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Umbilical Cord Arterial Blood Gas and Apgar Score: Who Is at Higher Risk?

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ABSTRACT

Background: Fetal asphyxia and the consequent neurological damages could be avoided if the risk factors are controlled at earlier stages. Umbilical cord arterial blood gas (UCABG) seems to be related to the Apgar scores, as well as the neonatal morbidity and mortality rates. Therefore, we designed this study to assess the correlation between the Apgar score and UCABG in Northeast of Iran.
Methods: This case-control study evaluated 438 term newborns and 62 preterm infants born during 2012-2013. Peripartum asphyxia, admission in the neonatal intensive care unit, and death were recorded as outcome measures. All the data were analyzed using the t-test and logistic regression analysis.
Results: Mild to moderate acidemia (pH=7-7.2) was reported in 9.6% and severe acidemia (PH<7) was observed in 1% of the participants. Multivariate analysis showed that aspiration of amniotic fluid, umbilical cord pH ≤ 7.2, umbilical cord base excess, and being preterm could be considered as the predictors of lower first-minute Apgar score.
Conclusion: Umbilical cord blood gas measurement is a useful tool to detect the neonates who are at higher risk of low Apgar.

Keywords: Apgar score, Neonates, Umbilical cord blood gas

Introduction

Transient hypoxic stress during the labor phase, even in the severe form, could be easily handled. However, pH decrease, accumulation of lactate, and augmented base deficit (BD) are the consequences of prolonged oxygen deficit (1). Umbilical cord arterial blood gas (UCABG) and low pH values (acidemia) at birth seem to be related to the peripartum asphyxia and its sequences (2, 3).

On the other hand, some recent studies concluded that complete data about cord blood gas might be a better indicator than the pH (2, 4). It should be noted that the pH of 7-7.2 is considered as mild or moderate acidemia and Severe acidemia is defined as pH < 7 and BD > 12 nM (5).

Fetal asphyxia is defined as hypoxemia and hypercapnia with a significant metabolic acidemia (1). This avoidable condition can lead to permanent neurological damages in fetus and infant (3). Asphyxia constitutes of three main biochemical components, namely hypoxemia, hypercapnia, and metabolic acidosis. Significant asphyxia episode at birth would expose a fetus to hypoxic ischemic encephalopathy or other end-organ damages.

Furthermore, all the following conditions should be present to know a neonate as asphyxiated: 1) umbilical cord arterial pH < 7 (metabolic or mixed acidemia), 2) Apgar score of 0-3 for longer than 5 min, 3) neurologic deficits (e.g., seizure, coma, or hypotonia), and 4) multi-organ failure (6).

Acute birth asphyxia interferes with respiration resulting in hypoxia and tissue acidosis around the time of birth. Acute birth asphyxia is commonly associated with acidemia in umbilical artery blood. Furthermore, it is assumed that asphyxiated infants

will not suffer from brain injury unless severe acidemia occurs (7).

Various maternal and fetal risk factors may impose influence on acid-base balance in the umbilical cord blood. Maternal co-morbid diseases, taking medicine, type of anesthesia, fetal breech presentation, oxytocin and pethidine administration, late or complicated decelerations, encircled umbilical cord, primiparity and gestational age are among the diverse factors affecting this balance (1).

In the previous studies, pH < 7 and low Apgar scores (total score of 3) showed an association with neonatal morbidity and mortality rates (1). Apgar score and blood gas analysis of umbilical cord are the routine methods for assessing the neonate outcome and fetal distress. Apgar score assessment in the first and 5th minute post-delivery are the most common clinical assessments for determining the neurologic outcome after labor (6). Early studies on the predictive role of Apgar score in fetal long-term neurological outcome indicated unrevealing results. Some authors have shown a low correlation between Apgar score and acid-base status at birth (1).

Therefore, measuring the acid-base status in the umbilical cord blood could be an important indicator of fetus exposure to hypoxia and her/his ability to adapt with low O_2 pressure. With this background in mind, this case-control study was designed to assess the correlation between the Apgar score and UCABG in a group of newborns during 2012-2013 in an academic hospital in Gorgan, Northeast of Iran.

