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Original Research Paper

Neonatology

UMBILICAL LACTATE AND BLOOD ACIDITY LEVEL IN ASSOCIATION WITH APGAR SCORE

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ABSTRACT

Background: Asphyxia can develop into progressive hypoxia which trigger anaerobic metabolism and cause lactate accumulation and decrease in pH. Analysis of acid-base and lactate in cord blood can provide an objective assessment of the metabolic status of the neonate.

Objective: To evaluate the association between umbilical lactate and blood acidity and Apgar score

Methods: Approximately 1 mL blood was taken from a clamped segment of cord from 35-42 weeks of gestation neonates then the pH and lactate measured. One and five minute Apgar score assesment was recorded.

Result: The umbilical artery pH was significantly associated with one minute Apgar score (p=0.018) with prevalence ratio (PR) was 3.45 (95% CI;1.47-8.1) but not associated with five minute Apgar Score (p= 0.356). The umbilical artery lactate was not associated with one and five minute Apgar score (p = 0.446 and p=1, respectively).

Conclusion: There was an association between umbilical artery cord blood pH and one minute Apgar score.

KEYWORDS : umbilical lactate, Apgar score, hypoxia

INTRODUCTION

Perinatal asphyxia can arise from a variety of intrapartum and postpartum risks including severe maternal anemia, hypertension, birth trauma, or disorders of the umbilical cord circulation during labor which results in the cessation of gas exchange in the fetus (Denihan et al., 2015). According to the American Academy of Pediatrics (AAP) asphyxia is a gas exchange disorders that can develop into progressive hypoxia, hypercarbia, and acidosis with diagnostic criteria: (i) metabolic acidosis or mixacidosis (pH <7) in cord artery blood samples, (ii) Apgar scores that remain zero to three for more than five minutes, (iii) neonatal neurological disorders (eg seizures, coma, hypotonia), and (iv) multi-organ disorders (eg kidneys, lungs, liver, heart and intestines) (Morales et al., 2011).

Asphyxia is still a world problem that causes nearly 1.2 million neonatal deaths per year (Larosa et al., 2017). The results of the Indonesian basic health research showed that 78.5% of neonatal deaths occurred at the age of zero to six days. The most causes of deaths are asphyxia, low birth weight babies, and infections (Riset Kesehatan Dasar., 2007). Infants who survive from asphyxia will experience various health problems such as brain damage with cerebral palsy manifestations, respiratory tract damage, cardiovascular disorders, kidney function disorders, and others (Denihan et al., 2015).

The Apgar score can provide information about neonatal status and response to resuscitation, but Apgar scores have several limitations because they describe the physiological state of the neonate at one time which is influenced by subjective components. There are a number of things that affect Apgar scores such as maternal sedation or anesthesia, congenital malformations, gestational age, and trauma. In addition, Apgar score elements such as muscle tone, skin color, reflex irritability are also affected by physiological maturity, so it is not appropriate to diagnose asphyxia with Apgar scores alone (AAP., 2015).

Reduced exchange of oxygen and carbon dioxide through the placenta is an important problem in perinatal asphyxia. When the fetal oxygen demand exceeds the ability of placental oxygen flow, the cell will try to meet energy needs with anaerobic metabolism. Anaerobic metabolism will cause lactate accumulation and a decrease in pH (Yli et al., 2015). Acidosis in newborns reflects the fetal environment before birth and is generally defined as low umbilical pH, or high base excess (BE) in the umbilical (Allanson et al., 2016).

The study by Sabina et al in 466 neonates who experienced acidemia showed pH, BE and lactate have the same predictive ability for outcomes of neonates who experience acidemia (Gamboa et al., 2016). Early identification of neonates who experience intrauterine disorders is important because it relates to neonatal development outcome (Skiold et al., 2016). Therefore analysis of lactate and cord blood gas can be used to add objective information to Apgar scores in detecting neonatal asphyxia.

MATERIAL AND METHOD

Patients selection

This study was conducted at Haji Adam Malik General Hospital in October to November 2018. Neonates with a gestational age of 35-42 weeks are included. Neonates with multiple pregnancies with one placenta were excluded from the study. After the umbilical cord cut off, a puncture of ± 1 mL blood on the umbilical artery in the umbilical cord which still connected to the placenta was done within one minute after birth. The Apgar score was assessed by onsite pediatric resident.

DATA ANALYSIS

Maternal characteristics was obtained from an interview. Demographic data such as gender, gestational age, birth weight, body length and head circumference were collected. Lactate was analyzed by Accutrend Plus Cobas ROCHE and blood gas analysis was done at the laboratory using Gem Premier 3500 blood gas analyzer with 1 ml of blood. Apgar score were assessed in the first and fifth minutes. The normal value in this study was > 7. Lactate value of <4 mmol / L was considered to be normal. The normal value of umbilcal artery blood pH was 7.1 to 7.38.

Statistical method

Demographic data were analysed by univariate analysis. The

association between lactate levels and pH on Apgar scores was assessed with Fisher exact test. Data was processed using SPSS version 20 software with a significance level of p <0.05 and 95% confidence interval.

RESULTS

This study enrolled 36 newborns with a gestational age > 35 weeks. The neonates and maternal characteristics is shown in Table 1.

