

Association of Post-Surgical Lactate Levels with Morbidity and Mortality in Pediatric Patients Undergoing Extracorporeal Circulation Pump

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Introduction

Lactate is a final product of anaerobic metabolism its accumulation can produce cellular and organic dysfunction of all systems leading to lactic acidosis [1]. Access to its measurement in hospitals has allowed it to be used as a marker of tissue hypoperfusion in multiple pathologies. This marker has been studied as a prognostic factor in patients with sepsis, septic shock, but has not been studied in patients undergoing surgical correction of cardiac malformations [2].

Between March and August 2016, under a cohort design, we studied pediatric patients under 12 years of age who entered the intensive care unit after surgical correction of congenital heart disease with the use of an extracorporeal circulation pump. All patients underwent quantification of serum lactate levels in the immediate postoperative period, at 12 hours and 24 hours after the surgical event [3].

We studied a total of 51 patients who underwent surgical correction with the use of extracorporeal circulation and aortic clamping. Male patients predominated 30 (58%), female 21 (42%). Within the immediate postoperative lactate levels the range was 0.7 to 15 mmol / L (6.7 mmol / L), at 12 hours postoperatively the range found was 0.6 to 15 mmol / L, (5.1 mmol / L) and measurements ranged from 0.4 to 15 mmol / L (4.2 mmol / L) in the 24-hour post-surgical measurements (Table 1).

The mortality rate was 35% (18 patients) the main complications were Renal Insufficiency (RI) 14/51 (27%), Multiorgan Failure (FM) 13/51 (25.4%) and some others related to cardiac function such as ventricular dysfunction, cardiogenic shock and heart failure in 17/51 (33%).

The association between post-surgical lactate levels immediately at 12 hours and 24 hours with mortality showed statistical significance and correlation coefficients a moderate relationship (Table 2).

The association between immediate postoperative lactate levels at 12 hours and 24 hours with the presence of complications was statistically significant and the correlation coefficients showed a moderate relation with the levels of immediate and strong post-surgical lactate with the measurements of 12 and 24 hours (Table 2).

This study demonstrates that serial analysis of serum levels of serum lactate in the immediate postoperative 12 and 24 hours are closely related to the patient's prognosis, with a moderate association to mortality and moderate to severe with the presence of complications, both statistically significant [4,5].

Recent evidence refers to lactatemia when patients enter intensive care units, allowing them to be divided into risk groups, with those with higher levels showing a greater tendency to unfavorable outcomes. [6] Hajjar et al [7] reported that there is a 3.3-fold increase in mortality risk in patients with lactate levels above 3 mmol / L at 6 hours post-operatively.

In our study we observed that patients with lactate above 5 mmol / L in the immediate postoperative period and especially at 12 and 24 hours had a higher incidence of complications such as ARF. As for the patients who died at 12 and 24 hours the vast majority presented lactate levels above 10 mmol / L, reflecting a state of severe hypoperfusion.

Table 1: Characteristics of pediatric patients with congenital heart disease undergoing corrective surgery under extracorporeal circulation.

n=54	Age	PT	ACT	IPSL	12PSL	24PSL
	(years)	(min)	(min)	(mmol/L)	(mmol/L)	(mmol/L)
Average	4	94	66.8	6.7	5.1	4.2
Median	3	91	67	5.7	3	1.4
Minimum	0.5	17	0	0.7	0.6	0.4
Maximum	12	281	168	15	15	15

PT= Pump Time of Extracorporeal Circulation; ACT= Aortic Clamping Time; IPSL= Immediate Post-Surgical Lactate; 12 PSL= 12 hours Post-Surgical Lactate; 24 PSL: 24 hours Post-Surgical Lactate; Min: Minutes; mmol/L= Milosmoles per liter; n=Sample size.

Table 2: Association of serial measurements of lactate with mortality and morbidity in patients with congenital heart disease undergoing corrective surgery under extracorporeal circulation.

n=54	Lactate Levels	Mortality	p	C	Complications	p	C
		N (%)			N (%)		
IPSL	< 5mmol/L	8(35%)	0.00*	0.422	3(13%)	0.03*	0.473
	5-10 mmol/L	6(40%)			6(40%)		
	>10 mmol/L	12(93%)			9(69%)		
12PSL	< 5mmol/L	12(35%)	0.00*	0.609	5(15%)	0.00*	0.69
	5-10 mmol/L	4(43%)			3(43%)		
	>10 mmol/L	10(100%)			10(100%)		
24PSL	< 5mmol/L	15(37%)	0.02*	0.71	7(82%)	0.00*	0.7
	5-10 mmol/L	1(100%)			1(100%)		
	>10 mmol/L	10(100%)			1(100%)		

IPSL= Immediate Post-Surgical Lactate; 12PSL= 12 hours Post-Surgical Lactate; 24PSL: 24 hours Post-Surgical Lactate; Min: Minutes; mmol/L= Milosmoles per liter; n=Sample size; p=Chi square; C=Correlation coefficient; * = Statistical significance: N= Number; %= Percentage.

To date there is no consensus regarding this association, since there are other transoperative factors that directly affect the prognosis of the patient, such as extracorporeal circulation pump time greater than 90 min, aortic clamping time above 60 min, which increase the risk of morbidity and mortality up to 80-90% [8]. There are some other factors related to patient, surgery and anesthetic management in this group of patients as administration of vasopressor drugs, especially adrenaline that has been associated with increased levels of lactic acid which were not included in this study and that it would be important to consider further research [9].

As conclusions of this study we can deduce that the serial serostatus lactate measurements are very useful to predict the occurrence of complications such as ARF, multiple organ dysfunctions, ventricular dysfunction, cardiogenic shock and the probability of death of the patient. Arterial lactate levels above 5 mmol / L lactate in the immediate postoperative period, at 12 and 24 hours, are indicators of poor prognosis, since in this group of patients it was associated in a moderate to strong manner with the presence of complications and death.

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