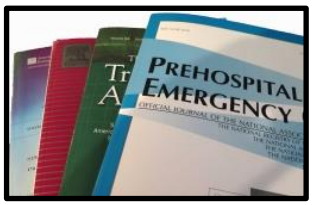
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

Vol. 2.8

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2. **The Impact of Treatment with Continuous Positive Airway Pressure on Acute Carbon Monoxide Poisoning.** Caglar B, Serin S, Yilmaz G, Torun A, Parlak I. Prehosp Disaster Med.2019;34:588–591.
3. **Abdominal Aortic and Junctional Tourniquets versus Zone III Resuscitative Endovascular Balloon Occlusion of the Aorta in a Swine Junctional Hemorrhage model.** Schectman DW, Kauvar DS, Guzman RD, et al. J Trauma Acute Care Surg. 2020;88:292-297.
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1. Appropriate Needle Length for Emergent Pediatric Needle Thoracostomy Utilizing Computed Tomography. Mandt M, Hayes K, Severyn F, Adelgais K. Prehosp Emerg Care 2019;23:663-671.

Tension pneumothorax, while relatively rare, is a preventable cause of death in trauma patients. In the adult population, there is ongoing discussion about the best location for life saving needle thoracostomy and the ideal needle length. Multiple studies have tried to address both questions. Advanced Trauma Life Support (ATLS) recommends using a 14-gauge, 5cm needle in the 5th intercostal space in the mid- to anterior axillary line. The Committee on Tactical Combat Casualty Care recommends at least a 14-gauge, 8.25 cm needle in either the5th intercostal space in the mid- to anterior axillary line or the 2nd intercostal space in the mid-clavicular line. Standard 14-gauge IV catheter needles are 3.8 cm long and inadequate in length to access the pleural cavity of most adults. Little research has been done to determine the appropriate length needle for needle thoracostomy in the pediatric population. This study evaluates what length needle will reliably access the pediatric pleural space without damaging the underlying structures.

Similar to recent adult needle length studies, the authors used computed tomography (CT) to determine the chest wall thickness of pediatrics less than 13 years of age. Their goal was determine the needle length required to access the pediatric pleural space at the two widely accepted needle thoracotomy locations, 2nd Intercostal Space – Mid Clavicular Line (2ICS-MCL) and 4th Intercostal Space – Anterior Axillary Line (4ICS-AAL). This was a five-year, retrospective study done of all pediatric (less than 14 years of age) CT's at an ACS verified Level 1 Trauma Center and regional pediatric trauma center. CT's excluded from the study included findings of chest wall mass, muscle disease, pectus deformity, anasarca, prior open thoracotomy, inadequate imaging, or missing height documentation. Height documentation was required to group patients according to the standard Broselow Length Based Tape (LBT).

Reviewers looked at a total of 273 chest CTs. Of those, 23 were excluded, resulting in a study population of 250 scans and 498 total measurements, 2ICS-MCL and 4ICS-AAL. Patients were grouped by size corresponding to standard Broselow LBT color-coded categories. Patients in the Gray/Pink (< 68cm) group had a median chest wall thickness at the 2nd ICS-MCL of 1.57cm and 1.67cm at the 4th ICS-AAL. The Red/Purple group (68.1 - 90cm) measured 1.96cm at the 2nd ICS-MCL and 1.73cm at the 4th ICS-AAL. Yellow/White (90.1 - 115cm) was 2.12cm at the 2nd ICS-MCL and 1.91cm at the 4th ICS-AAL. Finally, the combined Blue/Orange/Green group (> 115cm) was 2.45cm at the 2nd ICS-MCL and 2.19 at the 4th ICS-AAL.

Based on these findings, the authors recommend that standard-length 3.8 cm, 14 or 16 gauge IV needles be used to access the pediatric (<13 years old) pleural cavity, regardless of color-coded group as measured by Broselow LBT. Longer needles may result in a greater complication rate and should only be considered for pediatric patients that are morbidly obese. This study is another example of the importance of recognizing the need that all EMS services and prehospital personnel are prepared for the unique requirements of pediatric patients.

2. **The Impact of Treatment with Continuous Positive Airway Pressure on Acute Carbon Monoxide Poisoning.** Caglar B, Serin S, Yilmaz G, Torun A, Parlak I. Prehosp Disaster Med.2019;34:588–591.

