# Umbilical Artery Acid-Base Status and Lactate Levels in Term and Preterm Healthy Newborns: Relation to Delivery Mode

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**Abstract**

**Objective:** Measurements of umbilical cord acid-base status are routinely carried-out in many perinatology centers. Umbilical cord gas measurements and complementary, provide the clinician with information of patient assessment, therapeutic decision making and prognostication in NICU. The aim of this prospective study was to establish the normal range of umbilical artery gas parameters, acid-base status and lactate levels in term and preterm healthy newborns and their relationship between delivery mode.

**Methods:** Umbilical artery gas parameters from 108 healthy newborns (85 term, 23 preterm; 48 vaginal deliveries and 60 caesarean sections) which were followed-up in Neonatology Unit, were evaluated.

**Results:** Umbilical artery mean lactate levels were higher in preterm newborns than term newborns (29.4 ± 2.75, 21.0 ± 1.0 mg/dl, $p<0.01$). Umbilical artery mean pO2, sodium, chloride and osmolarity levels were lower in vaginal deliveries than caesarean section ($p<0.05$, $p<0.001$, $p<0.01$, $p<0.01$ respectively). Umbilical artery lactate levels were higher in vaginal deliveries (28.95 ± 1.65 mg/dl) than caesarean section (18.06 ± 0.99 mg/dl) ($p<0.001$). Umbilical artery p02, ct02 and s02 levels were positively correlated with F02Hb, FCOHb levels and negatively correlated with FHHb and FmetHb levels. Umbilical artery P02, ct02 and s02 levels were positively correlated with pH levels and negatively correlated with pC02 levels.

**Conclusion:** Umbilical artery blood gase parameters must be evaluated with the clinical and laboratory findings of the newborns.

**Keywords:** Umbilical artery, blood gase, delivery type, lactate, term, preterm.

### *Sağlıklı term ve preterm yenidoğanlarda umbilikal arter asit-baz durumu ve laktat düzeyleri ve doğum şeklinin ilişkisinin değerlendirilmesi*

**Amaç:** Umbilikal kord kan gazı analizi birçok perinatoloji merkezinde rutin olarak yapılmaktadır. Umbilikal kord kan gazı parametrelerinin yorumlanması, yenidoğan yoğun bakım ünitelerinde takip edilen bebeklerin klinik durumunun, tedavi planının ve prognozunun belirlenmesinde önemli göstergelerden biridir. Bu çalışmada; sağlıklı term ve preterm yenidoğanların umbilikal arter kan gazı parametreleri ile asit-baz dengesinin ve laktat düzeylerinin belirlenmesi ve bu parametreler ile doğum şekli arasındaki muhtemel ilişkinin değerlendirilmesi planlanmıştır.

**Yöntem:** Çalışmaya Neonatoloji ünitesinde takip edilen 108 yenidoğanda (85 term, 23 preterm; 48 vajinal yol ile doğan, 60 sezaryen ile doğan) umbilikal arter kan gazı parametreleri değerlendirildi.

**Bulgular:** Preterm bebeklerde umbilikal arter laktat düzeyleri term bebeklere göre yüksek olarak saptandı (29.4 ± 2.75, 21.0 ± 1.0 mg/dl, $p<0.01$). Umbilikal arter ortalama pO2, Na, Cl ve osmolarite değerleri vajinal yol ile doğanlarda sezaryen ile doğanlara göre daha düşük olarak saptandı (sırasıyla $p<0.05$, $p<0.001$, $p<0.01$, $p<0.01$). Vajinal yol ile doğan bebeklerde umbilikal arter ortalama laktat düzeyleri (28.95 ± 1.65 mg/dl) sezaryen ile doğan bebeklerin ortalama laktat düzeylerine (18.06 ± 0.99 mg/dl) göre yüksek olarak saptandı ($p<0.001$). Umbilikal arter p02, ct02 ve s02 düzeyleri ile F02Hb ve FCOHb düzeyleri ile pozitif, FHHb ve FmetHb düzeyleri ile negatif korelasyon saptandı. Umbilikal arter P02, ct02 ve s02 düzeyleri ile umbilikal arter pH düzeyi arasında pozitif, pC02 düzeyi arasında ise negatif korelasyon saptandı.

