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Determination of Neonatal Prognosis Based on Umbilical Vein Blood Gas in Hakim Hospital of Neyshabur, Iran during 2017-2018

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ABSTRACT

Background: In order to determine the prognosis of neonates, it is recommended to use umbilical gas analysis in all high-risk pregnancies. However, utilizing umbilical gas analysis and Apgar score together is very helpful for determining the mortality rate confidence interval. Therefore, in this study, we investigated the application of umbilical gas analysis in assessing the prognosis of infants.

Methods: This cross-sectional study was conducted in Hakim Hospital of Neyshabur, Iran during 2017-2018 with 100 subjects in each group of control and test. Blood samples were collected from the umbilical vein of all neonates. The data were compared between the two groups by the t-test and Mann-Whitney test using the SPSS software version 18 at the significance level of $P \leq 0.05$.

Results: Our findings demonstrated that both hospitalization and the need for resuscitation had significant relationships with pH and base excess (BE) in the case and control groups ($P<0.05$). Moreover, 52.7% of the subjects in the intervention group and 47.3% of the participants in the control group were born through cesarean section. Therefore, the two groups were not significantly different regarding the route of delivery ($P>0.05$)

Conclusion: According to the results of this study, a positive relationship was found between the neonatal prognosis and umbilical vein blood gas. Consequently, we can determine neonatal prognosis based on umbilical vein blood gas.

Keywords: Apgar score, Asphyxia, Newborn

Introduction

Considering the importance of determining the prognosis in neonates in terms of development, mortality, morbidity, disorders of the central nervous system, and the risk of asphyxia, various diagnostic criteria are used, such as Apgar score. Apgar score is a method for the assessment of newborns immediately after birth, which helps the immediate diagnosis of hypoxic acidosis. It includes heart rate, respiratory rate, muscular tone, reflexes, and skin color, each of which is given a score of 0-2 (1). As a result, the minimum Apgar score is zero and the maximum score is ten.

The Apgar score is efficient in diagnosing the neonates with fetal distress, intrauterine asphyxia, airway obstruction, and central nervous system (CNS) depression. However, the low score is not necessarily indicative of hypoxia or asphyxia of the fetus and other factors can reduce the Apgar score, including neonatal prematurity, narcotic use, sedatives consumption, magnesium sulfate usage by mother, congenital myopathy and neuropathy, spinal canal trauma, pulmonary abnormality (diaphragmatic hernia), congenital atresia, and the abnormalities of the CNS.

Furthermore, the Apgar score does not predict the subsequent cerebral palsy in neonates (2). In

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fact, the Apgar score is normal in a number of infants who later develop cerebral palsy and cerebral palsy is low in newborns with a low Apgar score (0-3 in minute 5). Therefore, the Apgar score is not enough as the only criterion for the diagnosis of hypoxia and asphyxia in infants. On the other hand, undiagnosed asphyxia imposes numerous adverse effects on the infant, namely myocardial ischemia and hypoxic-ischemic encephalopathy (HIE). The HIE causes permanent damage to the brain cells, manifests as cerebral palsy or mental retardation, and in some cases may cause death (3, 4).

Despite the widespread use of the Apgar score after birth, this index is not a suitable measure for the prognosis of the probability of cerebral palsy (5, 6). This scale does not predict the rate of neurological disorders and is in the normal range in most neonates with cerebral palsy (7, 8). Consequently, in order to determine the prognosis of newborns in the United States of America and England, it is now recommended to use umbilical gas analysis in all high-risk pregnancies. However, utilizing umbilical gas analysis and Apgar score together is very helpful for determining the mortality rate confidence interval (9, 10). Therefore, this study aimed to investigate the use of umbilical gas analysis in determining the prognosis of neonates.

Methods

This cross-sectional study was conducted in the Hakim Hospital of Neyshabur during 2017-2018. The exclusion criteria included premature infants, major anomalies, and congenital infections. Infants with pH > 7.2 and base excess (BE) > -12 were placed in the control group and infants with pH < 7.2 and BE < -12 were categorized in the case group.

In this study, blood samples were collected from the umbilical vein of all the infants born in Hakim Hospital within a 6-month period and were immediately analyzed by a trained person. Other variables, including gender, route of delivery, the age of the pregnancy, the need for resuscitation at birth, death, and the Apgar score were recorded in the questionnaire. The sample size was calculated as 100 subjects in each group with a power of 0.95.

