ETco₂: a predictive tool for excluding metabolic disturbances in nonintubated patients

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INTRODUCTION

- Arterial blood gas (ABG) analysis is a commonly ordered laboratory test in the emergency department (ED) for the diagnosis, management, and disposition of patients with hypoxia, acidosis, hypercarbia, and electrolyte abnormalities.

- bearing risks for patients and health care providers…

- ABG analysis is an invasive, painful, andtime-consuming procedure

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- Noninvasive ETCO2 measurement usage was investigated instead of arterial blood sampling …

- …in pediatric patients suspected of diabetic ketoacidosis and dehydration

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- This study has been designed to investigate the clinical value of ETCO2 measurement in patients requiring ABG analysis for the rapid evaluation of patients' metabolic status in the ED.

Method

- prospective cross-sectional study
- in a tertiary care university hospital ED
- During a period of 3 months..
- all patients presenting to the ED with any complaint needing ABG analysis were eligible for the study

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- Emergency physicians and senior emergency residents were trained in ETCO2 setup, measurement, and troubleshooting before the study started.

- Each patient used an oral cannula connected to the capnograph during spontaneous ventilation.
- This required the patient to be awake and alert.
- Intubated patients were not enrolled into the study

- Arterial blood gas sampling was taken soon after ETCO2 was measured.

- Because the main purpose of our study was to investigate the relation between ETCO2 measurement and bicarbonate level in patients with clinically suspected metabolic disturbance, patients (previously diagnosed) with <u>chronic obstructive pulmonary disease were excluded</u>.

- In our primary analysis, Cross-sectional associations between ETCO2 and bicarbonate were examined.

- We also tested the association between ETCO2 and return for reevaluation within 30 days after discharge and mortality.
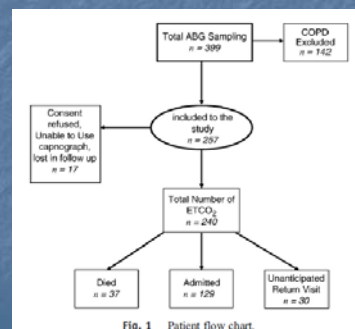
Results

Fig. 1   Patient flow chart.

Table 1   Patient's demographics

	Patients (N = 240)
Sex (male/female)	144/96
Age (y), mean ± SD	61.2 ± 15.4
Admitted	129 (53)
Died	37 (15)
Return visit in 30 d	30 (12)
Acute renal failure	118 (49)
Diabetes mellitus	26 (11)
Infections	24 (10)
Heart failure	20 (8)
Others	52 (22)

Values are given as n (%), unless otherwise stated.

Table 2   ETco_2 and HCO_3 values

	ETco_2 (mm Hg), mean	HCO_3 (mmol/L), mean
All patients	29.5	22.6
Died	26.5	21.8
Survived	30.0	22.7
Admitted	28.7	21.6
Discharged	30.3	23.7
HCO_3 ≤21 mmol/L	25.7	17.7
HCO_3 >21 mmol/L	31.6	25.3
Return visit	28.6	23.9
No return visit	31.0	22.4

- When compared with the patients with <u>normal bicarbonate</u> levels (>21 mmol/L) the mean ETCO2 level was statistically lower in the <u>low-bicarbonate group</u>.

- The mean ETCO2 levels of the patients that <u>died</u> and those that <u>survived</u> were statistically significantly different.

- However, ETCO2 measurements <u>were not</u> found to be independent predictors of mortality in a logistic regression model.

- The mean ETCO2 value was no statistically significant difference among…

- …patients with and without unanticipated return visits to the ED

- with unanticipated return visits to the ED was 28.7 mm Hg (minimum, 15; maximum, 38)
- Without unanticipated return visits to the ED 31.0 mm Hg (minimum, 10; maximum, 48)

Discussion

- ETCO2 measurement in the ED has become widespread in recent years.

- Its primary role has been to confirm endotracheal tube placement

- It has been well established that
- when the pulmonary ventilation/perfusion circuit is adequate,
- ETCO2 changes may reflect circulatory perfusion and metabolic states.

- A strong correlation (r = 0.80) between ETCO2 and HCO3 was found in <u>pediatric</u> patient population with <u>dehydration</u>

- Our study demonstrates a moderate correlation between ETCO2 and HCO3 levels among <u>patients with suspected metabolic disturbance</u>

- Even if the correlation coefficient <u>was not</u> found to be strong enough between ETCO2 and HCO3 levels in this study (r =0.506)…
- The sensitivity, specificity, and also LR's for <u>detecting low bicarbonate level</u> were found to be statistically significant.

- in our study, ETCO2 values of 37 mm Hg or greater basically ruled out HCO3 levels of 21 mmol/L or less.

- Conversely, ETCO2 values of <u>25 mm Hg or less</u> increased the specificity to 84%, which means that patients with ETCO2 values in this range were very <u>likely to be acidotic.</u>

- For patient who died … although ETCO2 could not be found as an independent predictive factor in logistic regression model..
- But routine ETCO2 measurements as an indicator of low bicarbonate levels seem to also provide information regarding <u>likelihood of mortality</u>

Limitations

- The number of <u>patients excluded</u> from the study might have influenced the results regarding the relation between mortality and ETCO2 level
- Recording ETCO2 values requires sampling <u>expertise</u>, and a degree of <u>observer interpretation</u> and therefore may be subject to measurement bias.

Conclusions

- This study demonstrates that bedside ETCO2 is a useful tool in the ED for the <u>detection of low bicarbonate level</u>

- The main finding of this study was that normal ETCO2 values are associated with a normal metabolic status.

- A cutoff level of 36 for ETCO2 has a negative predictive value of 0.05, which strongly <u>excludes metabolic acidosis</u>.

- ETCO2 should be used as a predictive <u>tool in excluding metabolic acidosis</u> in patients with possible metabolic disturbances.

- In addition, we have shown that very low bedside ETCO2 measurements <u>might have</u> prognostic value in determining <u>mortality</u>

Thank you !