The Diagnostic Accuracy of Spinal Wound Aspirations for Deep Surgical Site Infection Following Pediatric Spine Surgery

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INTRODUCTION: Deep surgical site infection (SSI) is a significant cause of morbidity and mortality following pediatric spine surgery. Currently, the gold standard for diagnosis of postoperative deep SSI is deep tissue culture obtained via surgical wound exploration. Aspiration of fluid from the deep wound may offer a less invasive diagnostic step that can guide the decision for surgery. Current best practice guidelines recommend wound aspiration as a helpful diagnostic tool for deep SSI; however, there currently exists limited evidence quantifying its diagnostic yield. The purpose of our study was to evaluate the accuracy of spinal wound aspirations in diagnosing postoperative deep SSI compared to the current diagnostic gold standard.

METHODS: Patients who underwent pediatric spine surgery by a single surgeon were retrospectively reviewed to identify those who underwent a deep spinal wound aspiration postoperatively. Aspiration was performed after chlorhexidine skin prep using an 18G needle inserted lateral to the wound, angling medial until it touched the metal. For patients who returned to the operating room, true infection was defined based on intraoperative tissue cultures, which were used as a reference standard. Patients whose symptoms resolved with conservative management were considered to not have a true deep SSI. Sensitivity, specificity, predictive values, and accuracy were then calculated to assess the diagnostic performance of wound aspirations overall, and between patient subgroups based on the reason for aspiration, timing, deformity etiology, and culture type.

RESULTS: 146 patients and 172 aspirations were studied, 75% of whom had undergone posterior spinal fusion (PSF). Other included pediatric spine surgeries included growth-friendly instrumentation, anterior spinal fusion, and kyphectomy. The majority of patients' primary deformity was scoliosis (76%) due to neuromuscular etiology (68%). The overall sensitivity and specificity among all included aspirations was 61.1% and 86.4%, respectively. Diagnosis of infection was accurately predicted in 78.4% of all aspirations. Although less sensitive, aspirations were highly specific among idiopathic patients (100%) and when used preoperatively before revision surgery to rule out chronic indolent infection (100%). Similarly, aspirations were 91.7% specific for infections beyond 12 weeks postoperatively but were only 55.6% sensitive for such late infections. The use of anaerobic culture testing in addition to aerobic cultures improved sensitivity and specificity by 3.2% and 2.7%, respectively (Table 1). Specifically, anaerobic cultures enhanced detection of several obligate anaerobes including Bacteroides fragilis. Parabacteroides, and Peptostreptococcus.

DISCUSSION AND CONCLUSION: Spinal wound aspirations demonstrate 61.1% sensitivity and 86.4% specificity in the diagnosis of deep SSI following pediatric spine surgery, with the highest specificity seen in idiopathic patients. The relatively low sensitivity indicates that aspirations should not be used in isolation, and surgeons should cautiously interpret a negative result in the context of the overall clinical presentation when deciding on next steps in management. The high specificity demonstrates that a positive aspiration is strongly suggestive of a true deep SSI, particularly among idiopathic patients and in ruling out chronic indolent infection. Therefore, positive aspiration in these patients likely warrants escalation to surgical management with irrigation and debridement. Given the minimal invasiveness and ease of performance, wound aspirations may serve as a valuable tool to supplement clinical decision-making.

Table 1: Diagnostic Performance b	by Patient Subgroup
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	Patients (N)	Aspirations (N)	Sensitivity	Specificity	PPV	NPV	Accuracy
	(1)	(1)					
Total	146	172	61.1%	86.4%	67.3%	82.9%	78.4%
Reason for Aspiration							
Suspicion for acute postoperative infection	136	156	63.8%	85.3%	65.2%	84.5%	78.8%
Preoperative rule out of chronic indolent infection prior to revision	16	16	42.9%	100%	100%	69.2%	75.0%
Timing							
Early (<12weeks)	122	130	63.9%	85.1%	62.2%	86.0%	79.2%
Late (>12 weeks)	31	42	55.6%	91.7%	83.3%	73.3%	76.2%
Etiology							
Idiopathic	35	37	50.0%	100%	100%	84.4%	86.5%
Neuromuscular	100	121	66.7%	82.9%	65.0%	83.9%	77.7%
Culture Type							
Aerobic	85	102	60.0%	85.1%	67.7%	80.3%	76.5%
Aerobic/Anaerobic	56	68	63.2%	87.8%	66.7%	86.0%	80.1%

PPV=Positive Predictive Value; NPV=Negative Predictive Value