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Association of Umbilical Artery Blood Gas Parameters with Neonate Birth Weight, Gestational Age and Maternal Age: A Study from Maharashtra

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ABSTRACT
The physiological changes that occur in several maternal organ systems during pregnancy are widely recognized. These changes play a crucial role in facilitating optimal nourishment of the fetus and preparing the mother for the process of childbirth. The aim of study was to explore association of umbilical artery blood gas parameters with neonate birth weight, gestational age and maternal age. The research sample comprised neonates who underwent birth through several delivery procedures at a tertiary care teaching hospital in Mumbai. A blood specimen was collected from the artery region of the umbilical cord using a syringe that had been pre-heparinized, within a time frame of 30 minutes following the birth. Subsequently, the specimen was transported utilizing ice packs and scrutinized inside a duration of 1 hour. The measurements of blood gas parameters were documented. Mean neonatal weight for pH$\leq$7 group was 2.7kg and for pH >7 group was 2.89kg. No significant association was noted between neonate birth weight and pH. The mean neonatal weight for BD <16 group was 2.93kg and for BD$\geq$16 group it was 2.58kg. The mean maternal age for pH $\leq$7 group was 28.6 years and for >7 pH group was 27.3 years and for BD <16 group was 27.4 years and for $\geq$16 BD group was 28.4 years. Factors including maternal age, gestational age, gender of baby, mode of delivery do not affect the values of umbilical cord arterial blood gas parameters.

INTRODUCTION

The physiological changes that occur in several maternal organ systems during pregnancy are widely recognized. These changes play a crucial role in facilitating optimal nourishment of the fetus and preparing the mother for the process of childbirth[1]. Although obstetricians possess this knowledge, they commonly rely on reference data obtained from non-pregnant women in order to evaluate the health status of pregnant patients. There have been limited studies[2,3] on physiological changes that occur during pregnancy and birth and there has been a lack of research on arterial blood gas levels such as electrolytes, bilirubin, glucose and lactate. Furthermore, there is a lack of research on the potential effects of many maternal and obstetric factors[4] that are frequently encountered during the process of childbirth. It is crucial to establish normal blood gas readings for healthy women during labor.

Obesity is a commonly encountered maternal risk factor over the course of pregnancy and childbirth. There exists a correlation between maternal obesity and many physiological changes, including heightened fat accumulation, reduced body muscle mass, diminished respiratory capacity and chronic inflammatory alterations. These factors contribute to an elevated likelihood of longer labor and unfavorable maternal-neonatal outcomes[5]. Pregnancy-related smoking is a risk factor that has the potential to negatively impact maternal acid-base balance due to its vasoconstrictive effects on blood vessels. It is widely acknowledged that maternal smoking is linked to hypertension and reduced lung capacity[6,7]. Therefore this study was conducted to explore association of umbilical artery blood gas parameters with neonate birth weight, gestational age and maternal age.

MATERIALS AND METHODS

This study was cross-sectional, prospective in design and was carried out at a tertiary care teaching hospital in Mumbai. The research sample comprised neonates who underwent birth through several delivery procedures at study site. The research encompassed a duration of eleven and a half years, commencing in December 2020 and concluding in May 2022. All neonates delivered at this hospital, regardless of the mode of delivery attended by the lead investigator, met the inclusion criteria for this study. The study population consisted of ninety newborns who were delivered using various means of delivery and were under my care at this hospital. Cases involving life-threatening congenital defects and stillbirths were omitted from this study.

After the baby was born, the obstetrics team wrapped the umbilical cord with two clamps and then cut the cord between these clamps. The placement of the third clamp is on the placental segment of the umbilical cord, ensuring a minimum length of 10-12 cm, while the placenta stays stationary. A pre-heparinized 2cc syringe and a 24-gauge needle, which had been flushed with a 1/1000 heparin solution, were utilized to collect a 1cc sample from the umbilical artery within 30 minutes of birth. The syringe was assigned a name. The item was subjected to vacuum storage and thereafter transported for examination using ice packs within a time frame of one hour from the moment of collection. The blood gas values in the medical ICU were tested using the Abbott i-stat handheld blood analyzer. In the context of this investigation, severe acidosis was operationally defined as umbilical arterial blood gas samples exhibiting a pH level below 7 and a base deficit below 16 mmol/lit. This threshold was established as the dividing factor between the two groups.

The prognosis of infants was evaluated within the first 7 days of their lives through monitoring. The groups were compared based on the necessity of intubation, the need for oxygen support and the demand for a stay in the Neonatal Intensive Care Unit (NICU). The collected data was entered into the Microsoft Excel spreadsheet, appropriately entered into codes and then examined for possible mistakes. The analysis in this study utilized IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp. Armonk, NY, USA). During the data cleaning procedure, supplementary variables were created to strengthen the relationship between variables. Categorical data was represented using percentages (%), while quantitative data was provided using mean and standard deviation. This study employed a significance level of 5% for the conducted tests. Hence, a statistically significant link was deemed to exist when the p-value was less than 0.05.