**Sonuç:** Sağlıklı yenidoğanlardan elde edilen kan gazı parametrelerinin hastanın klinik bilgileri ile bütünlük içerisinde değerlendirilmesi gerekmektedir.

**Anahtar Sözcükler:** Umbilikal arter, kan gazı, doğum şekli, laktat, term, preterm.

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## Introduction

Blood pressure parameters and the evaluation of these parameters is one of the most important indicators for determining the clinical condition of the patient, treatment plan and prognosis.[1-4] While the evaluation of blood gas parameters is an important investigation of all the patients in intensive care units, the fact that the physiology is different in the newborn period and changes quickly and using a small amount of blood increases the value of the investigation.[5] Only the pH, carbon dioxide and acid-base and oxygen partial pressures were evaluated but today many blood gas parameters are evaluated together in order to evaluate oxygenation and acid-base balance.[1-5] Blood gases are the most important tools to determine oxygenation, carbon dioxide homeostasis, acid-base balance and pulmonary functions efficiency.[5] Blood gases are also an important diagnosis tool for leading oxygen and ventilator cure for respiratory distress of newborns and also for the illnesses relating with cardiac, renal and central nervous system. Betterments in the values of blood gases can be seen as an efficiency of the treatment.[1-5]

Taking and evaluating the umbilical artery blood gases in the birth room has become a routine implementation for a quality newborn care.[1,2,4] Especially evaluation of the new born in the first hours, joint evaluation of traditional Apgar scoring and umbilical artery and blood gas parameters became important for early diagnosis approaches. Especially of the newborn with high risk and bad general condition, in cases such as shock, hypotension, peripheral vasoconstriction and acrocyanosis, capillary and blood gas values reflect the real data.[5] Notwithstanding, with the increase of the parameters in the blood gas analysis, hypoxia evaluation is not made by Apgar score and umbilical artery pH value. Lactic acidaemia developed by hypoxia or compensated acid-base unbalances can be stated, ideas can be developed whether the hypoxia is acute or chronic, which mechanism results the compensation. This study is done to determine the umbilical artery blood gas analysis results for term and preterm healthy newborn born in our clinic for the reason that the blood gas parameters in the context of evaluation increased and to evaluate the possible relationship between these parameters and type of birth.

## Methods

Newborns monitored in neonatology service with the 5th minute Apgar score above 6, and having neonatal period without problems are included in the study. 2 cc arterial bloods were taken from all the newborns after the cordon was clamped by an injector washed with heparin. Samples were reached to the laboratory in ten minutes in accordance with the cold chain. All the umbilical artery blood samples are investigated using the parameters in table 1 in our unit biochemistry laboratory with ABL Radiometer device. Cut-off value for the umbilical artery value for healthy newborns were determined 7.20 in previous studies, 108 newborns whose umbilical artery pH value is above that value were included in the study. Work group is grouped according to their gestation week and birth type.

All the statistical evaluation is done using SPSS for Windows 10.0 (IL, Chicago, USA). Umbilical artery blood gas parameters are given as average ± SEM. In order to compare the data between the groups, t test is used for independent groups, Pearson correlation analysis is used for correlations. $p<0.05$ value is considered significant statistically.

## Results

85 terms, 23 preterm in total 108 newborns were included in the study. 48 of the cases were born by vaginal delivery and 60 had cesarean section. Characteristics of the term and preterm infants evaluated in the study are given in the Table 2. The 1st and 5th minute average Apgar scores of the preterm infants were lower than term infants (in order $p<0.001$ and $p<0.001$).

