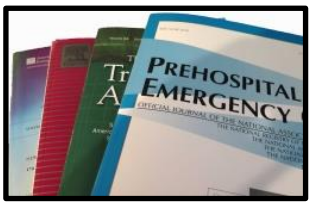
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

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1. Impact of time and distance on outcomes following tourniquet use in civilian and military settings: a scoping review.

Joarder M, El Moussaoui HN, Das, A, et al. *Injury* 2023;54:1236-1245

In the past two decades, the use of arterial tourniquets has reemerged as a key intervention to control significant hemorrhage in the prehospital environment. Prior to this, tourniquets were considered only in extreme circumstances when all other options, including direct pressure, elevation of the extremity and compression on pressure points had failed. EMS students were often taught to improvise a tourniquet from a triangular bandage and a heavy dowel or stick, as there were virtually no commercially available devices. The early experience from the wars in Iraq and Afghanistan demonstrated the effectiveness of manufactured tourniquets for controlling hemorrhage on the battlefield, and soon manufactured tourniquets made their way into civilian EMS. In most military situations, injured warriors are quickly evacuated to a medical facility capable of addressing vascular injuries. While much of civilian EMS care occurs in an urban or suburban setting with relatively short transport times to surgical intervention, some severe injuries occur in a rural or frontier environment where transport to definitive care is delayed by hours. Because little is known to guide the use of tourniquets in these situations, this study was designed to address these gaps in our understanding of prolonged tourniquet usage.

For this analysis, Joarder and colleagues conducted a scoping review of appropriate literature. While a *systematic review* summarizes the medical literature on a specific topic using clearly defined and reproducible methods to search for articles, critically analyze them and summarize the data, a *scoping review* strives to synthesize a larger and more diverse body of literature. The primary research question the authors attempted to answer was "what is the effect of time and distance on metabolic complications and hemorrhage control following tourniquet use in civilian and military settings?" Inclusion criteria for studies required meeting all the following criteria: patients of any age who had a

tourniquet applied following acute limb trauma where the mechanism of injury was described; improvised or commercial tourniquets applied for any duration of time or distance; studies conducted in both civilian and military settings and in any geographic location; full text articles published in peer reviewed journals; and original research including controlled trials, case series and case reports. Studies were excluded if the tourniquet was placed in a hospital location other than the emergency department, or if published only as an abstract or letter, or on a website. After removing duplicate studies, the first two authors individually screened articles to see if inclusion criteria were met, while two additional reviewers resolved any discrepancies. The investigators then abstracted the data once the final eligibility was determined.

A total of 86 articles were included in the review, comprised of 31 case reports, 13 case series, 38 retrospective observational studies and 4 prospective observational studies. No controlled studies were identified in the literature search. These studies included tourniquet application on 12,286 patients, with 55 studies involving civilian settings, 32 studies in military settings and one study that included both settings. The majority of military studies were from experiences in the Middle East, while the most common setting for the civilian studies was North America. In the military articles, blast injury was the most common mechanism of injury, followed by penetrating trauma. For the civilian studies, penetrating trauma was the most common mechanism of injury, followed by blunt trauma, but also included were animal bites and blast injury. Distance, prehospital time or tourniquet time was documented in 66 studies, including 51 studies with a mean tourniquet time of 2 hours or less, 4 studies with a time of 2 to 4 hours and 10 studies with more than 4 hours. Effectiveness of tourniquet placement was noted in only 38 studies. Limb salvage data could be obtained from 59 studies. While the overall limb salvage rates was 69.6%, the limb salvage rate trended downward with increasing ischemia time (< 2 hours, 83.1%; 2 – 4 hours, 81.3%; and > 4 hours, 57.1%). While 44 articles documented the presence of arterial injuries and three documented isolated venous injuries, 39 studies failed to document sufficient information regarding presence or absence of vascular injury.

Mortality data was obtained from 74 studies involving 9108 patients. Overall mortality was 6.7%. Interestingly, the lowest mortality rate (3.0%) was in the group with 2 – 4 hrs of ischemic time, followed by those in the < 2 hours group (5.2%) and then those in the > 4 hour group (7.1%). Metabolic outcomes were reported in only 28 of the 86 studies and no study included all the metabolic parameters deemed important by the investigators. Information on removal of tourniquets was available for 639 patients from 27 studies. The most common location of removal were emergency departments (131) and operating rooms (60), although 276 tourniquets were documented as removed with no location identified.

Despite the authors identifying more than 85 articles that met inclusion criteria, data regarding patients with a tourniquet/ischemia time > 2 hours was limited, primarily from case series and case reports. The investigators note that although many studies included information about limb salvage rates, there was little information regarding the justification for amputations, such as a mangled extremity, failure of revascularization or complication of tourniquet use, etc. Some patients sustained traumatic amputations prior to any medical intervention, further clouding this issue.

