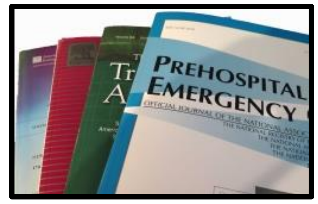
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

Vol. 1.10

1. **Prehospital tourniquet use in penetrating extremity trauma: Decreased blood transfusions and limb complications.** Smith AA, Ochoa JE, Wong S, et al. *J Trauma Acute Care Surg*. 2019;86:43-51.

The military experience with tourniquet use for extremity trauma with massive hemorrhage has been positive, with a demonstrated survival benefit if the tourniquet is placed prior to the onset of shock. Additionally, the military has shown there are a few, if any, significant long-term complications of tourniquet use. Following the publication of the Hartford Consensus statement in 2014, tourniquet use has been increasing in the prehospital and civilian setting. Additionally, the American College of Surgeons Stop the Bleed course has promulgated the teaching of tourniquet use to a widespread civilian audience.

To date, few studies have examined the efficacy of tourniquet placement in the civilian setting. Those civilian studies which have been published included large numbers of blunt trauma patients, while the military data was focused primarily on penetrating and blast injuries. Some felt the military data would not translate to the civilian world due to differences in the injury patterns. Additionally, no civilian study has compared a prehospital trauma population who received tourniquet placement to a similarly matched population which did not receive tourniquet placement.

The authors examined a single institution's experience with prehospital tourniquet placement. Patients were included in the study if they had a commercial tourniquet placed for extremity injury in the prehospital setting. Patients were excluded if they had a tourniquet placed for a non-traumatic injury or a noncommercial tourniquet device placed. The primary outcome measure was blood product utilization. Secondary outcomes included the presence of shock on arrival, limb complications related to tourniquet use, systemic complications, hospital and ICU length of stay, and in–hospital mortality. Casecontrol matching was done between patients with penetrating extremity injuries that had a commercial tourniquet placed versus those who did not.

A total of 238 patients had tourniquets placed for extremity injuries during the study period. The average age was 34.5 years, mostly male and African-American. Of the patients in the study, 74% had penetrating trauma with gunshot wound being the most common type. Most tourniquets were placed by paramedics or EMTs (68.5%), with firefighters and police officers placing 27.3%. There was no documented placement of a commercial tourniquet by a bystander during this study period although a number of improvised tourniquets were identified (13.9%) and replaced with a commercial device by rescuers.

In comparing patients with penetrating extremity trauma who had a commercial tourniquet placed to those who did not, the tourniquet group was noted to require fewer blood product transfusions (2.0 units RBCs and 1.5 units plasma versus 9.3 units RBCs and 6.2 units plasma respectively) and had a higher average systolic blood pressure on arrival to the emergency department than the non-tourniquet group (120 mmHg versus 112). Tourniquet placement was not associated with an increase in nerve palsies or secondary infection rates. Interestingly, patients who did not receive a tourniquet had a higher incidence of fasciotomy (deep leg surgical incisions to relieve pressure from compartment syndrome) and secondary amputation compared to those who received tourniquet.

This study is an important contribution to the growing body of literature supporting the civilian prehospital use of commercial tourniquets for patients with penetrating extremity trauma. Lower blood product utilization, higher systolic blood pressure on arrival, and fewer limb complications occurred in those patients who received prehospital tourniquet compared to those who did not. The old adage that application of a tourniquet should be considered only as a last resort is no longer true.

2. **Intuitive versus Algorithmic Triage.** Hart, A; Nammour, E; Mangolds, V & Broach, J. *Prehosp Disaster Med*, 2018;33(4):355-361.