Without separating pregnancy week and birth week, average umbilical blood gas parameter values of the 108 newborns are given in Table 3. In the evaluation due to the pregnancy week, umbil-

**Table 1.** Values from blood gas device and umbilical artery analysis.

| | |
|---|---|
| Blood gas values | pH, p02,pC02 |
| Oxmeter values | CtHb[1], Hctc, s02[2], F02Hb[3], FC0Hb[4], FHHb[5], FmetHb[6] |
| Electrolytic values | K, Na, Ca, Cl |
| Metabolic values | Glucose, lactate, bilirubin, mOsm |
| Oxygen condition | ct02[7], p50c[8] |
| Acid-base status | cBaz[1] $cHC0_{3}$-[1], ABE[1], SBE[1] |

1. CtHb: Is the total hemoglobin (Hb) concentration in blood. Total hemoglobin mainly includes all types pf hemoglobin; such as deoxy-, oxy, carboxy-, met- ve sulfhemoglobin.
   CtHb=c02Hb+cHHb+cC0Hb+cMetHb
2. s02: Oxygen saturation in the artery.
   s02=c02Hb/cHHb + c02Hb
   S02; Oxidized hemoglobin related with the oxygen carrying hemoglobin
   This parameter gives the best information when used realted with CtHb
3. F02Hb id defined as the ratio between (oxyhemoglobin n level _); 02Hb and ctHb (c02Hb/ctHb) concentrations .It is calculated as follows:
   F02Hb=c02Hb
   C02Hb+cHHb+cC0Hb+cMetHB
4. FC0Hb=Carboxy hemoglobin ratio
   FC0Hb=cC0Hb/ctHb
6. FmetHb=methemoglobin ratio
7. ct02 : oxygen concentration in blood,
8. p50 : Oxygen pressure in the half saturated blood. This parameter determines oxygen oscillation in the tissues and the position of the oxygen dissociation curve (ODC) which is essential.

ical artery sodium values (p<0.05) was found higher for term infants, potassium and calcium values being in the normal border were found higher for preterm infants (in order p<0.01, p<0.05). Umbilical artery lactate levels were found higher for preterm infants than term infants (29.4±2.75, 21.0±1.0 mg/dl, p<0.01) (Table3).

For the infants born by vaginal delivery (n=48), umbilical artery average pO2, Na, Cl and osmolarity values were lower than the cesarean section infants (n=60) (in order p<0.05, p<0.001, p<0.01, p<0.01). Umbilical Artery average Hct, K, Ca, glucose levels were found higher for the infants born by vaginal birth than the cesarean section infants (in order p<0.05, p<0.05, p<0.01, p<0.01). Umbilical artery average lactate levels were found higher for the infants born by vaginal birth (28.95 ±1.65 mg/dl) than the average lactate levels of cesarean section infants (p<0.001) (Table 4).

Positive correlation was detected between oxygenation parameters p02, ct02, s02 levels. Positive for umbilical artery o02, ct02 and s02 levels and F02Hb and FCOHb levels, and negative correlation between FHHb and FmetHb levels were detected. Between umbilical artery Po0, ct02 and S02 levels and umbilical artery pH level a positive, and between pC02 level and negative correction was seen. F02Hb was positively correlated with pH and negatively correlated with pC02. FHHb was negatively correlated with pH and positively correlated with pC02. There was negative correlation between FmetHb and pH, p50c value showed negative correlation with pH (Table 4). There was no

**Table 2.** Charecteristic of 108 infants who's umbilical artery blood gas was analyzed.*

| | Pregnancy week (week) | Birth weight (g) | Apgar score at 1st minute | Apgar score at 5th minute |
|---|---|---|---|---|
| **All the newborns** | | | | |
| **(n=108)** | 37.9 ± 0.2 | 3053.5 ± 68.0 | 8.28 ± 0.2 | 9.54 ± 0.1 |
| **Term (n=85)** | 38.9 ± 0.1 | 3315.4 ± 80.4 | 8.65 ± 0.1** | 9.74 ± 0.01** |
| **Preterm (23)** | 33.6 ± 0.4 | 2041.4 ± 112.4 | 6.90 ± 0.6 | 8.61 ± 0.4 |
| **Delivery type** | | | | |
| **Vaginal (n=48)** | 37.5 ± 0.4 | 2926.6 ± 110.9 | 8.52 ± 0.2 | 9.65 ± 0.1 |
| **Cesarean (n=60)** | 38.2 ± 0.3 | 3152.8 ± 83.1 | 8.10 ± 0.2 | 9.38 ± 0.2 |

* Values are given mean± standard deviation.
** p<0.001, term and preterm infants.

