

# International Prehospital Medicine Institute



## IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

### Vol. 5.2

- 1. An analysis of police transport in an Eastern Association for the Surgery of Trauma multicenter trial examining prehospital procedures in penetrating trauma patients.** Taghavi S, Maher Z, Goldberg AJ, et al. *J Trauma Acute Care Surg.* 2022;93(2):265-272.
- 2. Association of Prehospital Needle Decompression With Mortality Among Injured Patients Requiring Emergency Chest Decompression.** Muchnok D, Vargo A, Deeb AP, Guyette FX, Brown JB.. *JAMA Surg.* doi:10.1001/jamasurg.2022.3552 Published online August 17, 2022.
- 3. Coagulopathy Associated With Trauma. A Rapid Review for Prehospital Providers.** Friedman J, Ditzel R, Fisher AD. *J Spec Operations Med* 2022;22:110-115.
- 4. Acute Opioid Withdrawal Following Intramuscular Administration of Naloxone 1.6 mg: Prospective Out-Of-Hospital Series.** Isoardi KZ, Parker L, Harris K, Rashford S, Isbister GK. *Ann Emerg Med* 2022; 80:120-126.

- 1. An analysis of police transport in an Eastern Association for the Surgery of Trauma multicenter trial examining prehospital procedures in penetrating trauma patients.** Taghavi S, Maher Z, Goldberg AJ, et al. *J Trauma Acute Care Surg.* 2022;93(2):265-272.

Prehospital (PH) procedures, such as endotracheal intubation or administration of intravenous (IV) fluids, continue to be done for urban penetrating trauma patients despite growing evidence that they may be of minimal benefit and, in some cases, even harmful. Penetrating injuries continue to be a significant source of mortality in the United States, with over 100,000 firearm related deaths from 2017-2019. Studies have demonstrated that Advance Life Support (ALS) transport of penetrating trauma patients does not improve mortality compared to Basic Life Support (BLS) transport.

In the City of Philadelphia, police officers are mandated to transport victims of penetrating trauma to the closest trauma center. They are even allowed to transport multiple victims at once. This represents the truest form of "scoop and run" as the only prehospital intervention which may be done is tourniquet placement. The authors of this study hypothesized that police transport would not improve survival when compared with EMS transport in urban, penetrating trauma.

This study was a secondary, retrospective, multi-center analysis of a previously collected database of adult trauma patients with penetrating trauma to the torso and/or proximal extremity. Propensity scoring was used to compare similar patients who were transported by the police (PT) to those who were transported by ALS-EMS. Data collected included patient demographics, type of transport (PT vs ALS), initial vital signs and laboratory values, injury severity score (ISS), resuscitation requirements, ED procedures, hospital length of stay (LOS), intensive care unit (ICU) LOS, complications, and mortality.

A total of 1,618 patients were included. Of these, 294 (18%) arrived via PT and 1,324 by ALS. After propensity matching, the 294 PT patients were matched to similar patients in the ALS group, yielding 294 patients in each cohort for a total of 588 patients. After matching, the patient population was primarily black (n=497, 84.5%), males (n=525, 89.3%), and injured by GSW (n=494, 84%). Police

## **International Prehospital Medicine Institute**

transport patient presented with higher lactate and base deficit measurements compared with ALS-transported patients, indicating a higher state of shock and sicker patient population. The remainder of the coagulation laboratory values did not significantly differ between groups. The PT patients were more likely to undergo ED procedures compared with ALS patients (95% vs 73%). There was no difference in requirement for emergency surgery or in ED mortality (13.3% ALS vs. 11.0% PT,  $p=0.47$ ) between the two groups. Of the 68 patients who underwent resuscitative thoracotomy, a total of 2 (0.4%) survived to hospital discharge. There was no in-hospital difference in blood transfusion requirements, LOS, or mortality. Police transport was not found to improve mortality. These findings were also noted in a subset of patients considered severely injured (ISS > 15).

