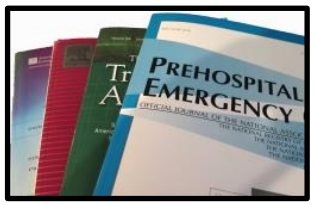
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

Vol. 4.8

1. **Assessing spinal movement during four extrication methods: a biomechanical study using healthy volunteers.** Nutbeam, T., Fenwick, R., May, B. et al. *Scand J Trauma Resusc Emerg Med* 30, 7 (2022). Open access, available at: https://doi.org/10.1186/s13049-022-00996-5
2. **Transport Terrorism: A Counter-Terrorism Medicine Analysis.** Tin D, Barten DG, De Cauwer H, Ciottone GR. *Prehosp Disaster Med* 2022;37:217-222.
3. **Distal femur versus humeral or tibial IO, access in adult out of hospital cardiac resuscitation.** Rayas E, Winckler C, Bolleter S, et al. *Resuscitation.* 2022;170:11-16.
4. **Emergency medical services shock index is the most accurate predictor of patient outcomes after blunt torso trauma.** Bardes JM, Price BS, Adjeroh DA, et al. *J Trauma Acute Care Surg.* 2022;92:499-503

1. **Assessing spinal movement during four extrication methods: a biomechanical study using healthy volunteers.** Nutbeam, T., Fenwick, R., May, B. et al. *Scand J Trauma Resusc Emerg Med* 30, 7 (2022).

Motor vehicle crashes (MVCs) are commonly seen by every emergency medical response service around the world. The trauma generated from these crashes can range from minor injuries not requiring transport to full trauma resuscitation needing aggressive and rapid interventions by the emergency medical response team. In recent years the decades old tradition of spinal immobilization using a short or long spine board combined with a cervical collar has been demonstrated to be ineffective and been discontinued in many areas of the world. Instead, selective spinal motion restriction is being applied.

The authors of this study attempt to demonstrate the amount of spinal motion during vehicle extrication using healthy volunteers. The authors identified four (4) types of extrication situations, self-extrication, roof removal extrication, B-Post rip extrication and rapid side door extrication. In all cases except for self-extrication, manual in-line stabilization was performed, a Stifneck cervical collar applied, and the volunteer extricated onto a long backboard. The goal was to identify which techniques resulted in the least movement of both the cervical spine and lumbar spine. Spine movement was determined using standard biometric measuring devices. A secondary goal was to assess the time needed for the above extrication processes. Six (6) healthy volunteers all under 100 kg participated in the study, three male and three female.

A total of 230 extrications were conducted over the course of the study. The smallest amount of spine movement occurred using self-extrication by the victim; this was also the fastest technique. The other three techniques produced similar and significantly more movement of the cervical spine with no statistical differences between them.

Limitations of this study include simulated patients receiving multiple extrications, although it was noted that there was no evidence of “learning by the roll players”. The simulated patients were uninjured and did not present with the complications of dealing with injuries that may result from a crash. Rescue teams performed multiple extrication evolutions, well beyond the normal number seen in

clinical practice on a routine basis, and rescue team fatigue during the final rotations may have affected the reported results.

The authors concluded that "Rapid, B-post rip and roof off extrication types are all associated with similar (spinal)movements and time to extrication in preprepared vehicles. In patients who can self-extricate, this should be the preferred extrication method. In patients who can't self-extricate, following disentanglement the most rapid method of extrication should be delivered".

This study provides further evidence that self-extrication, whether assisted or unassisted, is a valuable technique at the scene of motor vehicle crashes. The crash scene is a complicated and complex environment with ever changing variables that must be taken into consideration. As the authors have pointed out, self-extrication, when possible, is the quickest and most stable technique to remove a patient from a vehicle. While self-extrication works well in those patients without severe injury who are conscious and can follow commands, other techniques need to be used in a small sub-set of MVC's. This study demonstrated no statistical differences in cervical spine movement between the various techniques, other than self-extrication which had the smallest amount of movement. When self-extrication is not possible, EMS and rescue personnel should select the best and quickest techniques available that also maintain spinal motion restriction. The use of a transition device for extrication between the vehicle and stretcher needs to be defined both by local medical practice and the situation. Even though many EMS agencies have moved away from using short and long spine boards, these devices may still play a role as an intermediary device during the transfer phases of extrication and patient transport.

