

## Correlation between Umbilical Cord pH and Apgar Score in High-Risk Pregnancy

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### Abstract

**Objective:** The Apgar score as a proven useful tool for rapid assessment of the neonate is often poorly correlated with other indicators of intrapartum neonatal well-being. This study was carried out to determine the correlation between umbilical cord pH and Apgar score in high-risk pregnancies.

**Methods:** This is a prospective cross-sectional, analytic study performed on 96 mother-fetal pairs during 2004-2005 at Shahid Yahyanejad Hospital, which is affiliated to Babol University of Medical Sciences. Apgar score at 1 and 5 minutes after birth was taken and an umbilical cord blood gas analysis was done immediately after birth in both groups. Mothers came with a labor pain and were divided into high-risk and low risk if they have had any perinatal risk factors. Other data like gestational age, birth weight, need for resuscitation and admission to the newborn ward or Neonatal Intensive Care Unit was gathered by a questionnaire for comparison between the two groups. *P*-value less than 0.05 was considered being significant.

**Findings:** The gestational age and birth weight were the same in high-risk and low risk mothers. Mean umbilical artery blood pH in high-risk mothers was significantly lower than in low risk mothers ( $P=0.004$ ). Mean Apgar scores at 1 and 5 minutes were significantly lower in high-risk mothers than in low risk mothers ( $P<0.05$ ). According to the Kendal correlation coefficient there was no significant correlation between Apgar score at 1 and 5 minutes and umbilical cord pH in low risk group ( $r=0.212$ ,  $P=0.1$ ). But in high-risk group there was significant correlation between Apgar score at 1<sup>st</sup> and 5<sup>th</sup> minute and the umbilical cord pH ( $r=0.01$ ,  $P=0.036$  and  $r=0.176$ ,  $P=0.146$ , respectively).

**Conclusion:** Combination of Apgar score and umbilical cord pH measurement in high-risk pregnant mother could better detect jeopardized baby.

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**Key Words:** Apgar score; Umbilical cord; Pregnancy, High risk; Blood Gas Analysis; Neonate

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## Introduction

When oxygen supply to the fetus is significantly disrupted, tissue oxygenation deprivation develops, acids begin to accumulate and acidemia develops. Umbilical cord blood gas measurement in comparison with the fetal scalp pH monitoring could better detect a hypoxic baby<sup>[1]</sup>.

In 1952, Virginia Apgar, proposed a scoring system to assess the condition of newborns during the first minutes of life, and to evaluate anesthetic and obstetrical practices. She proposed five objectives and easily-measured clinical signs: heart rate, respiratory effort, muscle tone, reflex irritability, and color<sup>[2]</sup>. It has been used to assess asphyxia, predict neurological damage and vitality of a neonate during the first minute of life<sup>[3]</sup>. Umbilical cord blood gas assessment seems to be the most objective determination of the fetal metabolic condition at the time of birth<sup>[4-7]</sup>. Manganaro and colleagues suggested that the 5<sup>th</sup> minute Apgar score is useful for immediate clinical assessment and care of the neonate. They found 5<sup>th</sup> minute Apgar score had a high concordance with metabolic acidemia<sup>[8]</sup>, but Anyaegbunam and colleagues' study revealed that in 20.7% of neonates delivered had an abnormal pH (less than 7.20) and normal Apgar<sup>[9]</sup>. The present study was carried out to determine the correlation between umbilical cord pH and Apgar score in high-risk pregnant mother.

## Subjects and Methods

This was a prospective cross sectional study conducted in a teaching hospital during February 2004 to September 2005. The study was approved by the research ethics committee of Babol University of Medical Sciences.

Study population consisted of mothers who came with labor pain according to the sample size. At the time of admission, they were assigned to high or low risk group according to whether or not they had any perinatal risk factor that categorized them as high-risk pregnancy. High-risk pregnancy was defined as a pregnant

mother who is at risk to deliver a neonate with birth asphyxia according to the definition by American Academy of Pediatrics<sup>[10]</sup>. All normal vaginal and cesarean section (C/S) deliveries included in this study were chosen in accordance with this definition. All mothers who delivered a baby with a major congenital anomaly or had intra uterine fetal death (IUFD) were excluded from the study.

Immediately after delivery, umbilical cords were clamped on both ends and an arterial blood sample was collected anaerobically in a pre-heparinized insulin syringe. PH, base excess, carbon dioxide pressure (PCO<sub>2</sub>), PO<sub>2</sub> and HCO<sub>3</sub> were measured at 37°C by pH and gas analyzer (AVL, Compact3, Australia). The gas analysis was done in less than 30 minutes after sampling.

