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End-tidal CO₂ on admission is associated with hemorrhagic shock and predicts the need for massive transfusion as defined by the critical administration threshold: A pilot study

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Background: Critical administration threshold (≥ 3 units of packed red blood cells/hour or CAT+) has been proposed as a new definition for massive transfusion (MT) that includes volume and rate of blood transfusion. CAT+ has been shown to eliminate survivor bias and be a better predictor of mortality than the traditional MT (>10 units/24 hours). End-tidal CO₂ (ET CO₂) negatively correlates with lactate and is an early predictor of shock in trauma patients. We conducted a pilot study to test the hypothesis that low ET CO₂ on admission predicts CAT+.

Methods: ET CO₂ via capnography and serum lactate were prospectively collected on admission for 131 patients requiring trauma team activation. Demographic data was obtained from patient charts. Excluded were patients with isolated head injuries, traumatic arrests, or pre-hospital intubations. CAT \pm status as described was determined for each hour up to 6 hours from admission as described; likewise, MT \pm status was determined up to 24 hours from admission.

Results: After exclusion criteria, 67 patients were analyzed. Mean age was 41.2 \pm 18.5. Thirty-three patients had a blunt mechanism of injury (49.2%), median ISS was 9 (interquartile range 4-19), and there were 6 deaths (9%). ET CO₂ and lactate were negatively correlated by Spearman rank-based correlation ($\rho = -0.40736$, $p = 0.00062$). 21 (31.3%) and 8 (11.9%) patients were CAT+ and traditional MT+, respectively. There were a significantly greater proportion of patients with ISS >15 , ET CO₂ <35 , or who died found to be CAT+. A binomial logistic regression model adjusting for age, SBP <90 , HR, and ISS >15 revealed ET CO₂ <35 to be independently predictive of CAT+ (OR 9.24, 95% CI 1.51-56.57, $p = 0.037$).

Conclusions: This pilot study demonstrated that low ET CO₂ had strong association with standard indicators for shock and was predictive of patients meeting CAT+ criteria in the first 6 hours after admission. Further study to verify these results and to elucidate CAT criteria's association with mortality will require a larger sample size.

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