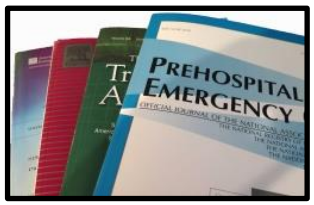
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

Vol. 5.1

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1. Paramedic Understanding of Tension Pneumothorax and Needle Thoracostomy (NT) Site Selection. Lubin JS, Knapp J, Kettenmann ML. *Cureus.* 2022 Jul;14(7)

Tension pneumothorax is the accumulation of enough air under pressure in the pleural space to cause hemodynamic compromise. Paramedics are trained to recognize the signs and symptoms of tension pneumothorax and appropriately treat it in the field. Field treatment of tension pneumothorax is with needle decompression (ND) of the involved thoracic cavity, most commonly in the 2nd intercostal space (ICS), mid-clavicular line (MCL). Prior studies have demonstrated difficulty by healthcare providers in identifying the proper site. A study of 25 emergency medicine physicians noted that the correct landmark was verbalized 88% of the time, but only 60% were able to correctly identify the proper site on a human volunteer. A similar study of 25 United States Navy corpsmen found incorrect placement in 82% of attempts in a cadaver model. Accurate placement is paramount, with improper placement into the surrounding structures (subclavian vessels and heart) often resulting in an additional life-threatening condition usually requiring emergency surgery.

This is a prospective observational study performed to assess paramedic ability to recognize and correctly treat a tension pneumothorax. Twenty-nine paramedics were recruited at Pennsylvania's annual statewide Emergency Medical Services (EMS) conference. Demographic data collected included years of EMS service, environment of practice, percentage of EMS vs transport calls, specific training in ND, certification in Prehospital Trauma Life Support (PHTLS), and the estimated number of NDs each participant has done. Subjects were asked to list signs and symptoms of tension pneumothorax as well as alternative sites for ND. They were then asked to identify the 2nd ICS-MCL on a human volunteer.

Of the study participants, 24 (83%) had been in practice for more than five years. All subjects reported training in ND, 10 (36%) were certified in PHTLS, and 16 (55%) had previous PHTLS training. Six (21%) had never performed a ND and 14 (48%) reported having performed five or more.

When asked to name the correct site of NT, nine participants (31%) recited the textbook answer of 2nd ICS-MCL. Twelve (41%) stated only the 2nd ICS without mention of the MCL. Eleven (38%) participants specified 2nd or 3rd ICS. Six paramedics (21%) named a wrong intercostal space. The MCL was correctly

named by 21 (72%) of paramedics. When asked for an alternate site for ND, five participants provided no answer or an inadequate answer (e.g., "lateral chest").

None (0%) of the 29 paramedics were able to correctly identify the 2nd ICS-MCL on the human volunteer. Most of the participants (27, 93%) were too inferior in their placement with an allowable leeway of 0.5 cm. Utilizing the same amount of lateral error range of 0.5 cm, 16 paramedics (55%) approximated the location of the MCL, however, their identified site was too medial in 15 (51%) and too lateral in 14 (48%). The overall mean distance from the correct site was 3.12 cm (1.2 inches).

This study has several limitations. This was a small sample size of paramedics at a single statewide EMS conference. Their experience may not translate to all practice settings. While severe trauma resulting in tension pneumothorax is more common in men, it does frequently occur in females, and the volunteer human models for this study were men with normal body mass indices. This study only considered the 2nd ICS-MCL as the preferred site. The American College of Surgeons Advanced Trauma Life Support (ATLS) course now recommends the 4th or 5th anterior axillary line as the preferred site for ND. However, the Royal College of Surgeons of Edinburg in the UK and the European Trauma Course (ETC) still recommend the 2nd ICS-MCL.

This study adds to the growing body of literature suggesting healthcare providers (including paramedics) have difficulty identifying the correct indications for, and placement of, ND. It supports previous studies that found that even emergency medicine physicians and Navy corpsmen have difficulty identifying the correct site for ND. Proper ND placement is critical, as incorrect placement can be non-therapeutic as well as cause life-threatening injuries to such critical structures as the subclavian artery and vein as well as the heart. Additional and recurrent training is needed at the national level to make this a safe and reliable procedure.

