

## ORIGINAL ARTICLE

# A Study of Umbilical Cord Blood pH and its Correlation with Oxygen Saturation in Hospital Born Babies

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### ABSTRACT

**Background:** The aim of this study is to determine the relationship between oxygen saturation (SpO<sub>2</sub>) by pulse oximetry levels and umbilical cord arterial pH values in healthy newborns during the first 15 minutes of life.

**Methods:** There were 148 healthy term, appropriate-for-gestational-age neonates were enrolled in the study which were divided in two groups: umbilical cord arterial blood pH value <7.2 (group 1) and >7.2 (group 2). SpO<sub>2</sub> levels during the first 15 minutes of life were compared between groups.

**Results:** The study was completed with 148 infants. A significant correlation was found between measured preductal SpO<sub>2</sub> levels by pulse oximetry and umbilical cord arterial pH values. In group 1, infants had lower SpO<sub>2</sub> levels measurements during the first 15 minutes of life in comparison to group 2 and time to reach >90% SpO<sub>2</sub> level was between 10-15 minutes in both the groups.

**Conclusion:** Determination of umbilical arterial blood pH values, in addition to clinical findings and oxygen saturation measurements, might be helpful in deciding the concentration of oxygen and whether or not to continue oxygen supplementation in the

delivery room.

**Key Words** delivery room; Newborn; oxygen saturation; umbilical cord blood pH

### INTRODUCTION

Resuscitation of the newborn in the delivery room is the fundamental approach to ensure the maintenance and quality of life. Published neonatal resuscitation algorithm have suggested that a pulse oximeter should be used during resuscitation of newborn to avoid potentially harmful effects of oxygen<sup>1,2</sup>. Worldwide, more than 1 million newborns per year need resuscitation<sup>3</sup>. 100% Oxygen supplementation during resuscitation may be harmful due to oxygen free radicals that influence the pathogenesis of many diseases of newborn and children (including leukemia and childhood cancer<sup>6</sup>). The most important finding is that 21% Oxygen is associated with lower neonatal mortality<sup>7</sup>. Oxygen saturation (SpO<sub>2</sub>) levels obtained by pulse oximeter from resuscitated asphyxiated newborns, healthy term and preterm newborn were found to be effective on saturation levels and in identifying fetal acidosis<sup>13</sup>. Oxygen supplementation is guided according to clinical findings like respiratory efforts, heart rate and oxygen saturation levels<sup>14,16</sup>. Umbilical cord blood gas analysis is considered to be an objective indicator of

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fetal acid base balance and fetal response to birth stress<sup>1-7</sup>. Thus umbilical cord blood gas analysis should be taken into account when evaluating fetal hypoxemia<sup>18-19</sup>. We planned this study to evaluate both oxygen saturation levels and umbilical arterial (UA) blood pH values together, which are accepted as objective indicators for accurate newborn oxygenation status determination.

The aim of our study was to find out the association between umbilical cord arterial blood pH and SpO<sub>2</sub> levels of newborn during first fifteen minutes of life,

### **PATIENTS AND METHOD**

#### **Study Population**

This was hospital based, cross sectional, observational case study, The study was conducted over a period of 1 year from August 2016 to July 2017 in hospital attached to SMS Medical College, Jaipur, after obtaining approval from the institutional ethics committee of SMS Medical College, Jaipur. A written consent was obtained from the parent(s). The inclusion criteria: were apparently healthy full term AGA newborns without fetal distress, born by vaginal or caesarean delivery. The exclusion criteria: were gestational age <37 or >42 weeks, small-for-gestational-age or large-for-gestational-age, Apgar scores <7 at birth, patient with respiratory distress requiring ventilator support or positive pressure ventilation, congenital anomalies, multiple pregnancies, complicated pregnancy (maternal infections, fever, bleeding, oligohydramnios, rupture of membranes up to 12 hours, meconium stained amniotic fluid, and other maternal and placental diseases etc.), poor peripheral circulation or delayed capillary refilling time (by CRT>3sec.) and refusal to give consent.

All newborns were assessed at birth. Two paediatricians and one nurse attended each delivery.

Resuscitation protocols were performed according to the NRP guidelines, if necessary. As soon as the baby was delivered and kept under radiant heat warmer. All newborns were given routine care as per standard NRP protocol; kept in thermo neutral environment with temperature of 36.5°C (±1°C). Babies were wiped with a pre-warmed cloth, and watched for cry and vitals e.g. HR, RR, TEMP, CRT, and SpO<sub>2</sub>. Color of amniotic fluid was noted and recorded.