2. **Transport Terrorism: A Counter-Terrorism Medicine Analysis.** Tin D, Barten DG, De Cauwer H, Ciottone GR. *Prehosp Disaster Med* 2022;37:217-222.

Transportation systems have been the targets of terrorist attacks for many years. Sabotage of rail lines dates to the 1800's and continues to this day. Large cities around the world have had various types of attacks on their mass transportation systems. These attacks, on what are considered "soft" targets, usually have resulted in a large number of civilian casualties and have had long-lasting impacts, both economic and psychological, on residents.

The authors of this paper conducted a retrospective review of data gathered from the Global Terrorism Database. The search focused on attacks on Air, Land and Sea transportation systems from January 1, 1970 - December 31, 2019. Attacks on individual workers were excluded.

During the study period there were 8,729 attacks on transportation-related targets. This accounted for 5.2% of all terrorist attacks. These incidents resulted in 19,020 fatalities and 45,218 injuries. A breakdown of location revealed that South Asia had the highest level of recorded attacks at 28.4%, followed by the Middle East/North Africa at 18.2%, and South America at 19.9%. Explosives were used in 61.5% of the attacks. Suicide bombings produced the greatest number of fatal and non-fatal injuries. Busses and trains were the most commonly targeted transportation modalities and accounted for over 50% of the combined attacks. Subway attacks have proven to be particularly deadly, producing the highest number of fatalities and injuries per incident, as they typically occur in a confined space, have difficult accessibility, communication limitations, and hampered evacuation.

This study is limited by the fact that the Global Terrorism Database excludes some causes of potentially terrorist-related bombings such as war-time suicide bombings, insurgency and guerrilla attacks, and intra/inter-group conflicts.

This study is important to all first responders for both planning and response. Worldwide, busses and trains were most often targeted and, in most jurisdictions, the most vulnerable to attack. Explosive devices were the most common method of attack followed by firearms. As part of the Global War on Terrorism many attacks have been thwarted and countless injuries and deaths prevented, however,

attacks on transportation platforms continue. Prehospital care providers should plan for and anticipate attacks based on their jurisdictional vulnerabilities. Large cities often spend countless man-hours in mitigation and preparation for terrorist attacks on their transportation systems. However, most jurisdictions, even those in the smallest rural communities, have some form of mass transit. This can be a school or area transit bus or a passenger train traveling through the community. As larger cities become better at mitigation and preemption of attacks, the terrorist will seek softer targets in smaller communities. Since terrorist organizations readily adapt to changes in attack profiles, first responders need to do the same.

3. **Distal femur versus humeral or tibial IO, access in adult out of hospital cardiac resuscitation.** Rayas E, Winckler C, Bolleter S, et al. *Resuscitation*. 2022;170:11-16.

Intraosseous (IO) infusions are an effective and reliable way to administer medications in time sensitive and critical situations. The American Heart Association (AHA) recommends IO administration of medications when intravenous access cannot be easily obtained. IO has better medication absorption rates than the previously AHA recommended endotracheal route. IO's can also be used with all patient age groups, from pediatric to geriatric with a high first attempt success rate. The most common locations for IO access are the proximal tibia, proximal humerus and sternum. It makes sense that the closer the IO is placed to the heart the sooner medications and fluids can be pumped throughout the body. During cardiac arrest, sternal IO access is difficult to accomplish without unduly interrupting chest compressions. The same can be stated for the proximal humerus. To obtain the landmarks for humeral IO placement, the practitioner will typically abduct the target arm at the elbow and place it across the chest / abdomen to facilitate palpating the tubercle of the proximal humerus and the surgical neck directly below. This can also interrupt chest compressions.

In 2016, the San Antonio, Texas Fire Department (SAFD) medical director trained all providers to place distal femur IO's and included the site in the Out of Hospital Cardiac Arrest (OOHCA0 protocol. SAFD EMS protocols permit both paramedics and basic providers to place IO's for OOHCA. The IO route has become the SAFD's preferred access point for OHCA due to first pass success rate and speed of access. This study was a retrospective review of the efficacy of accessing the distal femur as an additional IO site for adult OOHCA. The choice of IO access point location is left to the discretion of the provider. SAFD EMS uses the commercially available EZ IO device.