This large, multi-center analysis showed no mortality benefit for ALS transport for urban penetrating trauma compared to police transport (15% vs 15.6% respectively). These findings add to the growing body of literature indicating that PH procedures in his specific patient population offer no benefit. A recent study of over 3,300 penetrating trauma patients in the Pennsylvania Trauma Outcomes Study Registry also found no difference in mortality among those transported by police compared to EMS. Additional evidence suggests the reason for worse outcomes among those who receive PH procedures is not an increased scene time, as previously thought. Animal studies show that endotracheal intubation decreases venous return, thereby exacerbating malperfusion to vital organs. Intravenous fluid administration dilutes the remaining blood and coagulation factors, worsening the bleeding and “popping the clot.”

There are several limitations to this study. Prehospital transport time was not recorded in the dataset, nor was distance from injury scene to the trauma center.

This multi-center analysis adds to the growing body of literature suggesting that urban patients with penetrating trauma do not benefit from ALS care. Survival was similar between comparable cohorts of patients transported by the police and by ALS crews. Certain prehospital procedures, such as endotracheal intubation and intravenous fluid administration may be harmful. Further studies are necessary to answer this ongoing debate in prehospital trauma care.

### **2. Association of Prehospital Needle Decompression With Mortality Among Injured Patients Requiring Emergency Chest Decompression.** Muchnok D, Vargo A, Deeb AP, Guyette FX, Brown JB.. *JAMA Surg.* doi:10.1001/jamasurg.2022.3552 Published online August 17, 2022.

It is well established that trauma is a leading cause of death, particularly in younger age groups. Thoracic trauma makes up a large subset of this group. For over three decades paramedics have been trained and allowed to perform prehospital needle decompression (PND) under most trauma protocols. In recent years, the efficacy of PND has been questioned in the literature. Much of this literature was conducted in small cohorts and within a single system. The authors of this study attempt to examine the efficacy of PND in a statewide EMS and Trauma system when compared to emergent chest decompression in the hospital.

For this retrospective cohort study, the authors used the Pennsylvania Trauma Outcome Study based on data from the statewide trauma registry. The data are obtained from the forty-four (44) trauma centers located within the state. The treatment group was defined as those patients who received PND and the control group was those patients who did not receive PND but received emergent tube thoracostomy (chest tube) within 15 minutes of arrival at the trauma center. Trauma patients over the age of sixteen (16) years old were included in the study. The study excluded patients whose primary injury was burns and those were dead on arrival to the trauma center. The endpoint of the study was survival at twenty-four hours.

During the study period from January 2000 to March of 2020, of over 434,000 trauma patients in the database, a total of 8469 patients were included in the study with 1337 (11%) patients receiving PND

## **International Prehospital Medicine Institute**

prior to arrival at the trauma center. A total of 7132 patients were enrolled in the control group that did not receive PND prior to arrival at the hospital but did receive a tube thoracostomy within 15 minutes of admission. After statistical adjustments for injury severity the PND group demonstrated a 25% lower mortality (28.1% vs 37.8%) at twenty-four (24) hours.

The authors note some limitations in the study. Prehospital data collected did not indicate the anatomic location where the PND was performed and whether the decompression was single-sided or bilateral. The authors also note that since radiological imaging is not available to confirm the presence of a tension pneumothorax in the prehospital setting, a definitive diagnosis cannot be made as to the indication for PND. Conversely the authors could not determine if a pneumothorax or tension pneumothorax was confirmed by imaging prior to chest tube placement in the trauma room. Lastly the authors were unable to determine timing of vital signs and oxygen levels prior to the procedure. It was unclear from the data gathered whether the documented systolic blood pressures were pre or post PND.

While less than one (1) percent of the trauma patients required PND, the results showed a significant increase in survival at 24 hours. The low occurrence of the need for PND does not lend itself to prospective studies, however a study that provided more in-depth prehospital data would be beneficial. Other recent studies have shown failures of advanced prehospital care providers to correctly identify the correct anatomical location or to select an appropriate length needle to reach the pleural space. As with other seldom used but critically important procedures, prehospital care providers should review and train on needle decompression at least on an annual basis. Primary education programs as well should stress critical thinking skills as they relate to thoracic trauma and needle decompression in the classroom and laboratory portion of the program.

