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Critical Care Update

Critical Care Update/Air Transport Medicine Research Review

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Section Introduction

The aim of this section is to provide a high-quality summary of 5 recent journal articles that are relevant to the practice of air transport medicine. The most impactful, intriguing, and insightful articles have been handpicked by an academic prehospital medical team, providing a concise interpretation of the main findings from trusted experts. In this edition, we welcome the team from the East Anglian Air Ambulance (EAAA), United Kingdom.

Team Introduction

EAAA is one of the largest helicopter emergency medical services (HEMS) in the United Kingdom, operating a physician and critical care paramedic delivery model 24/7 from 2 operational bases to a population of over 6 million people. EAAA deploys either an Airbus H145 helicopter or Volvo XC90 rapid response vehicle. Since launching 24 years ago, EAAA has been activated on almost 40,000 missions.[1]

In 2020, EAAA founded their Department of Research, Audit, Innovation, and Development with the aim of improving patient outcomes through the power of clinical research. They are now a recognized leader in UK prehospital academia, having published many peer-reviewed articles and poster presentations, and through showcasing their work at international conferences. EAAA is also established in providing external courses in life support, prehospital ultrasound, and endovascular intervention as well as hosting a regular Breaking Barriers research conference (https://www.eaaa.org.uk/our-work/clinical-research).

Double sequential external defibrillation. Shock - it's all in the timing. Rahimi *et al.*[2] *Resuscitation*. 2024;194:11082.

Despite refinements in international advanced life support guidelines, no currently deliverable therapies have improved survival rates after out-of-hospital cardiac arrest (OHCA). When faced with refractory ventricular fibrillation (rVF), usually defined as ventricular fibrillation (VF) persisting after 3 shocks, EMS has limited therapeutic options, and the outcome is usually poor. Methods of improving shock delivery and maximizing myocardial depolarization may offer hope.

Two years have passed since the DOSE VF trial (Defibrillation Strategies for Refractory Ventricular Fibrillation) demonstrated improved survival in rVF patients who received either double sequential external defibrillation (DSED) or a change in the direction of shock delivery (vector change).[3] However, the optimal timing of DSED shocks remains unclear. This Canadian group performed a retrospective observational analysis of 106 rVF patients who underwent DSED in their service to establish the link between DSED shock interval and outcome.

Three hundred three DSED shocks were analyzed, with the main finding that the rates of VF termination and return of spontaneous circulation were highest when the shock interval was < 0.75 milliseconds. No significant survival or neurologic benefit was observed. The authors acknowledge that the group of patients receiving shocks < 0.75 milliseconds was small (n = 25, 8.2%), and the study was underpowered to make meaningful conclusions about patient outcomes.

Final thoughts: DSED may offer hope to patients with rVF. If implementing this in your service, 1 aspect to consider is robust training to ensure as short a shock interval as possible. Future defibrillator technology should make this easier to deliver by automating the process.

AED delivery to OHCA. Drone versus EMS - a race to survival? Schierbeck *et al.*[4] *Lancet Digit Health*. 2023;5:e862-e871.

Over the past decade, theoretical and simulated studies have introduced the concept of drone-delivered automated external defibrillators (AEDs) to patients in OHCA. A first of its kind, this real-life, prospective study demonstrates the feasibility of drone-delivered AEDs with a 'clinically significant time saving'.

Between April 2021 and May 2022, operators of 5 drones in different locations across greater Gothenburg, Sweden, were notified of all suspected OHCA cases within the study areas. The drones (modified DJI Matrice 600 Pro hexacopters) have a range of 12 km (7.5 miles) and a top speed of 60 km/h (37 mph). Flights were limited to favorable weather conditions, but partway through the trial the drones were adapted to also fly at night. Schiller (Barr, Switzerland) AEDs in a padded basket were winched to the patient side from a height of 30 m (98 ft).

During the study period, 211 potential OHCA cases were identified. There were 55 successful drone missions; 37 were before ambulance arrival, and 18 of those were confirmed cardiac arrests. In 6 cases, the AED was attached to the patient, and 2 were defibrillated. The median time benefit of

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AED drone delivery compared with ambulance arrival was 3 minutes 14 seconds, meeting the authors' predefined threshold of clinical significance.

Final thoughts: This study adds real-life weight to the feasibility argument of drone-delivered AEDs but with questionable effectiveness in its current form. We share the authors hope that advances in technology will overcome the operational restrictions responsible for the low number of successful deployments per cardiac arrest.

Decision making in prehospital blood transfusion. Is it not bleeding obvious? Marsden *et al.*[5] *Emerg Med J*. 2023;40:777-784.

Prehospital blood transfusion has the potential to improve outcomes in bleeding trauma patients. However, this resource is limited, and not all patients benefit from transfusion. Understanding how experienced prehospital clinicians identify life-threatening hemorrhage and decide to transfuse may improve future decision-making strategies.

