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Editorial

Resuscitation highlights in 2014

The number and quality of manuscripts submitted to *Resuscitation* continues to rise. The editors have highlighted some of the key papers published in the Journal in 2014.

1. Epidemiology

In 2014, a team of international investigators produced a landmark paper that updated the Utstein resuscitation registry templates for out-of-hospital cardiac arrest.[1] The primary template emphasises reporting of bystander-witnessed cardiac arrests with initial shockable rhythm as the most important measure of EMS system efficacy and all EMS system-treated arrests as a measure of system effectiveness.

More countries are now tracking both incidence and outcome from both in-and out-of-hospital cardiac arrest. One of the newest is the United Kingdom National Cardiac Arrest Audit (NCAA), whose investigators recently reported on 22,628 hospitalised patients aged 16 years or over receiving chest compressions and/or defibrillation and attended by a hospital-based resuscitation team in 144 acute care hospitals.[2] Adult cardiac arrests occurred with an overall median incidence of 1.5 events per 1000 hospital admissions. An initial shockable rhythm was present in 17% of cases. Overall survival to hospital discharge was 18.4%, but varied substantially across hospitals.

Investigators from Melbourne, Australia, characterised the causes and outcomes of respiratory arrests occurring in a Metropolitan tertiary teaching hospital.[3] Respiratory arrests occurred at a rate of 0.5 per 1000 inpatient admissions. An elevated respiratory rate and/or progressive hypoxaemia preceded the event in 39% of cases. In-hospital survival was 75% for respiratory arrests compared to only 25% for cardiac arrests.

In Perth, Western Australia, St. John ambulance paramedics attended 12,421 out-of-hospital cardiac arrests of presumed cardiac ideology during the last 14 years.[4] During the study period, there was a statistically significant decline in the age-and-sex-standardised cardiac arrest incident rate. Investigators attributed this favourable change to improvements in cardiovascular risk profiles.

In Melbourne, Australia, investigators analysed data from 38,378 out-of-hospital cardiac arrests attended by emergency medical services (EMS) personnel in which the initial rhythm was non-shockable.[5] The initial rhythm was asystole in 88% and pulseless electrical activity (PEA) in 12% of cases. Survival to hospital discharge was 1.1% for asystole and 5.9% for PEA. Survival outcomes did not improve over the 10-year study period from 2003 to 2013.

In Osaka, Japan, researchers studied the outcome of elderly out-of-hospital cardiac arrest victims.[6] One-month survival with neurologically favourable outcome, improved from 1.4% in 1999 to 4.8% in 2011 ($p < 0.001$). The proportion of nursing home patients with a neurologically favourable outcome did not change during this period. However, in a separate study, Danish investigators showed that nursing home residents admitted to hospital after cardiac arrest have survival rates that are similar to non-nursing home patients after adjusting for known prognostic factors in pre-existing comorbidities.[7]

An increasing number of epidemiological studies are now focusing on paediatric cardiac arrest. Investigators from Little Rock, Arkansas, analysed data on 329,982 patients from 108 centres in the United States participating in a virtual paediatric intensive care unit (ICU) system.[8] Cardiac arrest occurred in 2.2% of patients with an associated mortality rate of 35%. Both the incidence and mortality of cardiac arrest varied substantially across hospitals. Using multivariate models controlling for patient and centre characteristics, centre volume was not associated with either incidence or mortality from cardiac arrest.

In a separate study, investigators from Osaka University used a nationwide, prospective, population-based observational database to look at the relationship between survival following paediatric out-of-hospital cardiac arrest and time of day or day of week and 3278, bystander-witnessed cases.[9] One-month survival rate was significantly lower during nights and weekends/holidays, even when adjusted for potentially confounding factors.

2. Rapid response systems

In 2014, *Resuscitation* further consolidated its position as the lead journal for clinical publications related to rapid response systems (RRS) for the prevention of cardiac arrest. With the introduction of the National Early Warning Score (NEWS) across the United Kingdom (UK), a UK-based group was concerned that its specificity in patients with chronic hypoxaemia could lead to over triggering and alarm fatigue.[10] They designed a variation of NEWS for patients with chronic hypoxaemia: a Chronic Respiratory Early Warning Score (CREWS) and found that it could reduce excessive triggers and alarm fatigue, whilst identifying appropriate patients in need of response.

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The performance of human-generated NEWS was compared with one generated from algorithms using decision tree analysis.[11] In this rapidly evolving area of prediction of deterioration they suggested that a decision-tree technique may be used to develop models for disease-specific Early Warning Scores (EWS) that may be useful in the future.

A United States (US)-based group of investigators undertook a comparative analysis of common EWSs to see how they would function in automated systems.[12] They suggested that the most widely used weighted track-and-trigger scores would not be good for use in an automated alarm system. As automated systems are probably the future of Rapid Response Systems this will be a key area for future research.

Chen and colleagues from Australia compared outcomes at a teaching hospital with a mature RRS, with three similar teaching hospitals without a RRS between 2002 and 2009.[13] The findings add to the weight of evidence that implementation of a RRS is associated with a significant reduction in the rate of inhospital cardiac arrest (IHCA), IHCA-related mortality and overall hospital mortality.