### **3. Coagulopathy Associated With Trauma. A Rapid Review for Prehospital Providers.** Friedman J, Ditzel R, Fisher AD. *J Spec Operations Med* 2022;22:110-115.

Coagulopathy remains a “poorly understood complication after trauma, however there are recognized contributors to acute traumatic coagulopathy (ATC) and trauma induced coagulopathy (TIC) that are universal”. The paper provides an overview of the physiologic processes that help induce ATC and TIC, along with the unintentional causes related to the prehospital care of these patients.

The “lethal triad” of acidosis, hypothermia, and coagulopathy results from inadequate treatment of hemorrhage. Each element of this triad exacerbates the others in a downward, lethal spiral in uncontrolled hemorrhage patients.

ATC occurs within the first 30 minutes after an injury, exacerbating hemorrhage in approximately 25% of severely injured patients. ATC is associated with depletion of coagulation factors, acidosis, the dilutional effects of crystalloid infusion, and hypothermia.

TIC includes both hypercoagulable as well as hypocoagulable conditions.

**Dilution:** Dilution of blood normally occurs as a compensatory response to hemorrhage, with interstitial fluids being drawn into the bloodstream, thus increasing volume but diluting platelets and clotting factors as much as 30%. Further dilution with crystalloid infusion exacerbates this problem. The oxygen carrying capacity of blood and the ability to form clots is diminished.

**Acidosis:** Energy production suffers in the bleeding patient leading to acidosis. Decreasing pH values impair coagulation factor activity, in fact, a decrease in pH from 7.4 to 7.2 results in a 50% decrease in clotting efficacy. This can inadvertently be made worse by prehospital infusion of crystalloids, particularly 0.9% sodium chloride solution which has a pH of 5.5. More balanced solutions such as lactated Ringers solution may minimally raise the pH but still contribute to dilution and may be infused at lower than optimal temperatures contributing to hypothermia.

## **International Prehospital Medicine Institute**

**Hypothermia:** Hypothermia, defined as core body temperature <95 F or <35 C, is an independent risk factor mortality in trauma and results from such things as the patient lying on the ground, being disrobed and not protected from heat loss as well as infusion of cold crystalloid. Hypothermia contributes to clotting factor and platelet dysfunction.

**Hypocalcemia:** Calcium is a crucial co-factor in the clotting cascade, particularly in the formation of fibrin from fibrinogen to form a clot. This becomes even more important as EMS systems begin to implement blood transfusion protocols in the field. Citrate, an anticoagulant used in blood products, affects blood calcium levels. This has caused many to consider hypocalcemia as an addition to the lethal triad.

**Consumption, dysfunction and fibrinolysis:** Normal blood clotting involves a continuous process of both creating and then dissolving clots. As a result, clotting factors, platelets and fibrinogen are consumed and over time these normal processes fail without intervention. An interesting final note on this topic is that a study from 2014 noted that patients receiving non-steroidal anti-inflammatory medications were less likely to develop TIC which implies that inflammation plays a role in development of TIC that is not yet understood.

The review also discussed endotheliopathy in which endothelial glycocalyx breaks down, acts as an anticoagulant, and increases the loss of fluid from the vascular space.

**Determining Coagulopathy:** In the prehospital setting, hypotension (systolic BP < 90mmHg) and tachycardia (HR > 100 beats per minute) are signs that accompany ATC. While there are a number of lab tests that are also potentially useful, most are not available in the field.

**Treatment:** The first step in the management of the bleeding patient is control of any compressible external hemorrhage by whatever means, equipment, and protocols allow. Tranexamic acid (TXA), a medication that interferes with the breakdown of blood clot, has been advocated as a primary pharmacological intervention if used within the first 3 hours of the time of the injury. However, TXA continues to be controversial as there are conflicting studies regarding a survival benefit. They also suggest that 1 gram of calcium chloride or 3 grams of calcium gluconate be given with all blood product administrations to combat hypocalcemia. Lastly, the current military prehospital strategy of replacing what the patient has lost with either whole blood or in a 1:1:1 ratio of red blood cells, platelets and plasma was discussed.

