Original article

Comparison of oxygen saturation between Term and Preterm Newborns delivered by normal versus cesarean route

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Abstract

Introduction: Neonates undergo major physiologic changes during transition from intrauterine to extra-uterine period. Although, this transition is smooth mostly, 5-10% needs some assistance in breathing. The indications and timing of supplemental oxygen therapy to assist the newborn in this transition has been a matter of debate. ***Objective:*** To observe the range of oxygen saturation among healthy newborns in the first 10 minutes of life and to compare those with different gestation and mode of delivery. ***Materials and Methods:*** This cross-sectional study was conducted in the Department of Obs & Gynae, BSMMU for 9 months. All healthy neonates born by normal vaginal or cesarean delivery were included. For each newborn, oxygen saturation was recorded at 1, 5, and 10 minutes after birth and every 5 minutes thereafter till readings from both these sites crossed 90% and equalized. Parents were interviewed with a specific pre-designed and pre-tested questionnaire. Collected data were analyzed by using SPSS v20. ***Results:*** A total of 300 newborn data were analyzed. Newborns who were born by cesarean delivery had lower SpO2 than infants born vaginally (p <0.001) and they took longer time to reach SpO2>85%. The median SpO2 did not reach 90% until 5 minutes of life in either group. Significant difference in oxygen saturation was also found at 1, 5 & 10 minutes of life between pre-term & and term newborns (P value <0.001). ***Conclusion:*** Oxygen saturation was low in babies who were delivered by cesarean section compared to those delivered by normal vaginal route.

Keywords: Neonate, saturation of oxygen, SpO2 measurement, Saturation in NVD.

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Introduction

A neonate undergoes major physiologic changes during the transition from intrauterine to extra-uterine period.[1] This transition is smooth in most of the babies; however, 5-10% need some assistance in breathing, while 1% require extensive resuscitation.[2-3] It always remain a debate, whether to provide supplemental oxygen to babies during this transition period.[4-6]

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Oxygen is essential for adequate cellular functioning of the body. But long-term oxygen or irrational use of oxygen both are dangerous for newborns especially for preterm. Retinopathy of prematurity (ROP) is one of the well-known complications for infants particularly those born at less than 28 weeks' postmenstrual age (PMA).[7] In the 1940s and early 1950s, oxygen was used liberally which resulted in an "epidemic" of ROP.[8] This led to excess mortality as well.[9]

The transition from fetus to newborn is a complex physiological process. During the first few minutes of life, oxygen saturation (saturation by pulse oximetry, SpO2) increases from intrapartum levels of 30-40%.[10]According to the 2010 ILCOR recommendations, resuscitation can be initiated with room air or blended oxygen but oxygen saturation should be monitored meticulously by using pulse oximeter to avoid unnecessary use of oxygen.

In healthy term babies, it is evident that, following vaginal birth at sea level, the target saturation should fall in the interquartile range of preductal saturations.[2] These recommendations are mainly for healthy term newborns in the first few minutes of life.[11-13]Preterm infants must be considered in the evaluation of oxygen use and monitoring techniques. But there is no concise data.

Many factors play an important role to achieve normal saturation after birth including: gestational age, birth weight, mode of delivery, maternal disease conditions, fetal conditions, genetic and environmental factors etc. Cesarean deliveries have increased now-a-days due to many maternal complications.[14] It has been reported that, Cesarean delivered infants usually take more time to reach a stable SpO2 than vaginally delivered newborns.All these factors vary from country to country and even in Bangladesh.

Oxygen is the most common drug used in neonates worldwide. Inappropriate supplementation of oxygen may not decrease hypoxia and may lead to hyperoxia. So, this study was aimed to observe the level of oxygen saturation in all delivered term and preterm newborns. Time to reach normal oxygen level was also noted in first few minutes of life and was compared between babies born by normal vaginal route versus cesarean route.

