The Effect of mode of delivery on the umbilical artery pH

Original Article

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Abstract

Background: Abnormal umbilical cord pH can be indicated a distress imposed of newborn and can also be useful in determining the prognosis of the newborn. There are different views about the effect of the neonatal delivery method on the blood gas analysis of the umbilical artery. This study aimed to determine the effect of the method of delivery on umbilical artery pH.

Methods: In this Cross-Sectional study, 150 singleton newborns of 37 to 42 weeks, with birth weight 2500 to 4000 g, were allocated. The samples were calculated for values, based on similar studies, and were divided into two groups, including vaginal delivery and caesarian section under spinal anesthesia which have the least difference in pH. Umbilical artery blood gas analysis of both groups were studied. Finally, using statistical T-test for the quantitative data and chi-square for the qualitative data, hypotheses were answered. P-value less than 0.05 was considered statistically significant.

Results: Average gestational age was between 39±0.9 weeks and 76 (50.6%) and 74 (49.4%) of neonates were male and female respectively. The average birth weight was 3368.7±473.5 g. In this study, average umbilical artery pH at birth by vaginal delivery and by cesarean section was 7.25±0.06, 7.26 ±0.06 respectively (P>0.05). In this study, in both groups significant differences were seen in all the blood gas values except the umbilical cord artery pH.

Conclusions: Our study showed that the pH level of umbilical artery blood was in normal range among newborns of both groups, but Po2 and Pco2 were more appropriate in vaginal deliveries. Due to the prognostic value of umbilical artery PH and the essentiality of prognosis in the newborns under stress, we recommend that this study should be done in the emergency situation, too.

Keywords: Vaginal Delivery, Non-Emergency Cesarean Section, Umbilical Cord Blood pH.

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Introduction

Umbilical cord blood gas analysis is carried out to assess the oxygenation and acid-base status and fetal response due to delivery stress. Mild acidosis is a physiologic phenomenon and dose not threaten the neonate but severe acidosis may increase neonatal mortality and morbidity and impaired neurological development [1]. Usage of anesthetics drugs can affect the umbilical arterial blood gases directly or indirectly. [2] In most cases the best method of neonatal delivery is vaginal delivery, with less side-effect, but unfortunately for the significant increase in the cesarean section, its rate is declining. Generally, the cesarean section rate is increasing in the world that there is no acceptable reason for it [3]. According to World Health Organization's report, the rate of C-section must be between 5 and 15% [4]; however, in Iran it is far more than World Health Organization's standards and reached over 46% [5]. Labor makes sudden increase in fetal catecholamine, especially in the second stage of labor; it helps maintaining blood flow to the brain, heart and adrenal glands;

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improves adaptive changes in blood circulation after birth and increases postnatal surfactant. Although the fetal stress response is favorable, the maternal hyperventilation in response to pain has adverse effects on the fetus, such as respiratory alkalosis and left shift in the oxygen dissociation curve. On the other hand, labor stress and cortisol and catecholamine being released may prolong labor and reduce blood flow to the placenta and cause fetal asphyxia [6].

Using anesthetic drugs, spinal anesthesia or general anesthesia for C-section affects the fetus directly and indirectly and it can be indicated in cord blood gas changes [7]. Cord blood gases can largely determine fetal metabolic condition and using umbilical cord blood gas analysis has many backgrounds to investigate delivery asphyxia and goes back to several decades ago. Dudenhausen et al. during a study determined normal values in the umbilical cord blood indicators of term and vaginal deliveries. In addition, James et al. reported that the umbilical cord blood gas analysis can provide widely important information about the past, present and likely future conditions of the newborn [8].

Now, the neonatal blood gas analysis is recommended in all high-risk deliveries by both British and American College of Obstetrics and Gynecology and in some centers routinely perform all deliveries [9]. Intra-womb acid-base status plays an important role in determining the relationship between the events surrounding the delivery and fetal asphyxia [10]. Limited studies with different results have been conducted in this area [11, 7].

