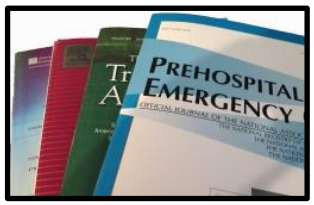
International Prehospital Medicine Institute



IPHMI Literature Review

Keeping You Up to Date with Current EMS Literature and Studies

Vol. 7.2

1. **Prehospital Use of Ketamine versus Midazolam for Sedation in Acute Severe Agitation.** Johndro C, Caffyn S, Chen J, et al. International J Paramedicine 2024;7:23-30. Available on-line at: https://internationaljournalofparamedicine.com/index.php/ijop/article/view/3015
2. **Witnessed prehospital traumatic arrest: predictors of survival to hospital discharge.** Schellenberg M, Owattanapanich N, Ugarte C, et al. European Journal of Trauma and Emergency Surgery. 2024;50(3):959-65.
3. **Evaluation of essential basic life support interventions for foreign body airway obstructions: A population-based cohort study.** Dunne CL, Cirone J, Blanchard IE, et al. Available on-line at: https://doi.org/10.1016/j.resuscitation.2024.110258
4. **Ambulance response times and 30-day mortality: a Copenhagen (Denmark) registry study.** Mills AAM, Mills EHA, Blomberg SNF, et al. European Journal of Emergency Medicine 2024, 31:59–67

1. **Prehospital Use of Ketamine versus Midazolam for Sedation in Acute Severe Agitation.** Johndro C, Caffyn S, Chen J, et al. International J Paramedicine 2024;7:23-30. Available on-line at: https://internationaljournalofparamedicine.com/index.php/ijop/article/view/3015

Agitated patients in the prehospital setting are both difficult to deal with and can pose a threat to themselves and to the providers attempting to care for them. When verbal de-escalation techniques fail, providers frequently opt for chemical restraint to safely transport agitated patients. Agitation in the prehospital environment can result from many causes or combination of causes. Prolonged agitated states may result in the patient experiencing acute severe agitation, which can be life threatening. Patients with acute severe agitation may present with mania, delirium, catatonia and in severe cases cardiac arrest from dysrhythmias resulting from catecholamine release in the presence of metabolic acidosis.

Historically, prehospital providers have treated acute severe agitation with benzodiazepines and antipsychotic medications, which have a delayed onset of action. More and more EMS agencies and protocols have progressed to including ketamine, a fast acting (3-4 minutes) dissociative anesthetic, as an intramuscular injection for sedation. Previous studies have indicated a higher rate of airway support for patients that received ketamine in the field for sedation. Ideally, prehospital sedation should be targeted to lowering the patient's Richmond Agitation-Sedation Scale (RASS), a ten-point scale ranging from -5 to 4 with -5 being unarousable to 4 being in a combative state, to -1, 0 or 1.

The authors of this paper compared the effects of midazolam versus ketamine when used by paramedics to manage acute severe agitation. This is a single site, institutional review board approved, retrospective study of EMS patient records and mandated quality assurance forms for patients that received either ketamine or midazolam for agitation between 9 February 2017 and 31 July 2018. Reviewers then evaluated these patients' hospital charts looking for a primary end point of endotracheal intubation in the field or within one hour of arrival at the emergency department. Secondary endpoints

were an improved RASS score (-1, 0 or 1), the need for additional sedation, airway or breathing support, or adverse events.

Two hundred and seventy-seven adult patients were initially identified. This number was culled down to 134 (66 in the ketamine group and 68 in the midazolam group) due to incomplete records, alternate indications for medication and RASS scores <3 or being transported to a hospital other than the research facility. Patient demographics were similar in each group. Differences in the groups included a slightly higher mean age in the midazolam group (44 years of age versus 35) and higher initial RASS scores in the ketamine group (3.88 Vs 3.63). In both groups, there were more male patients than females.

The mean prehospital ketamine dose given was 288 mg (3.32 mg/kg), lower than previous studies looking at post ketamine intubation rates, and 5.6 mg for midazolam (0.066 mg/kg). Consistent with previous research, more patients in the ketamine were intubated within one hour of arrival at the hospital (6.1% versus 2.9% vs midazolam, p = 0.383) although this difference was not statistically significant. A greater number of patients in the midazolam group achieved desired sedation (RASS of -1, 0 or 1) than in the ketamine group (28 versus 13). The ketamine group did experience a deeper initial sedation level, exceeding the desired RASS of -1, 0 or 1. The ketamine group also experienced a greater rate of re-sedation in the hospital. This was thought to be a result of re-emergence syndrome from the ketamine sedation.

The authors acknowledge multiple limitations in their work. The first two being the low number of enrolled subjects and the single site nature of their retrospective work. They also acknowledge that they were unable to meet their full enrollment goals of at least 70 patients in each group. It should also be noted that all data was self-reported by attending providers. Patients with initial RASS >3, were also excluded from the study.

