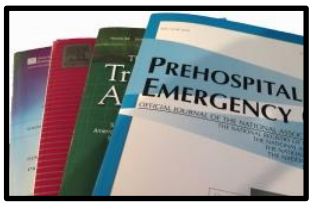
# ***International Prehospital Medicine Institute***




## IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

## Vol. 3.5

1. **Comparison of 10- versus 14-gauge angiocatheter for treatment of tension pneumothorax and tension-induced pulseless electrical activity with hemorrhagic shock: Bigger is still better.** Norris EA, McEvoy CS, Leatherman ML, et al. *J Trauma Acute Care Surg.* 2020;89(2):S132-136.
2. **Feasibility of bystander-administered naloxone delivered by drone to opioid overdose victims.** Ornato J, You A, McDiarmid G, et al. *Am J Emerg Med.* 2020;38:1787-1791.
3. **Prehospital External Aortic Compression for Temporizing Exsanguinating Sub-Diaphragmatic Hemorrhage – A Promising Technique, but with Challenges: Four Illustrative Cases, Including Two Survivors.** Paix BR, Tingey DJ, Copley G,et al. *Prehosp Disaster Med.* 2020;35:115-118.
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1. **Rescue Comparison of 10- versus 14-gauge angiocatheter for treatment of tension pneumothorax and tension-induced pulseless electrical activity with hemorrhagic shock: Bigger is still better.** Norris EA, McEvoy CS, Leatherman ML, et al. *J Trauma Acute Care Surg.* 2020;89(2):S132-136.

Tension pneumothorax remains a leading and survivable cause of death, especially in the prehospital setting. Early recognition and treatment are crucial for optimal patient outcome. Historically, needle thoracostomy with a 14-gauge angiocatheter (AC) in the second intercostal space (ICS), midclavicular line (MCL) has been the standard of care for the prehospital treatment of tension pneumothorax (tPTX). Recent data has suggested the traditional catheter length is too short to accommodate the body habitus of most trauma patients, and an 8 cm catheter length is now recommended. Additionally, recent studies have suggested the fifth ICS in the anterior axillary line (AAL) is more effective for needle decompression then the traditional 2$^{nd}$ ICS MCL, due to a less thick chest wall in the AAL than in the MCL. The Tactical Combat Casualty Care (TCCC) guidelines were updated in 2018 to include the 10-g AC as an acceptable alternative to the 14-g AC, but they did not go so far as to recommend the 10-g over the 14-g AC.

This study compares the 10-g AC to the 14-g AC for decompression of a tPTX and rescue from a tension-induced pulseless electrical activity (tPEA) in the setting of 30% estimated blood volume loss without hemothorax. The authors hypothesized the 10-g AC would be more effective and have a faster rescue from tension physiology than the 14-g AC currently used by most EMS systems.

This was an animal study utilizing anesthetized pigs. The researchers placed arterial and venous lines for hemodynamic monitoring. They then placed 12-mm trocars through each diaphragm through which they could infuse carbon dioxide to simulate a tension pneumothorax. The pigs were bled to an estimated 30% blood volume loss to simulate hemorrhagic shock. Decompression devices were inserted at the second and third ICS MCL or the fifth and sixth ICS AAL on the side of the tension pneumothorax. The animals were allowed to recover for five minutes with their vital signs checked every minute. During

this time, carbon dioxide insufflation was continued at a low rate to simulate a persistent air leak. The experiment was repeated up to four total times per animal. Similar methods were used to simulate the tPEA phase. tPEA was defined as a loss of the arterial waveform with the presence of cardiac activity. Successful recovery of an animal was defined as a return of mean arterial pressure to 20 mmHg and meaningful recovery was defined when SBP returned to 80% of the baseline value.