However, due to the high rate of cesarean section prevalence in the country, this study investigated the effect of delivery type on the umbilical artery blood pH in Ayatollah Rouhani Hospital

Methods

In this cross-sectional study, 150 singleton term newborns aging 37 to 42 weeks with birth weight of 2500 to 4000 g were selected according to Jain et al.'s study based on alpha 0.05 and Beta 0.1 for pH. The samples were divided into two groups including vaginal delivery and non-emergency cesarean section under spinal anesthesia. Umbilical artery blood gas analysis of both groups were studied.

Exclusion criteria included emergency cesarean section, diabetes, hypertension, preterm birth, two or multiple delivery, intrauterine growth restriction (IUGR), respiratory distress, breech delivery, vacuum delivery, Oligohydramnios, preeclampsia and major congenital malformations.

Cesarean sections with spinal anesthesia were performed using lidocaine 5% produced by Raven India Company. The sampling from umbilical artery was provided immediately after birth with clamping of two ends of a segment of the umbilical cord. A blood sampling was done using a 2 ml syringe of Supa Company (Made in Iran) integrated with heparin of Tehran Distributing Drugs Company.

If the umbilical artery of the umbilical vein was difficult to distinguish, two samples were taken, one sample from vein and another from umbilical artery, to distinguish artery from vein. The samples were sent to the Rouhani Laboratory for blood gas analysis which were performed in less than 60 minutes.

Blood gas analysis was performed using the device Gem Premery 3000, made in Swiss. Finally, the hypotheses were answered using statistical T-test for quantitative data and chi-square for qualitative data. P-value less than 0.05 was considered statistically significant.

Results

In this cross-sectional study, 150 singleton term newborns were studied in Ayatollah Rouhani Hospital during six months. The mean gestational age was 39.0±0.9 weeks. In terms of subjects' sex, 76 (50.6%) of the neonates were male and 74 (49.4%) were female. The average birth weight was 3368.7±473.5 g. The mean gestational age was 39.3±1.0 weeks in the group of vaginal delivery and 38.7±0.7 in non-emergency cesarean section delivery with spinal anesthesia, and there was a significant difference between the two groups (P<0.001).

The mean weight in the two groups, vaginal delivery and non-emergency cesarean section delivery with spinal anesthesia, were 3317±453 grams and 3420±489 grams ,respectively, and there was no statistical difference between the two groups (P=0.182). In addition, there was no statistically significant difference between the two groups in terms of the frequency of gender (P=0.312).

In vaginal delivery and cesarean section delivery newborns, the average umbilical artery pH was 7.26±0.06 and 7.25±0.06, respectively. The mean level of P_{O2} was 19.11±8.72 in vaginal-delivery group and 11.33±11.85 in non-emergency cesarean section-delivery newborns. In vaginal-delivery and cesarean

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section-delivery newborns, mean levels of Pco2 were 40.62±8.74 and 56.61±10.97, respectively.

In vaginal-delivery and cesarean section-delivery newborns, mean level of HCO3 was 20.37±4.11 and 24.68±2.86, respectively, and the average base deficit was -4.25±4.0 and -2.98±2.5, respectively (table 1).In the present study, except the umbilical cord artery pH levels which was not significantly different in the two groups, other blood gas values were observed with remarkable differences between the two groups.

The P_{O2} and Pco2 were levels were more appropriate in the vaginal-delivery newborns than the caesarean section group. The base deficit was in the normal range overall, but the numbers were better in the elective caesarean-delivery newborns.

Table 1: Comparison of between means of umbilical artery blood gas values at vaginal and cesarean deliveries

Groups Variable	NVD	CS	p-value
pH	7.26±0.06	7.25±0.06	0.123
Po_2	19.11±8.72	11.85±11.33	P<0.0001
Pco_2	40.62±8.74	56.61±10.97	P<0.0001

Discussion

The current study showed that PH level in both deliveries was normal, unlike other findings of this study, the rate of P_{O2} and Pco2 values was better in vaginal delivery. In Ratcliffe et al.'s study, pH level in healthy newborns after cesarean section with spinal anesthesia was 7.24 and in epidural method was 7.24 and pH in the spinal anesthesia group was lower than other group; unlike our study and the study by Rafeati et al that there was not much difference in pH of different methods [12].

