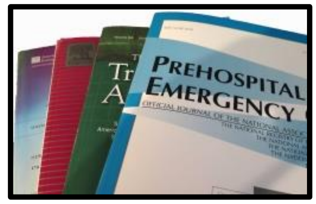
# International Prehospital Medicine Institute




## IPHMI Literature Review

Keeping You Up To Date with Current EMS Literature and Studies

## Vol. 1.11

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1. **Prehospital Use of Ketamine: Effectiveness in Critically Ill and Injured Patients**. Zietlow J, Burns K, Jenkins D, Zietlow S. *Mil Med*. 2019 Mar 1. 184(Supplement):542-544.

Ketamine is an anesthetic drug that has been widely used since the 1950s. It is classified as a dissociative agent, meaning it blocks environmental input from reaching the consciousness. It has both pain control properties as well as amnestic effects. It can be given intravenously (IV), intramuscularly (IM), or intraosseously (IO) and can be used in both pediatric and adult populations for pain control, psychiatric emergencies, and sedation for procedural use. The usual dose is 0.5-2 mg/kg given slow IV push over 1 to 2 minutes. This can be followed by repeat doses as necessary, with a usual time of action of 5-15 minutes. If IV/IO access cannot be obtained, an IM dose of 50 mg is usually equally effective.

Recently the Committee on Tactical Combat Casualty Care (TCCC) has added ketamine to the TCCC pain control guidelines for soldiers injured in combat. They currently endorse the use of acetaminophen (Tylenol™) and meloxicam for those with minor pain who can still perform in combat. Oral transmucosal fentanyl citrate (OTFC) is used for those in moderate to severe pain who are hemodynamically stable. Ketamine is recommended for combatants in moderate to severe pain who are also in hemorrhagic shock or respiratory distress.

While the use of ketamine has been very successful in the military setting, the civilian prehospital sector has been slower to adopt its routine use for pain control. This study was conducted by the Mayo One Medical Transport service, which provides helicopter and critical care ground transportation in a three state region of Minnesota, Iowa, and Wisconsin. They reviewed their experience with prehospital ketamine use from 2014-2016. During this time there were 167 incidents of ketamine administration for analgesia, sedation, or procedural use. The average patient population was 49 years old with 67% of the patients being male. Pediatric patients comprised 3% of the study group while patients above the age of

65 were 20% of the study group. Trauma was the most common indicator (69%) with medical patients making up the remainder (31%). Ketamine was used in 61% of patients after other medications, such as fentanyl, Dilaudid, or midazolam, were ineffective. The mean pain scale prior to ketamine use was 9/10, with the mean pain scale after use being 3/10. Eight (5%) patients had a decreased respiratory rate or oxygen saturation requiring bag mask ventilation after ketamine administration, but all recovered in less than 30 seconds. There were no hypotensive episodes reported. Additionally seven patients who were hypotensive became normotensive following ketamine use.

This study demonstrates the safety and effectiveness of ketamine use in the civilian prehospital setting. It has several advantages over narcotics in that it can be used in hypotensive trauma patients without lowering the blood pressure. In fact several patients had an improvement in blood pressure following ketamine administration. Additionally, ketamine is known to alleviate bronchospasm and reduce airway resistance in patients with underlying pulmonary disease. Because of this, it is ideal for rapid sequence intubation (RSI) in patients with COPD or asthma. Further studies are warranted to confirm these results; however ketamine appears to be safe and effective in the civilian prehospital setting.

2. **Timing of advanced airway management by emergency medical services personnel following out-of-hospital cardiac arrest: A population-based cohort study.** Izawa, J, Iwami, T Gibo, K, Okubo, M, Kajino, K, Kiyohara, K, et al. *Resuscitation* 2018;128:16-23.

