ACS 2025 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

P-E-07

Research In-Progress

Opportunity for Innovation: Prehospital Needle Decompression in Tension Pneumothorax Lacks Standardization, Accuracy, and has High Failure Rates

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Introduction: Tension pneumothorax is a life-threatening condition that occurs when a lung injury causes air to leak into the pleural space, leading to air trapping that compromises both cardiac and respiratory functions. Emergent needle decompression is a critical and potentially lifesaving intervention indicated in such cases. In prehospital settings, the decision to perform emergent needle decompression is typically guided by physical examination findings. However, the rate of successful intervention remains unclear due to significant variability in the literature. Some studies estimate a failure rate as high as 80%, most commonly due to inaccurate location of the needle. There is a clear need to enhance needle decompression techniques to improve success rates and minimize complications in these prehospital settings.

Methods: A literature review identified nine studies discussing prehospital management of tension pneumothorax, needle decompression failure rates, and their causes. A competitive analysis of existing products aimed at addressing this clinical need was also conducted, along with interviewing three experienced physicians.

Preliminary Results: This review emphasized the highly variable success rate for prehospital needle decompression. Common causes of failure include incorrect placement on the chest wall, insufficient depth of needle penetration, and inadequate catheter length. The competitive analysis identified gaps in currently available products, particularly in their ability to ensure accurate placement on the chest wall and optimal insertion depth, while remaining cost-effective and user-friendly. Physician feedback also confirmed the challenges of prehospital needle decompression on patients brought to hospital trauma bays by EMS.

Next Steps: Prototyping is in progress for a disposable device that precisely controls needle insertion depth, provides real-time guidance on chest wall placement, and requires minimal training. We hypothesize that this product could significantly improve the success rate of needle decompression for life-threatening tension pneumothorax in prehospital settings.