



# End-tidal Carbon Dioxide Levels are Associated with Mortality in Emergency Department Patients with Suspected Sepsis



Christopher L Hunter, M.D., Ph.D.<sup>1</sup>, Salvatore Silvestri, M.D.<sup>1</sup>, Matthew Dean<sup>2</sup>, Jay Falk, M.D.<sup>1</sup>, Linda Papa, M.D.<sup>1</sup>

Department of Emergency Medicine, Orlando Regional Medical Center<sup>1</sup>, Orlando, Florida; and The University of Central Florida College of Medicine<sup>2</sup>, Orlando, Florida

## Background

Sepsis is responsible for significant morbidity and mortality in the United States, and early recognition and treatment of septic patients is essential for improving outcomes. Lactic Acidosis has been shown to predict disease severity and mortality in ED patients with infection. Recently, exhaled end-tidal carbon dioxide concentration (ETCO<sub>2</sub>) was demonstrated to correlate with clinical measures of organ failure and lactate levels in febrile ED patients.

## Objective

This study assessed whether levels of ETCO<sub>2</sub> were associated with in-hospital mortality and examined the correlation between ETCO<sub>2</sub> and serum lactate levels in patients presenting to the ED with suspected sepsis.

## Methods

We conducted a prospective observational cohort study of suspected septic patients presenting to an urban tertiary care center ED with an annual volume of 70,000 patients. Adult patients who presented with suspected infection and two or more of the following SIRS criteria: temperature >38C or <36C, heart rate >90 beats/min, and respiratory rate >20 breaths/min were eligible. We excluded patients with craniofacial abnormalities preventing ETCO<sub>2</sub> measurement, history of acute asthma exacerbation or COPD, any environmental cause of hyperthermia, as well as those refusing to consent to standard therapy and interventions. The following data were collected: ETCO<sub>2</sub>, serum lactate level, blood culture result, the need for vasopressors or mechanical ventilation, length of hospital stay, and disposition. Our primary endpoint was the association between ETCO<sub>2</sub> (mmHg) and in-hospital mortality. Our secondary endpoint was the correlation between ETCO<sub>2</sub> and serum lactate (mMol/L).

## Results

We enrolled 201 patients over 22 months with a mean age of 65 years. 53% were male, 36% were admitted to the ICU, 24% were put on vasopressors, 31% were blood culture positive, and 18% were intubated. The mean length of stay was 8.6 days (range 1-54) and in-hospital mortality was 14%. Overall mean levels of lactate and ETCO<sub>2</sub> in all patients were 3.1mMol/L and 32 mmHg respectively. Mean ETCO<sub>2</sub> in patients who survived to discharge was 33 and in patients who did not survive it was 26 (P=0.001). Mean levels of lactate in patients who survived to hospital discharge was 2.6 and in non-survivors the mean was 6.1 (P<0.001). There was a significant inverse relationship between ETCO<sub>2</sub> and lactate levels with a correlation coefficient of -0.507 (P<0.001), so as lactate levels increased ETCO<sub>2</sub> levels decreased. This significant correlation existed regardless of whether lactate was measured via venous (correlation coefficient of -0.493; P<0.001), or arterial (correlation coefficient of -0.526; P<0.001) sampling.

Table. Patient characteristics

	Total Patients N=201 [95%CI]	Survivors N=172 [95%CI]	Non-survivors N=29 [95%CI]	P-value
Age in years	65 (range 18-99) [62-67]	65 [62-68]	63 [55-71]	0.610
Gender (%female)	47 [40-54]	49 [42-57]	34 [16-53]	0.162
Length of Stay (days)	8.6 [7.4-9.8]	9.2 [7.9-10.5]	5.0 [2.1-7.9]	0.014
Intubated (%)	18 [13-23]	13 [8-18]	48 [29-68]	<0.001
Mechanical Ventilation (%)	25 [19-31]	15 [10-21]	86 [73-100]	<0.001
Required ICU (%)	36 [29-42]	27 [20-34]	86 [73-100]	<0.001
Positive Blood Cultures	31 [24-37]	29 [22-36]	41 [21-60]	0.197
Required Vasopressors (%)	24 [18-30]	14 [8-19]	83 [68-97]	<0.001
Arterial Lactate Samples (%)	47 [40-54]	41 [34-49]	79 [64-95]	<0.001
Lactate (mMol/L)	3.1 [2.6-3.5]	2.6 [2.2-3.0]	6.1 [4.3-8.0]	<0.001
ETCO <sub>2</sub> (mmHg)	32 [30-33]	33 [31-34]	26 [21-30]	0.001