The department staff and midwives were trained to collect and send the venous blood gas (VBG) samples. The umbilical cords with a length of about 20 cm were clamped on both sides and were prepared for sampling. This was performed immediately after delivery because after about 20-30 sec the blood gas content may change. The samples were taken by an insulin syringe that was only heparin-impregnated at the volume of about 0.5 cc. The absence of any air bubbles in the syringes was checked because air bubbles or a high volume of heparin alter the VBG. The samples were transferred to an analyzer in an ice container.

Samples of this study were taken from the umbilical vein. On the umbilical cord, there is a loose and dilated vein that is distinguishable from two arteries with a very thick wall and a narrow duct and is visible on the clamped cord as a vascular hank. Samples were analyzed utilizing the Techno Medica GASTAT 602 and OPTI CCA analyzer. The analyzer was automatically calibrated and washed after each test. The data were compared between the two groups by the t-test and the Mann-Whitney test using the SPSS software version 18 (IBM, USA). P < 0.5 was considered significant for all tests.

Results

Our findings indicated that 106 neonates (53%) were female and 94 subjects (47%) were male. In the case group, 47 (47%) and 53 (53%) of the newborns were male and female, respectively. Moreover, in the control group, 47 infants were male and 53 subjects were female. The mean gestational age was 38.27±1.9 weeks in the control group and 39±1.826 weeks in the case group. Furthermore, the total mean gestational age was 38.43±1.846 weeks.

According to tables 1-4, in the test group, the Apgar score of 26 (26%), 65 (65%), 5 (5%), and 4 (4%) of the neonates was 6/10, 7/10, 8/10, and 9/10, respectively. In the control group, the Apgar score was found to be 7/10, 8/10, and 9/10 in 4 (4%), 19 (19 %), and 77 (77 %) of the subjects, respectively. In the present study, the infants with pH < 7.2 and BE < -12 (n=100) were categorized in the case group and the newborns with pH > 7.2 and BE > -12 (n=100) were regarded as the control group.

The mean pH of the umbilical blood in the case group was 7.14±0.07 and in the control group was 7.34±0.047. In addition, the overall mean pH of the samples was 7.24±0.12. The mean BE of umbilical cord blood in the case group was

Table 1. Difference between pH and BE based on hospitalization

	With mother (Mean±SD)	NICU (Mean±SD)	P-value
pH	7.26±0.106	7.22±0.13	0.012
BE	-6.69±6.29	-8.83±6.04	0.015

Table 2. Comparison of the case and control groups in terms of hospitalization

Rate of hospitalization based on the group		Case	Control	Total	
With mother (not hospitalized in the NICU)	Number	45	64	109	X2=7.279 P=0.007
	Percent	41.3%	58.7%	100%	
Hospitalized in the NICU	Number	55	36	91	
	Percent	60.4%	39.6%	100%	

	Need for resuscitation	No need for resuscitation	P-value
pH	7.13±0.072	7.31±0.083	0
BE	-12.77±3.52	-3.99±5.1	0

Table 3. Comparison of the need for resuscitation, pH, and BE values between the case and control groups

Resuscitation need		Case group	Control group	Total	
Need for resuscitation	Number	79	5	84	P=0 X2=112.397 (Mann-Whitney)
	Percent	94%	6%	100%	
No need for resuscitation	Number	21	95	116	
	Percent	18.1%	81.9%	100%	

Table 4. Comparison of pH and BE between the case and control groups

	NVD (Mean±SD)	Cesarean section (Mean±SD)	P-Value
pH	7.23±0.119	7.25±0.12	0.19
BE	-7.93±6.48	-7.34±5.97	0.503

Delivery route		Case group	Control group	Total	
NVD	Number	59	53	112	X2=0.731 P=0.393 (Mann-Whitney)
	Percent	53.4%	47.3%	100%	
Cesarean section	Number	41	47	88	
	Percent	46.6%	52.4%	100%	

reported as -13.13±2.91 and in the control group was -2.23±3.17.

Moreover, the overall mean of BE was revealed to be -7.64±6.19. The mean pCO_2 concentration was 46.92±12.53 in all samples, 44.41±14.78 in the case group, and 41.42±9.63 in the control group. On the other hand, the mean pO_2 concentration was 16.66±12.63, 17.43±15.14, and 9.53±16.48 for all samples, case group, and control group, respectively.