**Table 3.** Umbilical artery blood gas parameters due to age and delivery type for all the work group.

| | All newborns (n=108) | Newborns (n=108) min-max | | Term newborns (n=85) | Preterm newborns (n=23) | Vaginal delivery (n=48) | Cesarean section (n=60) |
|---|---|---|---|---|---|---|---|
| **PH** | 7.30 ± 0.01 | 7.211 | 7.472 | 7.30 ± 0.01 | 7.30 ± 0.01 | 7.31± 0.01 | 7.29 ± 0.01 |
| **P02 (mmHg)** | 19.1 ± 0.7 | 6 | 47 | 18.7 ± 0.7 | 20.8 ± 1.6 | 17.62 ± 0.89c | 20.35 ± 0.99 |
| **PC02 (mmHg)** | 43.0 ± 0.7 | 28.5 | 65 | 43.7 ± 0.8 | 40.7 ± 1.5 | 42.3 ± 1.0 | 43.6 ± 1.1 |
| **CtHb g/dl** | 14.6 ± 0.2 | 8.1 | 19.8 | 14.4 ± 0.2 | 15.1 ± 0.6 | 15.2 ± 0.3 c | 14.1 ± 0.3 |
| **Hctc (%)** | 44.6 ± 0.8 | 25.3 | 60.4 | 44.1 ± 0.8 | 46.2 ± 1.8 | 46.7 ± 1.0 c | 42.8 ± 1.1 |
| **S02 (%)** | 37.6 ± 1.9 | 9.2 | 96.8 | 36.5 ± 2.1 | 41.7 ± 3.7 | 35.5 ± 2.9 | 39.2 ± 2.4 |
| **F02Hb (%)** | 38.7 ± 1.9 | 9.6 | 94.7 | 37.2 ± 2.1 | 44.1 ± 4.2 | 35.8 ± 2.9 | 40.8 ± 2.5 |
| **FC0Hb (%)** | 1.02 ± 0.01 | 0 | 6.4 | 1.00 ± 0.1 | 1.08 ± 0.1 | 0.95 ± 0.1 | 1.06 ± 0.1 |
| **FHHb (%)** | 58.8 ± 2.0 | 3.1 | 89.6 | 59.9 ± 2.3 | 54.9 ± 3.7 | 61.4 ± 2.9 | 56.8 ± 2.7 |
| **FmetHb (%)** | 0.93 ± 0.01 | 0.2 | 2.5 | 0.94 ± 0.01 | 0.9 ± 0.01 | 0.91 ± 0.01 | 0.94 ± 0.01 |
| **Ck (mEq/L)** | 2.9 ± 0.01 | 1.4 | 3.93 | 2.83 ± 0.01a | 3.15 ± 0.01 | 3.01 ± 0.01 c | 2.80 ± 0.01 |
| **Cna (mEq/L)** | 146.9 ± 1.1 | 123 | 183 | 147.9 ± 1.3 b | 143.1 ± 1.25 | 142.6 ± 1.4 d | 150.2 ± 1.5 |
| **Cca (mg/dl)** | 1.82 ± 0.01 | 0.2 | 3.88 | 1.73 ± 0.01 b | 2.15 ± 0.17 | 2.12 ± 0.11 e | 1.58 ± 0.11 |
| **CCl (mEq/L)** | 111.6 ± 0.6 | 92 | 127 | 111.9 ± 0.7 a | 110.3 ± 1.0 | 109.8 ± 0.8 e | 112.9 ± 0.9 |
| **C glucose (mg/dl)** | 64.6 ± 2.7 | 23 | 163 | 62.8 ±2.8 | 71.6 ± 7.3 | 74.1 ± 4.8 e | 57.4 ± 2.6 |
| **Laktat (mg/dl)** | 22.8 ± 1.05 | 7 | 56 | 21.0 ± 1.0 | 29.4 ± 2.75 | 28.9 ± 1.6 d | 18.0 ± 0.9 |
| **Bilirubin (mg/dl)** | 0.77 ± 0.01 | 0 | 2.3 | 0.75 ± 0.01 | 0.81 ± 0.01 | 0.8 ± 0.01 | 0.7 ± 0.01 |
| **Mosm (mmol/kg)** | 295 ± 2.0 | 253 | 367 | 296 ± 2.5 | 290.7 ± 2.6 | 288.5 ± 2.6 e | 300.1 ± 2.9 |
| **Ct02 (Vol%)** | 8.02 ± 0.4 | 1.9 | 19.9 | 7.80 ± 0.4 | 8.90 ± 0.9 | 8.0 ± 0.6 | 8.0 ± 0.5 |
| **P50c (mmHg)** | 22.6 ± 0.3 | 17.5 | 32.1 | 22.8 ± 0.3 | 21.9 ± 0.4 | 22.7 ± 0.5 | 22.6 ± 0.3 |
| **Cbaz (mmol/L)** | -4.98 ± 0.3 | -12.9 | 7.9 | -4.6 ± 0.4 | -6.4 ± 0.6 | -5.3 ± 0.4 | -4.7 ± 0.5 |
| **HC03 (mmol/L)** | 19.1 ± 0.3 | 13.7 | 28 | 19.3 ± 0.3 | 18.5 ± 0.4 | 18.7 ± 0.3 | 19.5 ± 0.4 |
| **ABEC (mmol/L)** | -5.2 ± 0.4 | -12.8 | 6 | -4.9 ± 0.4 | -5.9 ± 0.6 | -5.3 ± 0.4 | -5.1 ± 0.5 |
| **SBEC (mmol/L)** | -4.86 ± 0.3 | -12.6 | 7.9 | -4.6 ± 0.4 | -5.8 ± 0.6 | -5.1 ± 0.4 | -4.6 ± 0.5 |