2. **Methods Used to Obtain Pediatric Patient Weights, Their Accuracy and Associated Drug Dosing Errors in 142 Simulated Prehospital Pediatric Patient Encounters.** Hoyle Jr JD, Ekblad G, Woodwyk A, Brandt F, Fales B, Lammers RL. *Prehospital Emergency Care,* 2022;26: 511-518.

Critical pediatric patient encounters are always stressful for prehospital providers due to the low occurrence of true pediatric emergencies encountered by each provider. Correct drug dosing is paramount in a successful outcome in many of these patients. Estimation of a child's weight has always been a concern for all providers that care for children. Unlike the in-hospital situation, most prehospital providers do not have a scale available to obtain an accurate measurement, thus necessitating the use of alternative methods. While a small error in weight estimation in adult or larger adolescent patients will most likely not result in a significant under- or overdosing of the patient, this does not hold true in infants and smaller children.

The authors conducted a simulated observational study to examine how prehospital providers determine pediatric weights and the dosing errors that may result. As part of a quality improvement program the investigators prepared four (4) vetted pediatric simulations utilizing high-fidelity simulators. The four predetermined and vetted simulations were a seizing infant with hypoglycemia, an infant in cardiac arrest, an 18-month-old burn patient. and a 5-year-old with anaphylactic shock. In each situation a roll-player simulating a parent was present and would provide any pertinent information when requested by the crew. During each of the simulations trained observers recorded the providers actions on a predetermined score sheet. After the simulation, a review of the video took place by the investigators. Participating EMS crews were made up of at least one paramedic and in some cases two paramedics. They were asked evaluated and treat per their current protocol utilizing the equipment that was currently stocked on the ambulance or response vehicles.

A total of 142 simulated pediatric patient encounters took place. Three (3) methods of determining weight were used by the EMS participants: Broselow-Luten tape (63%), asking the parent (12%) for the

weight, and asking the parent for the patient age (24.8%). There were 18 (12.7%) dosing errors: nine by using patient age, eight by using the Broselow tape, and one by asking the parent. Of these errors, 10 directly resulted mis-dosing of the simulated patient. Most dosing errors were small, however there were several that orders of magnitude large.

The use of an age-based determination of the child's weight is the least accurate as demonstrated by this and numerous other studies. In crews who used the Broselow tape as their primary method of determination of weight, errors were made in the incorrect application of the tape. It should be noted that in the study two patients were in a seated position. In the one of the incorrect weight dosing in the "asked parent group" it was determined that the crew made an error in pounds to kilogram conversion and did not use a calculator or another device. It was noted that some crews accessed multiple methods - asking the parent as well as using the Broselow tape. The crews defaulted to the Broselow tape in these cases.

This study was limited by the fact that it was conducted using simulated patients. When the "parent" was asked for a weight, an accurate weight was provided. In real situations, this may or may not occur. Another limitation is that this study was conducted using EMS providers from one state and the results may not be generalizable to other states.

Pediatric dosing for emergent medication administration relies on an accurate determination of the child's weight. While no method is foolproof, studies cited in this article demonstrate that, short of having a scale available to weigh a pediatric patient, the most accurate method for obtaining a pediatric patient's weight is from a parent. In the absence of a parent, the Broselow tape demonstrated to be most accurate followed by an age determinate calculation. This study demonstrated that errors using the Broselow tape were in the application of the tape itself, necessitating constant retraining and reinforcement of the correct use of the device.

3. Misdiagnosis of aortic dissection: A systematic review of the literature. Lovatt S, Wong C, Schwarz K, et al. *Amer J Emerg Med* 2022;53:16-22.

Aortic dissection (AD), a tear in the layers of the aorta0 is an uncommon but potentially catastrophic condition. The mortality for an acute aortic dissection not treated within the first 48 hours can be as high as 50%. Many patients die before reaching, or even seeking, medical attention. Patients with chronic aortic dissections tend to fair slightly better. Early and accurate diagnosis of an AD reduces patient mortality. Treatment of AD involves careful management of the patient's blood pressure, frequent imaging and either surgical or endovascular repair whenever possible. The presenting symptoms of AD's frequently mimic other common medical problems. Delayed or missed diagnoses of AD are not uncommon in the emergency setting while the other, more common diagnoses are being excluded.

Aortic dissections are often classified according to the Sanford criteria. AD's involving the ascending aorta are Type A and dissections involving the descending aorta are Type B. AD's may also be classified using the DeBakey classification. Type 1 ADs involve the ascending aorta to the aortic arch. Type 2 ADs are limited to the ascending aorta and Type 3 involve the descending aorta distally.

