoulder arthroplasties performed for stiffness, pain, or loosening. J Bone Joint Surg Am. 2012 Nov 21;94(22):2075-83. doi: 10.2106/JBJS.K.00861. PMID: 23172325.

3. Patel VV, Ernst SMC, Rangarajan R, Blout CK, Lee BK, Itamura JM. Validation of new shoulder periprosthetic joint infection criteria. J Shoulder Elbow Surg. 2021 Jul;30(7S):S71-S76. doi: 10.1016/j.jse.2021.04.009. Epub 2021 Apr 22. PMID: 33895298.

4. Garrigues GE, Zmistowski B, Cooper AM, Green A; ICM Shoulder Group. Proceedings from the 2018 International Consensus Meeting on Orthopedic Infections: the definition of periprosthetic shoulder infection. J Shoulder Elbow Surg. 2019 Jun;28(6S):S8-S12. doi: 10.1016/j.jse.2019.04.034. PMID: 31196517.

5. Klifto C, et al. Assessment of Periprosthetic Joint Infection in Revision Shoulder Arthroplasty. American Shoulder and Elbow Surgeons (ASES) 2024 Annual Meeting, San Antonio, TX.