The primary strength of the study is its rigorous scoping review methodology and inclusion of 86 publications representing over 12,000 tourniquet applications. The authors identified limitations of the review including the heterogeneity of the articles and inconsistent inclusion of key data points, as well as noting that the quality of the evidence was not assessed due to the study design. Unfortunately, there is little uncovered by this analysis that could contribute to guideline development for management of tourniquets in prolonged transport settings. However, the review highlights the need for a standardized approach to studying tourniquet application so that all important parameters can be captured, allowing for a more informed analysis.

2. A Comparative Analysis of Tranexamic Acid Dosing Strategies in Traumatic Major Hemorrhage.
Gunn F, Stevenson R, Almuwallad A, et al. *J Trauma Acute Care Surg* 2023;published on-line, ahead of print. DOI: 10.1097/TA.0000000000004177

Tranexamic acid (TXA) is commonly used as a treatment adjunct for severe hemorrhage, both in the in-hospital and pre-hospital settings. Patients with major bleeding are at risk for development of acute traumatic coagulopathy (ATC). A significant part of ATC is the development of hyperfibrinolysis, or the excessive breakdown of clot, which the body is trying to form to stop bleeding at the tissue level. TXA is an anti-fibrinolytic drug given in one of several dosing regimens by prehospital personnel or upon arrival at the receiving hospital.

The traditional dose for TXA is 1 gm administered intravenously (IV) followed by another 1 gm dose over an 8-hour infusion. This can prove challenging during a prolonged resuscitation, particularly when patients are undergoing multiple life-saving interventions. More recent dosing strategies which have been studied include a single 1 gm or 2 gm bolus without the infusion. Theoretical benefits to these bolus doses without the infusion is that it is easier on prehospital and trauma team personnel to administer since the bolus can be labor intensive during resuscitation.

This study compared clinical outcomes of the various dosing regimens: a 1 gm bolus followed by a 1 gm infusion over 8 hours, 1 gm bolus without the infusion, and 2 gm bolus without the infusion. The authors hypothesize that the use of bolus-only dosing was not associated with a higher mortality, adverse events (specifically embolic), coagulopathy, or fibrinolysis.

This study was a single-center observational study done at a single urban Level 1 trauma center in London. TXA is administered as part of their major hemorrhage protocol (MHP)and is administered by the prehospital paramedics and physicians as well as at the trauma center. This protocol evolved during the study period but is activated when a trauma patient presents hypotensive (systolic blood pressure < 90 mmHg) with suspected active hemorrhage. TXA is given as part of the resuscitation, which also includes blood transfusion and measurement of the coagulation profile.

A total of 525 patients were included in the study. The three dosing groups were: 1 gm bolus followed by infusion (n=80), 1 gm bolus (n=317), and 2 gm bolus (n=128). The demographics of the patients were similar. There were more females who received the bolus plus infusion, but this did not appear to alter the final results. Similarly, patients in this group were more severely injured.

There was no s difference in 28-day mortality between the groups (21% in all groups). The secondary outcome of 24-hour mortality was also not significantly different. Since this study was done over 11 years, the temporal trend over time was analyzed and there was no difference in 28-day mortality in the year-by-year analysis. There was a trend toward a higher multi-organ disfunction in the early years of the study (when the bolus plus infusion regimen was more commonly used). No difference in thromboembolic events was noted between the dosing regimens.

Limitations of this study include its retrospective nature. Additionally, it was a single-center experience, and the results may not translate to other trauma systems.

The authors found no significant difference in mortality or adverse clinical events between the three dosing regimens of TXA. There was also no difference in fibrinolytic activity between the groups. Their data suggest that a single bolus dose of TXA is equivalent, if not preferable, to the bolus plus infusion dosing. This has significant implications for prehospital and trauma team personnel, who face challenges administering the infusion dose. The single bolus dose appears to be just as effective without any additional side effects.

3. **A Retrospective Nationwide Comparison of the iGel and King Laryngeal Tube Supraglottic Airways for Out-of-Hospital Cardiac Arrest Resuscitation**. Smida T, Menegazzi J, Crowe R, Scheidler J, Salcido D, Bardes J. *Prehosp Emerg Care* 2023 Published on line doi: 10.1080/10903127.2023.2169422.

Various options for managing the airway in the prehospital setting are available to EMTs and paramedics. While intubation has been the traditional method of airway control, supraglottic airways appear to be as good or possibly better while having fewer complications. While individual studies have compared endotracheal intubation to a particular supraglottic device, this study sought to compare two supraglottic devices to each other in patients with out-of-hospital cardiac arrest (OOHCA).

The authors compared the King LT and iGel supraglottic airway devices. This is a retrospective study that used the 2018-2021 ESO Data Collaborative Public Use Research Datasets. Inclusion criteria were all non-traumatic OOHCA who had King LT or iGel inserted by EMS providers.

The outcome measures evaluated were survival to discharge to home, first pass success, return of spontaneous circulation (ROSC), and repeat prehospital arrest.

