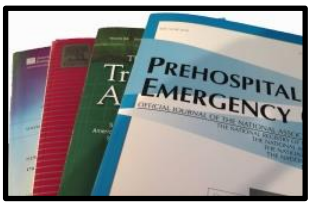
# ***International Prehospital Medicine Institute***




## IPHMI EMS Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

## Vol. 5.8

1. **Prevalence of secondary insults and outcomes of patients with traumatic brain injury intubated in the prehospital setting: a retrospective cohort study.** Butterfield M, Bodnar D, Williamson F, Parker L, Ryan G. *Emerg Med J* 2023;40:167-174.
2. **Tranexamic Acid Administration in Pediatric Trauma Patients: A Propensity-Matched Analysis of Israeli Defense Forces Registry.** Gendler S, Gelikas S, Talmy T, et al. *Ped Crit Care Med.* 2023;24(5): 1-8.
3. **Epinephrine administration in adults with out-of-hospital cardiac arrest: A comparison between intraosseous and intravenous route.** Yang S, Hsu Y, Chang Y, Chien L, Chen I, Chiang W. *Am J Emerg Med,* 2023; 67:63-69.
4. **The effects of timing of prehospital tranexamic acid on outcomes after traumatic brain injury: Subanalysis of a randomized controlled trial.** Brito AM, Schreiber MA, Haddi JE, et al. *J Trauma Acute Care Surg*. 2022;94(1): 86-92.

### 1. Prevalence of secondary insults and outcomes of patients with traumatic brain injury intubated in the prehospital setting: a retrospective cohort study. Butterfield M, Bodnar D, Williamson F, Parker L, Ryan G. *Emerg Med J* 2023;40:167-174.

Traumatic brain injury (TBI) is one of the leading causes of trauma related death and disability worldwide with almost 1 of every 1000 people sustaining a TBI every year. In addition, the deleterious effects of secondary insults (SI) are well documented and contribute to further brain injury. Because the secondary insults are preventable or quickly correctable, it is essential to reduce the incidence of SIs".

In this paper the authors sought to report on the incidence and prevalence of secondary insults (prolonged hypotension, prolonged hypoxia and hyperventilation) and the outcomes of patients with (TBI) traumatic brain injuries who underwent endotracheal intubation in the prehospital setting.

This was a retrospective study looking at adult TBI patients who underwent RSI by an urban service in south-East Queensland, Australia between January 1, 2017 and December 31, 2020. The ambulance service is staffed with critical care paramedics and physicians. In addition to airway management, they can provide hypertonic saline for signs on increased intracranial pressure. Inclusion criteria for this study included patients over the age of 16 year who had a suspected TBI and required rapid sequence intubation. Secondary insults were defined as either SpO2 less than 90% or systolic blood pressure less than 100 mm Hg for 5 or more minutes as documented by monitor trending using 5 minute recording intervals. Hyperventilation was defined as an ETCO2 less than 30 mm Hg. The primary outcome measure was 28 day mortality.

The study included 277 patients who met inclusion criteria. These patients were divided into two groups based on the presence (n= 146) or absence (n=116) of SI and missing data (n=15). Most of the episodes of hypotension and hypoxia were detected during the first patient contact on the scene. At the time of EMS arrival, sixty-six (24.3%) patients were hypotensive and eighty-seven (32.5%) were

hypoxic. Eighty (30.4%) patients had an ETCO2 less than 30 mm Hg at hospital arrival. Patients with SI had a higher mortality than those without SI (34.9% vs 14.7%). Prolonged hypoxia was an independent predictor of mortality (aOR 4.86 (95% Cl 1.65 to 15.6)) while prolonged hypotension was not (aOR 1.45 (95% Cl 0.5 to 4.25)) nor was ETCO2 <30mm hg on hospital arrival (aOR 1.28 (95% Cl 0.5 to 3.21)). Of note, 12 of 80 patients with prolonged hypoxic episodes had their

There are a number of limitations to this study. With RSI as an inclusion criteria, only the most critical patients, predisposed to SIs, were included. The retrospective design is subject to selection bias and identification of causation. Focusing on a single EMS service may limit the applicability of this study to other services and environments. The small sample of 200 may be insufficient to confirm their suspected independent risk factors and prognostic predictors. In addition, using prehospital findings rather than hospital findings, 44 patients were later determined not to have a TBI but were included in the analysis which may have confounded the results.

This study showed that the secondary insults of hypoxia and hypotension are often present in TBI patients at the time of EMS arrival. It is essential that EMS providers promptly recognize and correct these problems. While this study showed that the presence of hypoxia can affect mortality, the sample size was too small to comment on the effect the other criteria have on patient outcome, although other studies have shown a negative effect.

2. **Tranexamic Acid Administration in Pediatric Trauma Patients: A Propensity-Matched Analysis of Israeli Defense Forces Registry.** Gendler S, Gelikas S, Talmy T, et al. *Ped Crit Care Med*. 2023;24(5): 1-8.

