**** IPHMI Literature Review ****

Keeping You Up To Date with Current EMS Literature and Studies

Vol. 1.12

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2. **Prehospital Blood Product Administration Opportunities in Ground Transport ALS EMS –A Descriptive Study. Mix, F; Zielinski, M; Myers, L; et al. *Prehosp Disaster Med*, 2018;33(3):230-236.**
3. **Is Use of Warning Lights and Sirens Associated With Increased Risk of Ambulance Crashes? A Contemporary Analysis Using National EMS Information System (NEMSIS) Data. Watanabe BL, Patterson GS, Kempema JM, et al. *Ann Emerg Med* Article in Press, published on-line, https://doi.org/10.1016/j.annemergmed.2018.09.032**
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The current recommendations for severely injured trauma patients with hemodynamic instability and non-compressible hemorrhage include limited fluid resuscitation, permissive hypotension, rapid transport to the nearest appropriate trauma center, and now often recommend early administration of tranexamic acid (TXA),. Data from previous studies suggest TXA is most beneficial if given within three hours of injury, which makes its use in the prehospital setting especially relevant. Other data suggest TXA is not beneficial and may in fact increased complications such as deep venous thrombosis (DVT) or pulmonary embolism (PE).

This is a retrospective study conducted in Qatar of all adult trauma patients receiving prehospital TXA. Qatar EMS is staffed by critical-care paramedics and Emergency Medical Technicians. TXA was given to all adult trauma patients with ongoing significant hemorrhage who were in shock (systolic blood pressure < 90 mmHg and/or heart rate > 110 beats per minute), or considered to be at risk of significant hemorrhage, and who are within the three hour window of injury. Patients who met these criteria but did not receive prehospital TXA and required a blood transfusion were used as the control group to compare against those patients who met criteria and did received prehospital TXA.

During the study period, 204 patients were identified and matched into similar groups based on patient characteristics and injury severity - 102 patients received prehospital TXA while a similar group of 102 patients did not receive prehospital TXA. The median injury severity score was 22 and median serum lactate was 3.4 mmol/l, indicating the cohort was moderately injured and at least in a mild state of shock. However the median hemoglobin was 11.8 g/dl which shows many patients were not severely bleeding. Massive transfusion, defined as 10 or more units of red blood cells (PRBC) given over a 24-hour period or >40 ml/kg PRBC given in two hours or less, was required in 29% of the patients. The median number of PRBC transfused was five units.

The results of the study show that those patients who received prehospital TXA had a lower need for massive transfusion than the control group. In-hospital mortality was slightly better in the group that received TXA but did not reach statistical significance. Additionally, the group that received TXA had a slightly higher incidence of a venous thromboembolic event, such as a DVT or PE, but this also did not reach statistical significance. Approximately 50% of all patients required early operations, indicating they were severely injured. Among those who did require surgery, the requirement for blood transfusion was lower in those patients who received prehospital TXA compared to the control group.

There are some limitations to this study which limit its usefulness. It is a retrospective study with a matched cohort of patients who did not receive TXA. This limits the ability to fully draw any conclusions as patients were not randomized to treatment and the care providers were not blinded to the treatment being given. A criticism of the CRASH-2 trial is that only 50% of the patients received a blood transfusion, indicating the results may be skewed due to the high number of patients enrolled who were not truly critically injured. In this study, 37% of TXA patients did not receive a blood transfusion, which is also relatively high. Additionally the median initial hemoglobin was 11.8, which is normal, and information about the coagulation status of the patients was not provided.

In summary, this study demonstrates that prehospital TXA administration was associated with less in-hospital blood transfusions compared to a control group who did not receive prehospital TXA. However, it did not demonstrate an improvement in survival. The definitive role of TXA in prehospital trauma care requires additional, larger clinical trials.

1. **Prehospital Blood Product Administration Opportunities in Ground Transport ALS EMS –A Descriptive Study.** Mix F, Zielinski M, Myers L, et al. *Prehosp Disaster Med*, 2018;33(3):230-236.

Traumatic injury is the number one cause of death for individuals aged 1-44 years and the fourth leading cause of death overall, with uncontrolled hemorrhage being the major cause of preventable death. It has been estimated that hemorrhage accounts for approximately one third of civilian prehospital trauma deaths and 40.0% of deaths in the first day post-injury. In 2005, the concept of damage control resuscitation (DCR) was introduced which includes resuscitation with balanced blood product administration. Nearly 25% OF HEMS in the United States carry blood products including the MCMT service.

