

Show Notes

Here are the abstracts from the posters we discussed on this episode of Lighthouse Project Podcast.

EVALUATING THE UTILITY OF PREHOSPITAL SHOCK INDEX AND MODIFIED SHOCK INDEX TO PREDICT HOSPITAL SEPSIS AND SEPTIC SHOCK DIAGNOSIS

Remle Crowe, Antonio Fernandez, Ryan Schroeder, Scott Bourn, J. Brent Myers, ESO

Introduction: Prehospital sepsis recognition can reduce morbidity and mortality. Systolic blood pressure (SBP) < 90 is often included in sepsis detection criteria; however, sepsis may exist when SBP appears normal. Shock index (SI) and modified shock index (MSI) may be stronger predictors and are readily obtained in the prehospital setting; however, their predictive value for sepsis has not been assessed for use by EMS. **Objective:** To evaluate initial prehospital SI, MSI, and SBP as predictors of hospital sepsis/septic shock diagnosis. We hypothesized that SI and MSI would be stronger predictors of sepsis compared to SBP. **Methods:** For this retrospective analysis, we used linked prehospital and hospital patient care records from the national Health Data Exchange research database maintained by ESO (Austin, TX) from 1/1/2018–12/31/2018. We included all medical 9-1-1 responses with linked hospital diagnoses. We excluded patients <18 and those with traumatic injuries. We defined sepsis/septic shock diagnosis using hospital ICD10 codes. We calculated SI by dividing initial heart rate by initial SBP and MSI by dividing initial heart rate by initial mean arterial pressure. Using previous research, we defined elevated SI as >1.0 and elevated MSI was >1.3. We used multivariable logistic regression models to separately evaluate SI > 1.0, MSI > 1.3, and SBP < 90 as predictors of sepsis/septic shock, controlling for patient age, gender, race/ ethnicity, community size, and geographic region. Adjusted odds ratios (aOR) and 95% confidence intervals (95%CI) are reported. **Results:** We analyzed 325,558 records. Median age was 60 (IQR:43-75), 53% were female, 69% were white, and 94% were in urban communities. Five percent (n 1/4 16,881) were diagnosed with sepsis. Of these, 19% had septic shock (n 1/4 3,144/16,881). There was over a 5-fold increase in odds of sepsis diagnosis for patients with an initial SI > 1.0 (aOR:5.30, 95%CI:5.08–5.52) or MSI > 1.3 (aOR:5.42, 95%CI:5.21–5.64). A 9-fold increase in odds of septic shock was observed for patients with initial SI > 1.0 (aOR:9.05, 95%CI:8.32–9.85) or MSI > 1.3 (aOR:8.61, 95%CI:7.92–9.36). Initial SBP < 90 demonstrated a weak association with sepsis (aOR:0.99, 95%CI:0.98–0.99) or septic shock diagnoses (aOR:0.97, 95%CI:0.97–0.98). **Conclusion:** Elevated initial prehospital SI and MSI demonstrated stronger associations with sepsis diagnosis compared to SBP < 90 in this population. Limitations include not accounting for EMS provider impressions.

ARTIFICIAL INTELLIGENCE AND EMERGENCY MEDICAL SERVICES: CAN A MACHINE LEARNING FRAMEWORK IMPROVE THE IDENTIFICATION OF OUT-OF-HOSPITAL CARDIAC ARRESTS DURING 9-1-1 CALLS?

Catherine Counts, Lars Maaløe, Janek Latko, Jakob Havtorn, Michael Sayre, University of Washington School of Medicine

