Lactate Clearance as a Marker of Mortality in Paediatric Intensive Care Unit

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Abstract

Objectives: To correlate lactate clearance with Pediatric Intensive Care Unit (PICU) mortality. *Methods:* 45 (mean age 40.15 mo, 60% males) consecutive admissions in the PICU were enrolled between January 2015 and December 2015. Lactate clearance (Lactate level at admission – level 6 hr later x 100 /lactate level at admission) in first 6 hours of hospitalization was correlated to in-hospital mortality and PRISM score. *Results:* Twelve out of 45 patients died. 90% died among those with delayed/poor clearance (clearance <30%) compared to 8.5% in those with good clearance (clearance >30%) (P<0.001). Lactate clearance <30% predicted mortality with sensitivity of 75%, specificity of 97%, positive predictive value of 90%, and negative predictive value of 91.42%. Predictability was comparable to PRISM score >30. *Conclusion:* Lactate clearance at six hours correlates with mortality in the PICU.

Keywords: In-Hospital Mortality; Lactate Clearance; PRISM Score.

Introduction

Hyperlactatemia is an indicator of inadequate tissue perfusion, particularly in sepsis [1]. It reflects severity of illness with significant prognostic implications [2]. The severity and duration of lactic acidosis in critically ill patients correlates with overall oxygen debt, and increased production [3,4]. However, a single lactate measurement has not been correlated to mortality consistently [5]. Lactate clearance is the rate of fall in lactate after resuscitation is started. This has shown more promise in predicting mortality. Two studies in adult patients with shock showed that lactate clearance of <10% was related to mortality [5,6]. There are no pediatric studies looking at lactate clearance and mortality although Hatheril, et al. [7] showed that persistent hyper-lactatemia at 24 hours (>2 mmol/dL) was associated with mortality. We investigated whether lactate clearance in the early period of resuscitation (first 6 hours of hospitalization) could help predict mortality in pediatric patients

Methods

Admissions to the PICU (aged >1 month and <13 years) were studied between January 2015 and December 2015 after obtaining informed written consent from parents. Children with inborn error of metabolism and trauma were excluded. The study was approved by the hospital ethics committee. As a pilot study, a convenience sample of 45 patients admitted consecutively was enrolled. Heparinized syringe was used to collect venous blood. Lactate estimation was done by Radiometer Copenhagen ABL 555 blood gas analyzer. Lactate levels were estimated at admission and after six hours of admission and the clearance was calculated as follows: Lactate clearance = [Initial Lactate – Current

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Lactate) × 100 / Initial Lactate]. A positive value denotes clearance of lactate, whereas a negative value denotes an increase in lactate after intervention. Routine ICU care and investigations were performed and Pediatric Risk of Mortality (PRISM) score was calculated. In-hospital mortality was the primary outcome of interest. Survivors and non-survivors were compared by the Mann-Whitney test for continuous variables and by Fisher's exact test for categorical variables. For non- parametric data, pair-wise comparisons were made using Wilcoxon's signed-rank test. For continuous variable, we used t-test. A P value <0.05 was taken as statistically significant. SPSS version 16.0 was used.
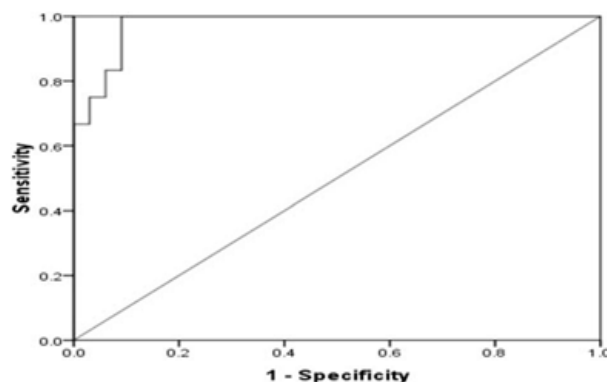
Results

Out of 45 children (mean age 40.15, range 1-144 months, M:F ratio 1.5:1), twelve died. The initial lactate was not significantly different between those who died and those who survived [8.44 (3.27) vs 7.29 (3.31), P=0.18], but clearance at 6 hours was significantly lower in those who died (-4.01%) than those who survived (55.53) (P<0.001). The mean (SD) PRISM score was also higher in those who died compared with those who survived [43.6 (7.27) vs. 21.7 (9.2), P<0.001]. Where lactate clearance was <30% at 6 hours, nine out of ten died. In those with clearance >30% only three out of thirty-five died. ROC curve analysis for mortality prediction was 0.97 (P< 0.001) (Figure 1). Three children died within 24 hours. Mean (SD) duration of hospital stay in those with lactate clearance >30% was 18.5 (8.44) d (range 3-40), against 3.1 (2.61) d (range 1-9) in those with clearance <30%. An inverse relationship was observed between lactate clearance and PRISM score (Table 1). Lactate clearance <30% at six hours predicted mortality with sensitivity of 75%, specificity of 97%, PPV 90%, NPV 91.42%. Observed and expected mortality was almost similar in those having PRISM score of >30.

Table 1: Ccorrelation of prism s core with lactate clearance in relation to observed and expected mortality

PRISM score	Number of patients	Lactate clearance at 6 hrs (%)	Observed mortality (%)	Expected mortality (%)
01-05	0	-		09
06-10	4	60.9		15
11-15	5	51.0		23
16-20	6	54.4		35
21-25	9	61.3		49
26-30	3	48.0		63
31-35	6	42.3	33.3	75
>35	12	0.7	83.3	>75

Fig. 1: ROC curve for lactate clearance at 6 hours in relation to mortality prediction

Discussion

Lactate clearance at 6 hours was significantly associated with mortality as was a PRISM score >35. The ROC curve shows mortality prediction of lactate clearance was 0.977. The duration of stay was longer in those with good clearance because of early mortality in the ones with poor clearance. There were very few survivors among those with poor clearance to allow us to compare duration of stay in survivors in the two groups. High admission lactate was a significant independent predictor of mortality in adult patients admitted to ICU [8-10] but it could not be replicated in other studies [6,11].

Studies have suggested the value of monitoring for lactate clearance with hypo-perfusion [6,7]. One of these studies found a 41% higher mortality rate among those subjects who failed to reach a lactate clearance of 10% when compared with those that effectively cleared lactate (60% vs. 19% mortality) during the early resuscitative period. The only study in pediatric age group conducted by

Hatheril, et al. [7], showed that persistent hyper-lactatemia >2 mmol/L after 24 hours was associated with 93% mortality, as compared to 30% in those children whose lactate level had normalized. Following the study in adults, we used lactate clearance at 6 hours [6]. We found that we can predict mortality as early as 6 hours. In our study PPV, NPV

and ROC curve analysis for mortality prediction at 6 hours of lactate clearance are comparable to Hatheril, et al. [7] findings at 24 hours. We found that a lactate clearance ≤30% at six hours and PRISM score more than 30 have high prediction for mortality. Lactate clearance can probably be used as a screening tool to predict adverse outcome. We have provided stratification and cut-off values of lactate clearance which need validation by more studies with larger samples.

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