

Is a Change in End-tidal Carbon Dioxide concentration associated with Hypotension during Periods of General Anesthesia with Stable Mechanical Ventilation? Analysis of a Large Cohort

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BACKGROUND

Significant decrease in end-tidal carbon dioxide concentration (etCO₂) can indicate decreased cardiac output [1].

Non-invasive blood pressure (NIBP) readings are sampled every 5 minutes [2], etCO₂ is monitored every 3-9 seconds.

OBJECTIVE

To determine if acute decreases in etCO₂ can predict hypotension in patients undergoing general anesthesia during otherwise stable mechanical ventilation.

METHODS

Study approved by the UBC Research Ethics Board (H20-01248).

Population: Non-cardiac surgery patients undergoing general anesthesia at a FHA hospital between Jan'14-Jun'20.

Artifacts were removed [3]; Stable ventilation episodes identified using positive end-expiratory pressure and minute ventilation.

Hypotensive instance defined as MAP < absolute threshold (65 mmHg or 50 mmHg) and MAP decrease ≥20 mmHg from baseline measurement (10 mins prior).

Magnitude of delta etCO₂ within stable ventilation period used to predict hypotension.

Area under the receiver operating characteristic curve (AUROC) was computed, and confusion matrix values were computed using the delta etCO₂ at maximum Youden index.

RESULTS

Data were available for N=66,683 procedures (Table 1). Delta etCO₂ was -2 mmHg at the maximum Youden index.

True positive rate was 59% for MAP threshold <65 mmHg and 69% for <50 mmHg (Figure 1b,d).

No correlation was found in the differences from previous measurement between MAP and etCO₂ (Figure 2).

CONCLUSION AND FUTURE WORK

We found no evidence that acute changes in etCO₂ were a reliable predictor of hypotension.

Advanced analysis will be explored before ruling out this potentially useful clinical warning sign.

References

1. JAMA 1987 Jan 23-30;257(4):512-5. 2. Can J Anaesth. 2018 Jan;65(1):76-104. 3. Anesthesiology. 2017 Jan;126(1):47-65.

In this study, end-tidal carbon dioxide changes were not predictive of intraoperative hypotension as detected by non-invasive blood pressure readings.

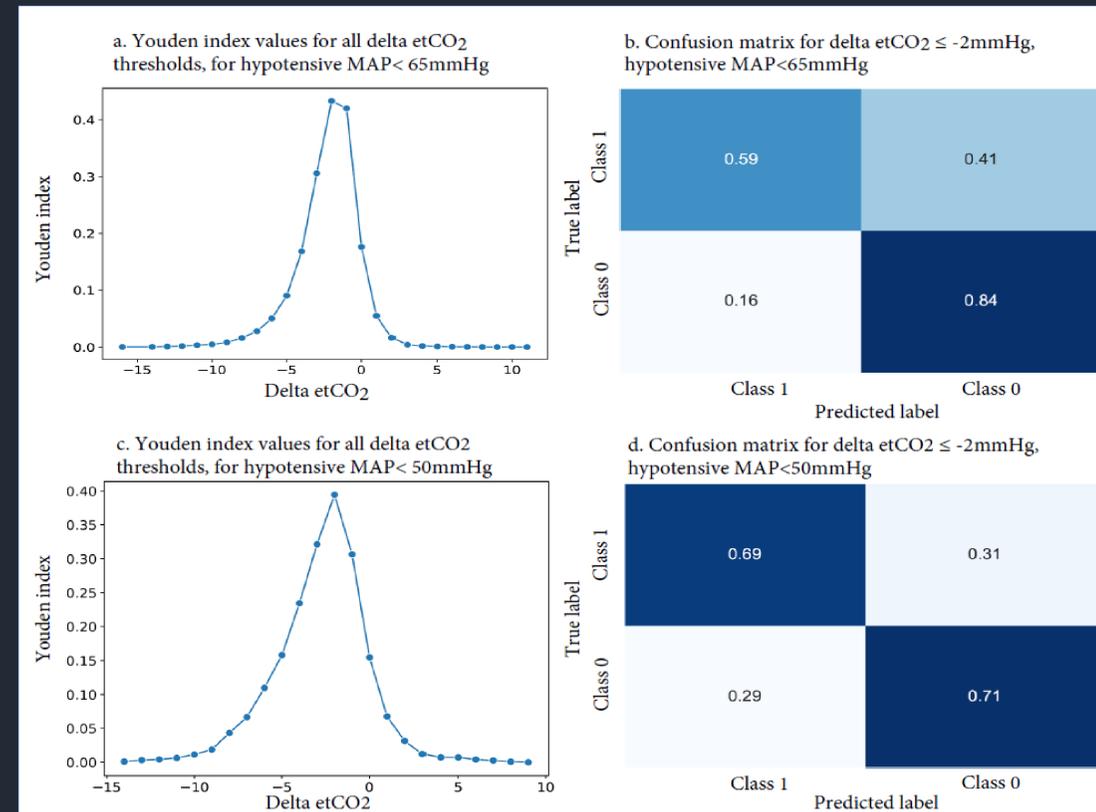
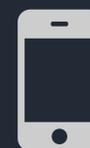


