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IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

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- 1. Evaluation of the efficacy of commercial and noncommercial tourniquets for extremity hemorrhage control in a perfused cadaver model.** Cremonini C, Nee N, Demarest M, et al. *J Trauma Acute Care Surg* 2021;90:522-526

Tourniquets applied as soon as possible to limbs with life-threatening external hemorrhage save lives. This has been proven both in the military and civilian settings. While many police, fire, and EMS personnel have immediate access to this life-saving tool, the general public often does not. Efforts to train civilians in the use of commercial tourniquets have been undertaken worldwide and tourniquets or bleeding control kits have been placed in areas of public gatherings. However, the question arises of what to do if a commercially available tourniquet is not available? The authors of this study attempt to determine if non-commercial tourniquets are a viable option to control external hemorrhage in situations where commercial tourniquets are not available.

The authors conducted a prospective study using a perfused cadaver model with bleeding from a standardized superficial femoral artery wound. The authors selected 3 commercial tourniquets (CAT, RAT, SWAT) and 2 improvised tourniquets (leather belt and a windless made from a commercial triangular bandage with wooden windless) to evaluate. Forty-eight (48) medical students without prior hemorrhage control experience were selected for the study. The participants were given a standardized training in tourniquet application and a demonstration of all five (5) of the tourniquets and allowed to practice once on each other prior to application on the cadaver. The participants were then asked to apply the tourniquets to the cadaver in a randomized order determined by an online randomizer.

All forty-eight (48) candidates were able to apply and abate the hemorrhage using the two improvised devices. Of the commercial devices, two (2) candidates were unable to stop the hemorrhage using the RATS tourniquet within the allotted time period of four (4) minutes. The belt was the quickest to apply and resulted in the least amount of blood loss. However, the authors noted that the belt needed the continuous application of pressure to maintain control of the bleeding, which could prove difficult if required for any significant length of time. The windlass was the second fastest and resulted

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in the second least blood loss. The commercial tourniquets followed closely behind. The participants rated the SWAT-T as the most difficult to use, followed closely by the RATS.

The authors noted that the use of medical students with an understanding of underlying anatomy was a limitation of the study.

In numerous studies, tourniquets have been demonstrated to save lives. Clearly in the military where all service members are trained in their application and issued an approved tourniquet, the use and application of a tourniquet has revolutionized the prehospital care of life-threatening limb hemorrhage. In the civilian environment, the quick self-application or buddy applied tourniquet in the law enforcement environment has demonstrated a positive effect. However, in mass shooting events commercially manufactured tourniquets have not been available to the first care givers (victims themselves or civilian responders) involved in the event. This study demonstrates that efforts to control bleeding with an improvised device can abate the bleeding and possibly have a positive outcome. Further study should be carried out using untrained or minimally trained members of the general population.

2. Routine Use of a Bougie Improves First-Attempt Intubation Success in the Out-of-Hospital Setting.

Latimer AJ, Harrington B, Counts CR, et al. *Ann Emerg Med* 2021;77:296-304.

Endotracheal intubation has been the traditional method for providing definitive airway control in the prehospital setting. The procedure requires practice to maintain proficiency and is not without potentially significant complications, particularly when the initial pass fails. In recent years, the bougie has been adopted by many EMS agencies for use as a rescue device when attempts to perform routine endotracheal intubation have been unsuccessful. The goal of this study was to determine if the routine use of a bougie improved the first pass intubation success rate.

This study was a prospective, observational study. An 18 month control period consisted of routine airway management in which the bougie was used as a rescue device. A 3 month training period was instituted during which all providers were instructed in the study protocol which involved using the bougie on the first intubation attempt for all cases, both with and without medication assistance. The second study period also lasted 18 months and was referred to as the “bougie period”.

A total of 823 patients were included in the control period and 771 patients in the bougie period. The first attempt success rate was 70% for the control period and 77% in the bougie period. Paramedics were asked to grade the laryngeal view using the Cormack-Lehane 4 point grading system, with grade 1 being a full view of the glottis and in grade 4 neither the glottis nor the epiglottis are visible. First attempt success rates increased for all four grades when using the bougie (Grades 1, 2, 3, 4 – control period 91%, 60%, 27%, and 6% respectively versus the bougie period 96%, 85%, 50%, and 14%). Also, the incidence of hypoxia during the procedure decreased from 29.8% to 19%. Finally, there were 3 and 2 unrecognized esophageal intubations in the control and bougie periods respectively.

This study had a few limitations. This was a post-intervention observational study, even though the data were collected prospectively. The EMS system involved does not use either Miller laryngoscope blades or video laryngoscopy. The overall compliance with the airway protocol during the bougie period was 81.3% which could influence the results.

This study showed that experienced paramedics can improve their first attempt success rate for endotracheal intubation by use of a bougie, particularly in patients whose airways are more difficult to visualize. This study also suggests that the bougie should no longer just be considered an airway rescue device, but rather an option for primary airway management.

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3. Retrospective Study of Midazolam Protocol for Prehospital Behavioral Emergencies

Huebinger RM, Zaidi HQ, Tataris KL, et al. *West J Emerg Med.* 2020;21:677–683.

