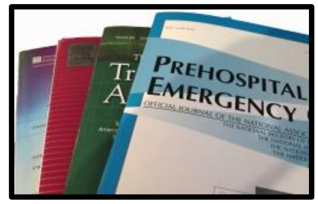
# ***International Prehospital Medicine Institute***




# IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

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1. **Prehospital Resuscitative Thoracotomy for Traumatic Cardiac Arrest.** Perkins ZB, Greenhalgh R, Avest E, et al. JAMA Surg. 2025;160:432-440

Traumatic cardiac arrest (TCA) frequently results from treatable and reversible causes, such as cardiac tamponade, severe hemorrhage, and tension pneumothorax. The time interval to intervene is very short and often missed, since TCA usually occurs in the prehospital setting. This results in a dismal survival rate for those with TCA. Resuscitative thoracotomy (RT) is a dramatic and potentially life-saving intervention for those in TCA and is typically performed on arrival to the hospital. The goals of the RT are to immediately relieve tamponade and tension pneumothorax and preserve remaining blood flow to the heart and brain by clamping the descending thoracic aorta until blood volume can be restored. Even under ideal circumstances in a well-organized trauma center, survival from RT is low and normally only seen in a small percentage of patients. The aim of this study was to review the outcomes of patients in TCA who undergo RT in the prehospital setting and analyze outcomes based on duration of cardiac arrest, underlying causes, and patient outcomes.

This was a retrospective study from the London Air Ambulance (LAA) service for the 21-year period from 1999-2019. The London Trauma System serves over 10 million people and is a regional network consisting of the LAA, the London Ambulance Service (LAS), 4 major trauma centers, and 22 smaller trauma units. The LAA began doing prehospital RT in the early 1990's to address the survival challenges of RT. Of note, the LAA is staffed by physicians trained in the procedure. The LAA's primary mission is to provide immediate life-saving care while rapidly transporting trauma patients to one of the four major trauma centers in the city. Interventions they provide include general anesthesia, blood transfusion, resuscitative balloon occlusion of the aorta (REBOA), and RT.

Over the study period, LAA treated 45,647 trauma patients, of which 3223 had TCA and 601 (1.3%) underwent prehospital RT. Their median age was 25, most (89%) were male, and most (88%) also had penetrating trauma. From the emergency call, the median time to reported TCA onset was 20 (6-22) minutes and to the advanced trauma team's arrival was 20 (16-26) minutes. On their arrival, 481 patients (80%) were already in TCA. The median time between emergency call and thoracotomy was 22 (17-29) minutes. The underlying cause of the TCA was cardiac tamponade in 105 patients (18%), exsanguination in 418 patients (70%), or a combination of both in 72 patients (12%).

Survival from TCA was significantly associated with the cause of the cardiac arrest, with tamponade having a clearly higher survival rate (21% vs 1.6% for all other causes). The duration of TCA was also associated with survival (16% for < 1 minute, 9% for 1-5 minutes, 2.6% for 5-10 minutes, and 0.8% for > 10 minutes). Survival was also associated with the initial cardiac rhythm. Pulseless electrical activity (PEA) had a significantly higher rate of survival (16%) vs asystole or agonal rhythm (1.8%). Multivariable analysis showed that the cause of TCA, duration of TCA, and the absence of the need for internal cardiac massage were all independently associated with a higher survival.

Overall, 30 patients (5%) survived to hospital discharge. Of those, 77% had a favorable neurologic outcome. Among those who had tamponade, 21% survived to discharge. There were no survivors after 15 minutes of TCA. The initial cardiac rhythm for survivors was PEA (48%), and asystole/agonal (12%). For those who died from exsanguination, only 1.9% survived to hospital discharge and there were no survivors beyond 5 minutes of TCA. All survivors were in PEA and there were no survivors whose initial rhythm was asystole or an agonal rhythm. Nobody survived TCA with a combination of tamponade and exsanguination.

This study shows that prehospital RT is feasible in a mature trauma system and offers some hope for the severely injured. There are several limitations to this study. The most obvious limitation is that the LAA is staffed by trauma physicians trained in RT, which is not the standard in U.S. systems. Additionally, the London Trauma System and its prehospital care are highly organized and advanced, often regarded as a model for the rest of the world, so their results are not applicable to most other cities. This is a retrospective collection of data over a 20-year period, during which time trauma care has evolved significantly. Results from 20 years ago are likely not applicable to today's care. Their primary penetrating mechanism is penetrating trauma from stab wound, while in the U.S. it is from gunshot wounds. The underlying kinematics of injury are quite different between the two injury patterns, so survival results may not translate to the U.S.

In conclusion, this is an interesting study from the LAA, one of the most advanced EMS agencies in the world. They demonstrate that physician-led prehospital RT for TCA is feasible. However, their results likely don't translate to the rest of the world at this point.

