Towards evidence based emergency medicine: Best BETs from the Manchester Royal Infirmary

Edited by Simon D Carley

BET 1: CAN THE VALUE OF END TIDAL CO₂ PROGNOSTICATE ROSC IN PATIENTS COMING INTO EMERGENCY DEPARTMENT WITH AN OUT-OF-HOSPITAL CARDIAC ARREST (OOHCA)?

Authors: Harish Venkatesh, Elizabeth Keating
Affiliation: Royal Berkshire Hospital, Berkshire, London, UK

ABSTRACT
A short cut review was carried out to establish whether end tidal CO₂ can be used to prognosticate in out-of-hospital cardiac arrest. 232 papers were found of which 4 presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. The clinical bottom line is that a single end tidal CO₂ reading cannot be used as an indicator to terminate resuscitation attempts in out-of-hospital cardiac arrest.

THREE-PART QUESTION
Patient group—(In adults admitted to the ED with an out-of-hospital cardiac arrest)
Intervention—(does end tidal CO₂ measurement)
Outcome—(predict/prognosticate return of spontaneous circulation)?

CLINICAL SCENARIO
A 60-year-old male is brought into the ED with an out-of-hospital cardiac arrest (OOHCA). All monitoring is attached while ALS protocol is ongoing, including CO₂ monitoring. You want to assess whether the patient is going to survive and thereby achieve a return of spontaneous circulation (ROSC) and you wonder whether the patient’s end tidal CO₂ (ETCO₂) level can prognosticate this.

SEARCH STRATEGY
Medline, Cochrane and EMBASE databases (2006 to present).
[exp HEART ARREST/ or “Heart arrest”.ti,ab or “cardiac arrest”.ti,ab] AND [ETCO₂.ti,ab or “end tidal co₂”.ti,ab or exp CAPNOGRAPHY/ or capnometry. ti,ab or (exp CARBON DIOXIDE/ AND exp TIDAL VOLUME/ AND 19 AND 20)] AND [(exp SURVIVAL/ OR exp SURVIVAL ANALYSIS/) or exp TREATMENT OUTCOME/ or {((ros OR “return of spontaneous circulation”).ti,ab) or exp “OUTCOME ASSESSMENT (HEALTH CARE)/“}]


SEARCH OUTCOME
232 articles obtained of which 4 were of sufficient quality (table 1). Results already reviewed in these meta-analyses were not presented below.

