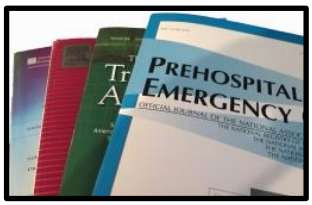
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

Vol. 2.11

1. **Does prehospital spinal immobilization influence in hospital decision to obtain imaging after trauma?** Drain J, Wilson ES, Moore TA, Vallier HA. Injury. 2020;51:935-941. https://doi.org/10.1016/j.injury.2020.02.097
2. **Comparison of non-invasive CPAP with mask use in carbon monoxide poisoning.** Turgut K, Yavuz E. Amer J Emerg Med 2020 Article in press, published on-line April 17,2020. https://doi.org/10.1016/j.ajem.2020.04.050
3. **Effectiveness of the combat application tourniquet for arterial occlusion in young children. .** Kelly JR, Levy MJ, Reyes J, Anders J. J Trauma Acute Care Surg. 2020;88:644–647. DOI: 10.1097/TA.0000000000002594
4. **Pediatric Prehospital Refusal of Medical Assistance: Association with Suspected Abuse or Neglect.** Mix F, Myers LA, Luke A, Sztajnkrycer MD. Prehosp Emerg Care 2017;21:688-692. https://doi.org/10.1080/10903127.2017.1321708

1. **Does prehospital spinal immobilization influence in hospital decision to obtain imaging after trauma?** Drain J, Wilson ES, Moore TA, Vallier HA. Injury. 2020;51:935-941.

Healthcare providers utilize spinal mobilization as a means of potentially preventing or worsening neurological injury following trauma. Spine immobilization can include the application of a cervical collar alone, or complete immobilization with a cervical collar and spine board. While this practice has been a mainstay of prehospital trauma care for over 40 years, little if any data exist to support the practice. Once at the hospital, the cervical spine typically is cleared either with physical examination, plain cervical spine radiographs, or cervical spine CT scan. The most common radiologic test to clear the cervical spine is now the CT scan, which has a sensitivity of 98- 100% for detecting fracture. Unnecessary utilization of the CT scan does have downsides. The cost to the patient and the overall health care system is significant, and it exposes the patient to radiation. The authors in this study hypothesize that patients who arrive with a prehospital cervical collar are more likely to undergo CT scanning regardless of the clinical need.

This is a retrospective study of all trauma patients transported to an urban, level 1 trauma center over a four-month period. Patients were categorized based on severity of injury, complaint location, and injury mechanism. Category 1 patients (n=244) were the most severely injured and had anatomic and physiologic injuries suggesting severe injury. Category 2 patients were also injured but less severely (n=721). Category 3 patients (n=463) were those who had no obvious injury but injury was suspected based on mechanism. Overall, 1438 patients were enrolled in the study. Category 1 patients were most often male (83%) and sustained gunshot injuries (56%). The proportion of Category 1 patients who received a CT scan was lower than those in Category 2 or 3 (likely due to

the higher rate of penetrating trauma in Category 1). The proportion of patients receiving CT scans in Categories 2 and 3 was similar so they were combined during the data analysis.

Seventy-five percent of patients arrived with a cervical collar in place. Those who had a cervical collar received a cervical CT scan 80% of the time and those arriving without a collar received a scan 30% of the time. A total of 35 patients (2.43%) had a cervical spine injury; 26 of them had a clinically significant cervical spine injury (1.81%). This is consistent with national data from other trauma centers. Those patients who did not receive a CT scan were followed for two years looking for a clinically significant missed injury. No missed injuries were found during the two year follow-up. Category 1 patients received 15 cervical CT scan per diagnosed cervical spine injury while Categories 2 and 3 patients received 46 surgical CT scans per diagnosis. When looking specifically at motor vehicle collisions, 66 patients received a scan per one injury diagnosed.

The most significant predictor of cervical spine injury was a patient complaint of pain or known injury above the clavicles. No patient without a complaint above the clavicles had a cervical spine injury. Additionally, 161 of the 458 patients (35%; 11% of total) with a complaint only below the clavicles still received cervical CT imaging and none of them had a cervical spine injury.

The authors then looked at the effect of prehospital cervical collar placement on future imaging upon arrival to the trauma center. They noted that Category 1 patients who had gunshot wounds above the clavicles underwent cervical CT imaging in a greater proportion if they arrived wearing a cervical collar than those who arrived without a cervical collar (66% vs 14%), suggesting a bias toward imaging patients based on prehospital treatment. This is significant because prior studies have shown no benefit to prehospital cervical collar placement in penetrating trauma. Among the Category 2 and 3 patients with an injury above the clavicles, those injured in motor vehicle collisions (88% vs 70%) , low-energy falls (83% vs 59%), and assault (86% vs 37%), received CT scans more frequently if they arrived with a prehospital cervical collar in place. Additionally, Category 2 and 3 patients without an injury above the clavicles still received cervical spine CT imaging if they arrived with a prehospital cervical collar already in place: motor vehicle collision (66% vs 21%), low-energy fall (82% vs 35%) and pedestrian versus motor vehicle (56% vs 13%).

