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Keep pushing! Limiting interruptions to CPR; bag-valve mask versus i-gel® airway ventilation

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ABSTRACT

Background: Recent recommendations made by ILCOR have de-emphasised the role of advanced airway management such as "endotracheal intubation" (ETI) during cardiac arrest in favour of maximising the number of chest compressions performed by rescuers. Maximising time available for compressions is achieved by minimising hands-off time (HOT). This has led to first responders and paramedics performing single rescuer CPR using a bag-valve-mask (BVM) device as opposed to the historical practice of intubating and ventilating via an endotracheal tube. Bag-valve-mask ventilations, especially during single rescuer CPR, are however associated with complications potentially resulting in increased ventilation times. More time spent on ventilations in the single rescuer scenario naturally leads to an increase in HOT and less time being available for compressions. It is postulated that the use of an appropriate supraglottic airway device (SAD) may decrease the time spent on the ventilation component of CPR and result in a decrease in HOT.

Objectives: This pilot study evaluated how interruptions to chest compressions or hands-off time (HOT) are affected by the placement of an i-gel® airway vs. simple BVM ventilation during single rescuer CPR.

Method: 16 participants performed two, ten-minute single rescuer CPR simulations, firstly using the BVM and later the i-gel® airway for ventilation. Data pertaining to ventilations and HOT in each scenario was statistically analysed and compared.

Results: The i-gel® airway demonstrated a superior ease of ventilation compared to BVM alone and resulted in a reduction of time spent on ventilations overall. The i-gel® however took a mean of 29 s, ± 10 s, to secure which contributes considerably to HOT.

Conclusion: The use of the i-gel® airway resulted in a considerable decrease in the amount of time spent on ventilations and in more compressions being performed. The overall reduction in HOT was, however, offset by the time it took to secure the device. Further investigation into the use and securing of the i-gel® airway in single rescuer CPR is recommended.

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1. Introduction

This study compared differences in HOT between single rescuer CPR using a BVM and single rescuer CPR using the i-gel® airway with reference to a) chest compressions, b) cycles of CPR, and c) time taken to assess and secure the airway and ventilate using an i-gel® SAD.

1.1. Background

In South Africa, heart disease and sudden cardiac arrest is on the increase. When cardiac arrest occurs the prognosis is poor unless effective resuscitation measures are rapidly initiated. The International Liaison Committee on Resuscitation (ILCOR) strives to promote prompt and skilful responses to cardiac arrest that can make the difference between life and death. Every five years ILCOR convenes to review the latest literature and science regarding CPR and to reach consensus on treatment recommendations (Hazinski et al., 2010). Over the past five years, ILCOR has de-emphasised the role of endotracheal intubation (ETI) in CPR, and re-emphasised the importance of maximising the number of chest compressions and limiting sources of hands-off time (HOT) during CPR (Berg et al., 2010).

The above recommendations, however, assume that a single rescue scenario is unlikely to persist for a considerable length of time. The South African scenario is somewhat different to both the American and European models, in that many advanced life support (ALS) paramedics work alone on a primary response vehicle (PRV) and are therefore commonly required to manage cardiac arrest cases alone until the ambulance crew arrives. Taking the recent ILCOR recommendations into account, local ALS paramedics are performing single rescuer ventilations during CPR with a BVM apparatus as opposed to the historical practice of ETI which is seen to create an opportunity for significant HOT.

Having said this, bag-valve-mask (BVM) ventilations, especially those being performed during single rescuer CPR, are associated with many complications. These include gastric insufflation, aspiration and delays associated with repeated attempts at positioning and opening the airway together with difficulties in obtaining an appropriate face-mask seal. All of these complications may result in an increase in the time spent attempting to provide rescue breaths during CPR. More time spent on ventilations in the single rescuer scenario naturally leads to less time being available for compressions (Berg et al., 2010).

1.2. Problem statement

Evidence indicates that interruptions to chest compressions or hands-off time during single rescuer CPR are undesirable and negatively impact on cardiac output (Hazinski et al., 2010). The time spent securing the airway and providing ventilations during CPR serves as a source of interruption to chest compressions or HOT. Limited data currently exists to support one form of airway management above the other during CPR and that airway management strategies should be adapted to the specific circumstances surrounding CPR. Increases in HOT during CPR lowers the likelihood of achieving a return of spontaneous circulation (ROSC) and survival. CPR techniques where HOT is minimised are preferable and certain ventilation techniques may be beneficial to decreasing time spent on ventilations. Prior to this study no data existed comparing HOT during CPR with BVM ventilation to HOT during CPR using a supraglottic airway device.

1.3. Aim

The aim of this study was to determine whether or not the insertion of an i-gel® airway during single rescuer CPR would minimise HOT compared to single rescuer CPR using only a BVM.

1.4. Literature review

1.4.1. Hands-off time

Hands-off time is defined as any period of time during CPR that there is a cessation in the performance of chest compressions (Nolan et al., 2010). End organ perfusion pressure decreases with the cessation of chest compressions and it may take a significant number of compressions to regain adequate end organ perfusion after a period of HOT. Disruptions to chest compressions should therefore be limited as far as possible in order to promote blood flow and adequate end organ perfusion (Perkins, Brace, Smythe, Ong, & Gates, 2012).

A direct correlation exists between the fraction of each minute of CPR spent performing chest compressions and the incidence of ROSC (Christenson et al., 2009). Limiting the frequency and duration of interruptions in chest compressions may improve the incidence of ROSC and clinically meaningful outcomes in cardiac arrest patients (Abella et al., 2005; Christenson et al., 2009; Eftestol, 2002). Similarly, findings suggest that CPR should focus primarily on chest compressions and that time taken for airway management during CPR may have a negative effect on ROSC (Bobrow et al., 2008).

1.4.2. Airway management during CPR

Periodic ventilation during CPR is an important component of the resuscitation sequence as it brings about oxygenation of lung tissue (Perkins et al., 2012). However, during cardiac arrest, a lower minute volume is required to achieve normal oxygenation of organ tissues. This is based on the fact that pulmonary perfusion is only 25%–30% of normal during optimal CPR, resulting in oxygen uptake from the pulmonary circuit being significantly reduced (Perkins et al., 2012). A literature shift regarding the importance of ventilation in CPR has occurred, with the emphasis falling on the circulation component (Berg et al., 2010). Excessive ventilation during CPR has been proven to be detrimental to patients, resulting in poorer outcomes (Aufderheide et al., 2004). Another function of airway management during CPR is the protection of the airway against pulmonary aspiration of gastric contents. It has been reported that as many as 12% of patients aspirate at some point during the resuscitation effort (Berg et al., 2010; Stone, Chantler, & Baskett, 1998).

Preceding 2005, ETI was regarded as the gold standard for airway management during CPR (Zaritsky & Morley, 2005). The importance of ETI during CPR has, however, recently been de-emphasised as it was not shown to improve outcome