

Role Cord Blood Gas Analysis in Predicting the Short-Term Outcome in High-Risk Deliveries: A Retrospective Study

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Abstract

Aim: The aim of the present study was to investigate the relationship between cord blood gas analysis and neonatal outcome.

Methods: A retrospective hospital-based observational study was conducted at the Department of Paediatrics, JLNMCH, Bhagalpur, Bihar, India for the duration of 12 months. A total of 100 term neonates were delivered at our hospital to mothers who experienced a prolonged second stage of labour, foetal heart rate deceleration or acceleration, an emergency caesarean section for foetal or maternal problems, and placental insufficiency were all included.

Results: In the present study, 66% were male neonates and 34% were female neonates. 2840.8±432 was the mean body weight of neonates. 60% were delivered vaginally, followed by instrumental labour. 100 babies were included in the study; among them, 45 babies had pH <7.25, and 55 babies had pH >7.25. Out of 100 babies, 15 babies needed resuscitation, 8 needed for NICU admission and 4 had convulsions.

Conclusion: When compared to those with pH >7.25, high-risk term babies with cord pH <7.25 have an increased need for resuscitation, NICU admission, and delay in achieving full feeds. In this study, there is no statistical correlation between cord blood pH and the incidence of convulsions and encephalopathy in term high-risk newborns. When comparing high-risk newborns to other babies, the median cord blood pH is significantly lower in those who required resuscitation, NICU admission, or had a delay in achieving full feeds. All high-risk newborns should have their cord blood pH measured.

Keywords: Cord blood gas pH, Resuscitation, Convulsions, Encephalopathy

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Introduction

Labour is a stressful event for the fetus. Foetal distress has been described as “a condition in which foetal physiology is so altered to make death or permanent injury a probability within a relatively short period of time and usually considered to denote disruption of normal foetal oxygenation, ranging from mild hypoxia to profound foetal asphyxia”. [1] Perinatal asphyxia is a one of the major causes of stillbirths, neonatal death, infant death and adverse long-term outcomes such as cerebral palsy and developmental delay. [2,3,4,5]

After birth foetal asphyxia is subjectively assessed by APGAR score and objectively by cord blood pH and Lactate levels. Low cord pH in infants who are vigorous at birth and free of cardiopulmonary compromise does not indicate an increased risk of adverse outcome. [6]

At birth, each newborn is assigned a score based on the Apgar scale. This system is a quick way to assess the newborn's clinical status at 1 minute and 5

minutes after birth. [7] Low Apgar scores are associated with birth weight and gestational age, but only a low score cannot predict morbidity or mortality for each individual newborn. [8] As a result, the score is a useful tool for decisions made in the delivery room during newborn care, but it is not a good idea for assessing short and long term health status. Hermansen et al described the "acidosis paradox," which states that newborns who do not have acidaemia at birth can still develop a hypoxic condition. Indeed, adverse outcomes in newborns with normal pH are possible. [9,10]

Umbilical cord blood acid base analysis has emerged in recent years as a method of assessing new born objectively because other predictors of outcome including APGAR score are based on subjective criteria and they correlate poorly with neonatal outcome. [11] Blood Gas Analysis is a tool that can aid in determining the patient's health status (BGA). The BGA allows for the assessment of the

patient's respiratory exchanges, metabolism, and electrolytic state. [12] pH is determined by the balance of lactates, which tend to decrease pH. [13] A good blood gas in a depressed newborn should alert the neonatologist to search more diligently for other causes of neonatal depression like sepsis, trauma or congenital abnormalities. [14] Umbilical cord blood gas analysis is critical for determining neonatal acidemia during delivery.

Hence the purpose of this research is to investigate the relationship between cord blood gas and neonatal outcome

Material & Methods

A retrospective hospital-based observational study was conducted at the Department of Paediatrics, JLNMCH, Bhagalpur, Bihar, India for the duration of 12 months. A total of 100 term neonates were delivered at our hospital to mothers who experienced a prolonged second stage of labour, foetal heart rate deceleration or acceleration, an emergency caesarean section for foetal or maternal problems, and placental insufficiency were all included.

