

Prospective Comparison of Standard Technique, Doppler Ultrasonography, and Waveform Analysis of Pressure Transduction for Confirming Correct Intraosseous Catheter Placement

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Background: Intraosseous (IO) catheters allow rapid administration of medications to critically ill patients when intravenous access is not feasible.¹ Improperly placed IO catheters can cause delay of care and complications such as limb necrosis and osteomyelitis.² We hypothesized that a novel method using waveform analysis of a transduced IO catheter (M3) would be superior to the standard of care technique (M1) and Doppler ultrasound technique of verification (M2).

Methods: This was a single-center prospective, reviewer-blinded study. Patients ≥ 18 years old with an IO catheter placed for clinical purposes were enrolled. All IO catheters underwent the three confirmatory techniques within a 24-hour period. M1 criteria for correct placement: (1) stability of catheter; (2) ability to aspirate blood or marrow; (3) ability to flush without extravasation. M2 criteria: Doppler signal only in the IO space. M3 criteria: visualization of a pulsatile waveform by pressure transduction of the IO catheter. M3 was considered the gold standard for comparison. The data captured for M2 and M3 were stored in a secure database and were reviewed by two blinded reviewers.

Results: Forty-two IO catheters were placed among 34 subjects. The majority were placed in hemodynamically unstable patients requiring systemic access or during a cardiac arrest. 24% of catheters were misplaced. M3 identified all misplaced catheters correctly, while M1 identified only 30% (McNemar $p < 0.01$). Interrater agreement between the two blinded reviewers for M3 was substantial (κ 0.77, $p < 0.001$). M2 performed similarly to M3 (McNemar $p = 1$), however interrater agreement was inferior (κ 0.58, $p = 0.001$).

Conclusion: Waveform analysis via pressure transduction (M3) is superior to the standard of care method (M1) of confirming placement of IO catheters.