Diagnosing Prosthetic Joint Infection in Total Hip Arthroplasty: A Comparison of Fluoroscopic- and Ultrasound-Guided Hip Aspiration

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INTRODUCTION:

Aspiration of total hip arthroplasty (THA) is commonly performed to assist in the diagnosis of prosthetic joint infection (PJI). Traditionally, fluoroscopy has been used in this setting and has been well studied. However, ultrasound-guided aspirations are gaining popularity due to improved safety profile and cost effectiveness. The superiority of fluoroscopy or ultrasound as the preferred imaging modality remains controversial. Our retrospective cohort study aimed to determine whether fluoroscopic- or ultrasound- guided aspiration, performed to diagnose PJI, differs in the ability to acquire synovial fluid and in accuracy of diagnosing infection.

METHODS:

All THA aspirations performed between 2014 and 2021 at our institution were identified by Current Procedural Terminology codes 20610 and 20611. Chart review was performed to verify diagnosis and collect relevant demographic information, aspiration technique, aspiration results, and intraoperative findings. Aspirations were included if they were performed under image guidance for suspicion of PJI or desire to rule out PJI prior to revision surgery. Patients with more than one aspiration were included in the study as separate data points. Aspirations were excluded if they were incorrectly coded, performed on native hips, or aborted aspiration attempts. The outcome of the aspiration was recorded as well as the volume of fluid obtained if successful. The sensitivity and specificity of hip aspiration in identifying PJI were calculated with two methods. First, we used 2018 MSIS criteria to diagnose PJI. Aspirations were positive if they had culture growth or contributed to a preoperative MSIS minor score ≥ 6. Acute PJI (<12 weeks) was excluded from analysis in the first method due to differing cell count thresholds. Second, we used intraoperative culture growth to diagnose PJI. Only aspirations with culture growth were considered positive. Dry taps and aspirations with no subsequent surgery were excluded in the second method. Analyses were performed using Student's t-test for continuous variables and chi-squared and Fisher's Exact test for categorical variables. Statistical significance was defined as $p<0.05$.

RESULTS:

A total of 425 image-guided hip aspirations were identified by CPT code. In total, 134 of these were native hip aspirations and thus excluded from our study. One patient with total hip aspiration was excluded due to failure to tolerate the aspiration. Therefore, 290 image-guided total hip aspirations were included in this study on a total of 211 patients (155 with fluoroscopic guidance and 135 with ultrasound guidance). No difference in age ($p=0.28$), sex ($p=0.47$), or BMI ($p=0.10$) were found between fluoroscopic- and ultrasound- guided cohorts. Fluid (>0.5mL) was obtained more commonly in the ultrasound cohort (69%) than the fluoroscopy cohort (56%) ($p=0.026$). When successful, more total fluid was obtained in the ultrasound-guided cohort (mean 13.1 mL vs. 9.5 mL, $p<0.03$). Using MSIS criteria to diagnose PJI, sensitivity was 0.51 for fluoroscopic- and 0.77 for ultrasound-guided aspirations ($p=0.01$), and specificity was 0.97 and 0.99, respectively ($p=0.35$). Using only culture data to diagnose PJI, sensitivity was 0.44 and 0.67, respectively ($p=0.02$), and specificity was 0.88 and 0.96, respectively ($p=0.36$).

DISCUSSION AND CONCLUSION:

Ultrasound-guided aspiration is more frequently successful and yields more fluid than fluoroscopic-guided aspiration of THA. Ultrasound-guided aspiration is more sensitive in diagnosing PJI than fluoroscopic-guided aspiration using 2018 MSIS criteria or culture data alone to diagnose THA infection. Given these findings, ultrasound should be considered the aspiration imaging modality of choice in the diagnosis of PJI of the hip.

2018 MSIS Criteria		
	Positive MSIS criteria (major or minor)	Negative MSIS criteria (major or minor)
Aspiration positive for infection	21 fluoro 24 ultrasound (TP)	3 fluoro 1 ultrasound (FP)
Aspiration negative for infection or dry tap	20 fluoro 7 ultrasound (FN)	109 fluoro 102 ultrasound (TN)
Culture Data		
	Positive OR culture	Negative OR culture
Positive aspiration culture	12 fluoro 18 ultrasound (TP)	3 fluoro 1 ultrasound (FP)
Negative aspiration culture	15 fluoro 9 ultrasound (FN)	22 fluoro 22 ultrasound (TN)

Table 1: Correlation of aspiration results and PJI diagnosis