Term newborns with Meconium stained liquor (vigorous and non-vigorous) who required resuscitation were included. Babies with significant congenital anomalies were barred from participating in this study.

Methodology

Parents provided informed consent, and 1ml of umbilical cord blood was collected using a three

clamp technique under aseptic conditions and immediately transported to the biochemistry lab. The attending paediatrician reviewed the APGAR score and treated the baby according to protocol. The treating paediatrician decided on the baby's further management based on his or her needs. All of the babies were monitored.

Requirement of any form of intervention at birth, including positive pressure ventilation, endotracheal intubation, chest compressions, and intravenous medications (adrenaline). Need for NICU admission for Babies who require NICU admission for any reason as determined by the attending paediatrician. Delay in achieving full feeds such as feed intolerance or inability to breastfeed satisfactorily by day 3 of life was measured. Babies in the newborn period who have seizures, whether generalised or subtle were analysed. Encephalopathy is classified using the modified SARNAT scoring systems.

Statistical Analysis

Statistics Frequencies of the variables were expressed as percentages. Chi-square test has been used to find the association between outcome variables and socio demographic variables. Student's t test was used for comparison of means. P <0.05 was considered to be statistically significant. The statistical software, Statistical package for social sciences (SPSS) version 22 was used for the analysis of the data: Microsoft word and excel have been used to generate graphs and table.

Results

Table 1: Clinical characteristics of neonates

Frequency		
Gender, %	Male	66 (66)
	Female	34 (34)
Gestational age, wks (Mean± SD)		37.3±1.2
Body weight, gr (Mean± SD)		2840.8±432
Emergency or urgency caesarean section		14 (12%)
Elective caesarean section		3 (3%)
Instrumental labor		23 (23%)
Vaginal delivery		60 (60%)
Apgar score 1 min, median (25 ^o - 75 ^o percentile)		6% (8-9)
Apgar score 5 min		8% (9-10)

In the present study, 66% were male neonates and 34% were female neonates. 2840.8±432 was the mean body weight of neonates. 60% were delivered vaginally, followed by instrumental labour.

Table 2: Clinical variables measurements

Variables	Yes	No	Total	P value
Resuscitation				
pH<7.25 –group 1	10	35	45	0.007
pH>7.25 –group 2	5	50	55	
Delay in achieving full feeds				
pH<7.25	7	38	45	0.005
pH>7.25	2	53	55	

Encephalopathy				
pH<7.25	4	41	45	
pH>7.25	1	54	55	0.008
Convulsions				
pH<7.25	3	42	45	0.040
pH>7.25	1	54	55	
NICU admission				
pH<7.25	5	40	45	
pH>7.25	2	53	55	0.017

100 babies were included in the study; among them, 45 babies had pH <7.25, and 55 babies had pH >7.25.

Table 3: Association between requirements of variables with mean pH levels

Variables	No	Mean pH	P value
Need for resuscitation	15	7.18	0.007
No need for resuscitation	85	7.32	
The need for NICU admission	8	7.08	0.0012
No need of NICU admission	92	7.22	
Convulsions	4	7.13	0.5
No convulsions	96	7.28	
Encephalopathy	5	7.14	0.2
No encephalopathy	95	7.27	
Delay in attaining full feeds	7	7.09	0.003
No delay in attaining full feeds	93	7.26	

Out of 100 babies, 15 babies needed resuscitation, 8 needed for NICU admission and 4 had convulsions.

Discussion

WHO states that about 9 million neonates develop birth asphyxia every year, of them 1.2 million die and same number develop severe consequences like cerebral palsy, epilepsy and delayed developmental milestones. Considerable studies have been done to determine risk factors and role of intrapartum asphyxia causing adverse neonatal outcomes in infants delivered at term. [15]

The aim of foetal surveillance is to identify foetuses at risk for neonatal and long-term injury due to asphyxia and to prevent morbidity and mortality. Routine tools of intrapartum foetal surveillance are intermittent foetal heart auscultation, observation for MSAF, cardiotocography and foetal scalp blood sampling. [16] Acute foetal distress induces asphyxia leading to hypoxia of most of the organs which causes increase in lactic acid level along with alteration in pH and HCO₃. Most of the parameters used for foetal monitoring have good sensitivity but low specificity. [17] Umbilical cord blood acid base analysis has emerged in recent years as a method of assessing new born objectively because other predictors of outcome including APGAR score are based on subjective criteria and they correlate poorly with neonatal outcome. [18]

