Updates in Prehospital Emergency Medical Service Care

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Correction: Daniel Boutsikaris, MD, was an author of the July/August Resident Journal Review: “What is the Evidence for Therapeutic Hypothermia?”

Approximately 15% of all patients seen in the emergency department (ED) arrive via emergency medical services (EMS) which represents over 20 million annual visits.1 For this reason, improvement and expansion of evidence based interventions within the prehospital setting should continue to be explored. In this month’s “Resident Journal Review,” we focus on diagnostic, therapeutic, and logistical updates in prehospital care.

Pain Management

Management of pain after injury in the prehospital setting is important for patient comfort and outcome. The usefulness of opioid analgesia; however, may be limited due to side effects including nausea and respiratory depression.


This prospective, randomized, multicenter, double-blind trial sought to demonstrate the efficacy of using 50% nitrous oxide (N₂O) to treat moderate acute traumatic pain.

Patients with contraindications to N₂O, previous use of analgesic medication, or pregnancy were excluded. Adult patients with moderate traumatic acute pain who met the required inclusion criteria were enrolled over a one-year period. Patients were randomly assigned to receive either pre-mixed 50% N₂O (N₂O group) or medical air (MA group). Fifteen minutes after the beginning of inhalation all patients received 50% N₂O until ED arrival. The primary endpoint was percentage of patients with pain relief (pain score <3) 15 minutes (T15) after initiation of inhalation.

Fifteen minutes after the inhalation, 67% of the patients in the N₂O group had a pain score of 3 or lower versus 27% of those in the MA group (95% CI 17% to 63%, p<0.0001). The median pain scores were significantly lower in the N₂O group at T15 (2 vs 5; p<0.0001). All adverse events were reversible with no other complications five minutes after the end of inhalation.

This study has several limitations but is interesting in that it suggests N₂O may be a possible alternative to opioids in prehospital in patients with traumatic pain.


This prospective, randomized, controlled, open-label study compared IV ketamine with IV morphine in reducing prehospital traumatic pain.

After initial pain control with one dose of morphine, eligible patients were then randomized to receive either additional morphine every five minutes or ketamine every three minutes. Paramedics used clinical judgment to determine dosing on a per patient basis. Patients continued to receive morphine or ketamine according to schedule until they became pain free, arrived at the ED, or experienced a serious adverse event. The primary outcome was change in pain score upon arrival to the ED.

Over three years, 135 patients were enrolled. There were no significant baseline differences between groups. Mean pain score change was -5.6 (95% CI -6.2 to -5.0) in the ketamine group compared with -3.2 (95% CI -3.2 to -1.6) in the morphine group. The ketamine group did experience more adverse effects (39%) than the morphine group (14%).

A major limitation of this study is that only the patients, not the clinicians, were blinded. Additionally, the study did not explain the choice of dosing intervals or ranges for the drugs. The more frequent dosing of ketamine may have biased patients to believe their pain was being more aggressively managed.

This study suggests that ketamine may be superior to morphine for prehospital analgesia though this may be limited by an increase in adverse events effects.

Noninvasive Positive Pressure Ventilation (NPPV)

While the use of NPPV in all causes of acute respiratory failure (ARF) is still controversial, its use in acute cardiogenic pulmonary edema (ACPE) and COPD is well-supported, with NPPV decreasing both intubation and mortality.2-5 While it seems intuitive that earlier respiratory support, such as in the prehospital setting, would further improve outcomes, existing studies are too small to confirm this theory.


This systematic review and meta-analysis examined the treatment of ambulance-transported patients with ARF; including only studies that compared standard prehospital care to standard care plus the initiation of continuous positive airway pressure (CPAP).