This study demonstrates that the physician decision to obtain CT imaging of the cervical spine is influenced by prehospital application of a cervical collar. Perhaps the visual cue of a patient arriving to the trauma center with an immobilized cervical spine may unnecessarily bias the physician to obtain imaging despite the lack of clinical indication. Published guidelines exist regarding indications for cervical spine imaging in trauma patients. Most notably, the Canadian C–Spine Rule has the greatest sensitivity (99–100%). This decision-making rule has also been tested with paramedics and has achieved near 100% sensitivity for identifying trauma patients at high risk for cervical spine injury. However, many EMS protocols still require routine application of a cervical collar despite the data against the practice. As this study shows, these patients often don't need to receive unnecessary, expensive, and perhaps harmful CT scans simply because EMS applied a cervical collar. If prehospital providers can be given greater autonomy in deciding whether to place a cervical collar perhaps the downstream effect of unnecessary imaging in the trauma center could be avoided.

2. **Comparison of non-invasive CPAP with mask use in carbon monoxide poisoning.** Turgut K, Yavuz E. Amer J Emerg Med 2020 Article in press, published on-line April 17,2020.

Carbon monoxide (CO) is an odorless, tasteless, colorless gas that is produced anytime a fossil fuel is burned. It is also an inhaled poison, resulting in greater than 50,000 emergency department visits in the United States alone. Once in the human body, CO forms carboxyhemoglobin (COHb) by binding to hemoglobin with 200 times greater affinity than oxygen.

Patients with mild CO exposures often complain of headache, dizziness, muscle pain, and neuropsychological effects. Higher levels of CO poisoning may lead to confusion and death. CO poisoning may also result in neurological sequelae in some cases causing lifelong disabilities. In addition to the physical exam and history, the measured COHb level is used to diagnose CO poisoning. COHb levels of 3% or greater in non-smokers and 10% in smokers strongly suggest CO exposure.

Treatment for CO poisoning is aimed at removing the CO from hemoglobin, thus preventing hypoxia. This is typically accomplished by providing supplemental oxygen via mask or nasal cannula. This oxygen delivery method accelerates CO removal from hemoglobin but does not lessen the chance of neurological sequelae. Hyperbaric oxygen (HBO2) has been used to treat some patients. One prior study reported that HBO2 resulted in a 46% reduction in neurologic sequelae. HBO2 requires a hyperbaric chamber not immediately available to most emergency departments.

Continuous positive airway pressure (CPAP) is frequently used to treat pulmonary edema and can be used to deliver oxygen at a higher pressure than a mask or nasal cannula. The authors of this paper hypothesized that CPAP would decrease CO levels sooner than oxygen delivered via a standard nonrebreather mask (NRB).

This was a 12-month (C/Y 2019), observational prospective research project in the emergency department of a Turkish tertiary care center. The study was approved by the local Research Ethics Committee. Adult emergency department patients with CO poisoning were included in the study. In addition to medical history and physical examination, the carboxyhemoglobin saturation (SpCO) level of these patients was measured with a portable CO-oximeter (MasimoSET rainbow Rad-57 Pulse CO-oximeter, Masimo, Irvine, CA). Awake patients with SpCO levels between 20% and 35% were included in the study. Patients were divided into two groups, NRB and CPAP based on order of presentation to the hospital. The NRB group received 15 LPM of oxygen. The CPAP group was treated with a non-invasive mechanical ventilator (LTV 1200 portable ventilator) using the CPAP mode (FiO2: 100%, PEEP: 5 cm) using a full face mask. The patient's initial COHb level was measured by venous blood at the time of arrival as well as CO-oximeter. Subsequent and repetitive SpCO measurements (30-minute intervals) were obtained via the CO-oximeter. Based on past clinical experience with CPAP tolerance, CPAP was only used for 90 minutes in the CPAP group, and then oxygen was continued via a non-rebreather mask. Both groups received at least 90 minutes of therapy.

Forty-five patients were enrolled in the study (24 for NRB and 21 in the CPAP group). Median age was 40 years. The number of smokers was higher in the CPAP group than the NRB group (33.3% VS 16.7%). Presenting complaints for all patients were headache (68.9%), nausea and vomiting (15.5%), dyspnea (8.9%), and dizziness (6.7%). The initial SpCO level averaged 25% (range 21–33%). The CPAP group demonstrated a greater decrease in SpCO at 30 minutes than the NRB group [16% (range 12–27%) vs 21% (range 15–28%) respectively, $p<0.001$]. The 60-minute measurements were also lower in the CPAP group [10% (range 7–25%) vs 17% (range 11–26%), $p< 0.001$]. Again at 90 minutes, the CPAP group had significantly lower values [7% (range 2−23%) vs 13% (range 9–25%), $p< 0.001$]. The CPAP group had the fastest decrease from 0 to 30 min [median difference: 8% (range 3–14%), $p< 0.001$]. This improvement in CO levels relieved presenting complaints faster, resulting in earlier discharge from the emergency department (127.6 minutes in the CPAP group vs 201.3 minutes in the NRB group).

