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Clinical paper

PQRST – A unique aide-memoire for capnography interpretation during cardiac arrest☆

Bård E. Heradstveit[a,*], Jon-Kenneth Heltne[a,b]

[a] Department of Anaesthesia and Intensive Care, Haukeland University Hospital, Bergen, Norway
[b] Department of Medical Sciences, University of Bergen, Bergen, Norway

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ABSTRACT

The use of capnography is recommended during resuscitation. By implementing the mnemonic "PQRST", rescuers have a ready-made checklist to help them achieve the full potential of capnography. This approach can facilitate efforts to both reduce the hands-off time and individualize the treatment, which can lead to improved survival for our patients.

1. Introduction

The use of capnography during advanced life support was enhanced in recent guidelines.[1] Levels of end tidal carbon dioxide may reflect both production in the cells and ventilation from the lungs; however, assuming these variables are constant, the levels may also reflect the cardiac output induced by chest compressions. To implement capnography in a systematic manner, we advocate the introduction of the mnemonic "PQRST" as a unique aide-memoire when interpreting capnography for the resuscitation team. In the following, we address these different aspects of resuscitation, and interpretations of capnography data that may be useful during resuscitation.

2. The mnemonic "PQRST"

P Position of the tube
Q Quality of chest compressions
R Return of spontaneous circulation (detection)
S Strategy for further treatment
T Termination of resuscitation

2.1. P – position of the tube

Capnography, in contrast to capnometry, displays the level of carbon dioxide as a function of time. Grmec compared the use of auscultation, capnometry, and capnography, and found that the latter technique demonstrated superior sensitivity and specificity.[2] Moreover, when this method is selected, rescuers receive additional information that immediately confirms correct tracheal tube placement. Normally, positioning the tube is considered a primary task, and later, it is forgotten. When the intubated patient is transported, during cardiopulmonary resuscitation (CPR) or after the return of spontaneous circulation (ROSC), various situations may cause dislocation of the tube, and capnography monitoring can immediately warn the rescuers.

2.2. Q – quality of CPR

Quality of chest compression during cardiac arrest (CA) influences the level of end tidal carbon dioxide, as demonstrated by Kalenda, in 1979.[3] When fatigue occurs, indicated by a drop in capnography levels, he advocated that another person should take over the chest compressions. Higher levels of end tidal carbon dioxide are associated with a better outcome[4,5]; thus, it is reasonable to relieve the person performing chest compressions at every cycle, and to limit the individuals performing compressions to those that have achieved the highest levels. Qvigstad et al.[6] reported variations in end tidal carbon dioxide when they moved the compression

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* Corresponding author.
E-mail addresses: baard.heradstveit@helse-bergen.no (B.E. Heradstveit), jon-kenneth.heltne@helse-bergen.no (J.-K. Heltne).

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site to three different locations; that finding indicated that a single location may not be optimal for all patients. Capnography may facilitate the detection of the best site for compression, but maybe even more important, the early recognition of poor quality of chest compressions.

2.3. R – ROSC

Return of spontaneous circulation is normally detected during the analyzing phase. A sudden increase in end tidal carbon dioxide is an early, reliable indicator of ROSC.[7] Implementation of carbon dioxide detection is important, because checking the pulse to differentiate between pulseless electrical activity and ROSC is difficult and time consuming.[8,9] Any effort to reduce "hands-off" time[1] may be in vain in the absence of the potential provided by capnography. Although we clinicians are waiting for industry to establish software that can analyze heart rhythm during chest compressions, we already have a tool for detecting whether a given rhythm can provide a pulse.

2.4. S – Strategy

Strategy is important for individualizing resuscitation, and for evaluating a potentially treatable cause of the arrest. An early and aggressive strategy is of vital importance particular in CA victims with reversible causes. Approximately 70% of the out-of-hospital cardiac arrests were assumed to be caused by myocardial infarction or pulmonary embolism; that estimation led to a randomized study for testing tenecteplase treatment for patients with witnessed arrests.[10] By reducing pulmonary blood flow, a pulmonary embolism will influence the end tidal carbon dioxide levels, as described by Rumpf et al.[11] This influence would probably be more important when the obstruction causes cardiac arrest. Reduced levels of end tidal carbon dioxide have been described in patients with a suspected pulmonary embolism.[12] Therefore, capnography may assist clinicians in detecting patients suitable for fibrinolytic therapy during CPR. However, low levels of end tidal carbon dioxide may also indicate other causes, such as internal hemorrhage or tension pneumothorax; thus, interpreting capnography can be complicated. This situation also underlines the need for a thorough clinical examination and an early treatment strategy for improving survival.

2.5. T – Termination

Termination of resuscitation may become a self-fulfilling prophecy. Nevertheless, Levine et al.[13] found that an end tidal carbon dioxide level <10 mmHg (1.3 kPa), after 20 min of resuscitation, predicted death with 100% accuracy. The decision to terminate CPR is often challenging.[14,15] Keeping in mind that untreated pulmonary embolism may be the cause of low levels and death, declining levels of carbon dioxide, despite optimized chest compressions, may indicate the development of a "stone heart"[16] or a change in rheology.[17] Termination of resuscitation should probably be evaluated based on a declining trend over time, and not based on a few single low values, particularly when adrenaline (epinephrine) is used, because it has been shown to induce a temporary reduction in end tidal carbon dioxide levels.[18]

3. Conclusion

The use of capnography is recommended during resuscitation. By implementing the mnemonic "PQRST", rescuers have a ready-made checklist to help them achieve the full potential of capnography. This approach can facilitate efforts to both reduce the hands-off time and individualize the treatment, which can lead to improved survival for our patients.

Conflict of interest statement

The authors have no conflicts of interest.

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