The final study analysis included five studies with a total of 1,002 patients, 471 in the CPAP group and 531 in the standard care group. There was no difference between groups in terms of age or gender. Pooled analysis demonstrated a 69% overall reduction in rate of intubation (OR 0.31, 95% CI 0.19-0.51) and a 56% decrease in overall mortality (OR 0.41, 95% CI 0.19-0.87) in the CPAP group. There was no difference in hospital or ICU length of stay (LOS) between groups. An improvement in respiratory rate was documented in the CPAP arm in most studies. There was no difference between groups for reported adverse outcomes.

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Though there are several limitations of this meta-analysis, the results show prehospital CPAP did reduce the overall rate of intubation and decrease mortality.


Rather than focusing only on CPAP, Mal, et al., performed a similar meta-analysis that included all types of NPPV, including bilevel positive airway pressure (BIPAP) and pressure-support ventilation (PSV). The primary outcome of interest was the rate of in-hospital mortality, with secondary outcomes of hospital and ICU LOS, rate of subsequent intubations, and rate of complications secondary to NPPV.

The authors reviewed seven studies that included a total of 632 patients, 313 randomized to standard treatment, and 319 receiving NPPV in addition to standard therapy. The breakdown of etiologies included 522 patients with ACPE, 81 with COPD, 19 with pneumonia, and 10 with asthma. The final analysis demonstrated a benefit of NPPV with a relative risk of 0.58 for in-hospital mortality (95% CI 0.35-0.95) and number needed to treat (NNT) of 18. Six studies reported on rates of invasive ventilation after NPPV, and again there was a demonstrated benefit in the NPPV group, with a relative risk of 0.37 (95% CI 0.24-0.58) and a NNT of 8. Three studies reported hospital LOS, but only one demonstrated a statistically significant benefit to NPPV, and only one of four studies reported a significant improvement in ICU LOS.

The prehospital use of NPPV appears to provide benefits to both morbidity and mortality in ACPE and has been demonstrated to be feasible in a variety of EMS systems. While we still cannot comment on the benefit of prehospital NPPV in asthma and other less-studied conditions, the low rate of adverse events indicates NPPV may be able to be initiated safely in the prehospital setting, irrespective of underlying etiology.

Acute Coronary Syndrome Care

Easy to use prediction tools can aid rapid triage of patients in the ED as well as guide initial workup and therapeutic interventions. One area where these early indicators of serious disease may be beneficial is in the care of patients with suspected acute coronary syndrome (ACS).


This prospective observational study examined whether measurement of serum troponin level (POCt) by EMS providers in the prehospital setting could be used as a predictor of diagnosis and prognosis in patients with suspected ACS.

Of 1,099 patients who had an EKG by EMS, 985 were included in the study. The only exclusion criterion was inability to draw blood on scene. Of these, 192 were diagnosed with an acute myocardial infarct (AMI), but only 73 (39%) of these patients had a positive POCt measurement in the field. Conversely, of the 785 patients not ultimately diagnosed with AMI 34 (5%) had a positive POCt. The highest annual mortality was 0.38 (0.23-0.65 for 95% CI) for those with positive POCt but without AMI. Patients with positive POCt and diagnosis of AMI had an annual mortality rate of 0.17 (0.10-0.27 for 95% CI); and patients with negative POCt had annual mortality rates of 0.06 or less regardless of AMI diagnosis.

This study successfully demonstrates the feasibility of testing POCt levels in the prehospital setting; however the sensitivity for detecting AMI is poor as nearly 2/3 of those having AMI had negative prehospital POCt. A positive POCt was associated with an increased risk of mortality per year suggesting a positive value may have a role as a prognostic factor. More work is required to determine if this early testing may impact patient morbidity or mortality.

Ambulance Diversions

According to the American Hospital Association, 38% of all EDs in the U.S. reported capacity issues, either operating “at capacity” or “over capacity” in 2010. This has led many hospitals to use ambulance diversion as a technique to reduce crowding. In this same year, 50% of all urban hospitals spent some time on diversion. Because of this, many jurisdictions have moved to ban diversions.


