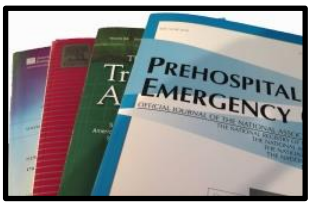
International Prehospital Medicine Institute



IPHMI EMS Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

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1. **Outcomes in Traumatic Cardiac Arrest Patients Who Underwent Advanced Life Support.** Williamson F, Lawton CF, Wullschleger M. *Emerg Med Australasia* 2023; 35: 205-212.

The outcomes for victims of traumatic cardiac arrest (TCA) have traditionally been quite dismal, with survival rates generally in the 2 – 8% range. While most experts believe these low rates result from the underlying pathophysiology (i.e, severe shock vs. a sudden dysrhythmia), others have noted that TCA accounts for only about 6% of cardiac arrest cases and, therefore, may be less likely to receive appropriate care. Males are more likely to be victims of TCA, with a median age of incidence between 30 and 40 years of age. Some previously described factors that are predictive of good outcomes for TCA include a fall mechanism (rather than motor vehicle crash), a shorter distance to the trauma center and a lower Injury Severity Score (ISS).

For this study, investigators from the large tertiary trauma center (Royal Brisbane and Women's Hospital, RBWH) in Brisbane, Australia set out to describe the incidence of, interventions for and outcomes of TCA in their mature trauma system. Their study design was a retrospective observational analysis of all adult ($\geq$ 18 years) patients who received advanced life support (ALS) for TCA in the prehospital setting or emergency department or operating room of their facility (RBWH) between January 1, 2008 and July 31, 2021. Per Utstein definitions, victims of cardiac arrest associated with drowning, hanging, electrocution, thermal injury and drug overdose were excluded from analysis. Three study populations emerged for comparative analysis: 1) prehospital TCA with return of spontaneous circulation (ROSC) on hospital arrival; 2) prehospital TCA without ROSC on hospital arrival; and 3) TCA that occurred after admission to the ED or operating room.

After identifying 156 victims of TCA, 19 met exclusion criteria (drowning, hanging, electrocution, or thermal injury), while another 26 were removed from analysis because of missing outcome data. This resulted in a study population of 101 patients, of which 84 first received ALS in the field and 17 first received ALS in hospital. Of those receiving prehospital ALS, ROSC was achieved in 56 (67%) and transport time for those with ROSC was the same as those who did not have ROSC (1:18 h vs 1:10 h). The majority of patients were male (76%) with a median age of 47 years (range 18-83). Arrival mode

was ground EMS for 83 patients, helicopter EMS for 15 and fixed wing ambulance for 3. A blunt trauma mechanism was most common in cases where ROSC was never achieved (84%). A trend toward improved survival to hospital discharge was noted when TCA occurred in the ED rather in the field (29% vs 24%).

Prehospital interventions included spinal immobilization (79%), airway management (88%, majority via endotracheal intubation), pelvic binder application (58%) and chest decompression (57%). Almost half (48%) had a prehospital focused assessment with sonography in trauma (FAST) scan performed, of which one-third were positive for free intraperitoneal fluid or pericardial fluid. A negative FAST scan was more likely to be associated with ROSC than a positive scan (25% vs 18.8%). In the prehospital setting, 29 patients received tranexamic acid (TXA). There were 25 patients who survived to hospital discharge, of which 12 were discharged home and 13 were transferred to another hospital or rehabilitation facility.

A limitation of this project was that about one-quarter of the subjects were excluded for lack of outcome data, which seems odd in that it is a single center study that includes in-hospital care. One of the interesting results of this study was that survival to discharge (25%) was notably higher than many studies involving TCA. In the US, some of the best survival rates have been demonstrated in penetrating trauma to the torso where transport time to a Level I trauma center is brief, whereas penetrating trauma accounted for only 13 patients of this cohort. In Australia, physicians frequently staff rotary wing and fixed wing air medical ambulances (unsure about ground EMS), and this may play a role with more experience in assessing and managing critically injured patients. Unfortunately, because of the retrospective nature of the study, the investigators did not have access to data regarding IV fluid administration and the use of blood products (plasma, red cells or whole blood) was not mentioned in the paper. Another notable finding was that no TCA patient in whom ROSC was not obtained in the prehospital setting survived to hospital discharge. This has potential implications regarding limiting resource utilization in the ED when a TCA victim arrives with cardiopulmonary resuscitation in progress.

While this paper is a nice description of the local outcomes of TCA from one tertiary trauma center in Australia, it was difficult to identify much that would inform the prehospital care of patients suffering TCA in the U.S.