Hemorrhage remains a leading cause of death in both adult and pediatric trauma patients. Over the last several years prehospital use of tranexamic acid (TXA) has gained increasing acceptance as a treatment option for patients with suspected hemorrhagic shock. Some studies in adult populations have shown a survival benefit with the use of TXA in hemorrhagic shock as well as demonstrating secondary benefits such as decreased blood transfusion requirements and a shorter length of hospital stay. The use of TXA in the pediatric trauma population has not been studied extensively and remains an area of uncertainty in the prehospital trauma world. This current study evaluates the use of prehospital TXA in the pediatric population and hypothesizes that prehospital TXA use was associated with a decrease in mortality for pediatric trauma patients.

The Israeli Defense Forces Medical Corps (IDF-MC) introduced a TXA clinical practice guideline (CPG) in 2011 and were among the first in the world to begin using TXA in the prehospital setting for military and civilian patients. They treat pediatric trauma patients in both military (terrorist attacks and military encounters) and civilian (falls, motor vehicle crashes, and penetrating trauma in civilian areas) settings. They maintain a trauma registry (IDF-TR) which documents relevant patient characteristics as well as mechanism of injury, vital signs, and treatment rendered.

The study evaluated all pediatric trauma patients (age < 18 years) entered into the IDF-TR between 2011 and 2021. Patients who died on-scene were excluded. Possible adverse events from TXA administration (such as seizures, rash, allergic reaction, or dyspnea) were recorded. Shock was defined hypotension or tachycardia as defined by pediatric age-related parameters. TXA was administered as an intravenous (IV) dose of 15 mg/kg, maximum dose 1000 mg). Patients with a head injury were also treated with TXA if they demonstrated signs of shock. Adult patients are treated with a single dose of 1000 mg.

A total of 911 patients met criteria for enrollment in the study. Of these, 70 patients received prehospital TXA, while 841 did not. Propensity matching was done to compare those who received TXA to a similar characteristic of patient who were not administered TXA. Propensity matching is a statistical method to create an artificial control group by matching each treated patient with a non-treated patient

of similar characteristics. The researcher can then evaluate the impact of an intervention between the groups. This research technique is especially useful when two study groups have dissimilar size, as in this study.

The median age of the study population was ten years and 49% sustained injuries in military circumstances. Penetrating injury accounted for 318 of 911 (35%) of the patients, of which 98 patients suffered penetrating trauma to the torso. A total of 118 patients (13%) were in shock. The prehospital mortality rate was 2.5%.

Those more likely to receive prehospital TXA were older, more likely to be in shock, had a lower Glasgow Coma Scale score, and more likely to have penetrating trauma as their mechanism of injury. Additionally, those receiving TXA also were more likely to undergo other prehospital interventions such as needle thoracostomy, chest tube placement, and endotracheal intubation. When comparing the two groups, the authors failed to identify an association between TXA administration and an improvement in mortality as the statistical analysis did not reach statistical significance. No adverse events such as allergic reactions and seizures were noted among the patients receiving TXA.

There are several limitations to this study. It is a retrospective review of a trauma database and not a prospective, randomized trial. The weight of the patients was not a variable recorded in the database, so the true weight of the patients could not be confirmed. This is important because 74% of the patients in this study received an adult dose. Additionally, the ideal dose of TXA for pediatric patients is not known and their dosing regimen was based on a position statement published by the U.K. Royal College of Pediatrics and Child Health. More optimal dosing regimens may be preferred. The overall sample size in this study was small. A larger study may demonstrate a survival benefit but has not yet been done.

In summary, this study does not show improved mortality following administration of TXA in pediatric trauma patients suspected of being in hemorrhagic shock. However, no adverse events were noted in those patients who did receive prehospital TXA. Further prospective large studies are warranted to continue to study this clinical issue.

3. **Epinephrine administration in adults with out-of-hospital cardiac arrest: A comparison between intraosseous and intravenous route.** Yang S, Hsu Y, Chang Y, Chien L, Chen I, Chiang W. *Am J Emerg Med,* 2023; 67:63-69.

Advanced Cardiac Life Support algorithms recommend epinephrine as the first drug to be given either via the intravenous (IV) route or intraosseous (IO) route to patients in cardiac arrest who are not responsive to electrotherapy or without a shockable rhythm. .

Many prehospital providers use IO access as an alternative route for medication administration for patients when they cannot otherwise obtain vascular access. The authors of this paper examined and compared the IV versus IO success rate for venous access, the rate of administration, and the time difference to first epinephrine administrations when given via IV versus IO.

The authors conducted a local IRB approved, retrospective study of out of hospital cardiac arrest (OHCA) EMS patient care reports within an urban EMS system. Data from OHCAs that received the first dose of epinephrine via an IV was gathered between 1 January 2020 and 31 December 2020. The data for similar IO cases was obtained from OHCAs between 1 January 2021 and 10 March 2021. Inclusion criteria were adults who received OHCA paramedic resuscitation attempts that included either IV or IO access. Exclusion criteria included patients that achieved return of spontaneous circulation before vascular access was achieved, patients less than adult age, patients that arrested enroute to the hospital, incomplete patient care reports, and patients not identified as OOHCA by the dispatcher (BLS response).