#### **Pulse Oxymeter measurement procedure**

Pulse oxymeter measurements were performed by using BPL pulse oxymeter. The sensor probe was placed at the right hand finger for the SpO<sub>2</sub> measurement immediately after cord clamping. The stopwatch was started at the time of cord clamping. SpO<sub>2</sub> levels were monitored and readings were noted at 1min, 5min, 10min and 15min of life. During and after 15 minutes of life if baby requires oxygen then we had given oxygen supplementation as per NRP guidelines and subject was excluded from our study group.

#### **Blood Sample**

Immediately after birth, umbilical cord arteries were felt and cord blood was withdrawn in pre-heparinized 1ml disposable plastic syringe for ABG. Apgar score was also noted subsequently. The ABG analysis was performed within 5 minutes in automatic blood gas analyzer(Cobas b 221).

#### **Determination of Patient Groups**

After applying inclusion and exclusion criteria, subjects were enrolled in study. First we arranged pH from highest to lowest. Afterwards we divided the study group into two groups based on pH value. Group 1 comprising of the subjects having pH value<7.2 while group 2 comprising of subjects having pH >7.2. SpO<sub>2</sub> levels during first fifteen

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minutes of life were compared between these groups.

**Statistical Methods**

All the data was entered in excel sheet and quantitative data were summarized as mean and standard deviation while qualitative data as percentages, quantitative data were analyzed with paired T test where as qualitative data with chi square test.

**RESULTS**

Total 148 newborns included in the study. There were no significant differences between the groups with respect to demographic data (Table 1). Out of 148 newborns, 76 (51.3%) were males and 72 (48.6%) were females. 64 study subjects were in group 1 while 84 study subjects were in group 2. 120 (81.1%) were Hindus and 28 (18.9%) were Muslims, 44 (29.7%) were vaginally delivered and 104 (70.3%) were LSCS

delivered. 79 (53.4%) were babies of primipara mothers and 69 (46.6%) were babies of multipara mothers. 97 (65.5%) babies were born to mother with clear amniotic fluid and 51(35.5%) babies were born to mother with meconium stained amniotic fluid. The mean temperature was 35.90C in group 1 and 36.110C in group 2. The mean HR was 146.75/min in group 1 and 141.40/min in group 2. The mean RR was 55.15/min in group 1 and 54.94/min in group 2. No significant difference was observed in base line Temp., HR and RR among the study subjects of both groups. The mean arterial PaO<sub>2</sub> at birth was 57.56 mm of Hg in group 1 and 65.96 mm of Hg in group 2. The mean arterial PaCO<sub>2</sub> at birth was 69.91 mm of Hg in group 1 and 52.1 mm of Hg in group 2. No significant difference was observed in ABG parameters at birth among both groups.

The mean SpO<sub>2</sub> at 1min of life was 62.54% in group 1 and 63.57% in group 2. The The mean SpO<sub>2</sub> level at 5

**Table 1: Subject Characteristics**

<b>Characteristics</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Total</b>
Male	32	44	76
Female	32	40	72
Hindu	49	71	120
Muslims	15	13	28
Vaginal delivered newborn	17	27	44
Cesarian delivered newborn	47	57	104
Primipara	33	46	79
Multipara	31	38	69
Clear amniotic fluid	34	63	97
Meconium stained fluid	30	21	51

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**Table 2: Vital parameters and ABG parameters in Group 1 and Group 2**

Parameters	Group 1	Group 2	p value
Mean Temperature	35.9°±0.72	36.1°±0.75	>0.05
Mean HR(rate/min)	146.75 ±13.41	141.40 ±12.71	<0.05
Mean RR(rate/min)	55.15 ±6.34	54.94 ±5.58	>0.05
paO2(mmHg)	57.56 ±32.7	65.96 ±30.42	>0.05
paCO2(mmHg)	69.91 ±31.85	52.1 ±19.21	>0.05

**Table 3: Percent spO2 at 1 min , 5 min, 10 min and 15 min of life in Group 1 and Group 2**

Parameters	Group 1	Group 2	p value
% spO2 at 1 min of life	62.54±2.38	63.57±3.12	<0.05
% spO2 at 5 min of life	77.89±3.99	80.36±4.96	<0.05
% spO2 at 10 min of life	87.26 ±3.49	89.17 ±4.47	<0.05
% spO2 at 15 min of life	93.53 ±1.708	95.03 ±2.55	>0.05

minutes of life was 77.89% in group 1 and 80.36% in group 2. The mean SpO2 at 10 min of life was 87.26% in group 1 and 89.17% in group 2. The P value was <0.05 for sPO2 at 1min, 5min, 10min which was statistically significant. The mean SpO2 level at 15 min of life was 93.53% in group 1 and 95.03% in group 2. The P value was >0.05 which was not significant.