RESULTS AND DISCUSSIONS

In this study, the mean neonatal weight for pH $\leq$7 group was 2.7kg and for pH>7 group was 2.89kg. No significant association was noted between neonate birth weight and pH (p value= 0.1). The mean neonatal weight for BD <16 group was 2.93kg and for BD $\geq$16 group it was 2.58kg. A significant association was noted between neonate birth weight and BD (p value=0.004). (Table 1).

In this study, 69% newborns with pH $\leq$7 and 83.6% newborns with pH >7 respectively and 83.3% with BD<16 and 66.7% with BD $\geq$16 respectively was found with $\geq$37 WOG. No significant association found between gestational age with pH (p value=0.11) and BD (p value=0.08). (Table 2).

The mean maternal age for pH $\leq$7 group was 28.6 years and for >7 pH group was 27.3 years and for BD <16 group was 27.4 years and for $\geq$16 BD group was

Table 1: Correlation between neonate birth weight with pH and base deficit

	pH		BD	
	≤7	>7	<16	≥16
Neonate Weight (in kg)	No. of Patients	No. of Patients	No. of Patients	No. of Patients
1.5-2.5	10(33.3%)	14(23.3%)	11(16.9%)	13(52%)
2.6-3.5	19(63.3%)	41(68.3%)	49(75.3%)	11(44%)
3.6-4.5	1(3.3%)	5(8.3%)	5(7.69%)	1(4%)
Total	30(100%)	60(100%)	65(100%)	25(100%)
Mean±SD	2.7±0.5	2.89±0.52	2.93±0.48	2.58±0.57
p-value	0.1		0.004	

Table 2: Correlation of gestational age with pH and base deficit

	pH		BD	
	≤7	>7	<16	≥16
Gestational Age (in weeks)	No. of Patients	No. of Patients	No. of Patients	No. of Patients
<37	9(31%)	10(16.4%)	11(16.7%)	8(33.3%)
≥37	20(69%)	51(83.6%)	55(83.3%)	16(66.7%)
Total	29(100%)	61(100%)	66(100%)	24(100%)
Mean±SD	7.09±0.22		13.98±4.30	
p-value	0.11		0.08	

Table 3: Correlation of maternal age with pH and base deficit

	pH		BD	
	≤7	>7	<16	≥16
Maternal Age	No. of Patients	No. of Patients	No. of Patients	No. of Patients
20-25	4(13.3%)	18(30%)	18(27.6%)	4(16%)
26-30	20(66.6%)	33(55%)	37(56.9%)	16(64%)
31-35	6(20%)	9(15%)	10(15.3%)	5(20%)
Total	30(100%)	60(100%)	65(100%)	25(100%)
Mean±SD	28.6±2.9	27.3±3.09	27.47±3.0005	28.44±3.25
p-value	0.058		0.18	

28.4 years. No significant association was noted between maternal age with pH (p value= 0.058) and BD (p value= 0.18). (Table 3).

In this study, more newborn babies were male than female in all groups of pH and BD.no significant association was noted between gender of newborn with pH (p value=0.54) and BD (p value =0.31). It was noted that 63.3% newborns and 68.3% newborns with birth weight between 2.6-3.5kg were found with pH ≤7 and pH>7 respectively, no significant association found between birth weight and pH (p value=0.1) while 52% with birth weight between 1.5-2.5kg and 75% with birth weight between 2.6-3.5kg found with BD≥16 and BD<16 respectively and the association was statistically significant (p value=0.004). In a similar study, the mean weight in the two groups, vaginal delivery and non -emergency caesarean section delivery with spinal anaesthesia, were 3317±453 grams and 3420±489 grams, respectively and there was no statistically significant difference between the two groups (P=0.182). In addition, there was no statistically significant difference between the two groups in terms of gender of the newborns (P=0.312)[8].

In this study, 69% and 83.6% newborns with ≥37 WOG had pH ≤7 and pH>7 respectively and 83.3% and 66.7% with ≥37 WOG had BD<16 and BD≥16 respectively. No significant association was found between WOG with pH (p value= 0.11) and BD (p value=0.08). A similar study by Kacho *et al.*[9] found that mean gestational age for low-risk group was 39.17 weeks and for high- risk group it was 38.68 weeks.

In this study, majority of newborns were delivered by LSCS than NVD in all groups of pH and BD. No significant association found between mode of delivery with pH and BD. A similar study showed that, in vaginal delivery and caesarean section delivery newborns, the average umbilical artery pH was 7.26±0.06 and 7.25±0.06, respectively and the average base deficit was -4.25±4.0 and -2.98±2.5, respectively. umbilical cord artery pH levels and base deficit values was not significantly different in the two groups[8,9].