For the 24-month period ending December 2018, there were 2,016 OOHCA in patients age 18 years or older. Pediatric patients, patients without access attempted, or patients obviously deceased on arrival of SAFD were all excluded. Sites utilized for IO access were femur (888), humerus (594), tibia (534). Selection of the femoral site increased by a factor of 2.5 times from 2017 to 2018 with a concomitant reduction in use of the humerus. Almost fifty percent of the IO's placed were performed by BLS providers, as permitted in the SAFD system protocols. Rates of dislodgement were 10% for the femoral IO, 16% for the humeral site, and 15% for the tibial location. There was no statistical difference in the amount of fluid infused among the three sites.

The authors concluded that the femoral IO site is a viable option for vascular access in adult OHCA. They also acknowledged that its use is an "off label" application for the EZIO device. While a well-documented and studied site for pediatric resuscitation, additional studies, including outcome studies, are needed to determine the long-term benefits of femoral IO access in adult OHCA

4. **Emergency medical services shock index is the most accurate predictor of patient outcomes after blunt torso trauma.** Bardes JM, Price BS, Adjeroh DA, et al. *J Trauma Acute Care Surg.* 2022;92:499-503

Shock index, defined as heart rate divided by systolic blood pressure, has been shown to be a predictor of worse outcomes and mortality in trauma patients. Additionally, the change in shock index over time (called the delta shock index, or ΔSI), has also been shown to be a predictor of injury severity and mortality in trauma. For trauma patients, the ΔSI is best measured from the prehospital transport vital signs to the vital signs on arrival at the hospital. Previous studies have focused primarily on urban populations. However, millions of Americans live over an hour transport time from definitive trauma care. In the rural trauma system, transport times are often measured not in minutes but in hours. The authors of this study hypothesized the initial EMS SI as well as the ΔSI to be predictive of mortality and blood transfusion requirements in trauma patients. This data could then be used by rural trauma systems to best triage patients to the most appropriate hospital.

This is a retrospective review of trauma patients from a Level I trauma center in West Virginia whose primary patient population is rural. The study included all adult patients who are trauma activations from blunt chest or abdominal trauma. They excluded patients with transport times less than 30 minutes, with severe head trauma, and with penetrating injuries. Additionally, patients who received blood products before arrival, inpatient transfers, and direct transfers from outside hospital operating rooms were excluded. The SI was calculated from the initial EMS vital signs (SI-EMS), transferring facilities (SI-TX), and on arrival for definitive care at the trauma center (SI-DC). The ΔSI was calculated as the difference between the initial EMS and definitive care shock indices: ΔSI = (SI-EMS) – (SI-DC). A negative value for ΔSI indicated a worsening SI over time.

A sample size of 676 patients were analyzed in the study. Of these, 549 were transported directly from the scene (81%) and 127 (19%) were transferred from another facility. The mean Injury Severity Score (ISS) was 11 for scene responses and 13 for transfers. The mean time for patients transported from the scene was 76 minutes and those routed through a transferring facility had a mean time of 367 minutes. Upon arrival to the trauma center, 9% of scene patients required blood product transfusion and 15% of transfer patients required transfusion. The mean ΔSI for patients transported directly from the scene was -0.007 and for those transferred 0.006.

The authors demonstrated SI-EMS and EMS hypotension were predictors of resource use such as blood transfusion and ICU admission. SI-EMS was the most significant predictor for blood transfusion requirement and ICU care for both scene-response patients and transferred patients. A 0.1 change in SI produced a 51% increase in the odds ratio of the need to receive a blood transfusion and a 31% increase in the number of units of blood required. This 0.1 change in SI-EMS also predicted a 14% increase in the expected days in the ICU. A negative ΔSI was a significant predictor of the need for transfusion and the number of blood products required.

This study has several limitations which should be acknowledged. This is a retrospective study and therefore constrained by the data set which was collected. There was no measurement of serial vital signs or the effect of prehospital interventions on those vital signs. There was a high percentage of missing data on prehospital fluid management, which prevented accurate analysis of the effect of EMS treatment on the shock index over time. The overall cohort of patients was not severely injured as the average ISS was less than 15 and this is the cutoff to define a severely injured patient.

In a rural trauma system, accurate predictors of the need for blood transfusion and ICU admission are important to improve patient outcome and transport the patient to the most appropriate facility. This study demonstrates that the prehospital SI as well as the worsening of the SI during transport are both predictors of the need for blood transfusion and ICU admission.