There were 141 patients with OOHCA identified during the study period of which 112 patients were enrolled after exclusions. The average patient age was 67 years and men out-numbered women, 71 to

41. There were 90 patients enrolled into the IV access portion of the study and 22 into the IO cohort. For IO access paramedics used the "EZ-IO" device and needles via a humeral approach.

First pass success rate was greater in the IO group than the IV group. It took 122 attempts to establish IV access for the 90 patients in the IV group and 24 attempts for successful IO placement in the 22 patients IO group. On average patients in the IO group received their first dose of epinephrine 90 seconds sooner than the patients in the IV group. The IO group had a higher incidence of sustained ROSC than the IV group (40.9% versus 25.6% respectively).

The authors acknowledge that limitations to their study include the small number of enrolled patients (especially in the IO group) which limited the ability to analyze long term outcome. The outbreak of COVID was a limiting factor due to the availability of resources and the changing EMS work environment. They also noted that the IO portion of the study was completed during the winter months. Seasonal temperature changes may have affected vascular access due to the presence of clothing and skin temperature issues.

OOHCA resuscitation remains a challenge for providers due the locations in which patients are found, environmental considerations, duration of time between initial arrest and first chest compression, the level and availability of responders, and the application of citizen chest compressions either with or without dispatcher coaching. Evidence such as this suggests that IO access is a fast and reliable means of establishing vascular access in the prehospital environment. Additional research needs to be done, preferably prospective, randomized and controlled, that look at long-term survival, not just ROSC in the two subgroups, IV and IO.

4. **The effects of timing of prehospital tranexamic acid on outcomes after traumatic brain injury: Subanalysis of a randomized controlled trial. Brito AM, Schreiber MA, Haddi JE, et al.** *J Trauma Acute Care Surg*. 2022;94(1): 86-92.

Traumatic brain injury (TBI) is a leading cause of death and disability around the world, yet few pharmacological advances have been made in the past several decades to improve outcomes in these patients. Tranexamic acid (TXA) has been used to control surgical bleeding in obstetric, cardiac, and orthopedic surgery. Recently it has become popularized in the trauma literature for treatment of post-traumatic hemorrhage. The CRASH-2 study demonstrated improved mortality in trauma patients given TXA within 3 hours of injury, with an even larger survival benefit noted in those receiving it within 1 hour of injury. A subgroup analysis of the CRASH-2 patients showed a trend toward decreased intracranial hemorrhage (ICH) expansion and mortality in those with TBI. The CRASH-3 trial showed improvement in head injury related mortality in patients with mild to moderate TBI, with an even greater benefit with earlier administration. However, these large studies did not include prehospital administration of TXA. Overall, data on prehospital use of TXA is limited, especially among those patients with TBI.

The prehospital TXA for TBI trial was a double-blinded, randomized trial at 20 trauma centers and 39 EMS agencies in the United States and Canada. Patients in the prehospital setting with blunt or penetrating trauma consistent with TBI, Glasgow Coma Scale (GCS) score ≤12, SBP ≥ 90 and received TXA (either a 2-gm bolus, or a 1-gm bolus followed by a 1-gm infusion over 8 hours) within 2 hours of injury were included. The study concluded that patients with TBI receiving the 2-gm bolus had an improved survival and 6-month Disability Rating Score.

The current study is a followup analysis of patients from the Prehospital TXA for TBI trial using 45 minutes from time of injury to define a "very early" cutoff group and compared those patients to patients receiving TXA later than 45 minutes (up to 2 hours) after injury. Time of injury was defined as the time EMS received the 911 call.

This study included 649 patients who met criteria. 354 patients received TXA less than 45 minutes from their time of injury and 295 patients received TXA between 45 minutes and 2 hours. There were

309 patients in the 1-gm group and 340 in the 2-gm group. Those receiving an earlier dose had a higher rate of seizures, although this did not affect their final outcome. Those receiving a later dose (after 45 minutes from injury) had higher rates of deep venous thrombosis (DVT) and cerebral vasospasm. The late-administration group had higher rates of intubation and prolonged time of transport, possibly indicating a sicker cohort. The 2-gm group had similar outcomes to the 1-gm group but maintained the higher DVT rates.

No mortality or functional improvement was noted in those who received "very early" TXA within 45 minutes of injury compared to those who received it between 45 minutes and 2 hours of injury. However, the "very early" group had a lower rate of DVT and cerebral vasospasm. The authors concluded that very early administration was better due to the lower rates of complications, even though overall outcome was no different.

This study is interesting in that is one of the first to review prehospital TXA given within 45 minutes of injury for TBI. The authors were not able to show a benefit in the very early administration but still concluded it was better since there was a lower overall complication rate. They concluded by recommending that a 2-gm dose be given within 45 minutes of injury. However, this study merely points out equivalency without showing a true benefit to either the timing of administration or the dose given. While avoiding DVT and cerebral vasospasm is always good, they were not able to demonstrate that this negatively impacted outcomes. Practice should not change because of this study.