The American Heart Association's (AHA) Advanced Cardiac Life Support Course stresses that providers must be aware of the risks and benefits of advanced airway management (AAM) during a cardiac arrest resuscitation attempt. Although insertion of an advanced airway (supra-glottic devices or endotracheal intubation) can be accomplished during ongoing chest compressions, placement is frequently associated with interruption of compressions for many seconds. The AHA's published position is that there is inadequate evidence to define the optimal timing of advanced airway management in relation to other interventions during resuscitation from cardiac arrest. Studies have been conflicting.  A study of 25,006 in-hospital cardiac arrests, showed earlier time to AAM (<5 minutes) was not associated with improved ROSC but was associated with improved 24-hour survival.  In an urban out-of-hospital setting, AAM achieved in <12 minutes was associated with better survival than AAM achieved in ≥13 minutes.  Another recent study found that delayed endotracheal intubation combined with passive oxygen delivery and minimally interrupted chest compressions was associated with improved neurologically intact survival after out-of-hospital cardiac arrest in patients with adult witnessed VF/pulseless VT.  The current study investigates the timing of AAM and its association with favorable outcome from out of hospital cardiac arrest (OHCA).

The EMS system in Osaka, Japan serves 8.8 million residents in both urban and rural communities. Each ambulance is staffed with three EMS providers who are authorized to use an AED, and one of whom is an emergency life-saving technician (ELST). ELST's may insert an intravenous line, administer adrenaline, and place AAM devices for OHCA patients under on-line medical direction.  All OHCA patients are transported to the hospital.  The authors screened seven years of data from all consecutive OHCA cases aged ≥18 years for whom EMS personnel attempted CPR. Traumatic arrests, patients whose time from the call to EMS until the start of CPR by EMS was ≥60 min, whose time between the start of CPR by EMS and the achievement of AAM was ≥30 min, or whose Glasgow-Pittsburgh Cerebral Performance Category scale (CPC) at one-month after OHCA was unknown were excluded from the study. There were 27,471 patients with OHCA treated with an AAM. Cases were divided into Early AAM, 0-4 minutes (11,536) and Late AAM, 5-29 minutes (15,939).

Primary outcome was functionally favorable survival at one-month. The authors estimated adjusted odds ratio (OR) of survival from time of CPR to AAM using multivariable logistic regression. In the secondary analysis, they divided the time from CPR to AAM into early (0–4 min) and late (5–29 min). They then calculated propensity scores (PS) for early AAM and performed PS-matching. Time from CPR to AAM was inversely associated with functionally favorable survival (adjusted OR 0.90 for one-minute increments as a continuous variable, 95% confidence interval [CI] 0.87–0.94). In the PS-matched cohort of 17,022 patients, early AAM, compared to late AAM, was associated with functionally favorable survival: 2.2% vs. 1.4%; adjusted OR 1.58 (95% CI 1.24–2.02).

There were several limitations to the study. All patients were from a single EMS System. Not all providers used the same AAM device. Most providers inserted supra-glottic airways while a small number of trained ELST's were allowed to use endotracheal intubation. Because AAM happened only when patients were still receiving CPR, a time bias toward favorable outcomes with earlier return of spontaneous circulation (ROSC) could exist.

This single system study demonstrated slightly better functional survival of OHCA patients with earlier AAM. This paper adds to the conflicting data regarding this issue. Unfortunately, the authors missed an opportunity to compare the outcome of OHCA patients who did not receive AAM with those who did as they chose not to analyze an additional 16,000 cases that were managed without AAM. The answer to the question of optimal airway management and the timing of that intervention for OHCA will have to await additional study.

3. **Association between Emergency Medical Service Response time and Motor Vehicle Crash Mortality in the United States.** Byrne J, Mann C, Dai M, et al. *JAMA Surg.* 2019;154(4):286-293.

The leading cause of trauma morbidity and mortality in the U.S. (and world-wide) is motor vehicle crashes (MVCs). Emergency Medical Services (EMS) ambulance response is an important bridge between the time of injury and the time to definitive care. This study looked to evaluate the relationship between ambulance response time (RT) and death from MVC.