Table 1. Neonates and maternal characteristics

Characteristics	*n*=36
Gender, *n* (%)	
Boys	19 (52.8)
Girl	17 (47.2)
Gestational age, *n* (%)	
≤37 weeks	13 (36.1)
>37 weeks	23 (63.9)
Maternal parity, n (%)	7 (19.4)
Primigravida	11 (30.5)
Secundigravida	18 (50)
Multigravida	
Maternal Disease *n* (%)	
Hypertension	1 (2.8)
Placenta Previa	15 (41.7)
Tetralogy Of Fallot	1 (2.8)
Placenta Acreta	2 (5.6)
Idiophatic Trombocytopenic	1 (2.8)
Purpura Hepatitis B	2 (5.6)
Maternal age, year, mean (SD)	31 (5.149)
Body weight, gram, mean (SD)	2927 (542.655)
Body length, cm, mean (SD)	47.94 (2.72)
Head Circumference, cm, mean (SD)	34.03 (2.145)
Apgar Score first minute, mean (SD)	7.99 (0.99)
Apgar Score fifth minute, mean (SD)	9.11 (0.82)
Umbilical artery pH, mean (SD)	7.19 (0.10)
Umbilical artery lactate, mean (SD)	3.92 (2.01)

The lactate value of umbilical artery blood was not associated to the first minute Apgar score, but for the cord arterial blood pH, we found a significant association (P=0.446 and P= 0.018, respectively) as shown in Table 2.

Table 2. Association between umbilical artery lactate and pH to first minute Apgar Score

	Apgar ≤7	Apgar >7	PR# (95% CI)	P*
Lactate >4	5	7	1.667 (0.636-4.368)	0.446
Lactate <4	6	18		
Abnormal pH	5	2	3.452(1.471-8.1)	0.018
Normal pH	6	23		

*#PR= Prevalence Ratio, * Fisher exact test*

Meanwhile, we we did not find a significant association between pH and umbilical artery lactate with fifth minute Apgar score (P=1 and P=0.356, respectively) as shown in Table 3.

Table 3. Association between umbilical artery lactate and pH to fifth minute Apgar Score

	Apgar ≤7	Apgar >7	PR# (95% CI)	P*
Lactate >4	1	11	2(0.137-29.281)	1
Lactate <4	1	23		
Abnormal pH	1	6	4.143(0.294-58.40)	0.356
Normal pH	1	28		

*#PR= Prevalence Ratio, * Fisher exact test*

DISCUSSION

The Apgar score does not provide information about acidosis / hypoxia that may occur in the perinatal period and has a very low predictive value in identifying long-term morbidity. Research in Malaysia in infants with a gestational age of 37-43 weeks showed that lactate values were influenced by birth methods where the highest lactate values were found in births with instruments (4.87 mmol / L) followed by normal labor (3.36 mmol / L) and the caesarean labor (3.0 mmol / L) (Subramaniam et al., 2017). In our study there was no relationship between lactate and the first minute and the fifth minute Apgar score statistically (P = 0.446 and P= 1, respectively). In our study most of the samples were born by caesarean labor as the reason of low lactate values in cord blood.

Research in Australia showed that lactate with a cut off value of 5.65 mmol / L could predict the the fifih minute Apgar score less than seven with sensitivity and specificity 64% and 69%, respectively. However this study involved a sample of preterm infants whose low apgar score was not only caused by intrapartum problems, but also due to their prematurity (Allanson, Pattinson et al., 2017). Pattil et al. (2018) showed that umbilical blood lactate was more specific than umbilical blood pH to predict bad outcome of the neonate. However, the sample in this study was neonates born to mothers with abnormal cardiotocography and suspected to experience intrapartum fetal distress. Chilinda et al. (2018) made a cohort study conducted in 2017 in Africa showed that of 54 infants who needed treatment at NICU had more than 5 mmol/L lactic artery values (36% of cases) and above 11 mmol / L (13%), whereas in six neonates who died, lactate value was found to be more than 13 mmol/L. Interpretation of blood gases and lactate values must pay attention to many physiological and methodological factors that can affect results (Mokarami, 2013).

In our study we found that abnormal pH was associated with a first minute Apgar score of less than 7 (P = 0.018). Ferreira et al. (2015) showed that low umbilical pH (≤7) was associated with low first-minute apgar scores and hypoxic events. This study also stated that neonates who experience shoulder dystocia will have a risk fifteen times higher for experiencing hypoxia in the neonatal period. Research in the United Kingdom found a relationship between pH and the fifth minute Apgar score but had a weak relationship with the outcome of a poor neonate. Most neonates with neurological morbidity have normal umbilical pH (Yeh et al., 2012). Kacho et al. (2010) in Iran shows that cord blood pH is associated with Apgar scores especially in infants born to mothers with high-risk pregnancies, but this does not occur in mothers with low-risk pregnancies.

Paradeep et al. (2015) showed that the pH value at birth was a good marker of perinatal asphyxia. If the duration and severity of asphyxia increases, the umbilical pH will decrease. Kiruthiga et al. (2017) in Tamilnadu shows that Apgar score and umbilical pH scores are inversely related to the occurrence of neonatal seizures in perinatal asphyxia. A study in India in 2012 also showed umbilical pH associated with a low Apgar score and could help other parameters in assessing neonatal outcomes such as low birth weight and NICU care. In this study it was stated that the length of labor was the most significant statistical finding in causing a decrease in umbilical pH compared to other labor methods (Goyel et al., 2014).

The limitation of our study was no similarity of time between blood sampling and analysis in all study samples. In addition, our study did not take into account the method of labor and the length of labor in each sample that might affect the umbilical pH and lactate values. We assume that further research is needed to assess the relationship of umbilical artery lactate and pH and a low Apgar score in high risk infants.

CONCLUSION

There was an association between umbilical artery cord blood pH and one minute Apgar score but there was no association between umbilical artery lactate and the first and fifth minute Apgar score.

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