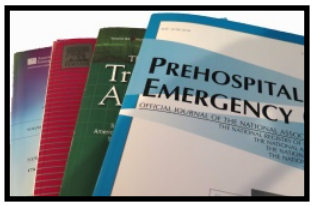
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

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1. **Permissive hypotension versus conventional resuscitation strategies in adult trauma patients with hemorrhagic shock: A systematic review and meta-analysis of randomized controlled trials.** Tran A, Yates J, Lau A, Lampron J, Matar M. J Trauma Acute Care Surg. 2018;84:802-808.
2. **Fatal Wounding Pattern and Causes of Potentially Preventable Death Following the Pulse Night Club Shooting Event.** Smith ER, Shapiro G, Sarani B. Prehosp Emerg Care 2018
3. **A tale of two cities: prehospital intubation with or without paralyzing agents for traumatic brain injury.** Bendinelli C, Ku D, Nebauer S, et al. ANZ J Surg (2018)
4. **Prehospital Plasma during Air Medical Transport in Trauma Patients at Risk for Hemorrhagic Shock.** Sperry JL, Guyette FX, Brown JB, et al. *N Engl J Med.* 2018;379:315-26.
5. **Plasma-first resuscitation to treat hemorrhagic shock during emergency ground transportation in an urban area: a randomized trial.** Moore HB, Moore EE, Chapman MP, et al. *Lancet.* 2018; 392:1-9.

1. Permissive hypotension versus conventional resuscitation strategies in adult trauma patients with hemorrhagic shock: A systematic review and meta-analysis of randomized controlled trials. Tran A, Yates J, Lau A, Lampron J, Matar M. J Trauma Acute Care Surg. 2018;84:802-808.

It was not that long ago that the standard prehospital treatment of bleeding trauma patients was to administer two liters of normal saline and run it wide open. For the last 20 years however, recommendations have been made to halt these massive infusions of IV fluids to bleeding patients. The argument is that these large infusions of crystalloid can ”pop the clot” by raising blood pressure or increase the rate of bleeding, essentially flushing the red blood cells and clotting factors out of the patients and replacing them with IV fluid.

The authors of this paper conducted a literature review identifying randomized controlled trials that compared large volume fluid resuscitations with resuscitations following permissive hypotension protocol in trauma patients. The studies, both civilian and military, included adults who sustained blunt or penetrating trauma with suspected hemorrhage. The outcome measurement was mortality in hospital or within 30 days along with blood loss volumes, utilization of blood products, and complications of either administration or restriction of fluids.

The authors found 722 publications and ultimately evaluated 1,152 patients from five randomized controlled trials that met criteria for this review. Four of the five studies documented a lower mortality with hypotensive resuscitation, however due to small sample sizes, only one of them reached the level of statistical significance. Two of the studies reported lower blood loss with hypotensive resuscitation and three trials reported fewer blood products transfused.

While the strength of this review is that only randomized studies were looked at, which should provide the highest quality evidence; the small numbers of patients in these studies create results that are underpowered.

This review suggests that there is a survival benefit, lower reported blood loss, and reduced blood product and crystalloid utilization with lower blood pressure targets compared to traditional resuscitation guidelines which return blood pressure to normal or near-normal levels. However, because the studies evaluated were underpowered and of varying quality, there is a need for higher quality and higher powered (more patients) research to be done before a specific resuscitation regimen can be agreed upon.

2. Fatal Wounding Pattern and Causes of Potentially Preventable Death Following the Pulse Night Club Shooting Event. Smith ER, Shapiro G, Sarani B. Prehosp Emerg Care 2018

The goal in responding to civilian public mass shootings (CPMS) is multi-faceted. Law Enforcement has always held the lead role in the suppression of the threat. EMS and Fire have historically been staged at an area outside of this threat zone until the scene had been made safe. This paradigm has changed in recent years through the introduction of Rescue Task Force type models. These models put EMS providers in the warm zone to provide lifesaving care to and the extrication of victims to areas of safety for further care and ultimate transport to definitive care. This study is a retrospective study that attempts to determine survivable injuries from the Pulse night club shooting by analyzing autopsy reports that were obtained by freedom of information request to the county Medical Examiner's office.

The authors reviewed all 49 deceased persons from this event. Each author independently reviewed each case to determine the potential survivability of the victims' wounds based upon receiving emergency medical care within ten (10) minutes and definitive care within sixty (60) minutes. These are the same time parameters that are generally recommended for all trauma in the developed world. The authors concluded that the fatal wound location was 41% chest/upper back, 24% head, 12% lower back, pelvis buttock and genitals, 12% neck, 8% extremity and 4% face. Sixteen of the 49 deaths (32%) were felt to be potentially preventable had care been rendered within the time parameters set in the study. The largest percentage of these patients (56%) had isolated lung injury without documented major underlying vascular injury. The authors conclude that these patients likely died either from hypoxia due to open pneumothorax or tension pneumothorax. Twenty five percent (4 of 16) of the potentially preventable fatalities classified died from exsanguination from an extremity or junctional hemorrhage. Two (2) of these were amenable to the application of a tourniquet while the remaining two were junctional and would require wound packing and or alternative techniques of bleeding control. The remainder of the victims classified as potentially survivable were either head injuries or GSW to the neck causing airway compromise.

