**** IPHMI Literature Review ****

Keeping You Up To Date with Current EMS Literature and Studies

V. 1.6

1. **Tourniquet usage in prehospital care and resuscitation of pediatric trauma patients - Pediatric Trauma Society position statement.** Cunningham A, Auerbach M, Cicero M, and Jafri M. *J Trauma Acute Care Surg.* 2018;85: 665-667.
2. **Can they stop the bleed? Evaluation of tourniquet application by individuals with varying levels of prior self-reported training.** McCart JC, Caterson EJ, Chaudhary MA, et al. Injury, the International Journal of the Care of the Injured. September 2018 (article in press)
3. **Revisiting Traumatic Cardiac Arrest: Should CPR be initiated**? Konesky KL, Guo1 WA. European J Trauma Emerg Surg. 2017 (epub ahead of print)
4. **Implementation of a Clinical Bundle to Reduce Out-of-Hospital Peri-intubation Hypoxia.** Jarvis JL, Gonzales J, Johns D, BS, Sager L. Ann Emerg Med. 2018;72:272-279
5. **Tourniquet usage in prehospital care and resuscitation of pediatric trauma patients - Pediatric Trauma Society position statement.** Cunningham A, Auerbach M, Cicero M, and Jafri M. *J Trauma Acute Care Surg.* 2018;85: 665-667.

Public preparedness for mass casualty incidents has increased significantly following many recent tragedies. In September 2015 the American College of Surgeons convened the Hartford Consensus group to develop “common sense recommendations” for “strengthening the security and resilience of US citizens” following mass casualty events. The “Stop the Bleed” initiative was developed from this group to teach basic hemorrhage control techniques to the public. As of now there is no mention of hemorrhage control in the pediatric population.

The Pediatric Trauma Society (PTS) conducted a literature review of pediatric tourniquet utilization using the US National Library of Medicine National Institutes of Health (PubMed) database. A total of 18 studies were evaluated by a group of four physician members of the PTS Guidelines Committee.

Six articles were reviewed from the combat experience in Iraq and Afghanistan. These studies demonstrated the use of commercially available tourniquets was effective not only in soldiers but also in pediatric combat casualties. Interestingly, adult- sized tourniquets were used effectively on pediatric patients without increased complications. The use of tourniquets was effective in controlling hemorrhage and in decreasing mortality in children in the combat setting. Pediatric survival rates were similar to that seen in adult literature. Tourniquet use increased survival by 92% over no tourniquet use and an additional 13% when applied in the prehospital setting over waiting until arrival to the emergency department. A study of 766 pediatric patients older than 8 years of age noted reduced resuscitation requirements from tourniquet use, most notably a decrease in blood transfusion and crystalloid requirements. Additional studies noted in-hospital tourniquet complications occur in 0.4% to 1.4% of all elective surgical uses. The most common complications resulted in soft-tissue injury (31%) or nerve damage (21%). This is similar to that noted in the adult tourniquet literature.

The PTS supports the use of prehospital tourniquets in children suffering exsanguinating hemorrhage from severe extremity trauma. They recommend direct pressure as a first step to control hemorrhage, with tourniquet placement indicated in those situations where direct pressure does not work. They also specifically note the risk of death from exsanguinating hemorrhage outweighs any slight complications which could occur from tourniquet use.

1. **Can they stop the bleed? Evaluation of tourniquet application by individuals with varying levels of prior self-reported training.** McCart JC, Caterson EJ, Chaudhary MA, et al. Injury, the International Journal of the Care of the Injured. September 2018 (article in press)

Uncontrolled hemorrhage accounts for up to 64% of preventable trauma deaths. The US Military focused their training on hemorrhage control enabling them to decrease deaths due to uncontrolled hemorrhage by 63%. As a result of the military success in improving survival, there are now numerous courses that teach bleeding control techniques (i.e. “Stop the Bleed”) to civilians in the hope that armed with this knowledge and training, they will act as immediate responders in the event of significant external hemorrhage after someone sustains an injury.

The Public Access and Tourniquet Training Study (PATTS) trial was a prospective randomized trial that identified skill decay in civilians trained in bleeding control, with only 54% of the participants being able to demonstrate the skills they learned three to nine months after the course. In this study, the authors decided to do a subset analysis of the PATTS trial to determine whether various levels of self-reported prior training influenced correct application of tourniquets by civilians. They also hoped to determine how willing these civilians would be to assist when they come upon someone needing their attention.

For this study, participants in the PATTS trial were divided in into three groups based upon prior training as follows: (1) No prior training, (2) First Aid training only, or (3) First Aid and Hemorrhage Control training. All of the participants were employees of a major sports stadium and the study took place over five months. Of the 562 participants in the PATTS trial, 317 met the criteria for inclusion in this study. Participants with prior bleeding control training were excluded.

In comparing participants with no prior training to those with First Aid training, there was no statistical difference in their ability to correctly apply a tourniquet, 14% versus 25.2%. Those who had first aid and hemorrhage control training did better with 36% being able to correctly apply tourniquets. In addition, those with first aid and hemorrhage control training were more willing to assist than either of the other two groups. The authors concluded that prior hemorrhage control training is correlated with increased odds of correct tourniquet application and willingness to provide assistance.

This study shows that hemorrhage control training improves both correct application of a tourniquet and willingness to act. Unfortunately, without formal bleeding control education and training, the success rate is rather low. Clearly, much work remains if the pool of immediate responders is to be expanded and adequately educated in the various techniques of external hemorrhage control and the survival of trauma victims improved.