Materials And Methods

This was a cross sectional study conducted in the Department of Obs & Gynae, BSMMU for the period of 9 months. All healthy neonates born by normal vaginal or cesarean delivery were included. However, those neonates both term and late preterm (>34weeks) who were not anticipated for resuscitation, were also included in the study. Babies who required resuscitation or supplemental oxygen or had major congenital malformations were excluded. A total of 340 deliveries were attended. The team of investigators were not involved in the care of infants in the delivery room.

After birth, the umbilical cord was clamped immediately according to the departmental protocol and a stopwatch was started. The pulse oximeter probe was placed simultaneously on the pre-ductal site (Right hand), as recommended for faster acquisition of the values.[5] The time taken to apply the probe and to obtain the display was noted. The APGAR score assigned by the caregiver was simultaneously recorded. For each newborn, oxygen saturation was recorded at 1, 5, and 10 minutes after birth. Thereafter, every 5 minutes interval till readings from both these sites crossed 90% and equalized. We used the Masimo rad 5 pulse oximeter with signal extraction technology (SET) which provides reliable readings even in low perfusion states and with patient movement.[4] The care of the neonate was not interrupted while doing this procedure.

Later the parents were interviewed with a specific pre-designed and pre-tested questionnaire. Some information was gathered by document review such as date and time of baby's birth, birth weight, sex, gestational age as well as maternal details including mother's age, pregnancy related problems, mode of delivery, indication for cesarean etc. All collected data were cleaned, edited and analyzed with the help of software SPSS v20.

Statistical Analysis:

Quantitative data were expressed as the mean ± standard deviation and categorical data were presented as frequency. Median and Inter quartile range (IQR) of SpO2 (%) were calculated using SPSS IBM 20 software. Two tailed Mann Whitney U test was used to compare two groups.

Results

A total of 300 delivered newborns were analyzed. Out of which 180 were vaginally born and 120 were cesarean delivered. Among the 120 Caesareans, 106 were done electively whereas 14 were unplanned/ emergency.

Table 1- shows the baseline characteristics of study population where mean GA was 35.97 (29-40) weeks, mean birth weight 2367± 569 g, 71.6% were term and late preterm newborns.

The mean (SD) oxygen saturation values for term babies at 1 minute, 5 and 10 minutes after birth were found 63.66±8.13 (40 to 75), 82.9±7.24 (60 to 95) and 95.7±2.87 (65 to 98) respectively.

On average cesarean delivered newborn had lower SpO2 than infants born vaginally (p <0.001) and they took longer time to reach SpO2>85%. The median SpO2 did not reach 90% until 5 minutes of life in either group. Significant difference in oxygen saturation were also found at 1, 5 & 10 minute between pre-term & term newborn (P value <0.001).

At 1 and 5 minutes after birth SpO2 measurements of preterm vaginally delivered infants was significantly higher than cesarean delivered preterm infants (p<0.001), but at 10 minutes of life, the SpO2 of each group was not different significantly (p>0.05) (Table2).

Twenty-one babies had SpO2 less than 50% at 1 min of life, 145 had SpO2 between 60-70% while no baby had SpO2 more than 80% at 1 min of life. At 5 min of life 149 babies had saturation more than 80% while at 10 min 290 babies reached target saturation more than 90%. Spo2 measurements of term cesarean delivered infants were found significantly lower than vaginally delivered infants at all points of time (p<0.001) (Table 3). Preterm babies had lower saturation values at all points of time compared to term babies (Table 4).

Discussion

This study observed the range of oxygen saturation as well as difference between neonates born through normal vaginal versus cesarean route. Our data are comparable to other studies reporting SpO2 measurements in term infants not receiving resuscitation in the first minutes after birth.[5,15]

This study has found that during neonatal transition oxy-hemoglobin saturation does not reach 90% until approximately 10 minutes of life. Thereafter, it reaches to normal level spontaneously. It is believed that this delay in reaching normal SpO2 values is physiological, as there are residual cardiopulmonary shunts.[1]Thus, the practice of supplementing 100% oxygen based on visual interpretation of cyanosis without doing pulse oximetry could potentially lead to adverse outcome in the baby.[16] In a resource limited setting with a low staff- patient ratio as ours, it is important for us to judiciously conserve and utilize the resources for more deserving areas.