The authors of this paper conducted a systematic literature review to understand the reasons behind missed AD diagnosis. Twelve papers were included in their review. These 12 papers included 1,663 patients from retrospective research. All 12 papers were hospital based.

AD was initially missed or misdiagnosed in 1/3 of all of the patients (33.8%). Acute coronary syndrome, stroke and pulmonary embolus were the most frequent misdiagnosis. Chest pain (67.5%), back pain (24.8%) and syncope (6.8%) were the most common presenting patient complaints. The majority of the patients were male with a mean age of 60 years old. Most of the studies identified that providers made their diagnosis based on patient history, examination and investigations (X-ray without a

widened mediastinum, ECG changes, mild congestive heart failure and elevated troponin levels). The papers reviewed suggested that a more in-depth patient history, better patient pain analysis and advanced imaging may reduce the number of missed AD's. Patient pain description alone may help differentiate acute coronary syndrome from Type A AD and lower back pain from Type B AD. Each has an inpatient mortality rate of 32.5% and 10.6% respectively. It was noted in one of the papers reviewed that those patients with AD that arrived by ambulance versus an Emergency Department "walk in" had a decreased misdiagnosis rate.

This paper is limited by the fact that all of the studies reviewed were retrospective in nature. The misdiagnosis of AD did not have a single definition. There was no follow up information about the missed AD diagnosis and what specifically led the evaluator astray.

Although this was a hospital-based review, the findings are important for prehospital providers as well. Prehospital providers set the stage for the ED response to a patient. Pre hospital providers should consider AD in the differential diagnosis for patients that present with chest pain, back pain and syncope. Concise history taking, including pain assessment and descriptors may decrease the initial misdiagnosis of AD and potentially steer hospital providers to do the same and include advanced imaging to rule out the potential for acute aortic dissection.

4. **Association of Advanced Airway Insertion Timing and Outcomes After Out-of-Hospital Cardiac Arrest.** Okubo M, Komukai S, Izawa J, et al. *Ann Emerg Med* 2022;79:118-131.

The ideal time for endotracheal or laryngeal tube insertion in out-of-hospital care cardiac arrest patients is unclear. This paper sought to determine whether there was a difference in survival rates from out of hospital cardiac arrest victims depending on whether they had endotracheal or laryngeal tubes secured early in the resuscitation versus later.

This was a retrospective secondary analysis of data from the Pragmatic Airway Resuscitation Trial (PART) which was a randomized controlled trial encompassing 27 EMS agencies in the United States that compared out of hospital cardiac arrest patients that had been endotracheally intubated versus patients that had laryngeal tube insertion. The study included 3,004 patients between December 2015 and November 2017. In addition to the exclusion criteria utilized in the original PART study, patients excluded in this study included those with EMS witnessed out-of-hospital cardiac arrest, unknown age, unknown time of ALS arrival, unknown time of first airway insertion attempt, unknown time of other time-dependent covariates (shock delivery after advanced life support arrival, epinephrine administration and departure from scene), or unknown hospital discharge status. The primary outcome measure was survival to hospital discharge.

Of the 2,146 patients included in the study, 1091 were randomized to initial laryngeal tube placement (923 had first attempts of laryngeal tube insertion) and 1055 to endotracheal intubation (776 had endotracheal tube first attempt at insertion). After matching patients, 746 and 598 patients underwent laryngeal tube placement and endotracheal intubation, respectively, and were included in this analysis. The timing of either laryngeal tube or endotracheal tube insertion in out-of-hospital cardiac arrest patients was not associated with survival to hospital discharge, favorable neurological outcome while in the hospital, or 72-hour survival. There was no survival difference associated with either airway being inserted within five minutes, five to ten minutes, ten to fifteen minutes, or fifteen to twenty minutes.

Limitations of this study include the difficulty associated with accurately measuring time variables in the out of hospital environment and the precision of the collected time variables. In addition, the time to advanced airway insertion and time to successful insertion may reflect practices of individual EMS systems and that that result may be differ from agencies with different practices. Lastly, the specific

clinical scenario for each patient may have affected the decision regarding the timing of advanced airway intervention

While other studies have shown associations between the timing of advanced airway management, the type of airway intervention utilized, and patient outcomes, this study did not show any differences. The choice of most appropriate airway device and the optimal timing for placement remains a controversial issue requiring additional randomized studies before a more definitive recommendation can be made.