Hyperventilation in Cardiac Arrest: A Systematic review & narrative synthesis

Background
Out of Hospital Cardiac Arrest resuscitation occurs in around 30,000 cases across the United Kingdom each year (1). Ambulance crews deliver advanced life support which includes chest compressions, ventilation, defibrillation, and drug administration. During a cardiac arrest, patients are unable to perform gaseous exchange and so have a build up of carbon dioxide in their bloodstream which can lead to a severe respiratory acidosis; this can reduce the likelihood of sustaining a return of spontaneous circulation (2). Ventilation is essential to ensure adequate oxygenation and carbon dioxide removal. Resuscitation Council UK outline that ventilations should be conducted at a rate of 10 min⁻¹ (3). However, ventilation with higher rates & volumes can decrease carbon dioxide concentrations more quickly (2).

Previous studies have shown hyperventilation can lead to barotrauma, hypotension, diminished pulmonary blood flow, and a reduced cardiac output (4).

The aim of this project is to describe the incidence, effects, and patient outcomes of hyperventilation by ambulance clinicians in out-of-hospital medical cardiac arrests.

Methodology

Systematic Review & Narrative Synthesis

**Databases**: CINAHL, MEDLINE, and Science Direct

**Dates**: 1st January 2000 - 27th April 2022

**Keywords**: Out of hospital | Prehospital | Ambulance | EMS | Cardiac Arrest | Resuscitation | Hyperventilation | Ventilation Rate | Return of Spontaneous Circulation | Survival | Discharge

**Inclusion Criteria**: English language | Primary Research | Human only (Adult 18 years or older)

**Exclusion Criteria**: Traumatic cardiac arrest | Animal studies | In-hospital or Simulated settings

A Critical Appraisal Skills Programme (CASP) checklist was followed to evaluate the quality of research papers included.

Findings & Recommendations

**Hyperventilation is still commonly reported in practice.**

- Ventilations are consistently delivered at a rate & tidal volume higher than is international recommended.
- Ventilation rates do vary throughout a resuscitation due to differing chest compression to ventilation ratios (30:2 synchronous vs continuous).

**Hyperventilation occurs due to:**

- Stress | Poor leadership | Focus on other tasks (Intravenous/Intraosseous cannulation) (5) (6).
- Short bursts of Hyperventilation can be purposeful & occur due to planned pauses in ventilation (before / after endotracheal intubation) (7).
- Recent evidence challenges previous concerns over the negative effects of hyperventilation (8).
- There are no discernible clinically significant differences between ventilation rates of ≤10min⁻¹ vs >10min⁻¹ and patient outcomes (9).

**Recommendations:**

- Ventilation feedback devices should be used to guide clinicians in delivering ventilations at the recommended rate & tidal volume.
- Ambulance crews should receive regular education to ensure they are up-to-date on current guidelines & undertake high fidelity scenarios to simulate real-world stressors.
- There are no human randomised control studies examining how ventilation rate, tidal volume or pressure effect patient outcomes and this warrants further research.

**References**

7. Recycling and Reuse: No, the construction industry is not recycling and reusing glazing systems.