In the present study, 66% were male neonates and 34% were female neonates. 2840.8±432 was the mean body weight of neonates. 60% were delivered

vaginally, followed by instrumental labour. 100 babies were included in the study; among them, 45 babies had pH <7.25, and 55 babies had pH >7.25. Ahmadpour-Kacho M et al [19] examined the outcomes of 120 high-risk neonates in a study. 42 babies out of 60 in the neonatal group with a pH less than 7.2 required resuscitation, compared to 13 in the other group with a pH greater than 7.2. They concluded that a pH of 7.2 could be used as a cut-off point for determining the prognosis of neonatal outcome. Andres et al. assessed ninety three neonates for the correlation between the umbilical cord PCO₂, PO₂, pH, bicarbonate and BD with death, need to cardiopulmonary resuscitation, convulsion, RDS, PDA, NEC, IUGR, sepsis and HIE. Although in their study there was no correlation between sepsis, RDS, NEC, PDA and UABG parameters, need to cardiopulmonary resuscitation, need to intubation, convulsion, HIE and IUGR were correlated with low UABG pH. [20] In their study PO₂ had no correlation with outcomes. In our study, abnormal UABG pH had no significant correlation with convulsion.

Goldhaber and colleagues studied the association between umbilical arterial acidosis and neurologic complications (encephalopathy and convulsion) among 3506 term, singleton neonates with cord arterial pH < 7.20. [21] Neonatal death was much more likely at pH < 7.00. The cutoff value at which seizures became more likely was pH < 7.05, and for unexplained seizures pH < 7.00. They suggested that a realistic value for defining pathological academia was pH < 7.00. Out of 100 babies, 15 babies needed

resuscitation, 8 needed for NICU admission and 4 had convulsions. In Williams et al. study, neonatal seizure was predicted only by low umbilical artery pH. A pH of less than 7 was more (73.8%) sensitive than a base excess of -16 (52.5%) in predicting the development of neonatal seizures. [22] Victory et al [23] found that there is a progression of risk in term infants for NICU admission and need for assisted ventilation with worsening acidosis at birth. Not all neonates with acidosis at birth require resuscitation or have adverse outcome. In the present study 60 percent did not require admission. King et al [24] concluded that infants with an umbilical artery pH \leq 7.0 and assessed to be clinically well can be treated similar to non-academic infants. The cut off value for pH in our study is somewhat higher than in King's study.

Conclusion

When compared to those with pH >7.25 , high-risk term babies with cord pH <7.25 have an increased need for resuscitation, NICU admission, and delay in achieving full feeds. In this study, there is no statistical correlation between cord blood pH and the incidence of convulsions and encephalopathy in term high-risk newborns. When comparing high-risk newborns to other babies, the median cord blood pH is significantly lower in those who required resuscitation, NICU admission, or had a delay in achieving full feeds. All high-risk newborns should have their cord blood pH measured.