A total of 286,192 OHCA patients were assessed for eligibility and 93,866 patients were eligible for the study after exclusion criteria were applied. Patients were treated by 1,613 EMS agencies across the Unites States. Of the 93,866 patients identified, 49,203 were transported to Emergency Departments. Disposition information was available for 9,456 patients. Of those patients transported to the hospital, 84.5% died after arrival at the hospital, 7.4% were discharged to home or self-care, 4.4% were discharged to hospice, 3% were discharged to skilled nursing facilities, and 0.7% were discharged to long-term acute care.

iGel supraglottic airways were placed into 54,189 (57.7%) of patients compared to the King LT airway which was inserted into 39,677 (42.3%) patients. Of the two devices, the iGel device was used less often than the King LT following failed endotracheal intubation attempts (12.6% vs 22.4%). The iGel was associated with a 36% greater odds of survival to discharge home, 94% greater odds of successful first attempt placement, 19% greater odds of ROSC and 27% lower odds or repeat prehospital arrest.

The limitations of this study include the fact that is a retrospective study which limits their conclusions to association and they encouraged caution when interpreting their results. The number of patients that could not be included because of missing data was also a limitation with only 20% of the patients transported to the hospital having linked disposition data. In addition, the King LT airway was used more often after failed endotracheal intubation attempts which could have affected the ROSC data.

In their conclusion, they re-stated that the iGel "was associated overall with better outcomes compared to the use of the King LT." Further they pointed out that the "iGel was associated with significantly higher odds of achieving the primary outcome than the King when used as a rescue device but not when used as primary airway management device." Unfortunately, a direct head-to-head comparison in a randomized trial is needed to truly determine if one of these devices is, in fact, superior to the other.

4. **Predictors of Non-Transport for Older Adult EMS Patients Encountered for Falls**. Joiner A, Fernandez A, Van Vleet L, et al. *Prehosp Emerg Care* 2023;27:859-865

Twenty five percent of older adult Americans reported having at least one fall during the past year. During that year roughly twenty percent of all requests for EMS for older adults (age greater than 65 years) were for falls. Approximately twenty percent of EMS responses for falls result in a patient refusal. Slip and falls from or to ground level can be benign in nature with patients only requiring assistance back

on to their feet or to a chair. However, studies have shown that twenty percent of adults not transported after a fall result in a hospitalization, and often a second EMS response, within 7 days.

The authors of this study attempted to determine if there are there common characteristics or underlying conditions amongst that twenty percent group that eventually require hospitalization that could help identify them for earlier intervention by mobile integrated healthcare providers or the first responding EMS providers insisting on transport that could curtail further injuries or the need for later hospitalization.

The authors of this paper looked at one year's de-identified data (1/01/2019 – 12/31/2019) captured across the United States by a single nation-wide EMS data reporting system (ESO). Exclusion criteria for this adult-only study included age equal to or greater than 60 years, falls that originated higher than ground level, falls at health care facilities, falls at congregate living facilities, patients in cardiac arrests and drownings. This retrospective data review was approved by the Institution Review Boards at St. David's Health Care and at Duke University Medical Center.

Data points examined included basic demographics, age, sex, ethnicity, and urban or rural locations. Clinical data included vital signs (heart rate, blood pressure and Glasgow Coma Scale), Rapid Emergency Medicine Score (REMS) and who requested EMS for the patient. A higher REMS score is predictive of higher nonsurgical mortality. Fewer than half the included EMS reports had a documented blood sugar resulting in the exclusion of that data point.

In 2019 the ESO database contained data on 6,780,966 EMS responses. During the study period there were 195,204 9-1-1 calls for falls. Of these, 27,563 patients (14.1%) were not transported Females accounted for 57% of the no transports and 63% of the transports. Median REMS scores for all non-transports were 6 and 7 for patients that were transported. Roughly 29% of non-transports were from locations outside of the patient's home. Patients were more likely to refuse transport when EMS was requested by someone other than a family member. Overall, the older the patient, the more likely they were to refuse transport to a hospital after a fall. In addition, higher no-transport rates were noted for males as well as Hispanic/Latino fall victims

Limitations of this study include the retrospective nature of the study. Variations in EMS protocols may have accounted for different thresholds for permitted non-transports. Varying definitions and documentation requirements for "lift assists" and "no transport / refusal" calls may have also skewed data collection and provider reporting. Lastly, there was no way for the authors to determine if there were, or the number of repeated responses to the same patient experiencing multiple falls over multiple days.

This is a paper was based on data from a multi-agency, national database. EMS agencies should consider a similar examination of their own datasets from their patient care reporting systems. This may help to identify vulnerable patient populations within their community. Based on the data these authors presented, older persons who experience falls are more likely to refuse transport. It seems reasonable to expect that the older the patient the more likely they are to be fragile and have comorbidities resulting in subsequent calls for assistance and requiring later hospitalization. EMS protocols for patient refusals should account for patient age and the possibility of referral to community programs aimed at fall reduction and follow up care.