Methods

The study population (N=500) of this case-control study consisted of 438 term newborns (gestational age of 37 weeks) and 62 preterm infants (gestational age <37 weeks) born during March 2012-February 2013 in an academic hospital in Gorgan, Northeast of Iran. Amon the subjects, 250 of the neonates were delivered through spontaneous vaginal delivery (SVD) and 250 through cesarean section (C-section).

A checklist of different data about the mothers was completed that included the age, ethnicity, education, residency, cousin marriage, weight before pregnancy, taking medications, and history of chronic diseases, such as diabetes mellitus. The other collected information entailed the gestational age, baby gender, fetal presentation, twin pregnancy, congenital malformations, fetal growth status, non-stress test (NST) results,

length of delivery, amniotic fluid state, premature rupture of membranes (PROM), status of the umbilical cord, type of delivery (SVD or C-section), and type of anesthesia (spinal or regional).

The exclusion criteria encompassed recent history of taking any sedative or analgesic medications by mothers, fetal sepsis (clinically diagnosed by a neonatologist), and incorrect sampling from the umbilical cord.

In order to assess the UCABG, the umbilical cord was double clamped immediately post-delivery at a minimum distance of 10 cm with the placenta in situ. Next, both the artery and vein were sampled in pre-heparinized labeled syringes and were analyzed within 15 min. Afterwards, the arterial blood gas (ABG) was analyzed by Eschweiler (ECO SYS II, Germany) for PO_2, PCO_2, pH, HCO_3 and base excess (BE).

The Apgar score was recorded in the first and 5th min after birth. The scoring system is based on the subjective assessment of the newborns appearance (skin color), pulse (heart rate), grimace (irritability reflex), activity (muscle tone), and respiration (breathing) (1). In addition, presence of the peripartum asphyxia, admission in neonatal intensive care unit (NICU), and death rate were recorded as the adverse events.

Statistical Analysis

The SPSS software version 18 was used to analyze the data with t-test and logistic regression. P-value < 0.05 was considered as statistically significant for all the tests.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Golestan University of Medical Sciences, Iran. Following comprehensive explanations about the study protocol and answering the possible questions, an informed consent form was signed by both parents.

Results

Demographic Data

The 500 pregnant women participating in the study aged 26.43±6.16 years and their neonates entered this study. Among them, 198 (39.6%) were primiparous and 62 (12.4%) delivered preterm neonates. Twin pregnancies, PROM, and cousin marriage were reported in ten (2%), 63 (12.6%), and 187 (37.4%) cases, respectively. According to our results, 254 (50.8%) were from rural districts and 250 (50%) were from Persian tribes.

Moreover, maternal underlying diseases, such

Table 1. Clinical characteristics of the studied newborns

Variables	Mean ± SD
Gestational age (weeks)	38.12±2.2
Fetal birth weight (grams)	3045.09±593.35
Apgar (1st min)	7.76±0.91
Apgar (5th min)	8.81±0.75

as diabetes and hypertension were reported in 416 (83.2%) of the women in this study. Baby girls were 253 (50.7%) of all the neonates and circular umbilical cord was observed in 92 (18.4%) of the participants. Placenta ablation, breech fetal presentation, prolonged labor, aspiration of amniotic fluid, NST, fetal death, and intrauterine growth restriction (IUGR) were found in two (0.4%), 20 (4%), two (0.4%), 16 (3.2%), two (0.4%), two (0.4%), and 17 (3.4%) cases, respectively. Furthermore, 21 (4.2%), 51 (10.2%), 7 (1.4%), 40 (8%), and 5 (1%) of the subjects were reported as congenital malformations, cardiopulmonary resuscitation (CPR), post-birth convulsion, NICU admission, and mother death, respectively.

The pH values of 447 (89.4%) newborns were measured as normal (7.2). We mentioned mild to moderate acidemia (pH=7-7.2) in 48 (9.6%) cases, while severe acidemia was observed (PH<7) in 5 (1%) neonates. It should be noted that the first-minute Apgar score of 7 was reported in 53 neonates (10.6%). All the demographic data of the studied newborns are summarized in Table 1. Acidemia was found to be more significant in the neonates with lower first-minute Apgar score (Table 2).

Predictive Factors of the First-minute Apgar Score

Multivariate analysis of the factors associated with the first-minute Apgar score demonstrated that aspiration of amniotic fluid, umbilical cord pH ≤ 7.2, umbilical cord BE, and being preterm can be considered as the predictors of lower first-minute Apgar score (≤7). As could be seen in Table 3, type of delivery (SVD or C-section) had no significant effect on the Apgar score.