This retrospective chart review study looked at trauma patients transported by the Mayo Clinic Medical Transport (MCMT; Rochester, Minnesota USA) prehospital care system, including ground (Gold Cross Ambulance Service) and helicopter (HEMS - Mayo One) assets to determine if trauma patients benefit from blood product administration by ground ALS ambulances. Calls for service between January 1, 2011 through December 31, 2015 were reviewed. Inclusion criteria were: calls involving scene transport for acute traumatic injury, emergent dispatch request, patient age 18 years or older at time of patient contact, and predetermined physiological and/or mechanistic criteria. The physiological (hemodynamic [HD]) criteria were a heart rate (HR) ≥120 beats per minute and/or systolic blood pressure (SBP) ≤ 90 mmHg; the mechanistic criterion was penetrating trauma. Individual patient care reports were reviewed for all cases and those with minor mechanisms of injury were excluded. Cases meeting inclusion criteria were linked to their hospital charts for outcome data.

Fifty-one of 7,900 ground transport patients satisfied the inclusion criteria and had a known outcome. Of these 51 patients, 17 received blood product transfusions in the ED as part of the initial resuscitation. Patients meeting HR and SBP criteria were most likely to receive blood products in the ED (53.3%). In all, 74 of 753 HEMS patients met HD and mechanistic criteria for blood product administration of which 28 (40%) received blood during transport. There was a trend to increasing blood product use as physiologic severity increased, with 60.0% of patients meeting both HR and SBP parameters receiving transfusion, however this was not statistically significant. The mean transport times were slightly longer in the HEMS group (4.9 minutes). Overall, less than one percent (0.7%) of the ground ALS transports and 10.1% of the HEMS transports identified in the study met criteria for blood product administration. In this single site study population, HD parameters alone appear to overestimate the need for transfusion and did not predict subsequent ED blood product administration for trauma patients transported by ground ambulance.

As acknowledged by the authors, the complex logistical and regulatory requirements involved in blood product storage and administration limit the utility of blood product administration within the described ground system. They do recognize that some ALS ground transport systems have begun using blood products in the field but that each EMS system is unique and should be viewed as such. One possible development that may significantly simplify the use of prehospital blood product administration is the future availability of freeze-dried plasma.

1. **Is Use of Warning Lights and Sirens Associated With Increased Risk of Ambulance Crashes? A Contemporary Analysis Using National EMS Information System (NEMSIS) Data.** Watanabe BL, Patterson GS, Kempema JM, et al. *Ann Emerg Med* Article in Press, published on-line, https://doi.org/10.1016/j.annemergmed.2018.09.032

This study was undertaken to provide a contemporary, nationwide comparison of reported crash rates for US ambulances responding to or transporting patients from a 911 emergency scene with or without lights and sirens.

This is a retrospective study that analyzed data from the 2016 National EMS Information System (NEMSIS) which included nearly 30 million EMS activations from 9,993 EMS agencies servicing 49 states and US territories. Primary analysis included all dispatches of a transport-capable ground EMS ambulance to a 9-1-1 emergency scene. Response to the scene and transport from the scene were evaluated separately as some responses did not result in transport. Interfacility transfers, intercepts, medical transports, standbys, responses by non-transport, rescue vehicles, mutual aid activations, supervisor responses, or transports by fixed-wing or rotor-wing air medical services were not included. Reported crash-related delays were used as a proxy measure of an ambulance crash, recognizing that minor crashes that did not result in a reported delay would go unaccounted for. The results were grouped into 2 major categories: response without use lights and sirens (No L&S) and response with use of lights and sirens, which was further subdivided into response with any use of lights and sirens to include partial usage during response (Any L&S) and full use of lights and sirens throughout the response (Full L&S).

The 2016 NEMSIS data set included 20,465,856 dispatches of a transport-capable ground EMS vehicle to a 9-1-1 scene. Lights and sirens data were available for 19,040,095 of the scene responses (93%). A crash-related delay occurred in 1,000 of the responses (5.3 per 100,000 responses). The crash rate for 9-1-1 scene response with use of lights and sirens (Any L&S / Full L&S) was greater than the crash rate for 9-1-1 scene response without use of lights and sirens (5.4 vs 5.5 vs 4.6 per 100,000 responses).

OF the 19,040,095 responses to a scene, there were 14,549,776 subsequent patient transports. Lights and sirens data were available for 13,892,345 of the 9-1-1 scene transports (95%). Crash-related delays occurred in 1,289 transports (9.3 per 100,000 transports).

The crash rate for 9-1-1 scene transport with use of lights and sirens (Any L&S / Full L&S) was greater than the crash rate for 9-1-1 scene transport without use of lights and sirens (17.1 vs 16.5 vs 7.0 per 100,000 transports).

 Several limitations were identified during this study. The analysis of NEMSIS information relies on the accuracy and completeness of submitted data elements. There may be inconsistencies in how lights and sirens use or crash-related delays are reported. Also, NEMSIS does not include minor crashes that did not result in delay of response or transport. Confounding factors such as weather, traffic conditions, lighting conditions, or travel distance cannot be accounted for.