In our study, it was observed that oxygen saturation increased with time gradually; it was more in 5 minutes than in 1 minute and similarly more in 10 minutes than in 5 minutes. These findings are in agreement with other studies. This observation suggests that over correcting SpO2 values before 10 minutes, is not logical as it may cause prolonged oxidative injury.[16]

It has been shown that infants born by cesarean section have lower SpO2 values when compared with those born through vaginal delivery, and take a longer time to attain SpO2 values of more than 85%.[11] In our study, we got similar findings that, a neonate delivered through cesarean section, needed more time to reach 90% SpO2 than vaginally delivered babies. It may be noted that ILCOR guidelines make no recommendations for using different time cut offs for these differing sets of babies.[2]

None of the babies in our study, even when they had SpO2 values below 90%, were observed to have central cyanosis by the team of investigators. This finding is also consistent with other study results.[11]The skin complexion of majority of our babies did not allow an easy detection of cyanosis and higher incidence of polycythemia makes central cyanosis an unreliable index of oxygenation. Hence, we agree that routine pulse oximetry is a more reliable and objective method of monitoring newborn babies.

There are reports of SpO2 measurements in term infants just after birth but few for preterm infants. Our study supported the evidence that preterm babies have lower SpO2 compared to term babies and they take longer time to achieve normal saturation.[17] ILCOR guidelines have no separate cut off values for normal saturation depending on gestational age. Dawson and coworkers also presented reference ranges of SpO2 values for term, pre-term and extremely pre term infants.[18] Preterm infants are at most risk of oxygen toxicity.[11,19] Our percentile values for SpO2 in preterm infants after birth could assist clinicians in reducing the oxygen load when supplemental oxygen treatment is used.[20]

Conclusion:

Healthy preterm and term newborns have relatively low oxygen saturation in first few minutes of life. Babies who are delivered by cesarean section tend to have lower oxygen saturation when compared to

those delivered by normal vaginal route.

Limitations:

Small sample size and lack of randomization are the main limitations of this study.

Recommendations:

After birth all neonates should be screenedfor oxygen saturation as a routine. Unnecessary administration of oxygen also needs to be avoided in first few minutes of life in both term and preterm newborns even born by cesarean delivery.

Conflicts of interest: None

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Author's contribution:

Data gathering and idea owner of the study: Prof. M A Mannan

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Data gathering: Dr. Shahana Akter

Writing and submitting manuscript: Dr. Shahana Akter and Dr. Sharmin Afroze

Editing and approval of final draft: Dr. Sharmin Afroze, Dr. Md. Mozibur Rahman and

Dr. Nargis Ara Begum

Table 1: Newborn baseline characteristics

Characteristics	Key	Values
Gestational Age (weeks)	Mean (range)	35.97 (29-40)
Preterm (up to 34 weeks)	N (%)	85 (28.3%)
Late Preterm (> 34 weeks) & term	N (%)	215 (71.6%)
Birth Weight (grams)	Mean (SD)	2367 (569)
Vaginal delivery	N (%)	180 (60%)
LSCS Elected	N (%)	106 (35.3%)
LSCS Emergency	N (%)	14 (4.6%)
APGAR at 1 min	Median (IQR)	7 (6-7)
APGAR at 5 min	Median (IQR)	8 (8-9)

Table 2: Comparison of saturation in preterm vaginal and cesarean babies

Minutes after Birth	SPO2 (%) Preterm's Vaginal deliveries (n=49)	SPO2 (%) Preterm Cesarean deliveries (n=36)	U/z/ P value
1	64 (54-66)	52 (47-54)	353/4.7/<0.001
5	85 (80-88)	74 (70-76)	208/5.9/<0.001
10	95 (94-96)	94 (91-96)	668/1.90/>0.05

Table 3: Comparison of oxygen saturation between term vaginal and cesarean babies

