

**Assessment of the Relationship between Cord Blood Gas Analysis and Neonatal Outcome: A Prospective Study**Pradeep Kumar Singh<sup>1</sup>, Ajay Kumar<sup>2</sup>, G. Dharamraj Patra<sup>3</sup><sup>1</sup>Assistant Professor, Department of Paediatrics, Shri Ramkrishna Institute of Medical Sciences and Sanaka Hospital, Durgapur, West Bengal, India<sup>2</sup>Associate Professor, Department of Paediatrics, Shri Ramkrishna Institute of Medical Sciences and Sanaka Hospital, Durgapur, West Bengal, India<sup>3</sup>Assistant Professor, Department of Paediatrics, Shri Ramkrishna Institute of Medical Sciences and Sanaka Hospital, Durgapur, West Bengal, India

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Conflict of interest: Nil

**Abstract****Aim:** The aim of the present study was to investigate the relationship between cord blood gas analysis and neonatal outcome.**Methods:** A prospective hospital-based observational study was conducted at the Department of Pediatrics 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, EncephalopathyThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**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 acidaemia during delivery.

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

#### Material & Methods

A prospective hospital-based observational study was conducted at the Department of Pediatrics, Shri Ramkrishna Institute of Medical Sciences and Sanaka Hospital, West Bengal, 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
<b>Gender, %</b>	Male	66 (66)
	Female	34 (34)
<b>Gestational age, wks (Mean± SD)</b>		37.3±1.2
<b>Body weight, gr (Mean± SD)</b>		2840.8±432
<b>Emergency or urgency caesarean section</b>		14 (12%)
<b>Elective caesarean section</b>		3 (3%)
<b>Instrumental labor</b>		23 (23%)
<b>Vaginal delivery</b>		60 (60%)
<b>Apgar score 1 min, median (25<sup>o</sup> 75<sup>o</sup> percentile)</b>		6% (8-9)
<b>Apgar score 5 min</b>		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
<b>Resuscitation</b>				
pH<7.25 –group 1	10	35	45	
pH>7.25 –group 2	5	50	55	0.007
<b>Delay in achieving full feeds</b>				
pH<7.25	7	38	45	0.005
pH>7.25	2	53	55	
<b>Encephalopathy</b>				
pH<7.25	4	41	45	0.008
pH>7.25	1	54	55	
<b>Convulsions</b>				
pH<7.25	3	42	45	0.040
pH>7.25	1	54	55	
<b>NICU admission</b>				
pH<7.25	5	40	45	0.017
pH>7.25	2	53	55	

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 HCO<sub>3</sub>. 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 PCO<sub>2</sub>, PO<sub>2</sub>, 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.

Goldaber 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 acidemia 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<sup>24</sup> concluded that infants with an umbilical artery pH ≤ 7.0 and assessed to be clinically well can be treated similar to non-acidemic 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.

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