* Values are given mean± standard deviation. **a.** When p<0.001 term-preterm infants are compared, **b.** When p<0.05 term-preterm infants are compared, **c.** p<0.05 When vaginal deliveries and cesarean sections are compared, **d.** p<0.001 When vaginal deliveries and cesarean sections are compared, **e.** p<0.01 When vaginal deliveries and cesarean sections are compared.

correlation between oxygenation parameters and parameters showing the acid-base status except of the positive correlation between umbilical artery s02 level and cbase level.

Negative correlation of electrolyte values of Na and Cl with cbase, HCO3, ABEC, SBEC and lactate and positive correlation of K and Ca with these values were detected (Table 4).

**Table 4.** Correlation analysis results of the data of oxygenation.

| | $p0_2$ | $S0_2$ | $ct0_2$ | $F0_2Hb$ | FC0Hb | FHHb | FmetHb |
|---|---|---|---|---|---|---|---|
| **$p0_2$** | | r=0.89<br>p<0.01 | r=0.73<br>p<0.01 | r=0.86<br>p<0.01 | r=0.33<br>p<0.01 | r=-0.81<br>p<0.01 | r=-0.51<br>p<0.01 |
| **$S0_2$** | | | r=0.764<br>p<0.001 | r=0.96<br>p<0.01 | r=0.42<br>p<0.01 | r=-0.84<br>p<0.01 | r=-0.48<br>p<0.01 |
| **$ct0_2$** | | | | r=0.79<br>p<0.01 | r=0.47<br>p<0.01 | r=-0.8<br>p<0.01 | r=-0.55<br>p<0.01 |
| **$F0_2Hb$** | | | | | r=0.39<br>p<0.01 | r=-0.86<br>p<0.01 | r=-0.53<br>p<0.01 |
| **FC0Hb** | | | | | | r=-0.43<br>p<0.01 | r=-0.33<br>p<0.01 |
| **FHHb** | | | | | | | r=0.55<br>p<0.01 |