Patients with severe agitation are a risk to public safety providers trying to render aid and protect them from further injury. Comorbidities like existing mental health issues and substance abuse problems compound a provider's ability to de-escalate these patients, often resulting in the need for chemical sedation. Both ketamine and midazolam are viable options for chemical sedation. They can both be given via the intramuscular route and are relatively fast acting. Providers need to be cognizant of appropriate patient weight estimates and weight-based medication dosing. EMS systems should consider using a pre- and post-sedation behavioral scale for patients who receive prehospital sedation for both confirmation of appropriate prehospital sedation and research. Chemical sedation is a viable option to control otherwise agitated patients who pose a threat to themselves and healthcare workers and should be used judiciously with appropriate medical oversight and quality assurance initiatives.

2. **Witnessed prehospital traumatic arrest: predictors of survival to hospital discharge.** Schellenberg M, Owattanapanich N, Ugarte C, et al. European Journal of Trauma and Emergency Surgery. 2024;50(3):959-65.

Prehospital traumatic cardiac arrest is a criterion for full trauma team activation yet has a low probability of patient survival. Patients who are alive on-scene but go into cardiac arrest en route to the hospital with EMS are a cohort of patients who have a higher probability of survival to hospital discharge. The goal of this study was to delineate predictors of survival among patients who arrest with EMS on the way to definitive care while recognizing that overall survival remains low.

The National Trauma Data Bank (NTDB) is a large, national database created by the American College of Surgeons Committee on Trauma (ACS-COT) of all trauma patients transported to an ACS-verified trauma center. Participation is mandatory for all Level 1 and 2 trauma centers and voluntary for the others. This is a retrospective study of NTDB patients from 2017-2018 of all trauma patients who

had an EMS-witnessed cardiac arrest either on scene or during transport to the hospital. Witnessed prehospital cardiac arrest was defined as any patient with a documented blood pressure and heart rate upon EMS scene arrival but were in cardiac arrest upon arrival to the hospital. Study groups were divided into three categories based on survival status. Group 1 were patients who survived to hospital discharge. Group 2 survived through the emergency department (ED) but died later in the hospital. Group 3 patients were pronounced dead on arrival (DOA) or died in the ED.

A total of 14,711 patients were included in the study. Of these, 1487 survived to hospital discharge (a 10% overall survival rate); 3126 died in the hospital (22%); and 9564 (68%) were DOA or died in the ED. Overall 1048 (12%) of blunt trauma patients survived to discharge compared to 371 (7%) of penetrating trauma patients. Survivors to discharge had a higher initial systolic blood pressure (SBP) than those who died later in the hospital or were DOA (121 mmHg vs 105 mmHg vs 101 mmHg respectively). The initial Glasgow Coma Scale (GCS) score also differed among groups (15 for group 1 vs 3 for groups 2 and 3). Among those who survived to hospital discharge, the majority (54%) were discharged directly home. Survival to hospital discharge was higher among those with a higher initial SBP and GCS. Increasing age, male sex, higher initial heart rate, lower head abbreviated injury score (AIS), higher injury severity score (ISS) and penetrating mechanism were all associated with a lower rate of survival to hospital discharge.

This study demonstrates that predictors of survival following witnessed prehospital traumatic cardiac arrest include female sex, younger age, a blunt trauma mechanism, and higher initial SBP and GCS. Scene GCS was particularly striking as a predictor of survival, which is not surprising as survival from cardiac arrest in patients with a severe head injury is highly unlikely.

This study has several limitations. The NTDB is a large, nationwide dataset in which it is impossible to assess the accuracy of the data inputted into the registry. Traditionally penetrating trauma patients who undergo resuscitative thoracotomy have a slightly higher rate of survival than blunt trauma patients in cardiac arrest, but that was not demonstrated in this study. The reasons are unclear to the authors and may be related to the quality of the data in the registry. This is a retrospective study, so a complete understanding of the details of the prehospital cardiac arrest is impossible to discern. The survivors in this study had a higher head injury AIS score, which doesn't make clinical sense. Due to the inherent weaknesses of large retrospective database reviews it is impossible to explain this discrepancy and may be related to data input errors.

I n summary, this study demonstrates a 10% survival from EMS-witnessed prehospital cardiac arrest. Predictors of survival include female sex, higher on-scene initial blood pressure and GCS, and a blunt mechanism. The data in this study was gathered from 2017-18 and much has changed in prehospital trauma care since that time, particularly the increased usage of tranexamic acid (TXA) and prehospital blood transfusion practices. Survival may be higher now due to these changes in prehospital care but cannot be discerned from this study. Further studies are warranted using our current prehospital treatment protocols to discern if this data is still relevant.

3. **Evaluation of essential basic life support interventions for foreign body airway obstructions: A population-based cohort study.** Dunne CL, Cirone J, Blanchard IE, et al. Available on-line at: https://doi.org/10.1016/j.resuscitation.2024.110258

Foreign body airway obstruction (FBAO) presents a substantial risk not only to individuals with impaired consciousness but also to those who are otherwise healthy. In cases of complete FBAO, immediate intervention by trained bystanders is crucial, as it may be difficult for first responders to arrive in time. Without prompt intervention, the lack of ventilation and oxygenation can lead to a high

risk of severe neurological damage or death. For years, essential Basic Life Support (BLS) techniques have included abdominal thrusts, back blows/slaps, and chest thrusts/compressions. A recent systematic review found that the evidence supporting their effectiveness is limited and mainly stems from case series and cross-sectional studies.