The findings from the study of this incident demonstrate that preventable fatalities from extremity hemorrhage in the civilian setting is much lower than in the military setting. Wounds to the lungs were deemed to be the largest number of potentially survivable injuries if care was initiated in 10 minutes or less after wounding. This is in contrast to the military experience that pointed to bleeding control of extremity wounds as the largest survivable wounding pattern. This difference is most likely is due to two factors, as pointed out by the authors. The first being the use of body armor by military victims, thus providing protection to the thorax, and the second being the close proximity of the shooter to the civilian victim. In addition, all US military personnel engaged in combat are trained and equipped via Tactical Combat Casualty Care (TCCC) in the immediate self-application of a tourniquet or to a wounded comrade as well as other methods of hemorrhage control. This is currently not the case in the civilian environment. Training has begun through the American College of Surgeons Bleeding

Control Course and the Stop the Bleed campaign. The results of this study suggest that while bleeding control is important, the management of lung injuries and airway maintenance also need to be considered as a high priority.

Limitations of this study include the fact that survivability was determined by expert opinion based only upon the autopsy report from the Medical Examiner's Office. No prehospital or hospital data was obtained, and it was difficult to determine whether or not attempts at resuscitation occurred on most of these victims. A second limitation of the study was the application of time to EMS contact and time to definitive care of 10 and 60 minutes respectively. These numbers are often difficult to achieve when responding to a single GSW victim, not to mention situations with multiple victims complicated by an unstable active shooter situation. Lastly, this report describes a single incident that may or may be representative of all multiple shooting events.

The goal of expanding the continuum of care for trauma victims needs to include everyone from the citizen immediate responder to the entire public safety community and will be gradually realized with the further implementation of the Stop the Bleed Campaign and Bleeding Control Course (B-Con) by the American College of Surgeons.

3. A tale of two cities: prehospital intubation with or without paralyzing agents for traumatic brain injury. Bendinelli C, Ku D, Nebauer S, et al. ANZ J Surg (2018)

Prehospital endotracheal intubation (PETI) is a widely accepted paramedic skill. Many paramedic services have successfully adopted rapid sequence induction (RSI) drugs to facilitate PETI. The role of PETI in traumatic brain injury (TBI) is not clear. In Victoria, Australia, paramedics use RSI protocols to assist with PETI. The New South Wales, Australia, paramedics are not allowed to use RSI drugs. The authors hypothesized that RSI would increases PETI success rate in TBI patients and improve mortality.

The authors conducted a retrospective comparison study of adult TBI patients admitted to Victorian or New South Wales Trauma Centers over 3 years. Inclusion criteria included Glasgow Coma Scale (GCS) score of <9 and abbreviated injury scale head and neck of >2. Included patients were compared via univariate and logistical regression analysis to estimate odds ratio for mortality and length of intensive care unit stay. The study was approved by the Hunter New England Human Research Ethics Committee.

One hundred and ninety-two Victorian patients and ninety-one New South Wales patients were included in the study. The two groups were similar in demographics (gender, age), GCS score, prehospital hypotension, and injury severity. The Victorian paramedics (RSI) obtained PETI in 85.5 % of their patients compared to 22.2% of the New South Wales patients (No RSI). Despite the significant difference in PETI success rates, overall mortality did not differ between the two groups. Interestingly, mortality for patients with GCS score 3-5 was similar but for those patients with GCS score 6-8, mortality was higher in the RSI group (15% versus 3%) although the RSI group had a higher head/neck AIS score (5 versus 4). The incidence of prehospital and ED arrival hypoxia was similar between the two groups. However, the patients who underwent RSI had a statistically significant longer stay in the intensive care unit than the patients who did not (364 hours versus 144 hours).

While not specifically investigated in this study, low oxygen saturations may be attributed to the risk of developing hypoxia during the intervention itself which has been reported in other studies as well.

Australian paramedics using RSI protocols had a much higher success rate for PETI when treating TBI patients than paramedics without RSI protocols, however PETI success did not equate to improved mortality rates. Prehospital intubation of patients with severe traumatic brain injury remains a controversial topic with arguments and data on both sides of the debate. Paramedics treating TBI

patients should carefully weigh the patient benefit versus the risks associated with performing PETI, especially when the patient is already maintaining their own airway.