2. Prehospital Intranasal Glucagon for Hypoglycemia. Haamid A, Christian E, Tataris K, et al. *Prehosp Emerg Care* 2023;27:356-359.

Approximately 2% of all EMS requests for service involve some type of diabetic problem. With an estimated 34,000,000 Americans already diagnosed with diabetes, and many more being diagnosed annually, diabetes related EMS responses are commonplace and often times resource intensive. Pre-hospital altered mental status is a common chief complaint. While this chief complaint can be associated with multiple medical problems such as stroke, sepsis and shock, hypoglycemia is a common cause of altered mental status and must always be ruled out.

The primary prehospital treatment for hypoglycemia has traditionally been dextrose. Dextrose can be administered via the oral route for patients that are awake enough to swallow, have a gag reflex and can maintain their own airway. IV dextrose administration, either push or by infusion, is a very common route in the patient who is unconscious or profoundly altered. This route of administration has its own inherent risks to both patients and providers. The hypertonic dextrose can cause tissue damage if the IV site is not patent or extravasates and placing the IV in an uncooperative patient can also be risky to the provider with the danger of needle stick injuries. Intramuscular glucagon is often the fallback treatment when hypoglycemic patients are too obtunded for BLS providers to administer oral dextrose or when ALS providers are unable to secure IV access.

As an alternative route for glucagon administration, some EMS protocols allow providers to administer glucagon via the intranasal route (IN glucagon). This route of administration has been studied for years in a different setting. Family members of diabetics have been taught to administer IN glucagon at home when their diabetic family member became hypoglycemic. This practice has met with mixed results. Prior to the advent of the mucosal atomizer device (MAD), the glucagon was dripped into the patient's nares often with a second agent needed to optimize absorption.

The authors of this institutional review board approved, retrospective, chart review study attempted to determine the effectiveness of MAD delivered IN glucagon, as the only treatment modality, for hypoglycemic patients over 5 years in a busy, urban EMS system.

They looked at all cases where IN glucagon was administered (153). Cases that failed to include documentation of pre- and post- IN glucagon blood sugar levels were excluded (57) as were cases that had additional or alternate treatment therapies (52). The study group consisted of 44 patients. Standard demographics for patients included within the study were also collected. Patients were predominantly male (68%), black (86%), with a median age of 55.8 years. Outcome data was provided by the prehospital providers as documented on their patient care reports. Mental status post IN glucagon was rated as "substantial improvement" (32% [14]), "slight improvement" (30% [13]) or "no improvement" (30% [17]). There were no standardized definitions given for the determinant classification.

The "substantial improvement" group had a mean pre-IN glucagon glucose level of 33.8 mg/dl and a post administration level of 87.1 mg/dl. In the "slight improvement" group, mean pre and post IN glucagon blood sugar levels were23.9 mg/dl and 53.8 mg/dl respectively. The "no improvement" group saw a minimal pre and post IN glucose changes from 30.1 md/dl to 33.1 mg/dl.

The authors acknowledged that limitations of their study included the low number of included patients. They also theorized that nasal secretions may have hindered IN glucagon absorption in some patients. IN glucagon is a reconstituted medication and it is possible that, in some cases, it may not have been properly prepared. Lastly, for glucagon to be effective, the patient receiving the medication must have adequate hepatic glycogen stores. It is feasible that some of the patients encountered may have been malnourished, suffering from chronic alcohol use or less likely, fasting or engaging in prolonged exercise; all of which lower hepatic glycogen stores.

The authors also described a relatively new IN medication on the market that that contains both glucagon and an absorption enhancer. They suggest that this may be a medication worthy of further study for the prehospital environment.

In this study, the authors felt that IN glucagon provided a clinically significant improvement in mental status and blood glucose levels in select prehospital hypoglycemic patients. IN glucagon is a potentially needleless administered drug that may be beneficial to select populations of hypoglycemic patients. IN glucagon may be considered for needleless administration in patients with documented hypoglycemia, especially in the absence of ALS providers who can gain IV access for dextrose administration.

3. Prehospital shock index predicts outcomes after prolonged transport: A multicenter rural study. Bardes JM, Price BS, Bailey H, et al. J Trauma Acute Care Surg 2023;94:525-531

Approximately 60 million Americans (19% of the population) live in a rural location and 50% of these are over an hour from a trauma center. As a result, rural trauma victims have higher mortality than urban victims with similar trauma.

Shock Index (heart rate divided by systolic blood pressure) and the change in shock index over time (DeltaSI) help predict trauma patient outcome and are associated with mortality and the need for blood transfusion. Prehospital SI has now been included in the latest version of the ACS COT field triage

guidelines. Although most of the SI data comes from urban studies, one rural study reported that "EMS SI was the most accurate predictor of hospital outcomes in a rural environment with prolonged transport times."

