SH53: Can Leukocyte Esterase Test at the time of surgery accurately predict the presence of shoulder PJI? Should it be included in the minor criteria?

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Recommendation: Current evidence does not support the inclusion of LE testing in shoulder PJI diagnostic criteria.

Strength of Recommendation: Limited

Delegate Vote: 44 (98%) agree; 0 disagree; 1 (2%) abstain

Rationale: A Pubmed search using the MESH terms "Shoulder Surgery OR Shoulder Arthroplasty AND Periprosthetic joint infection", "Leukocyte esterase, Shoulder joint/surgery AND Leukocyte esterase, "Arthroplasty, Replacement, Shoulder AND infection/diagnosis AND Leukocyte esterase", and "Arthroplasty/Adverse effects AND Leukocyte esterase" was performed. A Google Scholar search using "Shoulder arthroplasty and leukocyte esterase" and "Shoulder Periprosthetic joint infection and leukocyte esterase" was also performed. Articles were searched through 2024. Inclusion criteria for our systematic review were all English primary research articles (Level I-IV evidence) that reported on shoulder arthroplasty and leukocyte esterase. Exclusion criteria were non-English language articles, case reports, review papers, studies with less than 10 patients in the sample size and technique papers without patient data. Prior published articles were cross-referenced to ensure no relevant studies were missed. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. Thirty articles met inclusion and exclusion criteria and were reviewed.

Leukocyte esterase (LE) is an enzyme secreted by activated neutrophils recruited to areas of bacterial infection. The LE strip test has been suggested to provide a widely available, quick, and cost-effective tool in the diagnosis of hip and knee periprosthetic joint infections (1,2,4,5,6,7,8). Koh et al. performed a prospective multicenter study of patients undergoing revision total knee arthroplasty and found that using a diagnostic threshold of "++", the LE strip test had 84% sensitivity, 100% specificity, 100% PPV and 100% NPV for the diagnosis of infection (1). Parvizi similarly found that a LE threshold of "++" had a sensitivity of 80.6% and a specificity of 100% (2). A meta-analysis comparing the accuracy of multiple synovial biomarkers by Lee et al. found a sensitivity of 77%, specificity of 95%, and a diagnostic odds ratio of 4.57 for the LE strip test (3). Tarabachi et al. found that a positive LE test using a + or ++ threshold correctly predicted the presence of infection in >95% of patients with elevated serum inflammatory markers. In patients with negative serology, it correctly ruled out infection in >99% of patients (4). However, LE strip testing has known limitations, with variability in sample handling, timing of test interpretation, and thresholds for positivity influencing the accuracy of the LE test (4,5).

In contrast, the utility of LE testing in shoulder PJIs has yielded less favorable results. This is likely because the most common offending pathogens, *Cutibacterium acnes* (formerly *Propionibacterium acnes*) and Coagulase Negative Staphylococcus (CNS), are of low virulence and elicit minimal neutrophilic responses. The presence of hemorrhagic

synovial fluid or inadequate synovial fluid volumes, commonly encountered during revision shoulder procedures, also interferes with LE colorimetric readings frequently yielding indeterminate results.

Nelson et al. prospectively evaluated the utility of LE strip testing in the diagnosis of PJI in 45 patients undergoing primary and 40 patients undergoing revision shoulder arthroplasty (9). Only 5 positive LE strip tests were obtained from all culture positive shoulders, producing an overall sensitivity of 23.8% in predicting positive cultures. In the revision setting, LE strip testing had 25% sensitivity and 75% specificity in predicting culture positivity. Importantly, LE testing was particularly poor at detecting *C. acnes* with a sensitivity of only 18.2%. Indeterminate LE results due to blood contamination were also common, occurring in 13.3% of primary and 22.5% of revision cases. In the revision group, 67% of the indeterminant samples ultimately produced positive cultures. 10 patients in this series met MSIS criteria for infection (7 True PJI, 3 Potential). The sensitivity of LE to detect PJI in revision patients who met MSIS criteria for infection was 30% and the specificity was 67% with a 43% PPV and 83% NPV. When bloody or indeterminate samples were considered positive in the patients who met criteria for infection, the sensitivity increased to 60% but the positive predictive value (PPV) dropped to 37.5. Overall, Nelson et al. concluded that LE testing is not recommended as a routine diagnostic tool for shoulder PJI.

Ecker et al. performed a retrospective review of patients undergoing aspiration for suspected shoulder PJI (10). They reported a sensitivity of 50% and specificity of 87% for LE strip testing, with a PPV of 60% and NPV of 81% and overall accuracy of 76%. 24 patients met MSIS criteria for PJI with C. acnes identified in 63% of these patients. LE strip testing correctly suggested infection in only 20% of C. acnes positive patients whereas a 13.3% false negative rate was observed. In a large proportion of patients with C. acnes infection, LE testing was indeterminate due to the presence of hemorrhagic fluid or insufficient synovial fluid aspirates. The utility leukocyte esterase testing in the diagnosis of shoulder periprosthetic infection is significantly hampered by factors such as low pathogen burden, frequent blood contamination, and poor sensitivity for detecting *C. acnes*. Current evidence does not support the routine inclusion of LE testing in shoulder PJI diagnostic criteria.

References:

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