Introduction: Delivery of telephone CPR instructions is dependent on suspecting out-of-hospital cardiac arrest (OHCA) during the 9-1-1 call. We developed a novel machine learning framework (MLF) that applies deep learning to 9-1-1 call audio in order to predict OHCA in real-time. We compared telecommunicator identification of OHCA to the MLF prediction, hypothesizing that MLF will identify more OHCA events than telecommunicators. **Methods:** We included 1,767 hours of 9-1-1 medical call audio recordings at a single call center serving a 725,000 population American city. Thirty percent were used to train, 19% were used to validate, and the remaining 51% were used to test the MLF. We compared the recognition of OHCA as well as the median time to detection (TTD) of the telecommunicators to that of the MLF. **Results:** Between August 2017 through February 2018, 33,054 calls from mostly English speakers were recorded. We excluded cases when the OHCA developed after EMS arrival and OHCA cases with no resuscitative efforts, leaving a final test set of 195 OHCA (0.6%) and 32,549 non-OHCA cases. Telecommunicators achieved a sensitivity of 68.7% (CI:62.2-75.2%; Likelihood ratio positive [LR] 57.3) and a specificity of 98.9% (CI:98.9-99.1%; LR 0.32). Compared to telecommunicators, the MLF increased sensitivity to 74.9% (CI:68.8-81.0%; LR 37.8) with a specificity of 98.0% (CI:97.8-98.2%; LR 0.26). During calls in which OHCA was detected, telecommunicators and MLF had similar median TTD of 58 seconds with IQR of 32-84 seconds and 41-87 seconds respectively. Combining the positive predictions of the MLF with the telecommunicator showed additional increase in sensitivity: 76.4% (CI:70.5-82.4%; LR 36.4) with a specificity of 97.9% (CI:97.7-98.1%; LR 0.24). About 40% of the MLF false positives were also telecommunicator false positives. The full analytic strength of the MLF is limited by the use of only spoken words. **Conclusions:** The highest sensitivity for detection of OHCA during 9-1-1 calls may occur when the machine augments telecommunicators. The MLF could have a significant impact on the identification and care of patients with OHCA.

PREHOSPITAL EPIDEMIOLOGY AND TREATMENT OF PATIENTS WITH ATRAUMATIC HEADACHE

Jeffrey Jarvis, Bryce Johnson, Remle Crowe. Williamson County EMS

Introduction: Headaches are a common cause for presentation to the Emergency Department. Substantial evidence supports the management of atraumatic headaches in-hospital with non-opiate medications, especially dopamine

antagonists. While much is known about in-hospital management of headaches, little is known about presentation or management out-of-hospital. **Objective:** The primary objective was to describe the epidemiology and treatment of prehospital atraumatic headaches in adults. The secondary objective was to describe meaningful pain reduction by commonly administered medications. **Methods:** This retrospective evaluation was conducted using the 2018 research dataset from ESO (Austin, TX). We included all 9-1-1 responses by paramedic-level crews for adult patients (18 and older) with a primary impression of headache or migraine. We excluded patients with trauma, fever, suspected alcohol/drug use, or receiving medications suggesting an alternative condition. For patients with multiple pain scores and an initial pain score >5, we described the proportion of patients with a clinically significant reduction in pain (>1.4 points), stratified by medication given. We calculated median and interquartile ranges [IQR] for continuous variables, and proportions for categorical data. **Results:** Of the 5,977,612 emergency responses, 66,235 (1.1%) had an impression of headache/migraine and 34,763 (52.5%) met inclusion criteria. The median age was 50 [IQR 35,65]. Two-thirds were female (66.8%) and approximately half were white (51.2%). An initial pain score was recorded for 22,544 (73.5%) patients and 14,948 (58.5%) patients had multiple pain scores. 8,037 (53.8%) patients had multiple pain scores and an initial pain score >5. Of these, 1,545 (19.2%) were administered any medication. Ondansetron was most commonly administered (n 1/4 703, 45.5%). Opioids were associated with the largest proportion of clinically significant pain reduction; fentanyl was given to 126 (8.2%) with 70.6% having a meaningful pain reduction. Dopamine antagonists were given rarely (e.g., prochlorperazine, n 1/4 8, 0.5%). **Conclusion:** Prehospital pain scores were documented infrequently. Less than one-fifth of patients with initial pain scores >5 received medication. The use of subjective retrospective data and different charting requirements were limitations of this study. This exploratory description provides a baseline for future studies and suggests room for improvement for prehospital assessment and treatment of pain among patients experiencing atraumatic headache.

SUSTAINED PREHOSPITAL TERMINATION OF BENZODIAZEPINE-REFRACTORY STATUS EPILEPTICUS WITH PARENTERAL RESCUE KETAMINE ADMINISTRATION

Kenneth Scheppke, Peter Antevy, Michael Perlmutter, Charles Coyle, Sebastian Garay, Paul Pepe, Palm Beach County Fire Rescue, Coral Springs-Parkland Fire Rescue

Purpose: Benzodiazepines remain the cornerstone prehospital treatment for seizures. However, paramedics generally have not routinely used other pharmacological tools for seizures refractory to benzodiazepines. While ketamine is occasionally administered in-hospital for status epilepticus, data are lacking for corresponding prehospital use. The purpose here was to report an initial

experience with the use of ketamine by paramedics for treatment of seizures refractory to parenteral midazolam. **Methods:** A retrospective analysis of patients who received parenteral ketamine for midazolam-resistant seizures (persisting convulsions after a 10 mg cumulative dosing of midazolam in both adults and children) from 2 proximal (but separate) EMS agencies over 2.5 years (January 2017–July 2019). The protocol called for administration of ketamine at a dose of 100 mg IV/IO in adults (1 mg/kg IV/IO pediatrics), or 3 mg/kg IM (adults and pediatrics). The primary outcome was the frequency of sustained seizure termination prior to hospital arrival following ketamine administration. Secondary outcomes included the frequency of oxygen desaturation (90%) and frequency of the need for invasive airway management following ketamine.