**DISCUSSION**

There were no significant difference in the study subjects belonging to group 1 and group 2. No significant difference was observed in base line temperature, heart rate and respiratory rate among the study subjects of both the groups.

Kheir and Hamza, et al.<sup>20</sup> observed similar results.

They studied to establish longitudinal normative limits of oxygen saturation, heart rate and respiratory rate for healthy term neonates. They studied 500 neonates with respiratory rate ranging from 40-60 per minute and heart rate from 100-160 per minute. The O2 saturation records were within the 96-99%. No significant difference was observed in ABG parameters at birth among both groups. A higher mean SpO2 levels at 1min, 5min and 10 min of life were observed in group 2 subjects in comparison to group 1 subjects. The difference in percent SpO2 was statically significant (P<0.05) . A significant association was observed between umbilical cord arterial blood pH at birth and percent SpO2 levels at 10 minutes of life. Our observations showed that term infants with pH<7.2 had lower SpO2 levels in the first 10 minutes of life in comparison to the newborn group

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with pH>7.2. Arikian, et al.<sup>21</sup> stated that low preductal fetal oxygen saturation measured at birth is associated with low fetal pH. Linhartova, et al.<sup>22</sup> found that in the group of fetuses with fetal oxygen saturation levels >30%, the umbilical pH were >7.2 in 82.2% and in other group of fetuses with fetal oxygen saturation values <30%, the umbilical pH values in 67.7%. Our study result confirms the good correlation between pH values and fetal SpO2 levels similarly as other workers have reported. This was most likely caused by the fact that at the time of measurement some of the fetuses were experiencing the early symptoms of impaired blood supply.

The mean SpO2 level at 15 minutes of life in babies of group 1 was 93.53% and 95.03% in group 2 subjects. No significant difference was observed in percent SpO2 levels at 15 minutes of life between study group subjects (P=0.0). In agreement to our results following workers namely Hulsoore, et al.<sup>23</sup> in 2011, Tiwari S, et al.<sup>24</sup> in 2013 and Ying CL, et al.<sup>25</sup> in 2014 have reported in their studies on continuous data recording basis the attainment of SpO2>90% after 15min, 10min and 10min respectively.

Following workers in their studies have reported an early achievement of SpO2 levels of >90% these were UmutZ, et al.<sup>26</sup> in 2011 and Suwattnaphim MD, et al.<sup>27</sup> in 2015 in 8 minutes and in 6.5 minutes time respectively. Ambey R, et al.<sup>28</sup> in 2016 also studied 500 newborns and observed time duration to achieve targeted SpO2 levels in preterm and full term babies that was 8.35+1.16 min and 7.77+1.45 min respectively.

The different pattern of attainment of SpO2 values as observed by different workers can be due to racial difference and different demographic features of study cohorts enrolled in their studies. We believe that in Indian newborns it might take longer time to attain target SpO2 levels after birth.

The other reasons of variations in observations by different workers can be due to various types of pulse oxymeters which have been used in different studies with variable sensitivity. We knew that conventional pulse oxymeters used in past had lower sensitivity in comparison of new generation pulse oxymeters. However not many studies are available in India to compare these observations of present study.

### **CONCLUSION**

The time to reach SpO2 >90% in full term newborn without respiratory distress was between 10-15 minutes in our study in both the groups without any intervention in delivery room irrespective of umbilical pH values.

### **What this study Adds?**

1. Overenthusiastic use of higher concentration of oxygen right from birth may not be required in most of the babies. Only masterly activity and sPO2 monitoring is all that is required.
2. In resource limited peripheral setting, resuscitation should be started using room air.

**Funding:** None

**Conflict of Interest:** None declared

**Ethical Approval:** This study was approved by the institutional ethics committee.

### **REFERENCES**

1. Wyckoff MH, Aziz K, Escobedo MB, et al. Part 13: neonatal resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2015;132:S543-60.
2. Vento M, Saugstad OD. Resuscitation of the term and preterm infant. *Semin Fetal Neonatal Med*. 2010;15:216-22.
3. Saugstad OD. Oxygen saturations immediately after birth. *J Pediatr*. 2006;148:569-70.