All women in labor pain were monitored by electronic fetal heart rate monitor. Apgar score was assessed by a trained physician at 1<sup>st</sup> and 5<sup>th</sup> minute after birth. In case of an Apgar score less than 8, additional Apgar scores were taken at 10<sup>th</sup> and 15<sup>th</sup> minute. Advanced resuscitation means that a baby required positive pressure ventilation, chest compression and/or drugs administration.

All resuscitated babies were transferred to neonatal intensive care unit or newborn services for post resuscitation care. Fetal distress was defined by an umbilical cord pH<7.2.

Demographic data like gestational age, birth weight, Apgar score, need for resuscitation and/or newborn ward admissions were collected by a questionnaire in both groups. Sample size calculated 96 mother-fetal pair for each group (if we consider 1- $\alpha$ =0.95, r=0.25 and 1- $\beta$ =0.80). For each high-risk mother, a low risk mother was selected as control. Analysis was performed by SPSS for windows version 16. Student's t-test, the Mann-Whitney and  $\chi^2$  test were used for analysis. Linear regression was used to control potential confounding variables.  $P$ <0.05 was considered statistically significant.

## Findings

During a 6-month period, 96 mother-fetus pairs, 49 in high risk, and 47 in low risk group

**Table 1:** Demographic characteristics of neonates of high and low risk groups

Variables		Low risk (n=47)	High risk (n=49)	P-value
<b>Gestational age (weeks)</b>		39.17± 0.56	38.68 ± 2.5	0.121
<b>Birth weight (grams)</b>		3189 ± 203.48	3052 ± 532.60	0.101
<b>Gender</b>	<b>Male</b>	19 (40.42%)	26 (53.06%)	0.228
	<b>Female</b>	28 (59.57%)	23 (47.04%)	
<b>Need for advanced resuscitation</b>		0 (0%)	3 (6.12%)	0.495
<b>Need for NICU admission</b>		0 (0%)	3(6.12%)	0.242

NICU= Neonatal Intensive Care Unit

participated in the study. The demographic characteristics of mothers and their neonates are shown in Table 1. Frequency of perinatal risk factors in high-risk groups is shown in Table 2.

The most common perinatal risk factors accompanied with low umbilical artery pH were prolonged rupture of membranes, breech presentation, and meconium stained amniotic fluid. The Apgar score at 1 and 5 minutes in high-

risk patients were significantly lower than in the low risk group (Table 3). pH, blood gas, and base excess values are shown in Table 4. pH values in mothers were significantly lower than those in low risk counterpart ( $P<0.001$ ).

According to Kendal correlation coefficient, there was no significant correlation between Apgar score at 1<sup>st</sup> and 5<sup>th</sup> minute and umbilical cord pH in low risk group ( $r=0.212$ ,  $P=0.1$ ),

**Table 2:** The frequency of perinatal risk factor in high-risk pregnant mothers

Risk factor	Frequency (%)
<b>Breech presentation</b>	5
<b>Infertility</b>	3
<b>Antepartum hemorrhage</b>	4
<b>Prolonged rupture of membranes</b>	12
<b>Post date</b>	8
<b>Negative Rh</b>	2
<b>Meconium stained AF</b>	14
<b>Hypertension</b>	2
<b>Multiple pregnancy</b>	1
<b>Induced labor</b>	7
<b>Abnormal AF volume</b>	4
<b>Diabetes</b>	1
<b>Abnormal FHR</b>	7
<b>IUGR</b>	3
<b>Emergency C/S</b>	32
<b>Circular cord</b>	2
<b>Preterm labor</b>	5
<b>Maternal age &gt;35</b>	1
<b>Chorioamnionitis</b>	1
<b>Previous neonatal death</b>	1

AF=Amniotic Fluid; FHR= Fetal Heart Rate; IUGR=Intra Uterine Growth Retardation; C/S= Cesarean Section

**Table 3:** Apgar score at 1, 5, 10 and 15 minutes after birth in high and low risk group (Mean  $\pm$ SD)

Apgar score	High risk Group (n=49)	Low risk Group (n=47)	P value
1 <sup>st</sup> min	8.65 $\pm$ 0.69	9 $\pm$ 0.00	0.001
5 <sup>th</sup> min	8.84 $\pm$ 0.51	9.98 $\pm$ 0.15	0.000
10 <sup>th</sup> min	9.88 $\pm$ 0.48	10 $\pm$ 0.00	0.083
15 <sup>th</sup> min	9.92 $\pm$ 0.45	10 $\pm$ 0.00	0.209

whereas in high-risk group, a significant correlation between Apgar score at 1<sup>st</sup> and 5<sup>th</sup> minute and umbilical cord pH was found ( $r=0.01$ ,  $P=0.036$  and  $r=0.176$ ,  $P=0.146$  respectively).