Table 2. Relationship between first-minute Apgar score and umbilical cord artery pH

		Umbilical cord artery pH		Total	Odd ratio	95% confidence interval
		>7.2	≤7.2			
first-minute Apgar	>7	417 (93.3)	30 (56.6)	447		
	≤7	30 (6.7)	23 (43.4)	53	10.657	5.522-20.567
Total		447 (100)	53 (100)	500		

Table 3. Logistic regression analysis of the factors associated with the first-minute Apgar score

	Univariate		Multivariate	
	Odd ratio	95% confidence interval	Odd ratio	95% confidence interval
Maturity				
Term	13.605	7.154-25.872	0.046	0.020-0.16
Preterm				
Type of delivery				
SVD	0.881	0.498-1.558	-	-
C-section				
Amniotic fluid aspiration				
Yes	5.579	1.941-16.036	7.709	1.839-32.315
No				
PROM	4.117	2.144-7.905	2.336	0.978-5.581
Umbilical Cord pH				
≤7.2	10.657	5.522-20.567	5.405	1.808-16.156
>7.2				
Umbilical cord BE	0.783	0.728-0.843	0.841	0.756-0.936

Discussion

In the present study, ABG analysis of the umbilical blood cord showed that 1% of our cases had pH = 7 (severe acidemia) and 9.6% had mild to moderate acidemia with pH of 7-7.2. Some previous studies reported a similar rate for pH of 7 (3, 8). However, various studies found different rates ranging from 0.37% (9) to as high as 20% (4). These differences might be related to the distinct obstetrics policies or underestimation/

overestimation in other studies.

Regarding the severe consequences of fetal academia, a close monitoring of fetus acid-base balance is crucial. The umbilical cord pH value is indicated to be an efficient outcome measurement in fetal acidemia (3). According to our findings, a pH value of < 7.1 is correlated with higher rate of adverse outcomes, such as convulsion during the first 24 h after birth, encephalopathy, NICU

admission and/or neonatal death. An ideal pH is assumed to be 7.26-7.3 and measures of > 7 are weakly associated with adverse neurological outcomes (3).

Adverse Events

Adverse events, including need for CPR at birth, convulsion during the first 24 h after birth, admission in NICU, and neonatal mortality were not common in the present study.

Low First-minute Apgar score and the Predictive Factors

First-minute Apgar score ≤ 7 was seen in 10.6% of our study population. Other studies in Iran, reported low Apgar score in 14.5% (4) and 16.5% of their cases (10).

Preterm neonates with amniotic fluid aspiration, umbilical cord pH ≤ 7.2, and the amount of umbilical cord BE had lower first-minute Apgar score (≤7). The present study showed that among the neonates with low Apgar score, 43.4% had flat pH, while just 6.7% of the cases with normal Apgar score had a low pH. The previous study in Iran performed by Rezaee et al. had similar findings (10).

In addition, a significant relationship between Apgar score and umbilical cord pH was reported in previous studies (4, 10). It is noteworthy that this relationship was seen to be more remarkable in high-risk pregnancies (11). We could not decide about being high-risk or low-risk, because the risk was not scored in our study population. Rate of preeclampsia or diabetes was low in the subjects of the current study.

Route of delivery (SVD or C-section) had no significant impact on the first-minute Apgar in our study. In a study carried out by Raafati et al. (Tehran, 2006), no significant relationship was found between the delivery route and the umbilical cord blood gas (12). However, in another study completed by Kaveh et al. in Tehran (2004), Cesarean section and low Apgar score had significant correlation with acidemia (13). These differences could be attributed to the emergency need for C-section or inducing regional or general anesthesia.

Conclusion

The elevated risk of low Apgar score is concerned as a criterion for close monitoring of the newborns. According to the findings of this study, it could be concluded that umbilical cord blood gas measurement is a useful tool for selecting the neonates at augmented risk of low

Apgar. As a result, umbilical cord blood gas might be considered for monitoring the neonates closely.

The neonates with low Apgar score are at higher risk of academia. Therefore, these cases should be under close monitoring.

Conflicts of interests

The authors declare no conflict of interests for the present study.

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