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Comparison of oxygen saturation range on the basis of mode of delivery in term new-borns: an observational study

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ABSTRACT

Background: All newborns are cyanotic immediately after birth. Gradually within next few minutes of life this saturation increases and reaches target level in approximately 10 minutes. But the saturation range differs on the basis of amount of stress a neonate develops while being delivered out of mother's womb.

Methods: A total of 215 term healthy neonates were included out of which 131 were delivered vaginally and 84 were delivered via cesarean section (elective or emergency). Relevant antenatal history was taken and noted. Pulse oximetry readings were recorded continuously by using Masimo rad 5 pulse oximeter with signal extraction technology (SET) for first 10 minutes of life in all neonates.

Results: At 1min of life spo2 of vaginal delivered babies was 70%(66% -73%) compared to cesarean delivered babies being 62%(57%-69%) with a highly significant p value (<0.001). Similarly, at 5 min the SpO2 was 89 % (85%-91%) and 80% (78%-82%) in normal vaginal delivered and cesarean section babies respectively. At 10 min of life when SpO2 measured in both groups the saturation difference was less but still significant.

Conclusions: all neonates at birth are cyanotic and have a lower saturation which increases gradually with time. Ceserian delivered neonates have a low saturation range as compared to vaginal delivered newborn.

Keywords: Cyanosis, Cesarean section, Newborns, Oxygen Saturation, Pulse oximetry, Vaginal delivery

INTRODUCTION

The health of an infant can be determined in various ways whether by outward appearance or by clinical situations that require detailed observation. Measurement of oxygen saturation can show how healthy an infant is, or it may point to a potential health problem.

Oxygen saturation is an indicator of the percentage of hemoglobin saturated with oxygen at the time of the measurement. All neonates are cyanotic at birth; the arterial oxygen tension in the normal fetus is approximately 20 mmHg, equivalent to an oxygen saturation of 60%. During the first few minutes of life,

oxygen saturation (saturation by pulse oximetry, SpO2) increases from intra partum levels of 30–40%.² Healthy newborns have relatively low oxygen saturation in the first few minutes of life. Blood oxygen concentration, measured by pulse oximetry, often is used to determine when neonatal resuscitation is required. But whether pure oxygen should be used for resuscitation still is questionable, in part because of limited normative data about normal newborn oxygen saturations. The new consensus report from ILCOR, the American Heart Association, the American Academy of Pediatrics, and the European Resuscitation Council states that initiation of resuscitation either with 100% oxygen or less oxygen even room air is a reasonable practice.¹ The new

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recommendations emphasize clinical judgment and individualized care more than before. It therefore is important to know the normal oxygen saturations after birth and to test the feasibility of using pulse oximetry soon after birth. American experts advocate a target "SpO2 of 85 to 90% by three minutes after birth for all infants except in special circumstances" e.g. diaphragmatic hernia or cyanotic congenital heart disease. International surveys show that oximetry is increasingly used during neonatal resuscitation.³⁻⁷

METHODS

This was a prospective observational study conducted in Labour room and neonatal resuscitation room of gynec operation theatre of level Ill institution Netaji Subhash Chandra Bose Medical Hospital. The resuscitation room was equipped with all necessary equipments needed for neonatal resuscitation. Total of 300 healthy newborns were taken for study which included term (>37 weeks gestational age) babies. The study was done over a period of 6 months. The study included- Inclusion criteria all the healthy newborns (term) delivered vaginally or by cesarean section who did not require any intervention or support for survival.

Exclusion criteria

Infants requiring intubation for meconium and those receiving supplemental oxygen at birth.

Pulse oximetry measurements were carried out using a probe and a Masimo rad 5 pulse oximeter with signal extraction technology (SET). The relevant antenatal history were reviewed and information on the mode of delivery, maternal age, duration of rupture of membranes and obstetric gestational age, history of pre eclampsia, ecclampsia, hypothyroidism, diabetes mellitus, maternal hypertension, jaundice were obtained. All infants were assessed at birth. Apgar score at 1minute, 5 minutes and 10 min after birth were recorded. Resuscitation protocols followed as per the NRP guidelines 25. All infants underwent nasal and oropharyngeal suctioning, but gastric suctioning was not routine. The probe of pulse oximeter was placed over the newborn's right hand or wrist as soon as possible after birth.