COMMENTS
Overall the recent paper by Hartmann et al is well-written and the most up to date and most pertinent study on this research topic. While the quality of the study may have been deemed low by the GRADE criteria, it is important to remember that ETCO₂ in participants (with and without ROSC) can be compiled, despite the variety of interventions in the included studies, as ETCO₂ is a proxy measurement for cardiac output—a physiological outcome that can be achieved under many differing circumstances. In a meta-analysis such as this one where homogenous study design is not necessary to evaluate a physiological state, the level of evidence appears falsely poor. This has been clearly addressed by the authors. This paper gives a clear idea of what ETCO₂ level should be aimed for when resuscitating patients and thereby can prognosticate between a positive and a negative outcome. It also emphasises that current guidelines may need to be updated to acknowledge that an aim of 10–20 mm Hg may be too low. The paper by Poon et al is important in deciding whether a 3 min ETCO₂ level of ≤10 mm Hg can help clinicians decide whether to discontinue resuscitation on the basis that there is a much greater chance of morbidity and mortality. The paper by Akinca et al...
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<tr>
<th>Author, year, country of publication</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
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<td>Hartmann et al, 2015, USA</td>
<td>7276 subjects from 27 studies used for qualitative analysis. 6550 subjects from 19 studies for meta-analysis</td>
<td>Systematic review and meta-analysis</td>
<td>Participants with ROSC after CPR have statistically higher levels of ETCO₂</td>
<td>The overall mean ETCO₂ value was significantly higher among participants with ROSC than those without ROSC (25.8 ± 9.8 mm Hg vs. 13.1 ± 8.2 mm Hg, p = 0.001) The average ETCO₂ level was 25 mm Hg in participants with ROSC The mean difference in ETCO₂ was 12.7 mm Hg (95% CI 10.3 to 15.1) between participants with and without ROSC (p &lt; 0.001) The mean difference in ETCO₂ was not modified by the receipt of sodium bicarbonate, uncontrolled minute ventilation or era of resuscitation guidelines The overall quality of data by Grades of Recommendations, Assessment, Development and Evaluation criteria is very low, but there are currently no prospective data</td>
<td>(1) The overall level of evidence was characterised as very low by the GRADE criteria. (2) Mostly only cohort studies analysed (26/27 studies). (3) Big variance on time taken to initiate resuscitation; quality of compression and use of different methods to deliver compressions between studies. (4) Presence of serious inconsistency, as measured by the degree of heterogeneity (p &lt; 0.001 and I² value of 98.5%)</td>
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<td>Poon et al, 2016, Hong Kong</td>
<td>319 patients</td>
<td>Prospective cohort study</td>
<td>A 3 min ETCO₂ ≤10 mm Hg was associated with poor prognosis and low chance of ROSC A 3 min ETCO₂ &gt;10 mm Hg was a predictor of ROSC with OR 18.16 (95% CI 4.79 to 51.32, p &lt; 0.001). In other words, when cardiac arrested, for a patient with a 3 min ETCO₂ &gt;10 mm Hg the odds of ROSC was 18 times higher than those with ETCO₂ ≤10 mm Hg</td>
<td>Large number of patients excluded due to improper documentation of the use of ETCO₂ (approximately one-third). (2) Quality of chest compressions was not controlled or measured. (3) The decision to stop resuscitation may have been influenced by the ETCO₂ value at the time, which could have potential bias on ROSC rate</td>
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<td>Akinci et al, 2014, Turkey</td>
<td>80 patients</td>
<td>Prospective cohort study</td>
<td>PetCO₂ values are higher in the ROSC group ETCO₂ levels of the ROSC group in the 5th, 10th, 15th and 20th min were significantly higher compared with the Exitus group (p &lt; 0.001) During the CPR, the most reliable time for ROSC estimation according to PetCO₂ values is 20th min</td>
<td>(1) ETCO₂ levels not measured on transport to hospital ETCO₂ value differences, which might be resulting from different arrest aetiologies (asphyxia and cardiac) could not be determined as a result of this. (2) Small sample size. (3) No clear indication or suggestion of what ETCO₂ level can be used to prognosticate ROSC—however, does give an indication of when best to assess this. (4) Published in a low impact medical journal</td>
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<td>Pantazopoulos et al, 2015, Greece</td>
<td>42 studies included in qualitative synthesis</td>
<td>Narrative review</td>
<td>None of the patients who had ETCO₂ levels less than 14 mm Hg survived</td>
<td>Although changes and trends in ETCO₂ values during CPR are more important than absolute ETCO₂ levels, current data suggest that certain cut-off values may be targeted; an ETCO₂ &gt;10 mm Hg is correlated with increased possibility for ROSC Rescuers should target a 20 min ETCO₂ of at least 20 mm Hg The value of a trend more than absolute ETCO₂ values may be most important in the presence of a treatable cause An abrupt increase in ETCO₂ under constant ventilation and CO₂ production, provides the fastest indication of ROSC</td>
<td>No systematic review or meta-analysis done</td>
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CPR, cardiopulmonary resuscitation; ETCO₂, end tidal CO₂; PetCO₂, end tidal CO₂ tension; ROSC, return of spontaneous circulation.
Best evidence topic reports

highlights that a 20 min ETCO₂ check has a greater performance in predicting ROSC than earlier times, although the data itself may not be robust enough to go by from a resuscitation guideline perspective. Having said this, the data are important and as such more studies in this research topic would definitely help.

Clinical bottom line

Current literature suggests that: (1) Our current ETCO₂ aim of 10–20 mm Hg may be inadequate and should be modified to 25 mm Hg. (2) A 3–5 min ETCO₂ level of ≤10 mm Hg is associated with bad prognosis and as such, it may be beneficial to consider stopping patient resuscitation should this be the clinical case. (3) It is important to see the trend of ETCO₂ rather than making a decision solely on one specific value, as sometimes an abrupt increase in ETCO₂ could be a sign of impending ROSC. (4) More robust prospective data on the optimal ETCO₂ value that is associated with ROSC would be helpful in defining a more accurate future target for intervention.

REFERENCES


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