**Summary:** Coagulopathy is an immediate and important danger for trauma patients and this paper provides an overview of the pathology associated with the problem. While much of the testing needed to definitively identify the presence of coagulopathy is not available in the prehospital setting, a high index of suspicion along with a measured responsible resuscitation including external hemorrhage control, prevention or correction of hypothermia, and judicious fluid administration is appropriate.

#### **4. Acute Opioid Withdrawal Following Intramuscular Administration of Naloxone 1.6 mg:**

**Prospective Out-Of-Hospital Series.** Isoardi KZ, Parker L, Harris K, Rashford S, Isbister GK.  
*Ann Emerg Med* 2022; 80:120-126.

Opioid overdose (poisoning) is a frequent patient encounter in EMS systems. Opioid overdose typically presents with respiratory depression, dangerously low room air pulse oximetry readings, and patient somnolence to the point of being totally unresponsive. Most, if not all, prehospital systems have protocols in place that allow providers to administer naloxone, an opioid antagonist, to reverse the respiratory depressive effects of the opioids. Systems vary in how much naloxone can be given and by which administration route. Most protocols have an end point for naloxone administration as the return of spontaneous and adequate respirations which elevate the patient's pulse oximetry readings above a hypoxic threshold. Often time these doses surpass that end point resulting in acute opioid withdrawal and sometimes severe patient agitation and/or violence.

## **International Prehospital Medicine Institute**

The authors of this study looked exclusively at one urban Australian ambulance service's standard use of 1.6 Mg of naloxone intramuscular (IM) for opioid overdoses, defined as respiratory rate <11, room air oxygen saturation <93%. This was a 22 month, prospective, consent waived study. It is noted that while other opioids were identified as the agents of the overdose, heroin was by far the predominant opioid encountered in this system. The frequency of opioid withdrawal resulting in severe agitation was defined by their Sedation Assessment Tool. The secondary goal of the authors was to identify how many patients showed other signs of acute opioid withdrawal, tachycardia (pulse rate >100 beats/min), hypertension (systolic blood pressure >140 mm Hg systolic), vomiting, agitation, seizure, myocardial infarction, arrhythmia, or pulmonary edema.

Over the 22-month period, the Australian field providers treated 232 cases of opioid poisoning from all opioid agents. One hundred ninety-seven of these cases met inclusion criteria for this study. There were 171 unique patients with a median age of 41. Seventy percent of the patients were male. The largest number of encounters were a result of heroin overdoses (66%), followed by oxycodone (7%) and morphine (6%). Successful treatment resulted in a respiratory rate greater than 10 breaths/min and oxygen saturation greater than 92% or Glasgow Coma Scale score of 15. Seven percent of the patients (14) experienced severe agitation within one hour of receiving the 1.6 mg, IM dose of naloxone. Three of the patients with severe agitation (1.5%) required chemical sedation (1 out of hospital and 2 within the emergency room). The other eleven patients were calmed with verbal de-escalation techniques. Other signs of acute opioid withdrawal were seen in 76 patients. The most common being tachycardia (18%), mild agitation (18%) and hypertension (14%).

While 7% of the patients experienced severe agitation, the authors felt this was a relatively low number and in line with, or lower than, the results of other studies discovered in their research. The authors did point out that one of the limitations of their work is the prominence of heroin in Australia and the absence of other, often more difficult to reverse, synthetic opioids such as fentanyl.

In this Australian study, a 1.6 mg IM naloxone injection successfully reversed opioid overdoses (poisonings) in most patients without pushing patients into acute opioid withdrawal and severe agitation. This study did not account for, or investigate, alternate doses and administration routes for naloxone. The Australian providers treated predominantly heroin induced overdoses. Their patient population was naïve to the synthetic opioids, such as fentanyl, that North American providers frequently encounter when reversing opioid overdose (poisoning) with naloxone. More work needs to be done to define the best route of administration and dose of naloxone to treat the synthetic opioid overdose population emergently without inducing acute opioid withdrawal.