Eighty tPTX and 50 tPEA events were conducted in 38 pigs. The 10-g AC successfully rescued 90% of the tPTX events, compared to the 14-g AC which rescued 80% of events. For tPEA, the 10-g rescued 87% of events, whereas the 14-g rescued only 48% of events. Time to rescue was also analyzed between the devices. In both tPTX and tPEA, there were no significant differences in percentages of devices rescuing animals within one minute. Any device which was successful did so within three minutes. When evaluating meaningful recovery (reaching 80% of baseline SBP), the 10-g AC was successful 75% of the time within one minute, compared to the 14-g AC which was successful 54% of the time within one minute.

There are limitations to this study which should be acknowledged. This was a swine model, and pigs have different chest wall anatomy than humans. The swine in this study were under positive pressure ventilation since they were intubated, so these results may not translate to those who were spontaneously breathing and not intubated.

The results of this study demonstrate that if the device is going to rescue a victim from tension pneumothorax, more than 80% of the devices will reach 80% or greater of the baseline blood pressure within one to two minutes. The 10-g AC was superior to the 14-g AC in achieving return of circulation following tPEA in the setting of 30% hemorrhage. This study further supports the importance of larger caliber devices to facilitate rapid recovery from tPTX, especially in the setting of hemorrhagic shock.

**2. Feasibility of bystander-administered naloxone delivered by drone to opioid overdose victims.**
Ornato J, You A, McDiarmid G, et al. *Am J Emerg Med.* 2020;38:1787-1791.

Opioid overdose deaths in the United States continue to be a significant healthcare crisis. The death rate from opioid overdoses in the US averages 130 per day. Often opioid overdoses can be reversed via the administration of naloxone, either by the intra-nasal spray route or via a naloxone auto-injector. Naloxone and naloxone administration training are available to the general public. However, less than 5% of citizens witnessing an opioid overdose administer naloxone to the victim. Naloxone is either not readily available where the victim overdosed, or the witness is unable to administer it on their own. The chance of survival once the victim progresses from respiratory depression to respiratory arrest and then cardiac arrests decreases by 10% every minute that goes by without treatment. Even the most efficient EMS systems can take 5-10 minutes to arrive on scene at these types of calls.

The authors of this study investigated the feasibility of citizen administered naloxone, delivered by an Emergency Medical Dispatch (EMD) launched drone, with scripted instructions to aid in its administration. They used an IRB approved human factors simulation study run at an outpatient medication assisted suboxone treatment clinic. The study subjects were male and female patients of the clinic with diagnosed Opioid Abuse Disorder. Study subjects were told they would be volunteer rescuers at a simulated medical emergency. They were not told the nature of the emergency. They would then be interviewed by a researcher after the simulation.

For each simulation, study subjects were given a portable radio to simulate a cell phone. They were then informed that a manikin placed in front of them was their patient. The “patient” had just collapsed, was unconscious and not breathing following an opioid overdose. A simulated 9-1-1 operator was on their simulated cell phone to instruct how to help the victim via scripted EMS instructions. The test subjects were first instructed to walk to the front door of the building to retrieve intra-nasal Naloxone already delivered by a small drone. The roundtrip walk took approximately 1.5 minutes. Once

back at the patient's side, study subjects were instructed by the EMD operator how to administer intra-nasal naloxone into either of the patient's nostrils. The simulation ended once the naloxone was administered. The primary measure of the study was the time between first contact with 9-1-1 and administration of the Naloxone.

All the 30 study subjects completed the simulation. The average time from the onset of 9-1-1 contact until the naloxone was administered was 122 sec. Study subjects with prior naloxone administration experience or medical training had shorter 9-1-1 contact to naloxone administration times. During subject pre-screening, four individuals reported minor physical limitations (2 had problems walking; 1 had "bad knees"; 1 was hard of hearing). The average time for this subset of subjects to complete the simulation was greater than the other test subjects (136 sec Vs 119 sec). Five study participants experienced challenges with the naloxone administration. They were unable to use the spray plunger quickly. Their average time was 135 sec vs. 119 sec for those without plunger difficulties.

This small study does demonstrate that this opioid non-naïve group was able to effectively follow EMD instructions to administer intra-nasal naloxone to a simulated overdose victim. It would be interesting to see if the results could be replicated with a more diverse, opioid naive study population. The study did not address any of the logistical or financial challenges associated with the delivery of naloxone via drone but it does reinforce the potential benefit of readily available public access naloxone.