1. **Revisiting Traumatic Cardiac Arrest: Should CPR be initiated**? Konesky KL, Guo1 WA. European J Trauma Emerg Surg. 2017 (epub ahead of print)

Traumatic cardiac arrest (TCA) is encountered frequently in the normal delivery of EMS and Emergency Department care. Overwhelming literature, as well as position papers from the American College of Surgeons and the National Association of EMS Physicians, has suggested that resuscitation from TCA is futile, consumes a large amount of resources, and produces few patients surviving to discharge from the hospital. This study attempts to determine the incidence, predictors of CPR failure, and outcomes following TCA.

This study is a retrospective study conducted over a 5-year period from July 2010 to June 2014. The study population included 124 adult trauma patients with blunt (56.6%) or penetrating (44.4%) injury who sustained TCA either on the scene, en route to, or in the Emergency Department of a Level 1 Trauma Center. Excluded from the study were those victims under the age of eighteen (18) years, hangings, and patients with severe burns. The most common presenting rhythms encountered were pulseless electrical activity (PEA, 55%) and asystole (34%) with ventricular dysrhythmias and sinus tachycardia (8.9% and 2.4% respectively) also noted. The study found that there were no statistical differences in mortality rates between these four groups. The study also pointed to statistically equal survival rates between blunt and penetrating trauma patients. Thirty-nine patients (31.4%) had ROSC, however only nine (9) (6.5%) survived to discharge with complete neurological recovery. The study pointed to a higher survival rate after CPR in the blunt trauma subgroup with the mechanism of injury from falls vs. motor vehicle-related trauma. In the penetrating trauma group, higher survival was noted with wounds to the head, neck and extremities vs. the torso. The most common procedures noted by the authors were transfusion (49) and tube thoracostomy (24). Statistically significant predictors of mortality were prolonged field time (injury to ED arrival) and injury severity score greater than 15 (which is not determined in the field). The authors note the limitations of the study included data from only one trauma center and the study period being over the transition time period of the American Heart Association implementation of the 2010 CPR guidelines focusing on chest compressions over ventilation. The authors concluded that based on these results, CPR should be initiated on all trauma patients who have, in the past, had historically dismal outcomes.

The results and recommendations of this study are in contrast to numerous other studies that point to the futility of CPR in TCA. There are however a number of some short comings from an EMS perspective. The study did not report the EMS protocols for initiation or termination of resuscitation efforts on the scene. Only those victims that were transported to the trauma center were included in the study. This could easily introduce bias if EMS could select those patients who would be transported and those who would be pronounced on the scene. No data was presented with reference to prehospital procedures performed prior to arrival at the ED or the protocols that the prehospital providers followed for traumatic cardiac arrest, thus limiting the applicability and generalizability to other EMS systems. This study does however point to the need to conduct more comprehensive studies on prehospital CPR on the TCA patient and better define the criteria for initiating and terminating resuscitation efforts on these victims.

1. **Implementation of a Clinical Bundle to Reduce Out-of-Hospital Peri-intubation Hypoxia.** Jarvis JL, Gonzales J, Johns D, BS, Sager L. Ann Emerg Med. 2018;72:272-279

Prehospital rapid sequence intubation (RSI) is a controversial procedure. Peri-intubation hypoxia is a known complication of this procedure that is associated with poor patient outcomes. This study evaluated whether a disciplined approach to prehospital rapid sequence intubation employing a clinical bundle encompassing positioning, apneic oxygenation and delayed sequence intubation reduces peri-intubation hypoxia.

The authors report the results of a before and after study in suburban, central Texas involving a single EMS service. The study population included adults only who were undergoing prehospital intubation, excluding patients in cardiac arrest. Group 1 (before) period patients were intubated using standard RSI with apneic oxygenation at flush flow, ketamine, and a paralytic. The group 2 (after) patients were intubated using a strict, disciplined care bundle including patient positioning (elevated head, sniffing position), apneic oxygenation, delayed sequence intubation (administration of ketamine to facilitate patient relaxation and preoxygenation with a delayed administration of paralytics), and goal directed preoxygenation of greater than or equal to a SpO2 of 94%. If at any time the patient’s SpO2 dropped below 94%, the RSI was abandoned, adjustments were initiated, and the patient was ventilated for 3 minutes (or longer) with a bag mask valve device with or without the insertion of a supraglottic device until the oxygen saturation once again reached 94%.

The before group (October 2, 2013, to December 13, 2015) included 104 patients and the after group (August 8, 2015, to July 14, 2017) included 87 patients. The demographics of both groups were similar in sex, age, weight, ethnicity, rate of trauma, initial oxygen saturation, rates of initial hypoxia, peri-intubation peak SpO2, pre-intubation pulse rate and systolic blood pressure, peri-intubation cardiac arrest, and first-pass and overall success rates. The after group experienced less peri-intubation hypoxia (44.2% versus 3.5%) and higher peri-intubation lowest SpO2 values (100% versus 93%). The authors concluded that, in this single EMS system, a care bundle encompassing patient positioning, apneic oxygenation, delayed sequence intubation, and goal-directed preoxygenation was associated with lower rates of peri-intubation hypoxia than standard out-of-hospital rapid sequence intubation.

While a randomized, controlled study is needed to validate these results, EMS agencies and systems that include rapid sequence intubation as an option for airway management should consider employing a disciplined care bundle approach to the procedure encompassing patient positioning, apneic oxygenation, delayed sequence intubation, and goal-directed preoxygenation for reducing peri-intubation hypoxemia and minimizing associated complications.