Results: Of 16 patients meeting criteria, all were over 14 years of age with a mean age of 40.5 years (range 14–84) and 75% were women. Ketamine administration was provided intravenously (n/4 10), intramuscularly (n/4 5), or by intraosseous route (n/4 1). Sustained termination of seizure activity occurred in 93.7% following ketamine administration. Oxygen desaturation (spO₂ 90% observed at any time) occurred in 5 patients (but prior to ketamine in 2 of the 5). Normalization of oxygenation occurred in all 5 cases using supplemental oxygen in 3 cases, bag-valve-mask assisted ventilation in 1, and endotracheal intubation in 1 (for compromised airway reflex). No discernible differences could be delineated between the 2 EMS agencies although one agency exclusively used the intramuscular route. **Conclusion:** In this series of patients treated for seizures refractory to significant doses of midazolam, ketamine was effective in sustained prehospital termination of seizure activity in 93.7% of cases (15/16) and advanced airway management was required in one of 16 cases.

PREHOSPITAL RECOGNITION OF PATIENTS DIAGNOSED WITH SEPSIS AND SEPTIC SHOCK

Antonio Fernandez, Remle Crowe, Scott Bourn, J. Brent Myers, ESO

Introduction: Prehospital sepsis recognition may reduce time to treatment and lead to better outcomes. It is unknown how often sepsis is recognized in the prehospital setting. **Objective:** Estimate EMS sepsis recognition and describe prehospital characteristics of patients diagnosed with sepsis/septic shock. We hypothesized that sepsis was recognized in less than 30% of cases. **Methods:** Linked prehospital and hospital patient care records from the national Health Data Exchange research database, maintained by ESO (Austin, TX), were used for this retrospective analysis. All 9-1-1 patients from 1/1/2018–12/31/2018 with hospital ICD10 codes indicating sepsis or septic shock were included. Patients <18 and trauma patients were excluded. Prehospital provider primary or secondary impression of Sepsis/Septicemia was used as a proxy for EMS sepsis recognition. Descriptive statistics were calculated. **Results:** There were 325,558 adult non-trauma patients with linked EMS hospital records, 16,881

(5.2%) were diagnosed with sepsis. Of these, 18.6% (3,144/16,881) were diagnosed with septic shock. For all sepsis patients, median age was 71 (Interquartile range [IQR]:59-81), 49.6% were female, and 81.7% were white. Median initial systolic blood pressure (SBP) was 128 (IQR:104-150), median diastolic blood pressure (DBP) was 72 (IQR:60-86), median heart rate (HR) was 104 (IQR:88-120), and median respiratory rate (RR) was 20 (IQR:16-25). Prehospital temperature was documented for 40.1% (6,764) of sepsis patients (median 1/4 100 degrees; IQR:98-101). Septic shock patients median SBP was 108 (IQR:86-134), median DBP was 64 (IQR:50-80), median HR was 102 (IQR:83-121), and median RR was 20 (IQR:16-28). Prehospital temperature was documented for 32.0% (1,007) of septic shock patients (median 1/4 99 degrees; IQR:98-101). Sepsis was recognized in 11.4% of sepsis cases (1,931/16,881) and 11.8% of septic shock cases (371/3,144). When an impression of Sepsis/Septicemia was not documented, the top 5 primary impressions were Respiratory Distress (2,575, 15.3%), Altered Level of Consciousness (2,197, 13.0%), Generalized Weakness (1,550, 9.2%), Fever/ Infection (1,150, 6.8%), and Abdominal Pain/ Problems (961, 5.7%). **Conclusion:** Sepsis and septic shock patient vital signs were consistent with their diagnosis. Prehospital temperature was not documented consistently. Sepsis/Septicemia was infrequently documented as the primary or secondary impression. Limitations include sepsis suspicion recorded elsewhere in the prehospital patient care record.