EMS providers in the United States are currently taught, and most use, a structured algorithmic approach to triage at mass casualty incidents (MCI). The goal of MCI patient triage is to accurately assign a triage category within 30 to 60 seconds after each patient contact. Most of these triage systems utilize some combination of circulation, respiratory effort, and mentation as the basis to assign the triage category. Patients are commonly categorized as Immediate, Delayed, Minor, Expectant or Dead. Triage algorithms should be easy to recall and use and minimize over-triage (assigning a well patient to an urgent category) and under triage (the assignment of an ill patient to a less urgent category). Over-triage wastes resources and under-triage results in missed opportunities to use available resources for patients that urgently need them. There is no literature that demonstrates the effectiveness of algorithmic triage in real world incidents.

This study evaluated and compared the speed and accuracy of the algorithmic Simple Triage and Rapid Treatment (START) method with an "intuitive" triage method relying on the overall first impression assessment of an experienced pre-hospital provider. Adult volunteers, both patients and responders, were recruited for an active shooter MCI simulation. A clustered, randomized simulation was completed comparing START and intuitive triage. Paramedic participants were evaluated for both speed and accuracy of patient triage. Identical "mirrored" scenarios were run multiple times using a different set of randomized Massachusetts paramedic responders (START group vs Intuitive group). START is taught, practiced and the mandated EMS triage system in Massachusetts and was the control group for this study. Instructions to the "intuitive" paramedic group were: "Use your own intuition of who should be assigned what triage category, but do not use START triage."

The overall mean speed of the triage process was found to be significantly faster with intuitive triage (72.18 seconds) when compared to START (106.57 seconds). This effect was especially dramatic for Immediate (94.40 vs 138.83 seconds) and Delayed (55.99 vs 91.43 seconds) patients. In total, 84 patients were triaged. There were 17 episodes of disagreement between intuitive triage and START, with no statistical difference in the incidence of over- and under-triage between the two groups in a head-to-head comparison.

Intuitive triage was demonstrated to be faster than algorithmic (START) triage, while still providing a high degree of agreement with START between triage categories. This study may also demonstrate the importance of having high level, experienced prehospital providers complete the initial field triage at MCI events, regardless of which triage system is used.

3. **Identification of thoracic injuries by emergency medical services providers among trauma patients.** van Rein EA, Lokerman RD, van der Sluijs R, et al. *Injury.* 2018 Dec 6. In press, https://doi.org/10.1016/j.injury.2018.12.003

The thoracic body region is the second most commonly injured area of the body, second only to the head. Injuries of the thoracic region are time sensitive and have the highest mortality of any injured area of the body. In the United States, level I and II trauma centers routinely care for patients with thoracic injuries. In other countries, such as the Netherlands, these injuries are cared for in level I trauma centers. Triage protocols use two criteria to identify thoracic injury: 1) penetrating trauma to the chest, and 2) flail chest. Many thoracic injuries are difficult to identify as these injuries often do not affect vital signs or have obvious external findings. As many as 40 to 45% of severe thoracic injuries are missed by the prehospital provider, regardless of whether the provider is a paramedic or physician (as in many European EMS systems).

This is a multicenter study from the central Netherlands over a two-year period. They have one level I Trauma Center, which is equipped to care for patients with a severe thoracic injury, and nine level II or III trauma centers which are not equipped to handle severe thoracic injuries. All trauma patients age 16 years and over transported with the highest priority (lights and sirens) to a trauma center in this region were included in the study. By analyzing where prehospital providers transported these injured patients, the authors are able to deduce the accuracy of prehospital triage of thoracic injuries. The authors reviewed the ambulance reports to see if the medics suspected a thoracic injury. These were then compared to the patient charts from the hospital to confirm if a thoracic injury was present.

A total of 2766 patients were included in this study, of which 465 were diagnosed with a thoracic injury. The mean age was 49 years and 58% were male. EMS providers were able to identify 55% of all patients with thoracic injury (52% of those with a mild or moderate thoracic injury and 65% of the patients with a severe thoracic injury). Overall EMS providers missed 45% patients with a thoracic injury. Prehospital predictors of a severe thoracic injury included age, male gender, oxygen saturation, respiratory rate, Glasgow Coma Scale, fall > 2 m, pedestrian struck by a car that impact speed > 10 km/hr (6 mi/hr), and entrapment in the vehicle.