4. Prehospital Plasma during Air Medical Transport in Trauma Patients at Risk for Hemorrhagic Shock. Sperry JL, Guyette FX, Brown JB, et al. *N Engl J Med.* 2018;379:315-26.

5. Plasma-first resuscitation to treat hemorrhagic shock during emergency ground transportation in an urban area: a randomized trial. Moore HB, Moore EE, Chapman MP, et al. *Lancet.* 2018; 392:1-9.

(4 & 5 Combined Review) Optimal resuscitation of the trauma patient in hemorrhagic shock consists of minimizing the use of crystalloids such as Ringer's lactate and normal saline while transfusing blood components (packed red blood cells, plasma, and platelets). This resuscitation strategy minimizes the coagulopathy often seen in hemorrhagic shock. Lately research has focused on initiating this resuscitation in the prehospital setting, specifically the use of early plasma transfusion. Two trials were published in July 2018 examining the effect of prehospital plasma resuscitation in two environments: the aeromedical and urban. The Prehospital Air Medical Plasma (PAMPer) trial evaluated the survival benefit of plasma transfusion in trauma patients transported via helicopter. The Control of Major Bleeding After Trauma trial (COMBAT) assessed the use of prehospital plasma transfusion in an urban environment. Both studies were funded by the Department of Defense.

Inclusion criteria in both trials were similar. Eligible patients were any injured adult (age > 18) with suspected acute blood loss having at least one episode of hypotension (systolic blood pressure < 90 mmHg) and tachycardia (defined in these studies as a heart rate >108 beats per minute) or if they had any severe hypotension (systolic blood pressure < 70 mmHg) regardless of heart rate. Patients were randomized to receive either two units of thawed plasma or crystalloid along with the standard treatment. Patients in the COMBAT trial also had blood drawn on scene prior to administration of plasma or crystalloid to evaluate the presence of early coagulopathy. The primary outcome of both trials was mortality at one month.

PAMPer trial: 501 patients met all inclusion criteria and were enrolled: 230 received plasma and 271 received crystalloid placebo. 73% of patients were men, 82% had blunt trauma, and the median Injury Severity Score was 22, (with a score greater than 15 indicating severe injury). 35% also received a prehospital blood transfusion in accordance with local protocols. Surgeons performed urgent operative procedures in 58% of patients during the initial 24 hours of care. Being a helicopter trial, 111 patients were transferred from an outside emergency department but had similar demographic and injury characteristics to the 390 that were transported directly from the scene. Median prehospital transport time was 40 minutes.

The 30-day mortality was lower among patients who received thawed plasma compared to those who received standard resuscitation. Administration of prehospital plasma was associated with a 39% lower risk of death compared to those who received standard care. Mortality at 24 hours and overall in-hospital mortality was also lower in the plasma group compared to the standard group. Patients in the plasma group also received fewer units of blood components overall and fewer units of packed red blood cells within 24 hours. They also had a lower incidence of coagulopathy. There were no documented cases of significant transfusion -related complications.

COMBAT trial: 125 patients were enrolled (65 in the plasma group and 60 in the control group). The median time from injury to arrival at the hospital was 28 minutes for the plasma group and 24 minutes for the control group. Both groups had similar demographics and injury patterns. 53% were classified as severely injured (Injury Severity Score > 25) and 62% were in severe shock with a systolic blood pressure ≤ 70 mmHg. Interestingly, the early coagulopathy noted in previous studies was not

present in these patients. Also of note, patients who received plasma only had a scene time three minutes longer than those who did not receive plasma.

As is standard for any randomized trial, an interim analysis of the results was conducted by the institutional review board and FDA. The trial was stopped early because no difference in outcome was noted between the two groups. Coagulation factors, transfusion requirements, and transfusion safety outcomes were similar among the groups. The authors found no benefit to prehospital plasma transfusion in an urban setting.

Summary: These two studies are timely and relevant for the prehospital provider. Both studies were very well done. They were simple studies, meaning the medics conducted their normal care of the trauma patient with the only intervention being the transfusion of plasma in those patients who were randomized into that group. They demonstrate a survival benefit in severely injured trauma patients who received a prehospital plasma transfusion in the aeromedical setting but not in an urban environment. There are several possible reasons for these findings. An urban environment often has very short transport times with plasma and packet blood cells immediately available upon arrival to the emergency department. The findings in the COMBAT trial may not be applicable in the rural or austere environment. Additionally some believe there are better ways to identify patients in hemorrhagic shock then relying on blood pressure and heart rate parameters. What these other options are still remains to be determined. Finally, helicopter flight crews often have more experience, better equipment, and function in a more controlled environment than urban EMS providers which could explain the survival benefit in the PAMPer trial with helicopter plasma transfusion.