The pulse oximeter continuously recorded arterial oxygen saturation for 10 minutes. The maximum sensitivity setting was used because of its increased sensitivity in low perfusion states. The pulse oximeter also recorded a corresponding hexadecimal code; the values of saturation at 1minute ,5minute, and 10 minutes were recorded. Neonatal details such as date and time of birth, birth weight, sex, gestational age as well as maternal details including her age, pregnancy related problems, mode of delivery, indication for cesarean were recorded (Table 1). 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.

Table 1: Newborns characteristics.

Characteristics	Key	Values
Gestational age (weeks)	Mean (range)	35.97 (29-40)
Term (>36 weeks)	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)

RESULTS

A total of 215 newborns were included out of which 131 were delivered vaginally and 84 were delivered via LSCS. Among vaginally delivered babies about 18 neonates had SpO2 less than 60%, 93 had between 61-70%, 56 had 71 -80% but none had more than 81%. This saturation range increased to more than 80% at 5 minutes of life and at 10 min all had saturation more than 90% (Table 2).

Table 2: SPO2 levels of babies by NVD at 1, 5 and 10 min (n=131).

SpO ₂	1 min	5 min	10 min
40-50	0	0	0
51-60	18	0	0
61-70	93	0	0
71-80	56	0	0
81-90	0	109	0
91-100	0	22	131

However, in cesarean delivered neonates saturation was less than 70% in all neonates which increased to more than 70% in all newborn at 5 min but 20 had still SpO2 less than 80% during that time and all neonates achieved a saturation of more than 90% after 10 minutes of life (Table 3).

Table 3: SPO2 levels of babies by Elected LSCS at 1, 5 and 10 min (n=106).

SPO ₂	1 min	5 min	10 min
40-50	0	0	0
51-60	34	0	0
61-70	50	0	0
71-80	0	20	0
81-90	0	64	0
91-100	0	0	84

At 1 min of life vaginal delivered neonates had a higher SpO2 range as compared to those delivered via cesarean section (p value <0.001). Similarly, there was significant difference in saturation of both groups at 5 min of life (p

value <0.001). However, at 10 min of life the difference in range of saturation was not much high but was still significant (p value <0.001) (Table 4).

Table 4: Comparison of SpO2 between vaginal and cesarean deliveries.

Time (minutes)	SPO2 (%) terms vaginal deliveries (n=131)	SPO2 (%) term caesarean 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

DISCUSSION

The SpO2 is slightly lower during the first few minutes after elective caesarean section delivery. Present study results were similar to those done previously which also suggested the same. They postulated that the difference was due to the increased amount of lung fluid after caesarean section.^{2,3} Several small studies using pulse oximetry in the delivery room have documented that it takes more than 5 minutes for a newborn undergoing normal postnatal transition to attain an oxygen saturation more than 80% and almost 10 minutes to reach 90%.³⁻⁷ Present study results also explain the same.

Various studies have found that SPO2 in the first 5 minutes of life is much lower in babies delivered by cesarean section when compared to those delivered vaginally.^{8,9} Altuncu study aimed to establish the reference values of preductal SpO2 in healthy infants immediately after birth and showed that the time needed to reach a SpO2>90% was three times longer in caesarean deliveries and also that all healthy neonates have poor saturation at birth.¹⁰

Present study results were also similar to studies done previously in which it was found that the duration to reach a SpO2 >90% was longer in infants born by caesarean deliveries.

Mariani Toth B Becker et al, Gonzales GF, Salirrosas A also have similar results as found in our study that it takes 12-14 min for healthy neonates to reach an oxygen saturation of 95% pre respectively post ductal, in some cases. ¹¹⁻¹³

It would require very large randomized and blinded studies to compare the outcomes of babies having different SpO2 levels for the first 10 minutes of life. In our opinion, it is reasonable to accept that all these studies of oxygen saturations after birth define the healthy SpO2 levels for the first 10 minutes of life.

CONCLUSION

This study thus concludes that healthy newborns have relatively low oxygen saturation in the first few minutes of life and there is difference in saturation range on the basis of mode of delivery and hence oxygen should be used cautiously to achieve normal saturation. It is suggested that starting resuscitation with a low oxygen concentration and increasing the oxygen according to heart rate and colour response, and perhaps also with pulse oximetry readings.

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Institutional Ethics Committee

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