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)?

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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).

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The BETs published below were first reported at the Critical Appraisal Journal Club at the Manchester Royal Infirmary or placed on the BestBETs website. Each BET has been constructed in the four stages that have been described elsewhere. The BETs shown here together with those published previously and those currently under construction can be seen at http://www.bestbets.org. Three BETs are included in this issue of the journal.

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# Table 1 Relevant papers

| Author, year, country of publication | Patient group | Study type (level of evidence) | Outcomes | Key results | Study weaknesses |
|-------------------------------------|---------------|--------------------------------|-----------|-------------|-----------------|
| Hartmann et al, 2015, USA           | 7276 subjects from 27 studies used for qualitative analysis. 6565 subjects from 20 studies used for average ETCO₂. 6550 subjects from 19 studies for meta-analysis | Systematic review and meta-analysis | Participants with ROSC after CPR have statistically higher levels of ETCO₂ | 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) | (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 compressions and use of different methods to deliver compressions between studies. (4) Presence of serious inconsistency, as measured by the degree of heterogeneity (p < 0.001 and I² value of 98.5%) |
| Poon et al, 2016, Hong Kong         | 319 patients | Prospective cohort study | A 3 min ETCO₂ ≤10 mm Hg was associated with poor prognosis and low chance of ROSC | A 3 min ETCO₂ >10 mm Hg was a predictor of ROSC with OR 18.16 (95% CI 4.79 to 51.32, p < 0.001). In other words, when cardiac arrested, for a patient with a 3 min ETCO₂ > 10 mm Hg the odds of ROSC was 18 times higher than those with ETCO₂ ≤10 mm Hg | 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 |
| Akinci et al, 2014, Turkey         | 80 patients | Prospective cohort study | 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 < 0.001) | (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 |
| Pantopoulos et al, 2014, Greece     | 42 studies included in qualitative synthesis | Narrative review | None of the patients who had ETCO₂ levels less than 14 mm Hg survived | 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 > 10 mm Hg is correlated with increased possibility for ROSC | No systematic review or meta-analysis done |

CPR, cardiopulmonary resuscitation; ETCO₂, end tidal CO₂; PetCO₂, end tidal CO₂ tension; ROSC, return of spontaneous circulation.
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.

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