2. **Prehospital emergency finger thoracostomy in compensated obstructive shock: Benefits and outcomes.** Sutori D, Erdelyi LS, Uri I, et al. *Injury* 2025;56:112331 Full text available on-line at: https://doi.org/10.1016/j.injury.2025.112331

Effectively and efficiently managing chest trauma in the prehospital setting requires recognizing potential life-threatening conditions and providing the appropriate treatment. Tension pneumothorax is one of the most recognizable and treatable causes of preventable death resulting from chest trauma. Many avenues are available to decompress the chest cavity in the setting of closed chest trauma. These include simple needle decompression, emergency finger thoracostomy (EFT), and insertion of chest tubes. Each has its own advantages and disadvantages in prehospital emergency situations.

The authors of this retrospective review investigate the efficacy of EFT over a 53-month period from May 1, 2018, to November 1, 2022, utilizing records and data from the Hungarian HEMS service. The Hungarian HEMS service crew consists of a pilot, paramedic, and physician, who are equipped to utilize RSI and ultrasound during patient care. During the study period, 114 cases that met the inclusion criteria were evaluated. Inclusion criteria included:

- patients who were intubated and ventilated, aged 18 years or older,

- Had blunt chest trauma with potential pneumothorax or hemothorax,
- EFT performed on one or both sides of the chest according to the criteria and,
- Stable hemodynamics with the time window between RSI and thoracostomy defined as BP 90mm Hg, MAP > 65mm Hg, P < 140/min.

The exclusion criteria in this study included the following: Traumatic Cardiac Arrest (TCA) or uncompensated obstructive shock with macro-hemodynamic parameter changes (SBP < 90 mmHg, MAP < 65 mmHg, P > 140/ min. This includes patients with suspected tension pneumothorax who automatically qualify for EFT.

The primary endpoint of the study was whether or not EFT had any effect on physiologic parameters. They also looked at observed intrathoracic findings, including the release of air, blood, or both, on the physiologic parameters.

During the study period, a total of 114 patients met the inclusion criteria. Of these patients, 56 were identified as having a pneumothorax based on observation and the audible release of air upon EFT. Five (5) patients demonstrated having a hemothorax, and twenty-four (24) showed a combined hemo-pneumothorax. Twenty-nine (29) patients showed no signs of either a hemo- or pneumothorax. Of the groups with positive findings, Sp02 increased on average from 89.6% to 94.9% ($p<0.001$). Other vital signs showed minimal improvement after the ETF procedure. The authors stated that no complications were noted during the primary ETF procedure.

The authors noted limitations. This study, being an observational study, inherently has a significant limitation. The use of a "rule of thumb" measurement for the estimation of both hemo- and pneumothorax was noted secondary to not having imaging available. Follow-up for complications was limited, particularly for detecting late-onset issues. Additionally, the role of ultrasound in clinical decision-making could not be evaluated because of inadequate documentation.

Thoracic trauma is a significant cause of mortality in the prehospital setting. The authors of this study investigated an aggressive approach for the prevention of a simple pneumothorax progressing into a tension pneumothorax in the setting of rotor-wing transport of these patients by performing a preemptive thoracic decompression. While the study demonstrated a statistically significant increase in SpO2, it is unclear whether this was clinically significant. Due to the study design, it was not possible to determine whether those with positive findings for pneumothorax or hemothorax would have progressed into a tension pneumothorax situation and whether this would have affected the ultimate patient outcome. The authors state that it is preferable to perform EFT on stable patients as it is extremely difficult to accomplish the procedure on an immobilized patient in a helicopter during transport. Also of note is the twenty-five (25) percent of the patients who showed no air or blood in the pleural space after EFT. While the authors noted no complications, this was simply related to the procedure itself. No in-hospital follow-up or outcome was reported in the study. Providers must consider whether performing an invasive procedure on 25% of patients, with no resulting benefit, is genuinely worth the associated risks in their own practice. The use of ultrasound may be of benefit to identify these patients. Lastly, providers need to assess how a study such as this one applies in their own situation. Unlike most EMS agencies in the US, the crew configuration in this study included a physician trained in EFT.

3. **Timeline for Repeat EMS Encounters Resulting in Transport Following "Lift Assist" in a Suburban EMS System.** Dorsett M, Allen H, Garbacz H, et al. *Prehosp Emergency Care*. 2025 https://doi.org/10.1080/10903127.2025.2502459

EMS crews often use the generic "lift assist" or "public assist" call impression to close out responses for geriatric falls and other geriatric mobility issues resulting in no transport. Often times EMS crews respond to the same address and patient multiple times for the same issue. An important question is whether the initial EMS response is indicative of a sentinel event, representative of a previously undiagnosed or worsening underlying medical condition? The authors of this study evaluated return calls after a so-called "lift assist" EMS response without transport.

This is an IRB approved, retrospective chart review of repeat encounters from one calendar year (2022) involving geriatric patients (≥ 60 years of age) following an initial, no transport encounter with an EMS provider impression of "lift assist only" from an upper New York state multiple agency EMS system. This suburban, combined ALS and BLS EMS system responds to greater than 120,000 combined requests for service a year. Individual agencies are dispatched via a common communications center using commercially available Emergency Medical Dispatch software. "Lift assist" is not used as a dispatch code or reason.