This study aimed to build on this prior work by looking at the use of SI and the change in SI over time across multiple rural environments. The authors conducted a retrospective review of ACS verified level I trauma centers. They looked at adult patients over the age of 18 with blunt chest or abdominal trauma with an AIS score $\geq$1 who were transported directly to a trauma center or were transferred from another hospital. They evaluated the effects of prehospital SI and Delta SI at the transferring facility as well as at the definitive care facility and looked at the need for blood product transfusion, the number of packed red blood cells, the need for surgical intervention and mortality.

The study included 789 patients, after exclusion criteria were applied. Of these, 502 patients came to the definitive care facility directly from the scene and the other 287 were transferred from other facilities. Changes in SI and hypotension were significant predictors of the need for surgery in the scene patients. They found that scene patients with hypotension had a 41.9% higher odds ratio for the need for blood than patients that did not present with hypotension. In the transfer patient group they found that changes in SI during both legs of the transport had an increase in the use of blood. An increase in the SI of 0.1 resulted in a 45.79% increase in the number of units of blood used. A change in SI of 0.1 from transfer facility to definitive care led to a 21.01% increase in the odds of needing surgery.

Limitations of this study are consistent with all retrospective studies. The lack of serial vital signs and reliable data from transferring facilities and EMS regarding interventions and fluid resuscitation were problematic. In addition, data were not available for patients that expired prior to arrival to the definitive care center this leading to the potential for survivor bias.

This study provides further support for the use of SI and Delta SI in rural trauma care. Evaluating vital signs and the values at every phase of a patient transport offers the ability to predict resource need and outcomes. Inclusion of SI in the field triage guidelines will support further research that will lead to SI and DeltaSI being a common language across EMS.

4. Paramedic educational program attrition accounts for significant loss of potential EMS workforce.
Ball M, Powell JR, Gage CB, et al. *JACEP Open* 2023;4:e12917. Full text available at: https://doi.org/10.1002/emp2.12917

Currently in the United States the shortage of paramedics (prehospital advanced care providers) has impacted the delivery of care to those who are sick or injured. As the country emerges from the impact left by the Covid-19 pandemic, many agencies along with other allied health care professions have struggled to recruit and retain qualified, well-trained providers. The authors of this retrospective analysis study reviewed the retention rate of accredited paramedic programs using data obtained from the Committee of Accreditation of Educational Programs for the EMS professions (CoAEMSP) annual program reports for students entering a paramedic program in 2019 and reported to the CoAEMSP during its mandated annual reporting period.

A total of 690 programs were identified in the CoAEMSP data set, representing 100% of accredited programs. Fifty programs were not included in the final analysis due to not enrolling students during the 2019 study period. A total of 17,457 students were enrolled in programs during 2019.

In 2019, 21% of the students enrolled in programs left prior to completion of the academic program. Failure to pass the certification exam within a 2-year window accounted for 11% who were lost from the potential workforce. One hundred thirty eight programs (22%) had retention rates that fell below the CoAEMSP benchmark of 70%. Programs with lower enrollment and greater course length had higher attrition rates. Of note however, there were 61 programs that reported a retention rate of 100%.

Limitations of the study include the 2-year certification endpoint measurement which allows remediated students more attempts and a longer time period to obtain certification, thus affecting the reporting statistic. Also noted was that the attrition measurement was self-reported by the programs and took place at no standard time during the academic process and was left up to the program to determine. Programs may have used first day of class, while others may have relied on the end of the drop-add period. Since 2021, the CoAEMSP has developed a policy better defining when attrition will be measured.

Attrition and certification rate is a concern to not only paramedic programs, but all allied health programs in the United States. A study conducted in North Carolina demonstrated only 58% of those entering an associate degree nursing program completed their degree. Many factors can influence a paramedic student's continuation in their paramedic program. Dematriculation secondary to academic failure is listed high on the reasons of why students leave a program. Further study is needed to determine the root causes of why 21% of students fail to continue in the program. Some programs have implemented pre-paramedic preparation courses to reinforce English comprehension, math and study skills prior to the actual start of the academic program. Many EMTs entering a paramedic program work either fulltime or part-time during their training as EMTs, which is different than most other allied health programs. This creates a time management issue for these students trying to juggle the work-life-school balance.

It is important to develop specific strategies to better prepare and guide paramedic students to be successful. Further studies should be aimed at determining the factors that lead to dematriculation and to develop strategies to better prepare students to be successful. Programs need to evaluate the resources that are devoted to ensuring student success, including number of faculty, duration of program and class size. Lastly, review of those programs that report 0% attrition should be undertaken to evaluate what leads to their successful retention of paramedic students.