Typically, vaginal delivery is considered the most optimal and least prone to complications kind of delivery. However, the natural birth method is currently witnessing a decline as a result of the significant rise in caesarian deliveries. In general, there has been a global rise in the prevalence of cesarean sections, without any valid justification being provided[10]. The diffusion of carbon dioxide across the placenta is facilitated. Lactic acid and b-hydroxybutyrate, which constitute the predominant metabolic burden, have a rather sluggish transit in the placenta[11]. The evaluation of both the respiratory and metabolic components of each sample holds significant importance. The concept of acidosis lacks global consensus, since many countries have reported varying cut-off values ranging from pH 7.10-7.00. According to Lynn A's (2007) study, it was shown that the

arterial-cord pH values of newborns after an elective caesarian section were considerably higher compared to those obtained after a normal vaginal delivery[12].

When the initiation of labor triggers uterine contractions, the flow of maternal blood to the placenta experiences intermittent strangulation when the intrauterine pressure above 30 mmHg. Nevertheless, in typical situations, research has indicated that uterine contractions do not have a negative impact on the blood flow of the umbilical artery[13]. However, all fetuses delivered vaginally exhibit a decrease in pH, accompanied by a rise in pCO2. This effect is most noticeable during the second stage of labor and during delivery[14]. Conversely, it has been demonstrated that newborns delivered through elective cesarean section exhibit elevated pH levels, which can be attributed to the absence of a physically demanding vaginal birth[15].

CONCLUSION

Factors including maternal age, gestational age, gender of baby, mode of delivery do not affect the values of umbilical cord arterial blood gas parameters.

REFERENCES

1. Zaigham, M., S. Helfer, K.H. Kristensen, P. Isberg and N. Wiberg, 2020. Maternal arterial blood gas values during delivery: Effect of mode of delivery, maternal characteristics, obstetric interventions and correlation to fetal umbilical cord blood. Acta. Obstetr. Gynecol. Scand., 99: 1674-1681.
2. Soma-Pillay, P., C. Nelson-Piercy, H. Tolppanen and A. Mebazaa, 2016. Physiological changes in pregnancy. Cardiovasc. J. Africa, 27: 89-94.
3. Klajnbard, A., P.B. Szecsi, N.P. Colov, M.R. Andersen and M. Jørgensen *et al*., 2009. Laboratory reference intervals during pregnancy, delivery and the early postpartum period. cclm., 48: 237-248.
4. Rodríguez-Mesa, N., P. Robles-Benayas, Y. Rodríguez-López, E.M. Pérez-Fernández and A.I. Cobo-Cuenca, 2019. Influence of body mass index on gestation and delivery in nulliparous women: A cohort study. Int. J. Environ. Res. Pub. Health., Vol. 16 .10.3390/ijerph16112015
5. Jauniaux, E. and G.J. Burton, 2007. Morphological and biological effects of maternal exposure to tobacco smoke on the feto-placental unit. Early Hum. Dev., 83: 699-706.
6. Rogers, J.M., 2009. Tobacco and pregnancy. Reprod. Toxicol., 28: 152-160.
7. Tarasi, B., J. Cornuz, C. Clair and D. Baud, 2022. Cigarette smoking during pregnancy and adverse perinatal outcomes: A cross-sectional study over 10 years. BMC. Pub. Health., Vol. 22 10.1186/s12889-022-14881-4
8. Roya, R.,Z. Akbarianrad, Y.P. and Zahed, 2016. The effect of mode of delivery on the umbilical artery pH. Casp. J. Pediatr., 2: 113-117.
9. Ahmadpour-Kacho, M.,N. and Asnafi, 2010. Correlation between umbilical cord pH and Apgar score in high-risk pregnancy. Iran. j. pediatr., Vol. 20.
10. Fleischer, A., A.A. Anyaegbunam, H. Schulman, G. Farmakides and G. Randolph, 1987. Uterine and umbilical artery velocimetry during normal labor. Am. J. Obstet. Gynecol., 157: 40-43.
11. Brar, H.S., L.D. Platt, G.R. DeVore, J. Horenstein and A.L. Medearis, 1988. Qualitative assessment of maternal uterine and fetal umbilical artery blood flow and resistance in laboring patients by doppler velocimetry. Am. J. Obstet. Gynecol., 158: 952-956.
12. Lynn, A. and P. Beeby, 2007. Cord and placenta arterial gas analysis: The accuracy of delayed sampling. Arch. Dis. Child. Neon. Ed., 92: 281-285.
13. Olofsson, P., A. Thuring-Jönsson and K. Marsál, 1996. Uterine and umbilical circulation during the oxytocin challenge test. Ultra. Obstet. Gynecol., 8: 247-251.
14. Hagelin, A.,J. and Leyon, 1998. The effect of labor on the acid-base status of the newborn. Acta. Obstet. Gynecol. Scand., 77: 841-844.
15. Zaigham, M., K. Källén and P. Olofsson, 2019. Gestational age-related reference values for apgar score and umbilical cord arterial and venous Ph in preterm and term newborns. Acta. Obstetr. Gynecol. Scand., 98: 1618-1623.