## Discussion

While Apgar scoring is taken as the major criteria in order to evaluate the condition of the newborn and to define the affective newborn classically, it is suggested that it is not efficient to evaluate the perinatal asphyxia defined as hypoxemia and metabolic acidosis only by Apgar scoring, and blood gas analysis should be taken into consideration for a more objective evaluation.[6] Umbilical artery gives a better idea than umbilical vein for evaluation of fetal metabolic condition. Even though venous pH is normal, arterial acidaemia can be detected. Umbilical artery can give an idea for fetal acid-base balance and also maternal acid-base balance and the effect of placental function.[1-3] It will be appropriate that the reference values due to gestation week and birth type being determined and all the parameters being evaluated totally. For instance; pO2, ct02 and p50 are the respiratory and homothetic section to maintain oxygen for the tissue and they are the key parameters for using the useable oxygen in the artery. There is a complex relationship between these parameters; a change in one of the parameters can be compensated by the other two parameters.[5] For instance, a patient with hypoxemia, if Hb concentration when pO2 become 56 mmGh and sO2 become 79%, patient will reach the useable of normal artery oxygen. On the other hand, if Hb concentration is low or there is dyshemoglobinemia for a patient with 56 mmGh pO2 and 79% sO2, oxygen usage will be low. For this reason, oxygen taking, carrying and release must be evaluated together for the appropriate diagnosis and treatment. In our study pO2 was lower but Hct was higher for the vaginal births and there was compensation.

In the studies about umbilical artery blood gas it is thought that there can be affects of some factors such as delivery type, gestation week and some other factors in addition to the differences between the countries and clinics.[7] Dudenhausen et al[7] found the lowest umbilical cord pH value 7.04 and percentile value 7.21 in their studies on 681 newborn. $10^{th}$ percentile BE value was 7.21, $90^{th}$ percentile pCO2 value was 62 mmHg. Helwig et al,[8] in their study on 16,060 newborns, average umbilical artery pH was 7.26, pCO2 was 52 mmHg, ABE was -4, PO2 was 177 mmHg. They showed that there was no relationship between delivery type and gestational week in this patient. Sener et al[9] found average umbilical pH value of 7.26±0.083 in their study on 188 newborns born with spontaneous vaginal delivery. In our study, cases having pH value above 7.20 was taken, average pO2 was 19.1 mmHg (6-47 mmHg), BE average value was -4.97 (-12.9- 7.9).

PaO2 is the most important determiner of sO2 but it is not the only determiner. Factors affecting oxygen dissociation, curve at a certain pO2 are temperature, pH and pCO2. As it can be seen in our study, there are positive correlation between sO2 and pH and a negative correlation with pCO2. pO2 is the impulsive force for the oxygen molecules to enter into erythrocyte and bind to hemoglobin chemically, the higher pO2 and the higher sO2 will be. ct02 is a parameter showing the total number of oxygen molecules directly (bind to hemoglobin or not) different than PaO2 or SaO2, and it is directly related with hemoglobin content different from the other two variable. It is calculate by the part of the ctO2 bound to hemoglobin (HbX1.34XSaO2) and the dissolved part (.003XPaO2):

ct02= Hb (g/dl) X1.34 ml O2/g Hb X SaO2 + PaO2 X (.003 ml O2/ Hg/dl).[5]

For this reason, it is an expected finding that these parameters (pO2, ctO2 and SO2 and FO2Hb, FHHHb and FmetHb) can show correlation with each other as seen in our study.

It is important to determine the reason of low Apgar sore for premature infants and cord blood acid-base status for these infants.[10] Ramin et al[10] detected a difference of umbilical artery pH, pCO2, PO2, HCO3 and BE values between preterm and term infants. Arikan et al[11] stated that the average pH values can be high for the preterm and low for post terms. But, researchers showed that there is no relationship between umbilical cord oxygen saturation and gestation and they are distributed in a wide range. We did not detected a difference between the values of umbilical artery pH, pCO2, PO2, HCO3 and BE values in our study. In a study in our country Benian et al[12] detected a difference between term and preterm newborns similarly and stated that there no impact of pregnancy age for the cases without uteroplacental deficiency.

