OXYGEN SATURATION TRENDS IN NEWBORN AFTER BIRTHShweta Gautam¹, Avyact Agrawal²**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: OBJECTIVE: To describe range of saturation in healthy newborn during first 10 minutes of life and their comparison on the basis of gestational age & mode of delivery. **DESIGN, SETTING AND PARTICIPANTS:** In this prospective observational study all healthy newborn (Term or Preterm) delivered normally or by caesarean section who did not require any intervention or support for survival. **RESULT:** A total of 300 newborns were analyzed. On average caesarian 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). **CONCLUSION AND RELEVANCE:** Study data show that healthy newborns have relatively low oxygen saturation is first few minute of life. Oxygen should be administered to newborn only if it is indicated clinically.

KEYWORDS: Oximetry, newborn, saturation, oxygen

INTRODUCTION: A neonate undergoes major physiologic changes during transition from intrauterine to extra-uterine period.^[1] In most of the babies this transition is smooth; however 5-10% needs some assistance in breathing, while 1% requires extensive resuscitation.^[2,3] The indications and timing of supplemental oxygen therapy to assist the newborn in this transition has been a matter of debate.^[4,5,6,7,8,9]

The 2010 ILCOR recommendations state that resuscitation can be initiated with room air or blended oxygen but it should be guided by measurement of oxygen saturation using pulse oximetry and the target saturation should fall in the interquartile range of preductal saturations measured in healthy term babies following vaginal birth at sea level.^[2] These recommendations are based on the existing data on oxygen saturation of healthy term newborns in the first few minutes of life.^[10,11,12,13,14,15,16]

Also caesarian delivered infants take more time to reach a stable SpO₂ more than 90% than vaginally delivered. Gestational age has been playing an important role to achieve normal saturation. We hypothesized that preterm neonates take more time to achieve normoxia compared to term babies. Oxygen is the most common drug used in neonatology worldwide. Inappropriate supplementation of oxygen may not decrease hypoxia or may lead to hyperoxia. So amount of oxygen needed for resuscitation is very crucial.

MATERIALS AND METHODS: This was a cross sectional study conducted in the labour room of a tertiary care hospital over a period of 6 months, from May to October 2013. All healthy neonates born by normal vaginal or caesarian delivery were included, however those who required resuscitation or supplemental oxygen or had major congenital malformations were excluded. A total of 300 deliveries were attended. The team of investigators were not involved in the care of infants in the delivery room. 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]

ORIGINAL ARTICLE

After birth, the umbilical cord was clamped immediately (As is the convention at our centre) and a stopwatch was started. The sensors were placed simultaneously on the pre ductal site (Right hand). The sensors were then connected to the oximeters, as recommended for faster acquisition of the values.^[5] The time taken to apply the sensor and to obtain the display was noted. The readings were recorded at 1, 5, and 10 minutes after birth and every 5 minutes thereafter till readings from both these sites crossed 90% and equalized. The care of the neonate was not interrupted while doing this procedure.

The APGAR score assigned by the care giver was simultaneously 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 caesarian were recorded (Table 1).

STATISTICAL ANALYSIS: A total of 340 deliveries were attended, 5 were excluded due to congenital anomalies, 25 infants needed intervention for survival and 10 were excluded as they have initial SpO₂ readings due to technical problems, Therefore, SpO₂ readings were obtained from 300 healthy newborns. Out of which 180 were vaginally born and 120 were caesarian delivered. Out of 120 Caesarians 106 were done electively whereas 14 were unplanned/emergency.

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

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

21 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%.

At all points of time spo₂ measurements of term caesarian delivered infants was significantly lower than vaginally delivered infants at term (p<0.001) (Table 3) Preterm babies had lower saturation values at all points of time compared to term babies (Table 4).

Characterstics	Key	Values
Gestational Age (weeks)	Mean (range)	35.97 (29-40)
Preterm (upto 36 weeks)	N (%)	85 (28.3%)
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)
Table 1: Newborn characteristics		

ORIGINAL ARTICLE

Minutes after Birth	SPO2 (%) Preterms Vaginal deliveries (n=49)	SPO2 (%) Preterm Caesarian 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 2: comparison of saturation in preterm vaginal and caesarian babies

Time (Minutes)	SPO2 (%) Terms Vaginal deliveries (n=131)	SPO2 (%) Term Caesarian 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 3: comparison of saturation in term vaginal and caesarian babies

Minutes after Birth	SPO2 (%) Preterm Newborns (n=85)	SPO2 (%) term Newborns (n=225)	SPO2 (%) All newborns (n=300)	P
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

Table 4: comparison of saturation in term and preterm babies

DISCUSSION: All enrolled newborns in our study had no serious complications and they survived to discharge. Our data are comparable to other studies reporting SpO2 measurements in term infants not receiving resuscitation in the first minutes after,^[8,9,10,11] birth. Our findings are consistent with those of Altuncu,^[15] who described the 10th, 25th, 50th, 75th and 95th centile range from 1-10 min newly born infants >36 weeks gestation. Our study supports the assertion that during neonatal transition oxy hemoglobin saturation does not reach 90% until approximately 10 minutes of life. 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 resulting from even a brief exposure to excess oxygen.^[6]

In a resource limited setting with a low staff- patient ratio as ours, it becomes all the more relevant to judiciously conserve and utilize the resources for more deserving areas. It is believed that this delay in reaching normal SpO2 values is physiological, as there are residual cardiopulmonary shunts ^[1]. Hence it is only logical not to actively intervene with the aim of overcorrecting SpO2 values before 10 minutes, given that there is enough evidence that excessive administration of oxygen may

ORIGINAL ARTICLE

lead to prolonged oxidative injury [6]. As a resuscitation strategy, reproducing the normal rate of increase in SpO₂ observed in healthy newborns is likely to reduce this injury.

It has been shown that infants born by caesarean 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 supported this assertion that the time taken by a neonate delivered through caesarean section, to reach 90% SpO₂ is more than vaginal 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 well below 90%, were observed to have central cyanosis by the team of investigators, a finding also supported by other studies.^[11] The skin tone of a majority of our patients does not allow an easy detection of cyanosis, and a higher incidence of polycythemia in our babies 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.

Our study also 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.^[14]

CONCLUSION: Our study is based on small data and 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.

We have developed centile charts for SpO₂ which can be used in resuscitation room. Deciding the right centile or SpO₂ to use to guide oxygen administration is a fine balance between giving oxygen to those infants who need it and not giving it to those who don't. Our aim is to prevent hypoxaemia and hyperoxia and hence the complications associated with hyperoxia and hypoxemia because both are dangerous and can produce fatal complications.

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ORIGINAL ARTICLE

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ORIGINAL ARTICLE

Graph shows the 3rd, 10th, 25th, 50th, 75th, 90th and 97th centile range for all infants who did not receive medical interventions after birth in the delivery room.

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