Figure 1: Youden indices for all delta etCO₂ thresholds and confusion matrices for etCO₂ ≤ -2 mmHg for hypotension defined as MAP <65 mmHg (a & b) and MAP <50 mmHg (c & d).



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Table 1: Number of procedures, candidate hypotensive episodes, and predictive performance for each definition of hypotension

	MAP <65 mmHg	MAP <50 mmHg
# procedures with ≥1 hypotensive episode	12,951 (19.4%)	7,903 (11.8%)
# episodes with MAP < threshold during stable ventilation	63,343	2,187
# episodes of stable ventilation with delta MAP ≥20 mmHg	7,456 (11.8%)	980 (44.8%)
AUROC (with 95% CI)	0.78 (0.77 to 0.78)	0.75 (0.73 to 0.77)
Maximum Youden index	0.43	0.40
Delta etCO ₂ at maximum Youden index	-2	-2

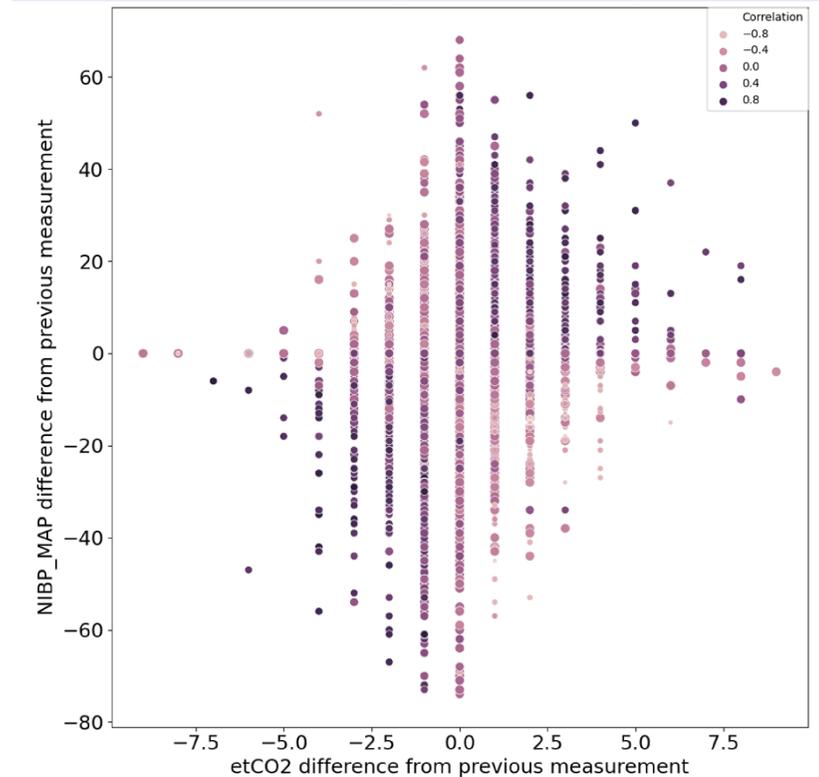


Figure 2: Correlation in the differences from previous measurement for non-invasive mean arterial pressure (NIBP_MAP) and end-tidal carbon dioxide (etCO₂); bubble size indicates the number of measurements at that point.



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