This study is a retrospective study evaluating EMS response time and mortality from motor vehicle crashes in 2268 counties in the USA during a three year period from January 2013 to December 2015. The study used data obtained from the National Emergency Medical Services Information System (NEMSIS) and the National Highway Traffic Safety Administration Fatality Analysis Reporting data. Inclusion in the study was limited to crashes involving standard motor vehicles and excluded motorcycles, heavy trucks, pedestrians and bicyclists as well as refusals of service and transport to urgent care centers.

During the study period there were over 2.25 million ambulance responses to MVC's. The average response time for these responses was 9 minutes. Rural/Wilderness counties had an average longer response times, had greater scene and transport times and generally had less access to a level 1 or 2 trauma center. The mortality rate was 11.9 per 100,000 person-years for counties with RT ≥12 minutes versus 4.9 for counties with a RT <7 minutes. Higher speed limits were associated with higher mortality while one-third lower mortality was found in counties with access to a level I or II trauma center.

The authors conclude that patients involved in MVC's with longer EMS response times in both rural/wilderness and urban/suburban locations have a significantly increased mortality after adjusting for such confounders as rurality, on-scene time, and transport times. Another important aspect that requires further study is the response time of first responders/care givers to MVCs. The available data for this study only looked at ambulance response times and not time to first care.

While EMS response time is one piece of the puzzle, it is not the only piece. An overall realignment of the trauma system focusing on getting the critically injured patient timely on-scene care and ongoing care at an appropriate level 1 or 2 trauma center must be considered. A comprehensive analysis of all variables, the modifiable aspects of response, and the associated costs of improving EMS response times and trauma care should be undertaken.

4. **Differences in Prehospital Patient Assessments for Pediatric Versus Adult Patients.** Ramgopal S, Elmer J, Escajeda J, Martin-Gill, C. *J Pediatrics* 2018;199:200-205.e6

EMS providers deliver care to patients of all ages. Approximately 10% of those patients are classified as pediatric. Pediatric patients that utilize the EMS system are generally more acutely ill than those who are transported by other means.

This study is a retrospective review of ground transports of pediatric patents by 20 urban, suburban, and rural EMS agencies in Southwestern Pennsylvania between April 2013 and December 2016. The goal of the study was to determine the rate of documentation of vital signs including heart rate, respiratory rate, and systolic blood pressure. Secondary outcomes also measured GCS and pain scores. A pediatric patient was defined as less than eighteen (18) years of age. The patients were further sub-categorized as: neonates (≤30 days), infants (1 month to <1 year), toddlers (1 to <2 years), early childhood (2 to <6 years), middle childhood (6 to <12 years) and adolescents (12 to <18 years). Twelve diagnostic categories were recorded; medical, trauma, respiratory, allergic, GI, cardiovascular, neuro, psychiatric, toxicology, syncope and other.

Of 371,746 patients transported, 21,882 were pediatric patients. This study demonstrated that the documentation of vital signs increased with age. The measurement and documentation of systolic BP shows the most drastic change between the early age groups (neonate, infant and toddler) as compared to early childhood, middle childhood, adolescent and adult. Measurement of BP took place only 50.4% of the time in the neonate compared to 98.9 in the adult patients. Documentation of all three vital signs also increased with increasing age from 49.6% in neonates to 97.7% in adults with measurement of vital signs from middle childhood and older nearly equivalent to the adult population. Of note, pulse oximetry had lower rates of documentation, even in pediatric patients with respiratory complaints.

This paper again demonstrates a deficit in prehospital care that has been documented in the past, but often ignored, specifically the measurement of complete vital signs (especially BP and oxygen saturation) in the pediatric age group, particularly the very young. As the patient grows older, obtaining these measurements increases, until reaching adult equivalencies in the 6-12 year old age group. The failure to adequately document vital signs raises a number of questions that this study does not answer.

1. What are the barriers to obtaining vital signs on these smaller and younger pediatric patients?
2. Does this lack of obtaining vital signs change the outcome of these particular pediatric patients?
3. Are the vital signs that were obtained and documented accurate within acceptable variances compared to the actual vital signs?

This paper points to the need for further research in the three areas above as well as an aggressive educational effort to improve EMS provider pediatric assessment.