Another factor that can be effective on umbilical artery blood gas is the birth action and the delivery type. It is shown that even the duration between the cesarean is decided and exercised have importance on blood gas parameters.[13] Nickelsen et al[14] detected low acidosis or mixed respiratory / metabolic acidosis in the newborns born in the 2nd phase of the birth between 10-30$^{th}$ minute. It was shown that oxytoxin and birth induction have no effect on the cord blood gas analysis. It was shown that vacuum extractions and low forceps implementations are related with low pH and high CO2 levels but it was thought to be related with the diagnosis reasoned for this type of birth and not related with vacuum or forceps. Difference between artery and vein parameters were seen generally for the healthy newborns, it was seen to be low difference between artery and vein parameters for depressed infants. In our study, umbilical artery average pO2, Na, Cl and osmolarity values were lower for newborns born by vaginal delivery than the newborns born by cesarean section. Umbilical artery average Hct, K, Ca, glucose levels were higher for newborns born by vaginal birth than the newborns born by cesarean section Christian et al[15] compared the infants born breech vaginal position and cephalic presentation, and found that cord blood pH values were low and pCO2 values were high for the infants born by vaginal position.

In recent years, in addition to traditional blood gas parameters, umbilical artery and lactate levels have been added to the evaluation. Lactic acid will accumulate because the cell transformed into anaerobic metabolism from aerobic metabolism in the tissue hypoxia. Metabolic acidosis resulting from lactic acid accumulation in the blood is a reason for hypoxia.[16] Westgren et al[17] stated that lactate of fetal head skin is successful as much as pH to determine perinatal prognoses and suggested that it can take the place of pH for intra partum monitoring. Kruger et al[18] showed that there is correlation between the lactate levels of fetal head skin blood and cordon blood. Cut-off value of fetal scalp lactate level for fetal asphyxia is told as 4.8 mmol/L. In the same study, serum lactate levels showed decrease wit the postnatal age; upper level was 3.8 mmol/l for the one less than 48 hours, 2.4 mmol/L of the ones between 49-96 hours, 1.5 mmol/L for the ones more than 96 hours. Shirley et al[19] stated that the lactate levels was more than 7 mmol/L for less than 2.5 % of the normal birth but no correlation between cord lactate levels and oxygen and carbon-dioxide partial pressure was seen. Shah et al[16] stated that the lactate levels were higher for newborns with hypoxic ischemic encephalopathy and returning to normal duration was longer. In our study, umbilical artery lactate levels for preterm infants were determined higher than term infants. Westgren et al[17] found higher lactate levels for instrumental delivery and cesarean sections than the vaginal births. Lactate levels had positive correlation with fetal pH, hemoglobin, base gap, pCO2 and HCO3 and had negative correlation with morbidity and mortality. In our study, umbilical average lactate levels was found higher for infants born by vaginal delivery than the average lactate levels for infants born by cesarean section.

On the other hand, lactate can accumulate resulting from other reasons than hypoxia. Liver disease and some medicine and toxins can increase the blood lactate level in adults. In addition, raise in the blood pyruvate can also increase the lactate level. For this reason, it is a more proper approach to accept the lactic acidosis as a non-specific determiner of hypoxia. Some studies show that there is a weak correlation between the oxygen accession to the tissue and lactic acid levels. It was emphasized that lactic acidosis is not a sensitive determiner for hypoxia. This insensitivity can result from the fact that there is no linear relationship with lactic acid while the progressive hypoxia. Raised levels can be temporary because lactic acid is metabolized by the liver.[17,18,20]

The main reason why the electrolytes does not exist in the blood gas analysis is for the calculation of anion gap (anion gap=AG).5 Lorenz et al[21] investigated that anion gap when there is not metabolic acidosis for the critically ill newborns and whether the metabolic acidosis is lactic acidosis of hypertrophic acidosis by anion gap. In the study by measuring lactic acid levels, 16 mmol/L or more anion gap was seen determiner for lactic acidosis, lower than 8 was seen determiner for no lactic acidosis, and values between 8-16 mmol/L was seen that it was useless to distinguish the diagnosis. In our study, electrolyte values of Na and Cl had negative correlation with cbase, HC03, ABEC, SBEC and lactate, and K and Ca had positive correlation with these values. In our study, pH and base deficit had no correlation with pCO2, had negative correlation with Na, Cl and positive correlation with K and glucose.

In conclusion, umbilical artery blood gases can give objective results to evaluate oxygenation, and acid-base status and to define perinatal asphyxia. Data must be evaluated with the results from healthy newborns and change levels taken as base. Evaluating every component systemically in evaluating and monitoring umbilical blood gases by knowing the interaction between them will be guiding.

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