The purpose of this study was to evaluate the effectiveness of FBAO interventions. Population-level data from Alberta, Canada, were gathered between January 1, 2018, and December 31, 2021, from patients of all ages who experienced an out-of-hospital FBAO and called EMS. The only exclusions were patients who presented with tracheostomy tubes in place. The search of the electronic patient care record (ePCR) revealed 3,677 unique patient encounters that met the case ascertainment criteria, with 709 (19.3%) classified as foreign body airway obstruction (FBAO) cases requiring intervention. The primary reason for excluding an FBAO case was if the obstruction was mild or partial and resolved by the patient without needing BLS intervention. Most FBAO patients were either very young (aged one or younger, 26.9%) or elderly (older than 65, 36.7%). Gender distribution was almost equal, and solid food was the most common cause of FBAO (80.8%). Most incidents (22.7%) occurred among long-term care residents, with most cases witnessed (86.2%).

Bystanders performed the initial FBAO intervention in 643 (90.7%) of cases, successfully relieving the obstruction in 76.5%. Abdominal thrusts were the most common initial intervention (46%), followed by back blows (36.4%) and chest compressions (17.6%). Back blows were associated with greater odds of FBAO relief and survival to discharge compared to other BLS interventions and combinations. This study also found that back blows did not have any intervention-associated injuries, unlike abdominal thrusts and chest compressions/thrusts. Responding paramedics were able to relieve an FBAO using Magill forceps in 52 of 70 unconscious patients.

The study authors identified limitations related to potential information bias, as paramedics collected data from untrained bystanders. Bystanders may have misidentified non-FB choking incidents as FBAO or reported interventions that were performed ineffectively or incorrectly which could have influenced the study's findings. If intervention quality were equally poor across all techniques, it would reduce the study's associations. The study also couldn't assess neurological outcomes, but only 1.4% of patients needed higher-level care after discharge. Lastly, the interventions were not time-recorded therefore the times from obstruction to intervention to relief could not be evaluated.

While there is a significant risk to the patient who presents with FBAO, bystander intervention is paramount to relief of the obstruction and increased survival. This study shows that the involvement and assistance of bystanders in these situations is not an issue. However, the most effective BLS intervention, still has not been effectively established. Further study is needed to determine the best intervention and the one that most bystanders would be willing and best able to safely employ in these situations.

4. **Ambulance response times and 30-day mortality: a Copenhagen (Denmark) registry study.**
   Mills AAM, Mills EHA, Blomberg SNF, et al. European Journal of Emergency Medicine 2024, 31:59–67.

Over the years, some studies have shown that critical patients have better outcomes when ambulance response times are as short as possible while other studies have shown no significant association between response time and trauma patient mortality. Conflicting results have also come from studies looking at response times for all medical conditions with some studies showing higher mortality with longer response times and other showing no difference unless the response times are greater than 4 minutes, particularly for cardiac arrest patients.

This Danish study sought to address the effect of prehospital response times on patient outcomes. The authors set out to investigate the association between response time and 30-day mortality for all ambulance responses of high priority in the Capitol Region of Denmark between 2014 and 2018. All priority A ambulance responses which called for a "lights and sirens" response were included. Patient records missing key data points such as times, date of birth and response times below 0 or above 24 hours were excluded as were psychiatric responses and newborn transports.

The study evaluated 337,433 ambulance responses that fit into the "A" or highest priority patients, of which 266,265 responses remained after exclusions were applied to 182,895 patients. The patients had a median age of 59.9 years and 51% were male. They noted that unconscious patients and crash victims dominated the faster response times while chest pain and dyspnea were over represented in longer response times. The median response time was 8.6 minutes with 75% arriving in under 11.8 minutes.

The results of their analysis showed no clear association between ambulance response times and 30-day mortality. In fact they found slightly increased mortality with shorter response times. Cardiac arrest was the exception to these trends with short response times resulting in improved survival.

The study was performed retrospectively study which is a limitation. They also pointed out that response times can vary as information obtained by dispatch and responding crews may upgrade the response to get an ambulance to the scene faster. In addition, they did not distinguish between low-energy and high energy vehicular crashes which may have diminished the significance of fast responses to high energy incidents. While the authors included the gross 1-day mortality, they did not perform any statistical analysis of the effect of response time.

With the exception of cardiac arrest patients who benefited from short response times in this study, there was no correlation between response times and 30-day mortality. In looking to explain their results being contrary to popular assumptions, they suggest that these response times may fall below the threshold point where faster response times no longer provide additional benefit. This study suggests that formal response time criteria, while commonly used to evaluate EMS system performance, remain elusive for all medical complaint outcomes except for cardiac arrest.