SH37: How important is positive frozen section for diagnosis of PJI? Should it still be included in the minor criteria?

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Supportive Delegates: Songeen Lv; Eric Ricchetti

Response: A positive intraoperative frozen section (IOFS) may help diagnose shoulder PJI and should be included in the minor criteria.

Strength of Recommendation: Limited

Delegate Vote: 49 (91%) agree; 1 (2%) disagree; 4 (7%) abstain

Rationale: A comprehensive literature review was performed to identify all studies on positive frozen section and its importance in the diagnosis of shoulder PJI. Searches for the terms "(frozen section OR histology OR histologic) AND shoulder AND (arthroplasty OR replacement) AND infection" performed using the search engines PubMed and Google Scholar which were searched through October 2024. Inclusion criteria for systematic review were all English studies (Level I-IV evidence) that reported on the use of the "frozen section" in making a diagnosis of PJI in shoulder arthroplasty. Eight articles met inclusion and exclusion criteria and were reviewed. Four of these articles presented data that supported the response to this query. Additional sources were obtained from the reference lists of these articles as well as from independent query.

Multiple studies have reported on the use of IOFS to aid in the diagnosis of shoulder PJI. The best study is the study by Patel et al. that aimed to validate the ICM 2018 criteria. The authors found that a positive IOFS, defined as ≥ 5 PMN in 5 high power fields or greater had a specificity of 100%, a sensitivity of 90%, an accuracy of 95%, as well as a positive predictive value of 92% and a negative predictive value of 50%. Of all the minor criteria, positive frozen section had a highest sensitivity. The addition of 2 positive cultures improved sensitivity and accuracy only marginally, from 90 to 95% and from 95 to 97.5%, respectively. The authors acknowledged the retrospective nature of their study as a limitation. Additionally, the study was performed at a tertiary medical center so that the results may not be generalizable.

The ASES Shoulder PJI Multicenter Research Group analyzed their database and employed receiver operating characteristics curves to evaluate the predictors of definite or non-definite shoulder PJI, according to the ICM 2018 criteria, including a positive IOFS, defined as ≥ 5 PMNs per high-powered field [ASES/Hsu, in preparation]. The authors found that a positive IOFS had a specificity of 78%, a sensitivity of 71%, a positive predictive value of 90% and a negative predictive value of 73% for a definite PJI with ≥ 2 cultures positive for the identical bacterium. Similarly, the authors found that a positive IOFS had a specificity of 50%, a sensitivity of 67%, a positive predictive value of 53% and a negative predictive value of 60% for a definite PJI with ≥ 3 cultures positive for the identical bacterium.

Two studies provided the foundation for the ICM 2018 consensus statement on the role of IOFS in evaluating for shoulder PJI. Topolski et al. also evaluated the value of IOFS and history in diagnosing PJI at the time of revision shoulder arthroplasty [Topolski]. An average of 2.2 biopsy for cultures were obtained along with biopsy for intraoperative frozen shoulder. Only 6 of

73 patients (8.2%) with at least one positive culture had a positive IOFS. The authors question the role for IOFS in diagnosing shoulder PJI.

Grosso et al. evaluated the role of IOFS for identifying shoulder PJI, and specifically infections with C. acnes [Grosso]. The authors used traditional thresholds of 5 PMN per HPF in at least 3 HPFs and determined a specificity of 100% for PJI as well as sensitivities of 50% for *C. acnes* and 67% for infection with other organisms. The authors used a receiver operating characteristics (ROC) curve to optimize the threshold of a total of 10 PMNs in the 5 highest density HPFs to increase the sensitivity to 72% for *C. acnes*, while maintaining 100% specificity. The threshold of 10 PMNs per PHF in at least 5 HPFs has been employed previously for hip and knee PJI [Banit].

Mansat opined in a commentary on the study by Grosso et al. that a positive IOFS may guide the surgeon towards bridge antibiotic therapy or away from single stage and towards two-stage revision surgery [Mansat]. Although bridge antibiotics therapy is performed routinely, irrespective of IOFS and good outcomes have been reported for single stage revision surgerya higher Minor Criteria score has been associated with an increased risk of PJI recurrence [Givens].

In contrast, Pottinger et al. found that the odds of a positive culture were not significantly increased by the findings of acute inflammation on histologic analysis of IOFS [Pottinger]. In contrast, the authors found male gender, humeral osteolysis, cloudy fluid at surgery, humeral loosening, and membrane formation were highly associated with the likelihood of obtaining a positive *C. acnes* culture.

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