The mean HCO_3 concentration in all samples was 21.82±5.8 mEq/L, in the case group was 21.09±5.87 mEq/L, and in the control group was 22.55±3.52 mEq/L. Out of the 200 infants, 112 (56%) neonates were born through normal vaginal delivery (NVD) and 88 subjects (44%) were born as cesarean section. In the case group, 53.4% were born through NVD and 46.6% were born through cesarean section. In the control group, 47.3% and 52.4% of the newborns were born through NVD and cesarean section, respectively.

The results showed that hospitalization had a significant relationship with pH and BE in the case and control groups. In other words, the hospitalization rate was significantly different between the neonates of the case and control groups.

As shown in Table 2, the number of infants hospitalized in the Neonatal Intensive Care Unit (NICU) was higher in the case group than the control group.

The need for resuscitation was found to have a significant relationship with pH and BE in the case and control groups.

According to Table 3, the number of infants who needed resuscitation was higher in the test group than the control group.

The results of this study revealed that 46.6% of the infants in the case group and 52.4% of the newborns in the control group were born as cesarean section. Therefore, there was no significant difference between the case and control groups in terms of the delivery route (P=0.393).

Discussion

According to the results of the current study, hospitalization and the need for resuscitation had significant relationships with pH and BE in umbilical cord blood in both case and control groups. On the other hand, the delivery route was

not observed to have a relationship with pH and BE in the umbilical cord blood of neonates. Therefore, it can be concluded that there is a significant relationship between neonatal prognosis and VBG in the umbilical cord.

In a study performed by Ahmadpour et al. (2010) at Babol University of Medical Sciences, Iran the relationship between umbilical cord blood pH and the Apgar score in high-risk neonates was investigated. The results of their study showed that the mean pH in the arterial blood gas (ABG) analysis of the umbilical cord in high-risk mothers was significantly lower than low-risk mothers.

Moreover, they reported that the mean Apgar score in the first and fifth minutes was significantly lower in high-risk mothers than mothers with low risk. In the high-risk group, there was a clear relationship between the Apgar scores in minutes 1 and 5 and the umbilical blood pH (9). The results of the latter study are in line with our findings regarding the significant relationship between neonate prognosis and VBG in the umbilical cord.

Boskabadi et al. (2015) at Mashhad University of Medical Sciences investigated the risk factors and prognosis among the neonates with asphyxia. Their results demonstrated that metabolic acidosis at the time of birth was a major risk factor in newborns with asphyxia. In addition, it was determined that a series of factors, including the Apgar score, acidosis severity, and the need for ventilation, are important factors for predicting the complications associated with asphyxia (6). Their findings are consistent with the present investigation.

Armstrong (2007) and Stenson in a case-control study in Scotland investigated the use of umbilical gas analysis for evaluating infants. These authors recommended that umbilical gas analysis to be performed in all high-risk pregnancies. In combination with other clinical information, normal paired arterial and venous cord blood gas results can usually provide a robust defense against a suggestion that an infant had an intrapartum hypoxic-ischemic event (5). We found that umbilical gas analysis could be useful in determining the prognosis of the neonates and should be performed in high-risk pregnancies.

Another study by Carluccio et al. (2017) in Milan, Italy evaluated the relationship between umbilical gas parameters in healthy newborns on diverse times from birth. The latter authors indicated the first minute of birth as the most critical time to adjust cardiovascular and respiratory functions. They claimed that post-birth umbilical cord blood gas analysis helps to improve knowledge on this issue and this analysis is a gold standard for predicting acidosis along with the respiratory and metabolic status of neonates (11-14). Findings of the current study confirmed that umbilical cord blood gas analysis can be a standard approach for predicting acidosis, respiratory and metabolic status, and the prognosis of a neonate.

Limitations

Individual error in performing the experiment was the limitation of our study. Therefore, the staff and midwives were trained to collect and send the VBG samples to the laboratory.

Conclusion

The present study showed a relationship between the neonatal prognosis and VBG in the umbilical blood gas in the Hakim hospital of Neyshabur, Iran. According to our results, umbilical vein blood gas can be used to determine neonatal prognosis.

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Conflicts of interest

The authors of this study declare no conflicts of interest.

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