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4. Naumburg E, Bellocco R, Cnattingius S, Jonzon A, Ekblom A. Supplementary oxygen and risk of childhood lymphatic leukaemia. *Acta Paediatr.* 2002;91:1328-33.
5. Saugstad OD. Oxidative stress in the newborn: a 30-year perspective. *Biol Neonate.* 2005;88:228-36.
6. Spector LG, Klebanoff MA, Feusner JH, Georgieff MK, Ross JA. Childhood cancer following neonatal oxygen supplementation. *J Pediatr.* 2005;147:27-31.
7. Saugstad OD, Ramji S, Soll RF, Vento M. Resuscitation of newborn infants with 21% or 100% oxygen: an updated systematic review and meta-analysis. *Neonatology.* 2008;94: 176-82.
8. Kamlin CO, O'Donnell CP, Davis PG, Morley CJ. Oxygen saturation in healthy infants immediately after birth. *J Pediatr.* 2006;148:585-9.
9. Nuntnarumit P, Rojnueangnit K, Tangnoo A. Oxygen saturation trends in preterm infants during the first 15 min after birth. *J Perinatol.* 2010;30:399-402.
10. Rabi Y, Yee W, Chen SY, Singhal N. Oxygen saturation trends immediately after birth. *J Pediatr.* 2006;148:590-4.
11. Toth B, Becker A, Seelbach-Göbel B. Oxygen saturation in healthy newborn infants immediately after birth measured by pulse oximetry. *Arch Gynecol Obstet.* 2002;266:105-7.
12. Shiao SYPK. Accurate measurements of oxygen saturation in neonates: paired arterial and venous blood analyses. *Newborn Infant Nurs Rev.* 2005;5:170-8.
13. Nonnenmacher A, Hopp H, Dudenhausen J. Predictive value of pulse oximetry for the development of fetal acidosis. *J Perinat Med.* 2010;38:83-6.
14. Kamlin CO, O'Donnell CP, Davis PG, Morley CJ. Oxygen saturation in healthy infants immediately after birth. *J Pediatr.* 2006; vol. 148: pp. 585-89.
15. Saugstad OD. Oxygen saturations immediately after birth. *J Pediatr.* 2006; vol. 148: pp. 569-70.
16. Rabi Y., Yee W., Chen, S.Y., and Singhal, N. Oxygen saturation trends immediately after birth. *J Pediatr.* 2006; vol. 148: pp. 590-4.
17. Goldaber KG, Gilstrap LC 3rd. Correlations between clinical events and umbilical cord blood acid-base and blood gas values. *Clin Obstet Gynecol.* 1993;36:47-59.
18. Martin GC, Gren RS, Holzman IR. Acidosis in newborns with nuchal cords and normal Apgar scores. *J Perinatol.* 2005;25: 162-5.
19. ACOG Committee on Obstetric Practice. ACOG Committee Opinion No. 348, November 2006: umbilical cord blood gas and acid-base analysis. *Obstet Gynecol.* 2006; 108:1319-22.
20. Kheir H, et al. Pattern of oxygen saturation, heart rate, respiratory rate in healthy term neonates in Khartoum state. *Journal of Basic and Applied Research International.* 2016;19(2):105-10.
21. Arikan GM, et al. Cord blood saturation in vigorous infants at birth: what is normal?. *Obstetrics & gynaecology.* 2000;Aug107(8):987-94.
22. Linhartova L, Kurtansky A, Suska P. Correlation between fetal blood oxygen saturation and umbilical pH values. *Brastil Lek Listy.* 2009;110:684-7.
23. Hulsoore R, et al. Normal oxygen saturation trends in healthy term newborns within 30 minutes of life; *Indian J Pediatr.* 2011;78(7):817-20.
24. Tiwari et al. Oxygen saturation profile in healthy term neonates in the immediate postnatal period; *Int. Clin Pediatr.* 2013;2(1):19-23.
25. Ying-Chun Lu et al. Re-evaluating reference ranges of oxygen saturation for healthy full-term neonates using pulse oximetry. *Paediatrics and Neonatology.* 2014;55:459-65.
26. Umut Zubarioglu, et al. Oxygen saturation levels during the first minutes of life in healthy term neonates; *Tohoku J. Exp. Med.* 2011 ;224:273-9.
27. Suwattanaphim S, et al. Time duration of oxygen adaptation immediately after birth; monitoring by pulse oximeter in perinatal period of the infants at Choroenkruypracha Charak Hospital; *J Med Assoc Thai.* 2015;98:656-62.
28. Ambey R, et al. Trends of oxygen saturation of newborns after birth from northern India; *Int. J Pediatr.* 2016;3(6):446-54.