This qualitative study used semistructured interviews with 10 experienced prehospital physicians and identified 3 themes relating to decision making around prehospital blood transfusion. "Recognition-primed analysis" describes how participants make decisions by recognizing cues derived from clinical experience. However, these decisions can be influenced by external rules and the pressure of post hoc scrutiny from colleagues. "Uncertainty" around the patient's underlying physiology and the intended effect of the intervention can impede decision making. Reversion to standard operating procedures and the use of clinical gestalt helps when there is uncertainty. Participants also described "imperfect decision awareness," relying on unconscious processes at risk of bias. They also recognized incomplete decision evaluation and learning because of difficulties with obtaining patient outcome information.

We commend the authors for using a transparent and robust qualitative methodology to explore this important topic within the setting of experienced physicians at 2 air ambulances in England. However, by only including 10 physicians (predominantly from a single specialty [emergency medicine]), the study is subject to significant risk of bias that limits its conclusions.

Final thoughts: Decisions by prehospital clinicians around blood transfusion are made under uncertain conditions and involve a complex interplay among clinician experience, guidelines, bias, and group expectations. Understanding these thought processes and scrutinizing patient outcomes may improve future training methods and decision-making strategies.

Prehospital ECPR. Feasible, effective, but too selective? Richardson *et al.*[6] *Scand J Trauma Resusc Emerg Med*. 2023;31:100.

Extracorporeal cardiopulmonary resuscitation (ECPR) has the potential to transform survival after refractory OHCA. However, the optimal method of delivery has yet to be demonstrated. This study is an evolution of the successful emergency department–initiated ECPR trial by the same group,[7] aiming to demonstrate the feasibility of prehospital ECPR and a reduced time to the initiation of ECPR compared with in-hospital cannulation.

During the study period, a 3-person team (2 intensive care physicians and 1 intensive care paramedic) were deployed to OHCA within the Melbourne, Australia, metropolitan area. After the confirmation of eligibility, ECPR was initiated at the scene using an ultrasound-guided percutaneous technique. Once extracorporeal membrane oxygenation (ECMO) blood flow was established, further treatment included early coronary angiography ± percutaneous coronary intervention, targeted temperature management, and routine placement of a 6F distal perfusion cannula (to reduce the risk of limb ischemia).

During the trial period of 117 days, the study team was activated to 709 dispatches coded as cardiac arrest. 10 patients met the inclusion criteria; all were successfully cannulated. The mean time from the EMS call to ECMO blood flow was 50 minutes (range, 35-62 minutes), which compares favorably with other published prehospital ECPR data. Overall survival to hospital discharge was 40%, and all were neurologically intact.

The authors acknowledge that this is a highly selected patient cohort of young, witnessed, refractory VF patients receiving bystander cardiopulmonary resuscitation in a single-arm, single-jurisdiction population. In addition, just 10 patients were cannulated of 709 (1.4%) potential OHCA dispatches, and 358 were confirmed as OHCA (2.8%), equating to only 1 case for every 12 days of ECMO team availability, thereby questioning the cost-effectiveness of the intervention.

Final thoughts: This study demonstrates the feasibility of prehospital ECPR in a highly selected patient cohort. However, the wider applicability and cost-effectiveness remain unclear.

EMS trends in c-spine stabilization. Life-saving, or just a pain in the neck? Muzyka *et al.*[8] *Acad Emerg Med*. 2024;31:36-41.

The use of C-collars to prevent secondary cervical spine injury is widespread in EMS practice. However, there are limited data supporting their use, and in patients with a low clinical suspicion of injury, the application of a C-collar may actually increase morbidity and mortality.

Over a 7-year period, Muzyka et al reviewed the changing trends in C-spine stabilization practices at a level 1 trauma center in the United States. Two thousand nine hundred and six patients were included; 1,619 received C-collar stabilization, and 351 had a C-spine injury. During the study period, the frequency of C-collar use decreased (blunt: 82% in 2014 to 68% in 2021; penetrating: 24% in 2014 to 6% in 2021), whereas the proportion of C-spine injury was constant.

Patients who had C-collars applied were significantly older with higher injury severity scores and lower levels of consciousness. Seventy-five percent of blunt trauma patients without C-spine injury and 8% of penetrating trauma patients without C-spine injury still received C-collars. In patients with penetrating injury, no clinical benefit of a C-collar was demonstrated. The study is retrospective and subject to bias that comes with this methodology. In addition, the authors were unable to comment on the specific indication for C-collar application, limiting the clinical understanding and decision making around this change in practice.

Final thoughts: Despite a reduction in their use, C-collars are still being applied to patients who do not require them. This study adds to the growing literature around C-spine stabilization, which is outpacing clinical practice guidelines. EMS protocols should be updated with particular emphasis on the avoidance of C-collar usage in penetrating trauma.

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