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Original Article

PELOD score, serum procalcitonin, and lactate levels in pediatric sepsis

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Abstract

Background Sepsis remains a major cause of morbidity and mortality among critically ill children in the pediatric intensive care unit (PICU). Procalcitonin and lactate have been used as biomarkers of sepsis, as they have been correlated with disease severity, organ failure and death. The Pediatric Logistic Organ Dysfunction (PELOD) score is a tool to assess the severity of organ dysfunction in critically ill children.

Objective To investigate the correlation between PELOD score and procalcitonin and lactate levels in pediatric sepsis.

Methods A cross-sectional study was conducted in children with sepsis who were admitted to the PICU from April to July 2012. Sepsis was defined as systemic inflammatory response syndrome (SIRS), as a result of suspected or proven infection. Proven infection was defined as positive culture findings (blood, urine or other specimens) and/or serum procalcitonin ≥2 ng/mL. Spearman's test was used to assess for correlations between PELOD scores and procalcitonin as well as lactate levels.

Results Thirty-two patients were analyzed, consisting of 18 males and 14 females with an age range of 1-432 months (median 21 months). There was no statistically significant correlation between procalcitonin level and PELOD score (r=- 0.186, 95%CI -0.502 to 0.174, P=0.308) nor between lactate level(r=-0.069, 95%CI -0.408 to 0.287, P=0.709) and PELOD score.

Conclusion Serum procalcitonin and lactate levels are not correlated with PELOD scores in children with sepsis.

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Keywords: *sepsis, procalcitonin, lactate, PELOD score*

Sepsis remains a major cause of morbidity and mortality among critically ill children in the PICU.[1,2] Physicians should be able to carefully monitor patient response to therapy, including the progression to septic shock, organ failure, or death. In addition to their use in sepsis diagnosis, biomarkers have been used to complement clinical assessments and provide information for diagnostic, monitoring and therapeutic decision-making at various levels of sepsis.[3,4] Biomarkers are useful to monitor disease course as testing is generally noninvasive and yields quick results.[5]

Procalcitonin and lactate are biomarkers of sepsis, where increased serial levels have been suggested to be good prognostic markers.[5,6] Several studies have shown the correlation between procalcitonin and severity of disease and organ failure.[6-8] The PELOD score is used to assess organ

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dysfunction in multiple organ systems.[9] The PELOD scores increase along with the cumulative effect of organ dysfunction and severity of sepsis.[10] There have been few studies on whether these biomarkers and PELOD score are strongly correlated; also results so far have been conflicting.[11,12] The aim of our study was to assess the correlations between PELOD scores and lactate as well as procalcitonin levels in children with sepsis.

Methods

This cross-sectional study was conducted in the PICU at Haji Adam Malik Hospital, Medan, North Sumatera, and included all septic patients. The study was conducted in April-July 2012. Subjects were septic children aged 1 to 432 months, with a PICU length of stay >24 hours, and whose parents provided informed consent. Patients with septic shock were excluded. Sepsis was defined as SIRS in the presence or as a result of suspected or proven infection. Proven infection was defined as positive culture findings (blood, urine or other specimens) and/or procalcitonin ≥2 ng/mL.

All patients underwent complete blood count examinations, liver and renal function tests, hemorrhagic screening tests, and blood gas analyses. Serum procalcitonin and lactate levels were also measured in all septic patients and PELOD scores were calculated after the diagnosis of sepsis was confirmed. Examinations were done within the first of 24 hours. For the PELOD score, six organ systems (neurologic, cardiovascular, renal, respiratory, hematologic, and hepatic) were evaluated, each with up to 3 variables (total of 12 variables). Each variable was assigned 0, 1, 10, or 20 points based on the level of severity. Each variable was scored and summed for the total PELOD score. Study approval was obtained from the Research Ethics Committee of the North Sumatera University Medical School.

Spearman's test was used to assess for correlations between either procalcitonin or lactate level and PELOD score and findings was presented as correlation coefficient with corresponding confidence interval. A P value of <0.05 was considered as statistically significant. We analyzed data by *SPSS version 15.0* software.

Results

Thirty-two septic patients were admitted to the PICU. **Table 1** shows the demographic characteristics of subjects. The majority of subjects (13/32) were 1 to 12 months of age. The most common primary source of the sepsis was respiratory (10/32). **Table 2** shows the median serum procalcitonin and lactate levels, as well as PELOD scores. **Table 3** shows there was no significant correlation between procalcitonin level and PELOD score (r= - 0.186, P=0.308), nor between lactate level and PELOD score (r= -0.069, P=0.709).