In a study by Loh et al., entitled "Cord blood gas analysis of deliveries", 153 vaginal delivery cases and 52 cesarean section cases were examined. PH level of vaginal delivery was higher than cesarean section, Pco2 and HCO3 levels were lower than C-section and base deficit of vaginal delivery was higher than cesarean section [1]. In Rafati's study, pH was not different in the two groups. Pco2 and HCO3 rates in vaginal delivery were lower the than cesarean section and it was consistent with our results [7].

Pence et al. studied the effect of type of delivery on cord blood gases and compared them among vaginal and cesarean section deliveries of 96 newborns. 40 cases had vaginal delivery, among the other 56 cases, 26 were delivered by epidural anesthesia and 30 by general anesthesia, and the venous blood gas analysis run immediately after delivery showed that P_{O2} in C-section with general anesthesia was higher than vaginal delivery and epidural method. Accordingly these results were consistent with ours [13].

Jain et al. in 2013 in India compared 40 umbilical arterial analyses of neonates who were delivered in spinal anesthesia and general anesthesia for cesarean in terms of pH level and they concluded that it was 7.23±0.06 and 7.27±0.04 in the two groups, respectively. P_{O2} levels in the spinal anesthesia group and general anesthesia group were 13.6±6.1 and 20.9±6.5, respectively. There was no difference between two groups in terms of umbilical artery base deficit [14].

Kwon et al. conducted a study to determine the relationship between the mode of delivery and umbilical cord blood gas analysis parameters of the second newborn in twin pregnancies and they suggested that there was no significant difference between the umbilical cord blood gas parameters of 40 newborns through cesarean and of 39 newborns through vaginal delivery. However, Apgar score was significantly higher in the vaginal-delivery newborns than those born by caesarean section [15].

A number of studies have compared umbilical cord blood gases in addition to; calculating the Apgar score of the newborns. In a study by Rafaeti et al. on mode of delivery there was a statistically significant relationship between mode of delivery and Apgar scores, and umbilical arterial P_{O2} showed that Apgar scores was less in general anesthesia than vaginal and spinal anesthesia delivery but the umbilical arterial P_{O2} was more in general anesthesia than the other two groups. Their study suggested significant relationship between the duration of anesthesia and umbilical arterial P_{O2}. They concluded that the longer the anesthesia lasts, the lower the P_{O2} will be. Among various modes of delivery, there was no significant difference between umbilical arterial pH, P_{CO2} and HCO3 [7].

However, in our study there was no relationship between the duration of anesthesia and other variables. Heidarzade et al. studied the relationship between umbilical cord blood gas analyses at the birth and Apgar scores and need to resuscitation of newborns. They reported that there was a significant relationship between umbilical cord blood pH and birth weight, gestational age, Apgar scores in the first and fifth minute, the need for advanced resuscitation, the incidence of asphyxia and neurological complications.

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There was a significant relationship between P_{CO2} of umbilical cord blood and birth weight, gestational age, Apgar scores in the first and fifth minute, the incidence of asphyxia and neonatal death rate, too.

There was a significant relationship between HCO3 of umbilical cord blood and birth weight, Apgar scores in the first minute, and incidence of asphyxia. Also, there was a significant relationship between base deficit and gestational age, Apgar scores in the first and fifth minute and incidence of asphyxia [11].

In a study conducted by Ahmadpour et al., the relationship between pH of umbilical cord and Apgar score was determined in full dangerous pregnancy, and it was indicated that mean of umbilical cord pH was significantly lower in full dangerous mothers group than low dangerous one, and there was a positive significant correlation between umbilical cord pH and Apgar score in first minute [16].

In Boland Hematan et al.'s study entitled "The relationship between usual obstetric interventions during labor stages and umbilical cord blood gas values", the statistical tests did not show a significant difference in the umbilical artery blood gas values between mothers who had received oxytocin and those who did not receive. The significant differences were not observed in umbilical artery blood gas values between mothers who had used sedation and those not used [17].

Our study showed that umbilical artery blood pH values among newborns from both of vaginal and cesarean delivery groups were in normal range, Po2 and Pco2 were more appropriate in vaginal deliveries. Considering the effect of umbilical artery blood pH on studying the prognosis of newborns under stress, it is recommended that at least in the case of vaginal deliveries and emergency caesareans, the umbilical artery pH values survey will be done properly. The limitation of the study was that there was no elective caesarean birth under general anesthesia during this period so it was impossible to study this group.

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