## Discussion

In the current study, we studied correlation of umbilical cord measures of acidosis at birth and the presence of risk factors in pregnancy. The mean $\pm$ SD value of umbilical pH in high-risk group was lower than that in low risk group. There was also a significant relation between umbilical cord pH and low Apgar score with the incidence of selective neonatal outcomes like NICU admission and need for advanced resuscitation. Other authors reported similar short-term outcomes for hospital based patients' populations giving birth at term [11, 12].

Mean $\pm$ SD for umbilical cord pH, NaHCO<sub>3</sub> and PCO<sub>2</sub> in neonates delivered to a high-risk pregnant mother differ significantly with those

in low risk mothers but mean ( $\pm$ SD) values for PO<sub>2</sub> and base excess did not differ between the two groups. This finding may emphasize the importance of the latter values on prediction of the occurrence of neonatal outcome. In fact metabolic and respiratory acidosis and hypoxia may jeopardize the baby more than a respiratory acidosis alone [13,14].

Apgar score at 1st and 5th minute in high-risk group was lower than that in the low risk group. But there was no significant difference in Apgar score at 10th and 15th minute between the two groups. This finding emphasizes the impact of the perinatal risk factors on the immediate general condition of the babies at birth and also the effect of immediate intervention on the improvement of the neonatal condition.

In our study, there was no significant correlation between Apgar score at 1<sup>st</sup> and 5<sup>th</sup> minute and the umbilical artery pH in low risk group. These two parameters, Apgar score at first minute and umbilical cord pH, behave independently. If immediate intervention and resuscitation commence, there would not be enough time to develop persistent hypoxemia

**Table 4:** Umbilical arterial blood pH, base excess and gas values in high and low risk mothers immediately after birth (mean  $\pm$  SD)

Variables	High-risk Group n= 49	Low-risk Group n= 47	P-value
pH	7.26 $\pm$ 0.002	7.23 $\pm$ 0.007	0.004
HCO <sub>3</sub>	20.004 $\pm$ 1.48	22.81 $\pm$ 2.88	0.000
PO <sub>2</sub>	19.51 $\pm$ 30.1	17.59 $\pm$ 7.39	0.09
PCO <sub>2</sub>	50.48 $\pm$ 5.94	55.91 $\pm$ 9.99	0.02
BE	-3.9 $\pm$ 1.5	- 4.9 $\pm$ 3.2	0.66

and acidosis. On the other hand, in high-risk group both the Apgar score and umbilical cord pH should be employed to interpret the actual condition of the neonate. Socol and colleagues showed that neonates with an Apgar score less than or equal to 3 at five minutes and a complicated clinical course were more likely to have lower umbilical cord arterial pH measurements and higher base deficit values than did their counterparts with an uncomplicated clinical course<sup>[15]</sup>. Vargas-Origel found a significant difference in the Apgar score at one and five minute, as well as in umbilical cord pH between asphyxiated babies and control group<sup>[16]</sup>.

In a newly published study, Locatelli and colleagues evaluated the predictors of umbilical artery acidemia in term infants and found that evidence of acidemia is present in only 38% of term babies with low Apgar score and it is predominantly associated with intrauterine vascular disease like preeclampsia, abruptio placenta, birth weight less than 10<sup>th</sup> percentile and placental vascular pathologies<sup>[17]</sup>.

Although Apgar score provides a convenient short hand for the status of the newborn, it is often incorrectly used as a correlate of neonatal acidosis. In fact, only a minority of neonates with low Apgar scores at 5th minute have cord evidence of metabolic acidosis<sup>[18]</sup>.

In order to evaluate how often low 5 minute Apgar score at term is associated with asphyxia, Hogan and their colleagues studied 183 term infants with Apgar score below 7 and concluded that in the absence of malformations, the majority of Apgar scores below 4 and at least half of scores 4-6 could be attributed to birth asphyxia. Signs of hypoxia usually appeared during labor but they were present at admission in 38% of cases with Apgar score below four<sup>[19]</sup>.

The most common risk factor found in high-risk group in our study was emergency C/S. In a local study, no relation was found between the mode of delivery and umbilical cord blood gases<sup>[20]</sup>. In another local study there was a significant correlation between C/S, low Apgar score and acidemia<sup>[21]</sup>. Emergency C/S can result in acidemia because of the underlying condition that necessitates the emergency C/S.

## Conclusion

Our study highlights a correlation between the presence of perinatal risk factors and umbilical cord pH in high-risk mothers. So we recommend assessing the umbilical cord pH in any mother who has a perinatal risk factor in her history or physical examination.

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**Conflict of Interest:** None to be declared

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