Table 1. Demographic data of subjects

Characteristics	(N=32)
Age, n	
1-12 mo	13
13-60 mo	10
61-144 mo	6
145-180 mo	2
18-432 mo	1
Gender, n	
Male	18
Female	14
Nutritional status, n	
Well-nourished	19
Moderately undernourished	7
Severely undernourished	5
Overweight	1
Blood culture result, n	
Positive	15
Negative	17
Primary disease, n	
Respiratory	10
Cardiovascular	1
Gastroenterological	1
Neurological	4
Post -neurosurgerical	8
Post-gastrosurgical	7
Post-thoracosurgical	1

Table 2. Median procalcitonin and lactate levels and PELOD scores

Variables	Median (range) (N=32)
Procalcitonin, ng/mL	10.5 (0.13-100)
Lactate, mmol/L	2.15 (0.3-6.8)
PELOD score	16 (0-40)

Table 3. Correlations between PELOD score and procalcitonin and lactate levels

	PELOD score			R	95% CI	P value
	<10	10-19	≥20			
Procalcitonin, n						
0.10-0.25 ng/mL	0	0	2	-0.186	-0.502 to 0.174	0.308*
1.01-5.00 ng/mL	3	1	5			
5.01-100 ng/mL	7	5	9			
Lactate, n						
<2 mmol/L	4	1	7	-0.069	-0.408 to 0.287	0.709*
≥2 mmol/L	6	5	9			

* Spearman's correlation test

Discussion

Our study showed that neither procalcitonin nor lactate level had strong correlation with PELOD score. Of our 32 PICU patients, 47% of the children had positive blood cultures. The initial conditions that led to sepsis were respiratory disease (10 subjects), post-neurosurgery (8 subjects), post-gastrosurgery (7 subjects), and neurologic disease (4 subjects). Similarly, an Indian study found that the most common primary source of sepsis was respiratory disease (pneumonia) in 73.3% of patients, but only 3 (10%) of their patients had positive cultures.[12]A Japanese study found a blood culture sensitivity of 42.6% in 47 sepsis patients.[13]

The median PELOD score in our subjects was 16 on day one. A German study found the median PELOD score to be 10 in 965 (54%) children.[10] Also, a study in Manado reported a median PELOD score of 8 in 26 (70.2%) children with sepsis.[14] Furthermore,a study in Canada, Germany, and Switzerland found that a high PELOD score (≥20 points) on day one was associated with death, and mortality rate was 50% when a high score on day one increased on day two.[15]

Five subjects had procalcitonin levels of 100 ng/ml. Their PELOD scores were 1 in one child, 12 in two children, and 22 in two children. In our study, there was no correlation between procalcitonin level and PELOD score. A London study in 75 children with septic shock determined that children with higher admission procalcitonin levels ultimately had worse organ failure and lower survival.[16] In addition, an American study found that procalcitonin concentration was increased among children with sepsis on day 1 (2.4 ng/mL), but not on day 3 (0.8 ng/mL), and procalcitonin was continuously increased among patients with bacterial sepsis who had persistent multiple organ failure.[17] Furthermore, a Canadian study showed that PELOD assessment scores for a specific set of 7 days (day 1, 2, 5, 8, 12, 16, and 18) can provide optimal information about evolving organ failure during treatment in the PICU.[15]

A Bandung study showed a significant association between plasma lactate level and the degree of organ dysfunction based on PELOD scores in 45 subjects with an average age of 48.7 months. Subjects were grouped according to lactate levels: <2 mmol/L or ≥ 2 mmol/L. Most of their subjects experienced cardiovascular events, had mean lactate levels of 3.45 mmol/L, and the average had dysfunction in 3 organs.[18] In our study, the median lactate level was 2.15 mmol/L. We grouped subjects according to lactate level (< 2 or ≥2 mmol/L), but found no association between plasma lactate level and the degree of organ dysfunction based on PELOD scores. A study in Australia showed that lactate levels were the earliest predictor for assessing outcomes in 31 children with sepsis. Lactate level assessments were made at 12 hours, 24 hours and 48 hours after PICU admission.[19] Lactate levels in our study were examined when patients were admitted to the PICU but after the diagnosis of sepsis was confirmed. No further serial lactate levels were investigated. The PELOD scores were assessed at PICU admission, after the diagnosis of sepsis was confirmed, but were not reassessed on following days.

This study had several limitations: a relatively small sample size (32 patients) and subjects were not grouped by source of sepsis. The small sample size may be associated by the fact that we did not find any statistically significant correlation between either lactate or procalcitonin levels and PELOD score and thus further research with larger sample size is required to confirm the findings.

In conclusion, PELOD score appears not correlated with either procalcitonin or lactate levels in children with sepsis.

Conflict of Interest

None declared.

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