References

1. Tasnim N, Mahmud G, Akram S. Predictive accuracy of intrapartum Cardiotocography in terms of fetal acid base status at birth. *J Coll Physicians Surg Pak*. 2009;19(10):632-5.
2. Leung TY, Chung TK. Severe chronic morbidity of childbirth. *Best Pract Clin Res Obstet Gynaecol*. 2009;23:401-423.
3. Wong STK, Tse WT, Lau SL, Sahota DS, Leung TY. Stillbirth rate in singleton pregnancies: a 20-year retrospective study from a public obstetric unit in Hong Kong. *Hong Kong Med J*. 2022;28:285-293.
4. Lau SL, Wong STK, Tse WT, et al. Perinatal mortality rate in multiple pregnancies: a 20-year retrospective study from a tertiary obstetric unit in Hong Kong. *Hong Kong Med J*. 2022;28:347-356.
5. Fung GPG, Lau SL, Hui SYA, et al. Neonatal mortality in singleton pregnancies: a 20-year retrospective study from a tertiary perinatal unit in Hong Kong. *Hong Kong Med J*. 2022.
6. Armstrong L, Stenson BJ. Use of umbilical cord blood gas analysis in the assessment of the newborn. *Arch Dis Child Fetal Neonatal Ed*. 2007;92(6):F430-4.
7. Watterberg KL, Aucott S, Benitz WE, Cummings JJ, Eichenwald EC, Goldsmith J et al. The Apgar score. *Pediatrics*. 2015;136(4):819-22.
8. Ehrenstein V. Association of Apgar scores with death and neurologic disability. *Clin Epidemiol*. 2009;1:45-53.
9. Hermansen M. The acidosis paradox: asphyxial brain injury without coincident acidemia. *Dev Med Child Neurol*. 2003;45(5): 353-6.
10. Martí GS, Pascual MJ, Rodrigo RM, Ruiz SJ, Castán MS. pH, base deficit or lactate. Which is better for predicting neonatal morbidity? *J Matern Fetal Neonatal Med*. 2017;30(19):23 67-71.
11. Modarressnejad V. Umbilical cord blood pH and risk factors for acidemia in Neonates in Kerman. *East Mediterr Health J*. 2005;11(1-2):96-101.
12. Tataranno ML, De Bernardo G, Trevisanuto D, Sordino D, Riccitelli M, Buonocore G, Perrone S. Differences between umbilical blood gas in term and preterm newborns. *Electronic Physician*. 2019 Apr 1;11(2).
13. Pramod S, Gunchan P, Sandeep P. Interpretation of arterial blood gas. *Indian J Crit Care Med*. 2010;14(2):57-64.
14. Loh SF, Woodworth A, Yeo GS. Umbilical cord blood gas analysis at delivery. *Singapore Med J*. 1998;39(4):151-5.
15. Malin GL, Morris RK, Kha KS. Strength of association between umbilical cord pH and perinatal and long-term outcomes: systematic review and meta-analysis. *BMJ*. 2010;340:c1 471.
16. Parveen S. Umbilical cord arterial blood base excess as gold standard for foetal well-being screening test validity at term delivery. *J PakMed Assoc*. 2010;60(5):347-50.
17. Johnson JW, Richards DS, Wagaman RA. The case for routine umbilical blood acid-base studies at delivery. *Am J Obstet Gynecol*. 19 90;162(3):621-5.
18. Modarressnejad V. Umbilical cord blood pH and risk factors for acidemia in Neonates in Kerman. *East Mediterr Health J*. 2005;11(1-2) :96-101.
19. Ahmadpour-Kacho M, Zahedpasha Y, Hagshenas M, Akbarian Rad Z, Sadat Nasserli B, Bijani A. Short Term Outcome of Neonates Born With Abnormal Umbilical Cord Arterial Blood Gases. *Iran J Pediatr*. 2015 Jun;25(3): e174.
20. Andres RL, Saade G, Gilstrap LC, Wilkins I, Witlin A, Zlatnik F, Hankins GV. Association between umbilical blood gas parameters and neonatal morbidity and death in neonates with pathologic fetal acidemia. *Am J Obstet Gynecol*. 1999 Oct;181(4):867-71.
21. Goldaber KG, Gilstrap LC 3rd, Leveno KJ, Dax JS, McIntire DD. Pathologic fetal acidemia. *Obstet Gynecol*. 1991 Dec;78(6):11 03-7.

22. Williams KP, Singh A. The correlation of seizures in newborn infants with significant acidosis at birth with umbilical artery cord gas values. *Obstet Gynecol.* 2002 Sep;100(3):557-60.
23. Victory R, Penava D, Da Silva O, Natale R, Richardson B. Umbilical cord pH and base excess values in relation to adverse outcome events for infants delivering at term. *Am J Obstet Gynecol.* 2004 Dec;191(6):2021-8.
24. King TA, Jackson GL, Josey AS, Vedro DA, Hawkins H, Burton KM, Burks MN, Yellin WM, Laptook AR. The effect of profound umbilical artery acidemia in term neonates admitted to a newborn nursery. *J Pediatr.* 1998 Apr;132(4):624-9.