Agitated patients, regardless of etiology, pose a significant management challenge for emergency medical services (EMS) responders. While verbal de-escalation techniques and physical restraints may be successful in some cases, pharmacologic sedation may be required when other methods have failed. The optimal medication has yet to be determined. Various benzodiazepines, butyrophenone antipsychotics, and ketamine have all been utilized with varying degrees of success and associated complication rates.

Midazolam is a rapid onset benzodiazepine that can be administered via the intravenous (IV), intramuscular (IM) and intranasal (IN) routes. The latter of which minimizes the risk of blood-borne pathogen exposure since a needle is not required for administration. Prior studies have demonstrated similar sedative efficacy to medications such as haloperidol and lorazepam.

This study was a retrospective chart review of agitated patients who were administered midazolam for behavioral control over a 29 month period ending June 2016. The protocol allowed for IV (1 mg), IM (5 mg) or IN (5 mg) administration once other methods of de-escalation failed. One repeat dose was permitted as necessary. Paramedics then documented the indication for treatment, dose, route, and their impression of the patient response as well as any noted complications.

During the 29 month study period, 478 patients were treated with midazolam. Of these, 221 patients were excluded for non-behavioral emergencies (41), protocol deviation (172), or missing data (8). This resulted in 257 study cases that received a total of 294 doses. For the initial administration, IM dosing accounted for 52% of administrations, 41% were IN and 7% were IV. Marked improvement was reported in 33% of cases, slight improvement in 39%, and no improvement in 27%. In the 37 patients (14.4%) treated with a repeat dose, substantial improvement was reported in 43% and slight improvement in 40.5%. There was no significant difference between using the IM or IN routes. There were a total of 9 adverse events (3.1%) including 3 cases of hypotension (BP < 100 mmHg), hypoxia necessitating airway intervention (1), hypoxia not requiring airway management (1), unresponsiveness (2), worsening agitation (2), and cardiac arrest (1) thought to be secondary to major blunt injury.

Limitations of this study include the fact that improvement was based on EMS responder impression and not on any kind of standardized assessment scoring system. Patients with excited delirium represented a very small portion of the patients in this study and the results may not be generalizable to those patients. Of interest, behavioral complaints represent 3% of all transports, however only 0.1% of patients required medication for control. This would suggest that less aggressive methods of de-escalation are successful in most cases. Lastly, no information about transport time or the time to effect onset was provided, thus making it difficult to determine how these results can be applied to other systems.

This study demonstrates the effectiveness of midazolam, both IM and IN, to provide sedation for agitated, combative patients. This is important as the initial enthusiasm for ketamine has diminished somewhat given the reported complication rate associated with its administration, particularly the need for subsequent intubation. It would be nice to see a randomized controlled study that compares midazolam to both ketamine and haloperidol in a head to head trial.

4. Trauma patient transport times unchanged despite trauma center proliferation: A 10-year review.

Jones MD, Paulus JA, Jacobs JV, et al. *J Trauma Acute Care Surg.* 2021;90:421–425.

Conventional wisdom holds that proximity to a trauma center, with the associated short prehospital transport time, is essential to give patients their best chance at optimal outcomes after sustaining traumatic injuries. It is assumed, therefore, that the proliferation of trauma centers would further

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reduce transport times. This study sought to evaluate transport times after an increase in the number of trauma centers.

The authors conducted a 10 year review (2009 to 2018) in the State of Arizona. During that period of time, the total number of trauma centers increased from 14 to 47. Level one trauma centers increased from 8 to 13. During that same time period, the population of the state increased from 6.3 million to 7.2 million. State-wide aggregated data summarizing level one trauma center admissions, patient demographics, transport times, and injury severity were reviewed and analyzed.

During the time period studied there were 266,605 level 1 trauma center activations. Activations increased 55% from 23,290 in 2009 to 36,100 in 2018. Urban locations accounted for 81.4% of these activations and rural areas resulted in 16.6%. This 55% increase in activations outpaced the increase in population of 14%. When patients were transported directly to level one trauma centers, the median transport times for urban transports were 0.9 hours for both 2009 and 2018 and 1.8 hours in 2009 and 1.9 hours in 2018 for rural transports.

There were a number of limitations to this study. The authors reviewed only patients taken to level one trauma centers and not any of the other available trauma centers. Patient outcomes were not evaluated. One third of cases had missing transport time data and could not be analyzed.

The authors concluded that “uncoordinated expansion of trauma centers within a state trauma system may not result in more expedient access to trauma care.” They point out that the proliferation of trauma centers across the state occurred without any central coordination or regulation. Despite the increase in urban level one trauma centers, transport times across the state remained flat. State legislation provided funding for trauma care, however 90% of the funding went only to level one centers. Their concern was that this funding scheme would cause competition and oversupply in urban areas with little funding available in underserved rural areas.

This issue is not unique to Arizona. Over 200 trauma centers opened across the country between 2009 and 2012 and often consideration is not given to what and where the best allocation of resources might be. This, in many cases, creates an oversupply in urban areas with fewer resources available in underserved areas. There is evidence that systems that apply resources according an organized regional approach may provide the best results and outcomes. At the very least, this study has pointed out that the lack of an organized design is not improving response times, and by inference, optimal outcomes.