This article examined the attitudes of ED staff about the perceived effects of a ban on ambulance diversion on patients, providers, and working relationships in a large urban EMS system. The qualitative study conducted semi-structured interviews of key individuals within ED leadership both before and after the diversion ban. Eighteen total interviews were conducted involving seven physician ED directors, two physician designees, and nine registered nurse leaders. All participants were from one of nine ambulance-receiving hospitals within the city of Boston.

Effects on patients during diversion were noted by most of those interviewed. During times of diversion, many patients were diverted away from the hospital with which they were most familiar. This was viewed as negatively impacting quality of care and patient satisfaction.

Most interviewees stated that providers disliked diversion as refusing patients is fundamentally opposed to the principles of emergency care. This led to feelings of job dissatisfaction, low morale, and high staff turnover, most notably among nurses. However, during times of crowding, some members of the staff request to go on diversion as a way to regroup. This would place colleagues at odds about whether or not diversion was appropriate, with some viewing diversion as a sign of weakness while others viewed it as a necessity. After the ban, these conflicts were eliminated, as diversion was simply not an option.

The diversion ban also improved prehospital and ED provider relationships. Prior to the ban, prehospital providers received negative feedback (both verbal and nonverbal) from various ED staff members if a patient was brought in during a period of diversion. These negative interactions had been nearly eliminated during the ban. Relationships between hospital administration and ED leadership also benefited as the ban prompted
the administration to consider other solutions to capacity problems as diversion was no longer an option.

Although this small qualitative study did not look at patient outcomes its results suggest that a ban on ambulance diversion may have favorable effects.

Resources

It’s a Privilege, Not a Burden
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After years of battling things like prematurely adopted EMRs, government bureaucrats, clueless hospital administrators, greedy insurance companies, malignant tort lawyers, CMG profiteers, and “emergency” patients who don’t need to see any doctor at all — much less an emergency physician — it is easy to become jaded and lose sight of our real value. That’s why I chose to publish this editorial from a medical student. I hope it reminds you of the true worth of what you do, and how important you are. Stay strong!

— The Editor

I recently read an article in the Chicago Tribune entitled, “Expert’s New Career Prescription: Forget About Becoming a Doctor.” In it author Dawn Turner Trice interviews the executive director of the Chicago Area Health and Medical Careers Program, Regnal Jones, who advises students not to pursue a career as a physician. He cites the cost of tuition, the many years of training, the long hours, and more medical graduates than residency spots — among other things — as reasons not to become a physician. I respect his opinion and have no doubt that some of his points are legitimate, especially regarding the cost of tuition and the fact that there are insufficient residency spots for graduating medical students. However, I respectfully disagree with much of what he says. At the end of her article Trice says, “You’ve heard Jones’ position. Now tell me what you think.” Well, I did just that — sending her an email rebutting most of Jones’ arguments. Now I want to explain to you why Jones is largely wrong, and present some of the positive aspects of being a physician.

Before I entered medical school, I understood the path to becoming a physician and what the difficulties would be. I knew about the long hours, time away from family, and a seven-year-minimum investment from the start of medical school until the end of residency. I realized that when “MD” was placed after my name I would carry a debt of over $200,000 — with interest that would accumulate while I was making $50,000 a year as a resident. I knew that as the American population ages, doctors will be in higher demand but will be faced with many uncertainties as the Affordable Care Act becomes more established. I knew that it was becoming increasingly difficult for physicians to maintain their independent practices without relinquishing control and autonomy to hospital systems or other corporations. These are all points Jones makes, and I do not deny that each is a challenge. However, he fails to mention any of the rewards of medicine.

Let’s start with finances, a minor but still relevant reward for practicing medicine. Though physician salaries remain uncertain, especially in light of health care overhaul, I don’t know a single attending physician who makes so little money he is unable to own a home and a car, support a family, and pay back educational loans — simultaneously. While medicine may not be as lucrative as it once was, most physicians are able to live quite comfortably.

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