Faster Access, Faster Action? Comparing Intraosseous and Intravenous in Simulated Prehospital Traumatic Cardiac Arrest

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Introduction

Traumatic cardiac arrest (TCA) is a rare but time-critical emergency with historically poor outcomes, with survival rates at approximately 2% (1); however, more recent military data report survival rates as high as 24% when reversible causes are rapidly corrected (2). These findings challenge the long-held perception that resuscitation in TCA is futile (3) and reflect evolving advances in trauma care and damage control resuscitation (2).

TCA typically presents with pulseless electrical activity (PEA), representing a low-output state (4) rather than the complete absence of cardiac function seen in medical arrests (1). Survival depends on the prompt identification and treatment of reversible causes, prioritising interventions that restore perfusion. The HOTT approach – targeting Hypovolaemia, Oxygenation (hypoxaemia), Tension pneumothorax, and cardiac Tamponade – provides a structured, internationally recognised framework for early management of TCA (5).

Evidence suggests that external chest compressions are rarely effective unless the underlying cause is first addressed (6), supporting a shift in priorities toward correcting reversible causes before initiating compressions. Vascular access is a critical component of early resuscitation, especially for treating hypovolaemia (7). Intraosseous (IO) access is widely supported in international literature as faster and more reliable than intravenous (IV) access during cardiac arrest scenarios (8). However, in Queensland, IV remains the first-line approach, with IO reserved for paramedics with extended scope (9).

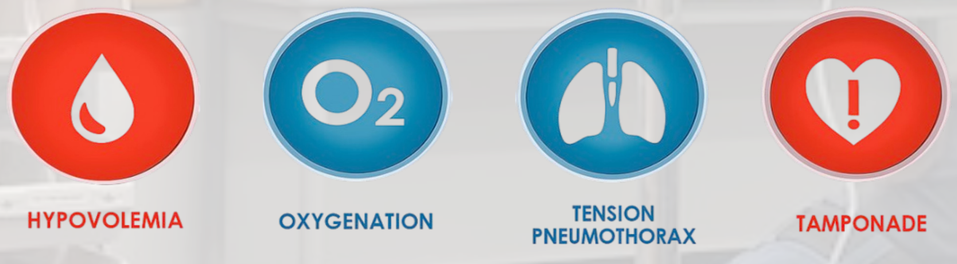

Figure 1. Line Graph Comparing Time to Interventions of Two Different Access Approaches

Aim

This study aimed to compare IO and IV access in simulated adult traumatic cardiac arrest, assessing which method enabled faster access and whether this led to earlier correction of reversible causes (HOTT) and initiation of CPR.

Methods

A prospective observational, simulation-based study compared IO and IV access in a resource-constrained, two-officer TCA scenario. Third-year paramedicine students managed an adult polytrauma patient in pulseless electrical activity. Teams completed simulations using either IO-first or IV-first access, following the HOTT sequence. before commencing CPR; scenarios concluded at return of spontaneous circulation (ROSC). Performances were video-recorded and time-stamped for vascular access, fluid initiation, HOTT completion, chest compressions, rhythm analysis, and ROSC. The primary outcome was time to vascular access; secondary outcomes were times to HOTT completion and CPR initiation.

Results

Two participants (n=2) completed one simulation video recording for each access method (IO vs IV). IO access was achieved faster than IV (3:50 vs 4:10). This allowed earlier fluid administration, with first fluids achieved at 4:45 vs 5:20, and bilateral access completed at 5:36 vs 6:40.

Earlier access translated into faster progression through subsequent resuscitation steps. Compared with IV, the IO group commenced chest compressions sooner (5:30 vs 6:05) following correction of HOTT reversible causes, delivered first ventilation earlier (6:10 vs 7:05), and reached first rhythm analysis earlier (7:30 vs 8:00). Overall, IO access produced a 40-second cumulative time advantage across critical interventions, supporting its potential to accelerate correction of reversible causes and initiation of CPR in traumatic cardiac arrest.

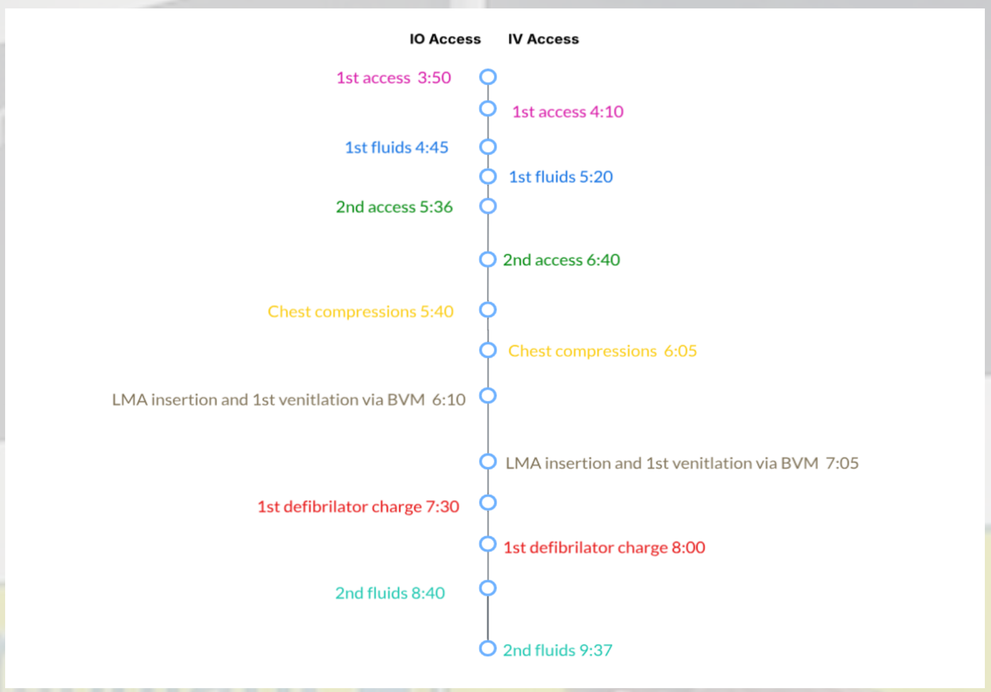

Figure 1. Timeline Comparing Time to Interventions of Two Different Access Approaches

Discussion

This study indicates that IO access provides a meaningful time advantage over IV access in simulated TCA. IO achieved faster access and earlier fluid administration, supporting existing literature that highlights its reliability in high-stress contexts (11). As survival in TCA depends on rapid correction of reversible causes (HOTT) (2, 5), earlier access may contribute to improved outcomes.

Compared with IV, IO also enabled earlier initiation of chest compressions, ventilations, and rhythm analysis. The known benefits of timely resuscitation measures underscore IO's potential to enhance efficiency (6–9). However, its current restriction to critical care paramedics in Queensland may limit these advantages (14). Expanding access warrants consideration, though introducing a new skill carries risks if not well-practised (24). IV access is often challenging in low-perfusion states due to collapsed veins (12, 25), a limitation not reflected in mannequin simulation. IO, by contrast, has higher first-attempt success under such conditions (11), suggesting its real-world advantage may be greater.

Limitations of this study include the pilot nature and small sample size, use of the same participants for both methods, and simulation design that may underestimate IV difficulty (26, 27). Although the IV approach was attempted after IO access and could have benefited from increased operator experience, early IO access still resulted in faster time to interventions, as illustrated in Figure 1. Further research with larger and more varied cohorts, both simulated and clinical, is required to validate these findings and guide decisions on optimal vascular access strategies in prehospital TCA.

References

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