Figure 1. Inverse Relationship between ETCO<sub>2</sub> and Lactate

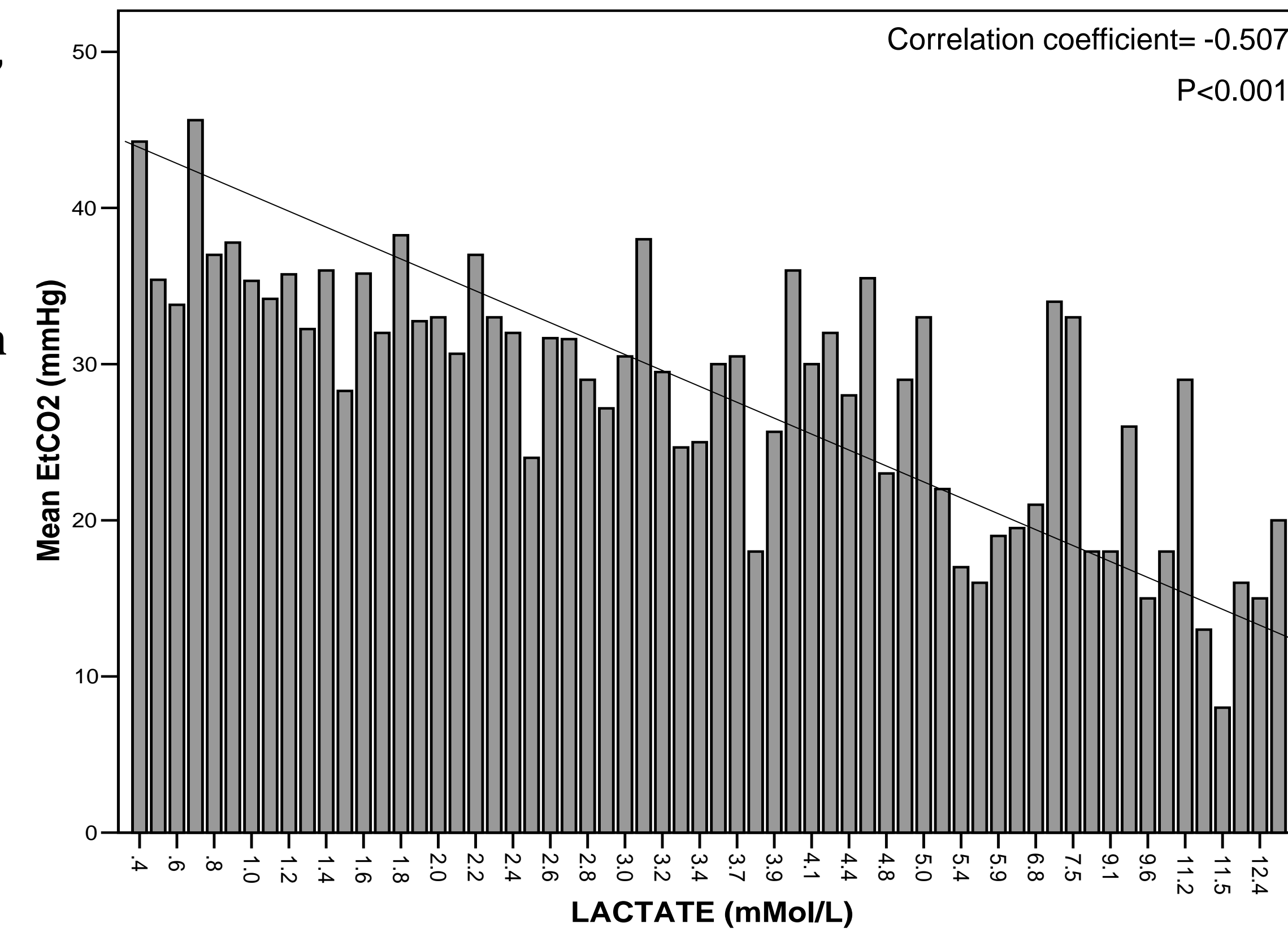
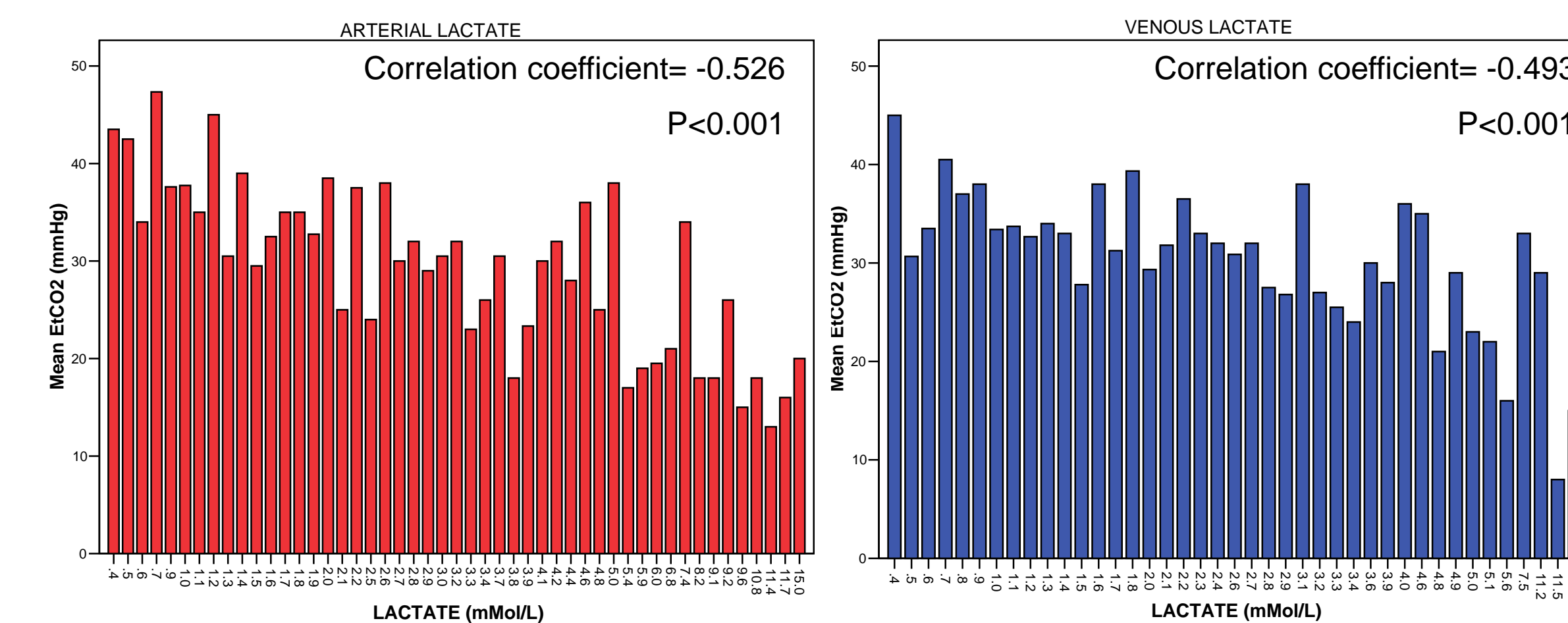