This study used data from the NEMSIS repository that contained the largest amount of response and transport data and from the largest number of multiple agencies in multiple locations and response areas. Using this larger data set provided a more comprehensive and valid analysis. This study demonstrated that the use of lights and sirens during response to 9-1-1 scenes and subsequent transport from the 9-1-1 scene clearly resulted in a higher incident of crash-related delays compared to response and transport without use of lights and sirens. In addition, when comparing the response phase data and analysis to the transport phase data and analysis, the number of crash-related delays was significantly higher in the latter, which is surprising given that only 23% of transports occur using lights and sirens compared to 77% of responses to the scene. Because of this reported difference, contributing factors need to be studied. One theory is that during the response phase there are usually two individuals in the front of the vehicle and both persons are watching for hazardous situations. During the transport phase there is typically only one person in the front of the vehicle controlling the driving and communications and could possibly be distracted more by the acuity of the patient and the need to get the patient to the receiving facility.

While this study of crash-related delays involving emergency vehicles clearly identifies a higher rate of crashes when using lights and sirens both in the response and transport phases compared to not using any lights and sirens, most importantly, this study does not answer the question: Does the use of lights and sirens truly provide a patient benefit that outweighs the risk? Bottom line, the use of lights and sirens during either the response phase or during the transport phase comes with an increased risk of being involved in a crash.

1. **Emergency Medical Services Experience With Barb Removal After Taser Use By Law Enforcement: A Descriptive National Study.** El Sayed M, El Tawil, Tamim H, et al. *Prehosp Disaster Med* 2019;34:38-45.

Conducted electrical weapons (CEWs) are increasingly used by law enforcement officers to control unruly suspected criminals or to neutralize violent situations as a non-lethal weapon alternative to use of a firearm. CEWs utilize two methods of deployment depending on the device: the “drive stun” mode that works by direct contact with the subject and the “probe mode” that fires two probes from the weapon. The “Thomas A. Swift Electric Rifle” or TASER uses the latter method and is the most widely available device. It is estimated that there are more than 140,000 TASERs in use by law enforcement officers in the US and an additional 100,000 TASERs owned by civilians worldwide. The TASER fires two metal barbs, which once embedded in the individual’s skin, deliver high voltage, low current shocks via 19 electrical pulses per second over a five-second period causing involuntary muscle contractions, pain, and non-lethal incapacitation. Little has been reported about the experiences of EMS providers following the discharge of a TASER and the assessment and treatment of the victim to include barb removal.

This was a retrospective study using 5 consecutive years (2011-2015) of National Emergency Medical Services Information System (NEMSIS) data from 48 US states and territories with information from 114,142,520 EMS activations. The study reviewed 648 EMS activations with confirmed TASER use and where the TASER barbs were removed by EMS.

The prevalence of EMS responding to events where a TASER was discharged and the EMS provider removed the TASER barbs was relatively small but increased over the study period from 4.55 per 1,000,000 activations in 2011 to 6.2 per 1,000,000 activations in 2015. There were no reported barriers to patient care in most TASER activations. Male patients outnumbered female patients 4:1. The provider’s common primary impression was traumatic injury (66.3%) or behavioral/psychiatric disorder (16.8%). In addition to TASER barb removal procedures performed by EMS providers included assessment (47.2%), venous access (21.8%), and cardiac monitor (21.5%). IV fluids were the most common medications administered (12.1%) followed by oxygen (8.3%) and narcotic pain medications (8.2%). Few patients (4.2%) required additional physical restraints or chemical restraints (2.5%). Over one-half of the activations (56.3%) resulted in transportation of the patient mainly to a hospital (91.2%). In 14% of the activations the patient was treated and transported by law enforcement. This rate may under-estimate the actual rate of TASER use since this study only reported those activations where the TASER barbs were removed by EMS providers. Standard operating procedures of different law enforcement agencies may also have affected this rate. Some agencies allow officers to remove TASER barbs themselves without calling EMS. Other agencies require officers to transport all affected individuals to a hospital for barb removal and EMS activation is requested only for life-threating conditions or when medical care is required on-scene. Additionally, most law enforcement agencies that use TASERs require medical assessment in the emergency department prior to barb removal for barbs embedded in sensitive body areas such as the face. There was one death reported in this study that may or may not have been related to the CEW.

Limitations identified in the study include the fact that using NEMSIS data from multiple states and territories and information submitted to the data base varies in reporting compliance and completeness. Only incidents where TASER barbs were removed by EMS providers were included in the review, thus patients who underwent barb removal at a hospital were likely not to have been captured.

The documented incidents where EMS was activated following TASER discharge for removal of TASER barbs are extremely rare. Currently most EMS protocols require leaving TASER barbs in-place if embedded in sensitive areas such as the eye, hands, feet, or genitalia. Based on the limited data available it appears removal of TASER barbs by EMS providers, when appropriate, poses no additional risk to the patient. EMS providers should be familiar with local policies and procedures related to TASER use as well as with other non-lethal weapons that may be utilized by law enforcement.