There were 1,054 patient encounters with 574 of these resulting in repeat EMS visits within 7 days of the initial call. After exclusions for cases where the disposition could not be determined, there were 428 individual repeat patients accounting for 480 patient clusters. A patient cluster includes all encounters within the 7-day period. The authors classified repeat encounters into one of four categories; medical (61%), trauma (29%), lift assist only (9%) and cardiac arrest (1%).

In addition to standard patient demographics (mean age of 81), the authors looked for complete sets of vital signs (85%), abnormal vital signs and ambulation assessment documentation (42%) during the patient's first encounter. The median time for a repeat EMS encounter was just over one day (1.13) from the index encounter and 76% of all repeat encounters were transported. EMS written narratives were reviewed for all initial no transport responses and the authors felt that they all documented decision making capacity by either the patient or the patient's caregiver.

The authors were unable to find a correlation between abnormal or missing vital signs and risk of transport. They felt that this finding suggests determining which "lift assist" patients should be transported is more complex than just looking at vital signs. Diagnosis errors may include history taking, overall patient assessments, recognition of abnormal findings and bias for "lift assist" only patient complaints.

The authors feel that based on their research, subsequent EMS responses for initial lift assist calls happen often within 72 hours of the index response and result in the patient being transported to the hospital for a medical reason. Index response vital signs and ambulation assessment were not indicators of repeat responses or the need for future patient transports in their small patient sample.

This study has multiple limitations. While multi-agency in nature, it is a single system, retrospective study. The overall patient numbers are low. The authors were unable to capture combined decision making and the patient's overall willingness to be transported. It also identified at least one home hospice patient who was included in this study. The authors listed that they did not examine hospital diagnosis or outcome data on any of these patients as a limitation.

EMS providers should not be quick to dismiss geriatric falls, or mobility issues as simply "lift assist" or "public assist" calls. Pre-hospital providers should always completely assess patients. Patient assessments should include a complete history of both the event and patient's medical problems. A full set of vital signs should be taken and along with an ambulation assessment for the patient's ability and safety of remaining independent when determining if a patient is a candidate to not be transported. It is also important to determine and document the patient's capacity to refuse transport. Providers should always consider the possibility that a geriatric fall or mobility issue may be the sentinel sign of a new or worsening underlying medical condition.

4. **Artificial Intelligence Driven Prehospital ECG Interpretation for the Reduction of False Positive Emergent Cardiac Catheterization Lab Activations: A Retrospective Cohort Study.** Baker PO, Karim SR, Smith SW, et al. *Prehospital Emergency Care*, 2025;29:218-226.

Rapid re-perfusion of the coronary arteries is essential to save at risk myocardium from infarction in patients with acute coronary artery occlusion. While the history and physical can be suggestive, ECGs are the only prehospital point of care tool available to identify these patients. ST-segment Elevation Myocardial Infarction (STEMI) criteria have been the traditional method of cath lab activation. However, patients with occlusions that do not have STE may not activate the system and at least a quarter of the non-STEMI cases have an associated coronary artery occlusion. A recent meta-analysis showed that STEMI criteria are only 43% sensitive for occlusion myocardial infarction (OMI).

This was a single center retrospective cohort study comparing the Queen of Hearts (QOH) Artificial Intelligence (AI) application for diagnosis of OMI compared to the current standard of care for EMS suspected OMI. The primary outcome was to determine the number of false positives of QOH diagnosis of OMI.

EMS identified 140 cases of OMI. Of these, 23 were excluded because no ECG was available, was of poor quality, was missed identified, o was deemed indeterminate. Of the remaining 117 OMI cases identified by EMS, the CCL was activated in 68 or 58% of the patients and another 11 of these patients later had non-emergency angiograms performed. On arrival, 16 of the 49 remaining patients were taken for emergency cardiac catheterizations bringing the total to 84 or 72% of the patients. Of those cases of cath lab activation by EMS, 27were subsequently cancelled by ED clinicians. Overall, 48 or 41% of the cases met the primary outcome of OMI.

The authors note that it is a single center retrospective study with a relatively modest number of cases which is a limitation of this study. They also did not assess the sensitivity of the QOH for OMI in all patients complaining of chest pain. The dependance on clinical expertise also points to the inability to generalize their results. In comparing the results of the QOH vs. the STEMI criteria they found that the AI tool significantly reduced EMS false positive CCL activations while not missing a single OMI.

This compared favorably with strict application of STEMI criteria without the cost of false negatives or missed OMI's. The authors conclude that their study "shows the potential to greatly reduce inappropriate activations by the use of an AI app trained to diagnose OMI. The report AI software trained by experts being able to achieve 91% accuracy vs. 84% using STEMI criteria. As might be expected, this study should be repeated in other settings with a larger sample size.