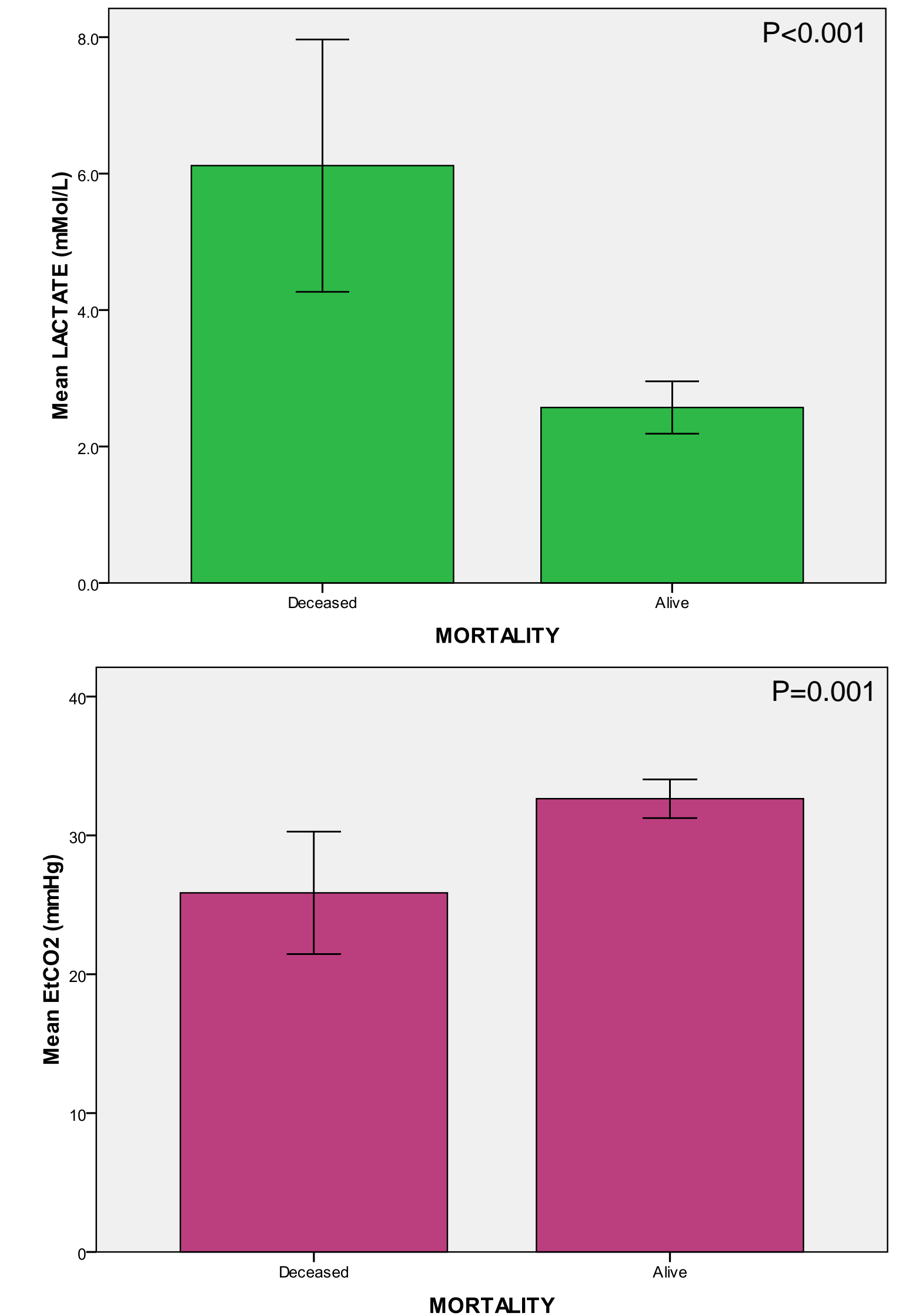
Figure 2. Comparison of Arterial and Venous Lactate



## Limitations

Small sample size, convenience sampling, single patient population, and confounding variables that were not otherwise controlled represent the main limiting factors of this study.

Figure 3. Lactate and ETCO<sub>2</sub> Levels in Non-Surviving and Surviving Patients



## Conclusions

There was a significant association between levels of ETCO<sub>2</sub> and in-hospital mortality in emergency department patients with suspected sepsis. Additionally, ETCO<sub>2</sub> levels were significantly and inversely correlated with lactate levels in these patients. Future studies are needed to assess whether use of ETCO<sub>2</sub> levels in clinical evaluation can decrease time to diagnosis and improve outcomes.

## References

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