

Isothermal Microcalorimetry Analysis of Synovial Fluid Aspirates Improves Accuracy and Time to Detection Compared to Conventional Cultures

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INTRODUCTION: Isothermal microcalorimetry (IMC) was evaluated compared to conventional cultures to determine clinical performance for synovial fluid aspirate samples in diagnosing periprosthetic joint infection (PJI) of hip/knee/shoulder replacements.

METHODS: We prospectively collected synovial fluid aspirate samples from 75 patients undergoing conversion or revision hip/knee/shoulder arthroplasty from August 2024 – April 2025. Cultures and IMC for each sample were compared for concordance, median time to detection (TTD) and diagnostic performance based on 2018 ICM/Parvizi criteria for hips/knees and the shoulder workgroup criteria for shoulders.

RESULTS: The 75 total patients had a sample concordance between cultures and IMC of 82%. IMC demonstrated sensitivity of 95% (77-100%), specificity 96% (88-100%), negative predictive value (NPV) 98% (89-100%), and positive predictive value (PPV) 91% (73-98%) for PJI. Cultures resulted in 64% (41-83%) sensitivity, 95% (85-99%) specificity, 87% (79-92%) NPV, and 82% (60-94%) PPV. The accuracy of IMC was 96% (89-99%) compared to 86% (76-93%) for cultures ($p < 0.001$). Median TTD of PJI by cultures was 24 (19-72) hours compared to 9 (0.5-76) hours for IMC ($p < 0.001$). Detected bacterial species include *S. aureus* (MSSA and MRSA), *S. epidermidis*, *S. lugdunensis*, *Enterobacter cloacae*, *Serratia marcescens*, group B *Streptococcus*, *P. aeruginosa*, *E. coli*, and *C. acnes*.

DISCUSSION AND CONCLUSION: Utilizing IMC for PJI detection improves TTD by 15 hours while improving diagnostic accuracy compared to cultures. Larger, multicenter studies are necessary to further validate the results of this pilot work. If these results are further validated, the use of calorimetry for detection of PJI represents a potential step forward toward pathogen detection in the up to 20% of cases that are conventional culture negative PJI, as well as dramatic improvement in time to detection over cultures that may lead to meaningful improvements in antibiotic stewardship and the ability to study the impact of time to detection PJI treatment outcomes—which are currently limited by conventional culture techniques.