There were a few limitations to this study. If a trauma patient was transported to a hospital outside of the study region, they were excluded which could influence the reported results. The paramedic identification of thoracic injury was performed in retrospect based on review of the prehospital record which often did not describe the suspected severity of the injury.

This study confirms earlier data revealing the difficulty of prehospital triage identifying thoracic injuries. Identification of a thoracic injury is difficult as most patients have near-normal vital signs and lack of obvious external injury findings. Unless the patient has obvious penetrating trauma or a flail chest, their injury may not be obvious. This study illustrates weaknesses in our trauma triage protocols and additional criteria may be necessary to identify those patients with a thoracic injury.

4. **Impact of Bystander Automated External Defibrillator Use on Survival and Functional Outcomes in Shockable Observed Public Cardiac Arrests.** Pollack RA, Brown SP, Rea T. et al. *Circulation.* 2018;137:2104–2113

This study sought to determine the survival and functional outcomes of patients with shockable observed public out-of-hospital cardiac arrest (SOP-OHCA) treated by bystanders using automated external defibrillators.

This study utilized out-of-hospital cardiac arrest (OHCA) data collected prospectively from nine regional Resuscitation Outcomes Consortium centers from 2011 to 2015. OHCA was defined as an incident in which cardiopulmonary resuscitation (CPR) was performed by EMS or defibrillation was attempted by EMS or a bystander. Patients included in the study were at least 18 years of age with non-traumatic arrest.

During the study period, a total of 49,555 cardiac arrests were identified, of which 4,115 took place in public and were observed. Of the observed public cardiac arrests, 2,589 presented with an initial shockable rhythm. Eighty-nine patients were excluded for do-not-resuscitate orders, patient dead on EMS arrival, missing data, or confirmed shockable rhythms that were not shocked by EMS or a bystander. The study cohort included 469 patients who were shocked by a bystander and 2,031 SOP-OHCA patients who were initially shocked by EMS for a combined total of 2,500 patients. Favorable functional outcomes using a modified Rankin Score and survivability to discharge were assessed from the patient's medical records.

Patients treated with initial bystander AED shock had functionally favorable survival that was greater (57.1%) than that of EMS delivered initial shock (32.7%). The biggest favorable outcome advantage between patients who received an initial bystander AED shock when compared to patients who received their initial AED shock from EMS appeared when comparing the patient groups with no identified subsequent disabilities (32.6% versus 14.4% respectively). Overall survival to hospital discharge was 66.5% for patients who received their initial shock from a bystander compared to 43.0% for patients who received their initial shock from EMS. In those cases of shockable arrest that were unwitnessed, there was no survival benefit of bystander shock in comparison with EMS delivered shock. In shockable arrest occurring in private locations there was a significant survival benefit when the arrest was observed by a bystander. As should be expected, survival for those victims treated by primary EMS shock declined as the EMS response time increased.

Several limitations were observed during this study. Functional outcome was based on the medical record at the time of discharge therefore any changes that emerged following hospital discharge could not be captured. The study was observational, thus the study could not determine if the survival advantage of bystander AED shock is solely the result of this action. Because the EMS systems involved in this study are also involved in different clinical trials, the EMS systems may be higher performing, so the results of this study may not be generalizable. Finally, this study could not determine if the quality of the EMS care provided affected the potential survival effects of bystander AED use.

This study demonstrated that survival with a favorable neurological outcome for patients who experience an out-of-hospital cardiac arrest with a shockable rhythm is greatest when an electrical shock can be delivered by bystander use of an AED as soon as possible following the arrest. The longer a patient is in cardiac arrest with a shockable rhythm before receiving an electrical shock the less chance of surviving with a favorable outcome. The healthcare community should continue to support the placement of public assess AEDs and the education of non-medical individuals in the use of an AED, along with CPR.