Petersen and colleagues from Denmark have looked at the performance of a new EWS system by reviewing all serious adverse events over a 6-month time period and found deficiencies in compliance, escalation and care provision.[14] They suggest that this quality information may be useful in improving compliance and performance of EWS systems.

3. Basic life support and CPR quality

A systematic review confirmed that both 'cardiac pump' and 'thoracic pump' have a key role in driving effective blood flow during adult cardiopulmonary resuscitation (CPR). The effect of each mechanism is highly depended on other resuscitation parameters, such as positive pressure ventilation and compression depth.[15] The integration of measurements of CPR quality with feedback technology allows CPR providers to improve performance[16–18] but a systematic review found no consistent evidence that this translates into improved patient outcomes.[18] One reason may be that CPR feedback systems differ in how they measure and provide feedback about CPR quality.[19] Transthoracic impedance signals can be used to produce reliable estimates of CPR quality indices[20,21] with the exception of chest compression depth.[22] Chest compression depth can be recorded by the use of an accelerometer device. However the accuracy of measurements is reduced with incomplete chest decompression[23] and when CPR is performed on a soft surface.[24] A new real-time compression depth feedback device that measures changes in magnetic field strength between a back pad and a chest pad was able to overcome the limitations of accelerometer technology independent of the stiffness of the surface[24] and improve the quality of simulated CPR.[25]

4. Defibrillation

Investigators in Canada studied data from 20,165 out-of-hospital cardiac arrest patients treated by EMS providers.[26] Good functional survival was associated with younger age, shorter times from collapse to initial defibrillation, and use of post-cardiac arrest targeted temperature management.

In Victoria, Australia, use of a public automated external defibrillator (AED) increased almost 11-fold between 2002 and 2013.[27] Investigators studied 2270 out-of-hospital cardiac arrest cases in which the event occurred in a public place. EMS personnel provided first defibrillation in 93.4% of cases. Bystanders using a public AED provided first defibrillation in 6.7% of cases. First defibrillation by a bystander using an AED was associated with a 62% increase in the odds of survival to hospital discharge.

A prospective, multicenter, international observational database from 12 European and Latin American countries was used to study the results of defibrillation during the treatment of 502 children with in-hospital cardiac arrest.[28] Ventricular fibrillation, or tachycardia was the first documented cardiac arrest rhythm in 43% of cases. Return of spontaneous circulation was obtained in 63% of all cases and was higher in those whose first documented cardiac arrest rhythm was ventricular fibrillation/tachycardia. Surprisingly, clinical outcome did not appear to be related to the cause or location of arrest, type of defibrillator/waveform, energy dose per shock, number of shocks, or cumulative energy dose. The authors concluded that the optimal paediatric defibrillation dose remains to be determined.

Lemkin et al. used six cadavers to estimate the rescuer-received dose of electrical energy when hands-on defibrillation was simulated.[29] Using this model, defibrillation exposed rescuers to energies between 1 and 8 J, which exceeds the accepted energy exposure levels. The authors concluded that hands-on defibrillation poses a significant risk to rescuers using currently available personal protective equipment and resuscitation procedures.

4.1. Trauma

Nevin and colleagues reviewed child trauma victims who required pre-hospital advanced airway management over a 12-year period and found their physician-led, pre-hospital trauma service attended 1933 children and there were 315 (16.3%) pre-hospital intubations. The majority received a rapid sequence induction and the main injury mechanism was road traffic crash and there was high success rate of advanced airway management.[30] Kleber and colleagues from Berlin looked at the epidemiology and autopsy data for failed trauma resuscitations over a 12-month period which led them to present an algorithm for use in trauma associated cardiac arrest situations.[31]

Schober and colleagues from Austria looked at outcomes for patients admitted to a Vienna University Hospital with cardiac arrest due to accidental hypothermia. While the condition appears to be rare the prognosis was particularly good for patients where hypothermic cardiac arrest was the result of intoxication.[32]

4.2. Drowning

Claesson and colleagues studied changes from 1990 to 2012 in characteristics and survival from cardiac arrest after drowning. Improved bystander help and CPR and early EMS arrival were credited for the improved survival found.[33] Quan and colleagues from the US failed to demonstrate any survival benefit from cold water drowning and that the estimated submersion duration was the best predictor of outcome. They suggested that resuscitation recommendations should be revised to reflect that after 10 min of submersion survival is highly unlikely.[34] Suominen and colleagues from Finland reported late cognitive and neurological outcome for surviving drowned children who had received CPR and found that 57% of the resuscitated children had neurological dysfunction. Clearly, neuropsychological long term follow-up in drowned children is highly recommended.[35] Szpilman and an international group have produced a Drowning Chain of Survival based on a best evidence approach and comprising of five links covering prevent drowning, recognise distress, provide flotation, remove from water, and provide care as needed.[36]

5. Advanced life support

5.1. Airway

A stepwise approach to airway management during CPR and after return of spontaneous circulation (ROSC) that is based on