Carbon Monoxide (CO) poisoning is a worldwide problem affecting over 50,000 patients annually. Carbon Monoxide is a byproduct of combustion and can come from many sources, from dwelling fires to malfunctioning heating systems. CO has over 200-times greater affinity for hemoglobin than does oxygen and has a half-life of four to five hours. Current prehospital therapy for CO poisoning is the administration of 100% oxygen to decrease the half-life of CO in the bloodstream to approximately 40 to 60 minutes. In severe cases patients may be transported for hyperbaric therapy.

This prospective study enrolled 80 patients who presented to the emergency department with a diagnosis of CO poisoning and an arterial blood gas carboxyhemoglobin (COHb) above 10%. Patients were excluded from the study if they were under 18 years of age, pregnant, complained of syncope, seizure, shortness of breath or chest pain. Further exclusions included unstable vital signs or GCS less than 15. The patients were divided into two (2) groups of 40 patients each: group one receiving standard care of 15 lpm of oxygen via a non-rebreather mask and group 2 receiving 100% oxygen at 12 cm H2O using continuous positive airway pressure (CPAP). Three patients in the CPAP group were excluded from analysis because of mask intolerance. COHb levels were measured non-invasively using a portable pulse CO-oximeter prior to treatment and at 30 minutes. Patients in the CPAP group demonstrated a reduction in median COHb levels of 13% (initial COHb 22%, repeat 9%) vs. 6% (initial COHb 14%, repeat 9%) in the 15 lpm mask group at the 30 minute mark.

This study demonstrates that the application of CPAP with 100% oxygen appears to decrease the half-life of CO attached to the hemoglobin. It should be noted however that this study excluded critical patients and those with a higher susceptibility to CO as well as not evaluating late neurological disorders. With CPAP being a common prehospital modality, it would seem a logical progression to include early application on the scene and during transport as a prehospital therapy for patients with suspected CO poisoning. Remembering that this study was a hospital ED study, further evaluation should be undertaken in the prehospital environment.

3. **Abdominal Aortic and Junctional Tourniquets versus Zone III Resuscitative Endovascular Balloon Occlusion of the Aorta in a Swine Junctional Hemorrhage Model.** Schectman DW, Kauvar DS, Guzman RD, et al. J Trauma Acute Care Surg. 2020;88:292-297.

Hemorrhage is a leading cause of death both on the battlefield and in the civilian trauma setting. A common cause of death in the military environment is death from bleeding in patients with junctional and non-compressible torso hemorrhage (NCTH) who die prior to reaching surgical care. Two adjuncts have been utilized to control life-threatening hemorrhage in these patients in the prehospital setting. The Abdominal Aortic and Junctional Tourniquet (AAJT) is a field- usable external abdominal device which is used to occlude the abdominal aorta and control pelvic and inguinal junctional hemorrhage. The Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is a device which can be placed through a femoral artery into the lower aorta to occlude blood flow distally. Although the REBOA is primarily used in the hospital, it has been tried in the austere military environment and select civilian prehospital settings. Both devices work by limiting arterial blood flow below the level of the device. While independent studies have confirmed the effectiveness of both devices, no study has compared the two directly.

This was an animal study utilizing anesthetized swine that underwent close hemodynamic monitoring while exsanguinated in a simulated military type injury pattern. The devices were then applied to control hemorrhage and the pigs were resuscitated using a standard protocol. The injury patterns for the swine included a controlled hemorrhage of 20 mL/kg followed by a mid-shaft femur fracture. Finally a laceration was made to the right femoral artery to allow the pig to bleed over a 15 minute period. Once the pig had lost 40% of their estimated blood volume a REBOA or AAJT was applied and the pig was resuscitated with whole blood transfusion. The REBOA was deployed in zone III (aortic bifurcation) which preserved blood flow to the proximal abdominal organs. The selected device was then removed and the pig monitored for six hours. Primary outcomes were survival, blood loss, hemodynamic performance, and laboratory parameters. All animals were euthanized upon completion of study.