3. **Prehospital External Aortic Compression for Temporizing Exsanguinating Sub-Diaphragmatic Hemorrhage – A Promising Technique, but with Challenges: Four Illustrative Cases, Including Two Survivors.** Paix BR, Tingey DJ, Copley G,et al. *Prehosp Disaster Med.* 2020;35:115-118.

Tourniquets have become the mainstay for limb bleeding that cannot be controlled by direct pressure. However non-compressible pelvic and abdominal bleeding presents a unique problem for responders. Various techniques for binding the pelvis and compressing the abdomen have been mentioned in the literature but most require extra equipment, some complex. The authors of the series of case studies report the use of External Aortic Compression (EAC) for uncontrollable non-compressible bleeding below the level of the diaphragm using manual techniques.

This case series was conducted in Southern Australia by the physician led Medical Retrieval Team (MRT). The paper describes the use of EAC, by or at the direction of the physicians on the MRT, four (4) times during recovery and transportation of patients. Three of the cases resulted from a traumatic event and one was due to a medical condition. In the trauma group, two victims had stab wounds to the abdomen, while the third patient was the victim in a motor vehicle crash with substantial lower extremity trauma. The medical case was an undiagnosed ectopic pregnancy that ruptured. Of the four cases, two patients survived to discharge (the ruptured ectopic pregnancy and the motor vehicle crash victim.

In comparing the effectiveness of aortic occlusion using various techniques of manual external compression, the authors conclude that the use of a knee placed high in the epigastric region produces the best results. They also note that crew safety is drastically compromised using this technique during transport. The use of this technique mandates additional healthcare providers accompany the patient in the back of the ambulance as the "compressor" is fully occupied in performing the compression and cannot provide any other needed interventions. In addition, there appears to be a significant circulatory "dump" that occurs when compressors change (due to fatigue) or when the patient is transferred from the pram to the ED stretcher or OR table.

While case studies such as this serve as a launching pad for future research, they should not be considered with the same confidence levels as quality peer reviewed studies. As an example, there was one survivor in this case series in whom the bleeding was eventually controlled with limb tourniquets,

but the authors felt "EAC appeared beneficial in restoring cardiac output before tourniquet application". Such observations are perhaps helpful in describing the clinical management of patients; they alone should not be used to generalize the data for widespread use. While clinical practice should not be changed based on this series of four cases, the principles described in this series of cases dictate future focused, controlled clinical research.

4. **Change in Traffic Fatality Rates in the First 4 States to Legalize Recreational Marijuana.** Kamer RS, Warshafsky S, Kamer GC. *JAMA Intern Med* 2020;180:1119-1120

Operating a motor vehicle while under the influence of an intoxicant continues to be an important public health issue and cause of significant traumatic injury and death. While alcohol has been the usual concern, as more and more states legalize the use of recreational marijuana, the effects of impaired driving are becoming more apparent.

Several early studies conducted in Colorado and Washington reported no significant change in motor vehicle crash-related deaths. The authors of this study conducted a review of fatality rates from the National Highway Traffic Safety Administration's Fatality Analysis Reporting system comparing 4 states with 2 full years of traffic fatality data after opening of commercial retail marijuana stores with 20 states that have not legalized either recreational or medical marijuana. The presence of a primary seatbelt law, maximum speed limit, and unemployment rate were included as potential variables.

The authors found that the traffic fatality rate increased by 2.1 deaths per billion vehicle miles traveled post legalization of marijuana in the four states included in the study. Using these data as a baseline and extrapolating this result to the entire nation would suggest that approximately 6800 additional traffic fatalities would result if the use of marijuana was legal nation-wide.

This study is limited by adjusting for only 3 state-specific variables. In addition, the study looked only at fatalities and not non-fatal traumatic injuries.

This study demonstrates that legalization of marijuana use contributes to the burden of impaired driving and increases motor vehicle crash-related fatalities.