Time (Minutes)	SPO2 (%) Terms Vaginal deliveries (n=131)	SPO2 (%) Term Cesarean deliveries (n=84)	U/z/ P value
1	70 (66-73)	62 (57-69)	2171/7.48/ <0.001
5	89 (85-91)	80 (78-82)	1674/3.76/<0.001
10	98 (96-98)	96 (94-97)	1579/ 3.54/ <0.001

Table 4: Comparison of oxygen saturation between term and preterm babies

Minutes after Birth	SPO2 (%) Preterm Newborns(n=85)	SPO2 (%) term & late preterm Newborns (n=215)	SPO2 (%) All newborns (n=300)	P value
1	56 (52-65)	68 (62-71)	65 (59-70)	<0.001
5	80 (74-86)	85 (80-90)	84 (78-89)	<0.001
10	95 (93-96)	97 (95-98)	96 (95-98)	<0.001

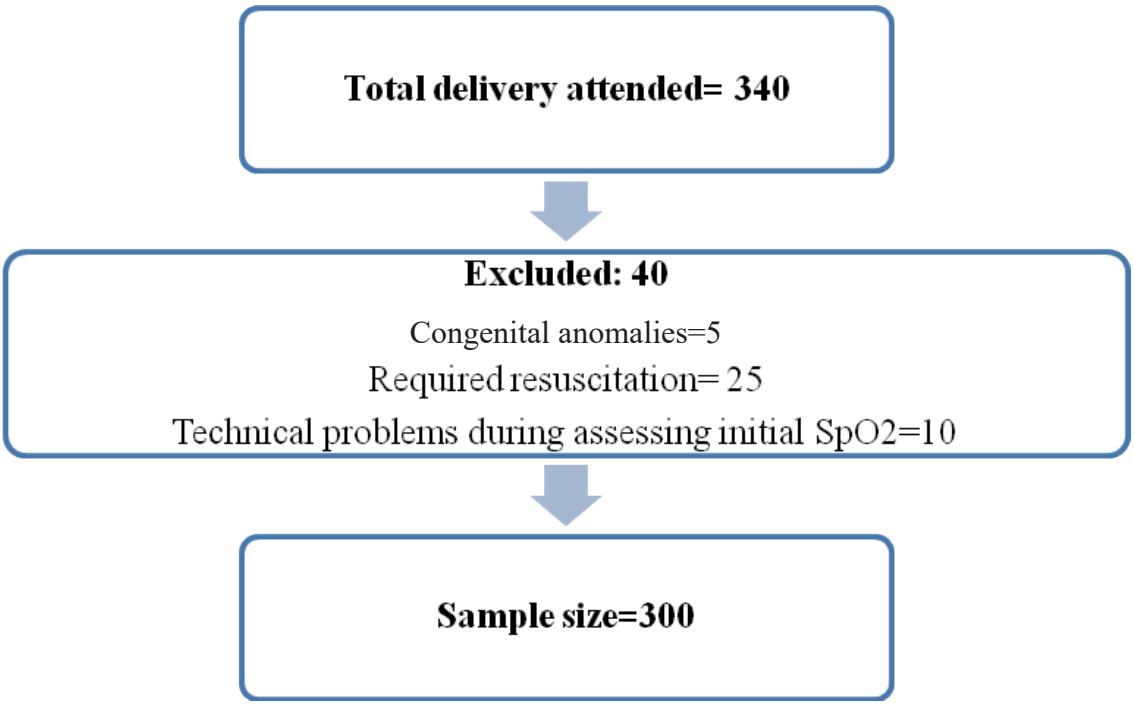

Figure-1: Study flow chart

Abbreviation:

BSMMU	Bangabandhu Sheikh Mujib Medical University
GA	Gestational Age
ILCOR	International Liaison Committee on Resuscitation
IQR	Inter Quartile Range
PMA	Post menstrual age
ROP	Retinopathy of prematurity
SpO2	Peripheral Oxygen saturation
SET	Signal Extraction Technology
SPSS	Statistical Package Software System

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