

Reconsidering the role of lactate as a predictor of acute asthma severity in the emergency department

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Abstract

Assessing acute asthma severity in the Emergency Department (ED) may be challenging for emergency physicians. In order to assess if lactate levels at ED presentation can independently indicate the necessity for hospitalization, thereby acting as an objective measure of asthma attack severity we retrospectively collected data from 96 patients accessed to our ED in 2024, including patients' medical history, vital signs and arterial blood gas analysis.

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Patients were divided in two groups: discharged or admitted. The primary endpoint was the need for hospitalization. In the results, hospitalized patients exhibited a markedly lower P/F and higher lactate levels. In the univariate analysis, admission was significantly linked to lactate levels and P/F ratio. The multivariate analysis further validated lactate and P/F ratio as independent predictors of hospital admission among a series of confounders. In conclusion, plasma lactate should be reevaluated as a severity marker for acute asthma patients in the Emergency Department.

Introduction

Assessing acute asthma severity in the Emergency Department (ED) poses a common yet complex challenge for emergency physicians. The absence of objective, easily accessible, and reproducible tools to determine the severity of asthma attacks complicates the timely identification of patients at greater risk of deterioration or those in need of hospitalization.¹ Commonly utilized clinical parameters, such as respiratory rate, accessory muscles recruitment, and peripheral oxygen saturation, often exhibit individual variability and subjective interpretation.² Recently, there has been increasing interest in finding blood biomarkers to assist with decision-making during diagnostic and prognostic stages. Among these, blood lactate levels, traditionally used to evaluate tissue hypoperfusion in critical care, have also demonstrated potential value in respiratory contexts, although their clinical importance in patients with asthma is still controversial.³ Consequently, we performed a retrospective study to assess if lactate levels at emergency department presentation can independently indicate the necessity for hospitalization, thereby acting as an objective measure of asthma attack severity.

Materials and Methods

We analyzed 96 adult patients (28% accessed by pre-hospital emergency system) who presented to our Emergency Department for acute asthma (mean age 43±18 years) during the year 2024, divided into two groups based on clinical outcome: discharged (group 1) or admitted (group 2). The diagnosis of asthma was determined i) on the basis of the patient's personal history (previous examinations/hospitalizations, ongoing therapy); ii) on a clinical basis due to the presence of symptoms of bronchial constriction that varied over time and after confirmation by retrospective consultation of the patient's electronic health records. Collected data included patients' medical history, assumption of rescue therapy (salbutamol) before accessing the ED, vital signs and arterial blood gas analysis. The primary endpoint was the need for hospitalization, considered as a surrogate marker of greater clinical severity, the decision to hospitalize or not was taken by the treating physician autonomously and without any consideration of the lactate levels and the results of this retrospective study. All statistical

analyses were performed using SPSS statistics version 19 software, with statistical significance at $p < 0.05$. The variables were expressed as mean values \pm standard deviation or as frequencies (percentage values). We used Student's *t* test and the Mann-Whitney *U* test to compare parametric and non-parametric variables. For testing the univariate and multivariate relations between variables we used binary logistic regression analysis.

Results

Among the patients analyzed, 42.2% were admitted to the hospital. Those in the hospitalized group exhibited a markedly lower P/F ratio (281 ± 63 mmHg compared to 359 ± 61 , $p < .001$) and higher lactate levels (1.2 ± 0.7 compared to 0.9 ± 0.6 mmol/L, $p = .010$). There were no notable differences regarding age, gender, smoking habits, allergic diathesis, heart rate, or blood pressure between groups. Moreover, comparing lactate levels between patients who assumed beta-2-agonists before arrival in the emergency room and patients who did not, no statistically significant difference emerged. In the univariate analysis, admission was significantly linked to lactate levels (OR 2.27; 95% CI: 1.07–4.83; $p = .033$) and P/F ratio (OR 0.975; 95% CI: 0.963–0.986; $p < .001$). The multivariate analysis further validated lactate (OR 2.62; 95% CI: 1.03–6.60; $p = .042$) and P/F ratio (OR 0.97; 95% CI: 0.956–0.984; $p < .001$) as independent predictors of hospital admission (table 1).

Discussion

Our data indicate that measuring plasma lactate levels upon arrival at the Emergency Department can provide an objective measure of acute asthma severity.

The aim of our study was to identify, in an early and simple way and already during the triage process, the elements able to detect the patients with the most severe acute asthmatic attack; therefore we relied only on clinical and blood gas analysis data, not taking into consideration other data such as laboratory tests. In this context, hyperlactatemia, detectable right from blood gas analysis performed during the triage process, may indicate heightened respiratory distress or increased muscular effort, facilitating early risk assessment.

Growing research suggests that hyperlactatemia arises from heightened metabolic demand due to increased respiratory effort, rather than from generalized tissue hypoxia.⁴ Another pathogenic hypothesis explores how endogenous catecholamines and beta-2 agonists may enhance the conversion of pyruvate into lactate.⁵ Some studies indicate that increased lactate levels might be caused by beta-agonist therapy, not always correlated with a worse prognosis.^{6,7} In their study, a planned sub-analysis of a prospective study aimed at determining the efficacy of a new IV beta-adrenergic drug as an adjunct to conventional therapy that also included albuterol, evaluating only the placebo group, Lewis *et al.* highlighted a direct correlation between plasma lactate and albuterol dosage.⁷ Furthermore, these authors did not highlight a correlation between lactate level and patient outcome. This study showed a correlation between plasma albuterol dosage and lactate levels, but

it should not be forgotten that all the patients evaluated had taken albuterol shortly before randomization and therefore did not allow for the definition of the lactate level of a patient population who had not taken this drug. Different from this, in our study the increase in lactate levels does not appear to be secondary to beta-2 agonist therapy assumption; indeed, there was no statistically significant difference in lactate levels between the patients who had taken beta-2 agonist therapy before arrival and those who did not (1.14 ± 0.8 mmol/l vs 0.96 ± 0.5 mmol/l respectively, ns). Hyperlactatemia is significantly linked to a higher risk of hospitalization, even after controlling for age and other physiological factors. Additionally, the predictive value of lactate appears alongside the P/F ratio, a recognized metric for evaluating respiratory function, further supporting its potential relevance in acute asthma management.

Limitations

This study has several limitations related to its retrospective design, the small sample size, and the lack of sufficient data to adequately adjust for potential confounding factors. Therefore, the results are not conclusive but rather serve as a preliminary signal to highlight the potential role of lactate measurement in the emergency/triage setting as a risk stratification tool for asthmatic patients, providing a foundation for future larger and prospective studies.

Conclusions

In light of the results, plasma lactate needs to be reevaluated as a potential severity marker for acute asthma patients in the Emergency Department. Its rapid and widespread measurement can significantly enhance traditional clinical and instrumental assessments. Nonetheless, additional prospective multicenter studies with larger sample sizes are essential to validate these results and define clinically relevant reference thresholds.

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