This study demonstrated that both the non-rebreather mask and CPAP method are effective in reducing CO levels in the blood. The CPAP method decreased CO levels faster than the NRB method resulting in quicker relief of symptoms and shorter emergency department stays. Limitations of the study include the small number of patients enrolled and that it did not address any possible reduction of neurological sequelae as a result of faster reduction of blood CO levels.

CPAP may be an effective treatment option for CO poisoning in the pre-hospital environment. Providers should note that the CPAP equipment used in this study was able to deliver oxygen at an FiO2 of 100%. It is unknown if the use of standard CPAP equipment with lesser FiO2 delivery capabilities would have the same results or be less advantageous than O2 via an NRB.

3. **Effectiveness of the combat application tourniquet for arterial occlusion in young children.** Kelly JR, Levy MJ, Reyes J, Anders J. J Trauma Acute Care Surg. 2020;88:644–647.

The Combat Application Tourniquet (CAT) has proven its effectiveness in controlling limb hemorrhage in adults in both military combat and civilian trauma settings, both for penetrating and blunt injury. An unanswered question has been the ability of the CAT to stop external hemorrhage in children.

After obtaining institutional review board approval, the authors of this study sought to enroll healthy children ages 1 through 8 years undergoing general anesthesia for elective orthopedic surgery. Permission was obtained from parents or legal guardians as well as from those participants age 7 years and older. Once anesthetized, a CAT was placed as proximal as possible on the limbs and tightened until Doppler pulses were no longer heard. After 30 seconds of arterial occlusion, the tourniquet was removed.

A total of 13 children, ages 2 to 7 years, participated in the study. Seven children were preschool age and 6 were school age. The CAT was applied to 11 upper limbs and 13 lower limbs. The arm circumference varied between 13 and 24 (average 16.3) cm (5.1-9.5 inches, average 6.4 inches). Leg circumference varied between 24.5 and 34.5 (average 27.9) cm (9.6-13.6 inches, average 11 inches). Complete arterial occlusion was achieved in all cases (100%).

Although this was not a prehospital study, the finding that the CAT can successfully provide arterial occlusion in children as young as 2 years of age in this study has applicability for emergency medical care providers of all types and levels. The study is limited by the small sample size, the use of only one commercial tourniquet, and the fact that a minimum effective limb circumference was not determined. However, in children and infants younger than those studied, in whom the CAT may not be able to be effectively applied, external hemorrhage control can usually be obtained by the application of direct pressure to the bleeding site.

4. **Pediatric Prehospital Refusal of Medical Assistance: Association with Suspected Abuse or Neglect.** Mix F, Myers LA, Luke A, Sztajnkrycer MD. Prehosp Emerg Care 2017;21:688-692.

In 2015, it is estimated that approximately 638,000 children (age less than 18 years) were victims of abuse or neglect in the United States. This number represents a 3.8% increase from five years before. Of these children, 75.3 % were victims of neglect, another 17.2% suffered from physical abuse, and approximately 1670 died as a result. Forty-eight of the 50 US states have mandatory reporting rules for medical and public safety workers whenever they identify children of Suspected Abuse and Neglect (SAN). It is thought that between 1 and 5% of all pediatric trauma seen in Emergency Departments may be victims of child abuse.

While adult EMS patients have the autonomy to elect to refuse medical assistance (RMA), children do not. Instead, it is their parent or guardian that makes that decision for them. The authors of this paper looked at the incidence of parental or guardian RMA to see if this could be a predictor of SAN. They conducted a five-year retrospective, cross-sectional analysis of a single EMS agency's pediatric RMA calls. They then used age and complaint matched control groups from transported patients with similar chief complaints to determine if subsequent SAN reports were documented in the patient's Electronic Medical Record (EMR).

Of 1904 pediatric EMS calls, refusal of care occurred in 241. Outcome data were available for 202 of these patients. Twenty-one RMA patients were considered to be SAN (11.4%). The authors did not see a difference in SAN between RMA patients and their age-matched controls (21 vs. 24). The same was true for the complaint matched control group (21 vs. 26). Fifty percent of the SAN patients had a documented follow-up plan. Sixty-three percent of the non-SAN patients had one. For those patients with a follow up plan, 85.7% of the SAN patients acted upon their plan while 84.4% of the non-SAN group followed their plan. The SAN group did not see additional Emergency Room visits, unless that was part of their follow-up care plan.

In this study's patient population, parental or guardian RMA, either single incident or multiple incidents, for pediatric patients was not a reliable predictor of SAN. SAN patients were less likely to have a documented follow-up care plan but if they did, the plan was carried out. They did feel that their EMS patient population had a higher incidence of SAN than the 1% to 5% that has been previously reported for emergency departments and that there are opportunities for improved detection and reporting at the field provider level.

Patient care providers at all levels need to be aware of Pediatric SAN and their state's reporting requirements. This study should compel EMS systems to look at outcome data through their CQI process to determine how well their providers are discovering and reporting pediatric SAN.