All animals survived the initial hemorrhage and intervention period. One animal from each group died during the observation period. Both AAJT and REBOA produced near-complete hemorrhage control. As expected, a significant decrease in mean arterial pressure (MAP) was noted in all animals during hemorrhage. This decrease was reversed with the application of either the AAJT or REBOA in the absence of fluid resuscitation. All monitored hemodynamic values improved after resuscitation but did not normalize in either group. Laboratory values were similar among both groups although an earlier hypokalemia was noted in the AAJT group.

This was a combat casualty care relevant swine model of severe shock and junctional hemorrhage. The AAJT and zone III REBOA showed similar survival, junctional arterial hemostasis, and physiologic impact. Both improved the MAP however distal tissue perfusion to the lower extremities was better with the REBOA, as expected. Aortic balloon occlusion does not affect distal venous outflow while the AAJT's nonselective abdominal compression affects both arteries and veins.

Since both devices had a similar survival and physiologic profile, either would be acceptable in the combat austere environment and the civilian prehospital environment. While the REBOA is a more flexible option, it is much more difficult to use. Even in a controlled hospital setting it can be challenging to obtain femoral artery access in a hypovolemic patient. The AAJT is much easier to deploy and sterile technique is not required. Much less training is involved in learning the proper utilization of the AAJT In contrast to the extensive training required to properly use the REBOA. The primary limitation of this study is that it was a simulation of hemorrhage in an animal model. The comparative effectiveness of these devices in humans in the prehospital setting is unknown. Another limitation in the use of these devices relates to the metabolic derangements including lactic acidosis and hyperkalemia that occur. In this study, application time for these devices was limited to

60 minutes. Previous animal studies have shown that longer application times can lead to impaired spinal cord blood flow and paralysis.

In summary, both the AAJT and REBOA are effective in controlling abdominal and inguinal junctional hemorrhage. Device selection should be based on available resources, provider training, and the potential complication profile.

4. **Pulmonary Complications of Opioid Overdose Treated With Naloxone.** Farkas A, Lynch MJ, Westover R, et al. Ann Emerg Med. 2020 Jan;75:39-48.

Opioid abuse has become a major public health crisis and overdose has become an increasing cause of death. This crisis has increased the use of naloxone to reverse signs of opioid overdose administered by EMS providers, first responders and the general public. The widespread use of naloxone has helped decrease the incidence of death associated with overdose of opioids. Naloxone has long been thought to have few or no side effects although pulmonary edema, aspiration, and acute respiratory distress syndrome have all been associated with both opioid use alone and naloxone reversal. In the past few years, studies have reported that higher doses of naloxone have been needed to achieve the desired clinical effect. The primary focus of the study was to investigate if higher dosages (above 4.4 mg) were associated with and increased risk of pulmonary complications.

This was a retrospective observational study which took place in the City of Pittsburg, population 380,000. The Bureau of EMS provides an all ALS response that utilizes two (2) paramedics on each ambulance who can administer naloxone intravenously. The Bureau of Fire provides BLS first response service with basic EMTs that are allowed to administer intranasal naloxone. The study was conducted by review of all electronic prehospital medical records from April 1, 2013 until December 3, 2016 searching for the words “naloxone”, “Narcan”, or the code for naloxone administration. The search was limited to patients transported to three major hospital emergency departments in the city where access to inpatient medical records was available.

There were a total of 1,980 EMS records identified, of which 1,456 were considered to be likely opioid overdose and were included in the study. Of these, 485 (26.5%) were identified as having pulmonary complications. These complications were defined as pulmonary edema, aspiration pneumonia and aspiration pneumonitis. The primary pulmonary complication was aspiration pneumonia or pneumonitis (461 of 485). Patients who received 4.4 mg or greater of naloxone had statistically significant higher pulmonary complications (42% versus 26%). Of note, patients who received an initial dose of naloxone greater than 0.4 mg also were found to have a higher incidence of pulmonary complications (27% versus 13%).

While this study demonstrates higher pulmonary complications in patients receiving high dose naloxone, it is important to recognize that this study does not demonstrate a direct causal relationship. Naloxone itself may not cause the increase in aspiration, but rather it results from the abrupt opioid withdrawal syndrome precipitated by the naloxone. Furthermore, these complications may result from the increased toxicity of or increased amount of the opioid itself. The goal of naloxone administration is to reverse respiratory depression associated with the opioid overdose, not complete reversal of all opioid effects. Respiratory depression can be reversed with smaller doses of naloxone and this should be the goal of treatment.