

Oxygen saturation trend and comparison between oxygen saturation levels in normal delivered and caserean section delivered babies within 30 minutes of life

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Abstract

Objective: To determine normal arterial oxygen saturation (SpO₂) trend during first 30 min of life and to evaluate for difference in SpO₂ trends in healthy term newborns of normal delivered (NVD) and caserean section (CS) and to determine the possible relationship between the normal levels of oxygen saturation and birth weight at 0 and 5th minute of life. **Methods:** This Prospective Cross-sectional Observational study was conducted in Department of Paediatric Medicine SMS Medical College, Jaipur. Term neonates born by NVD and elective CS were included and readings of oxygen saturation levels were obtained at an interval of 5 minutes up to 30 minutes. Secondary objective is to determine the relation of SpO₂ levels of term newborn with birth weight irrespective of mode of delivery. **Results:** Difference in values of NVD and CS neonates were statistically significant for 1st and 30th min (p- 0.001 and -0.003) respectively. SpO₂ is negatively related to birth weight. **Conclusions:** The study defines the normal SpO₂ in healthy term newborns of NVD and CS and also concludes that there is significant difference in SpO₂ levels at 1st and 30th minute of life in NVD and CS babies. In healthy term newborns, levels of SpO₂ measured at 1st and 5th minute of life are negatively related to birth weight.

Keywords: Oxygen saturation, normal vaginal delivery, caesarean section

Introduction

Transition from a foetus to newborn is a complex physiological process. Pulse oximetry is a simple, non-invasive, reliable method to assess the condition of infant immediately after birth. As respiratory failure is primary cause of mortality, the hypoxia and hyperoxia both can damage the various organs and this can be prevented if arterial oxygen saturation is monitored in normal set range.

NRP 2012 reviewed the target predicted SpO₂ levels at set timings after birth [1] The target levels are

1st min 60-65%

2nd min 65-70%

3rd min 70-75%

4th min 75-80%

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5th min 80-85%

10th min 85-95%

During the first few minutes of life, oxygen saturation (saturation by pulse oximetry, SpO₂) increases from intra partum levels of 30–40%. [2] In algorithms for neonatal resuscitation published by the International Liaison Committee for Resuscitation, [3] European Resuscitation Council and Australian Resuscitation Council, [4] clinical assessment of an infant's color (a measure of oxygenation) and heart rate are used as major action points.

O'Donnell *et al* [5] showed that the SpO₂ at which observers perceived infants to be pink varied widely, ranging from 10% to 100%. Assessing color is difficult and therefore is a poor proxy for tissue oxygenation during the first few minutes of life.

Kattwinkel [6] suggested pulse oximetry may help achieve normoxia in the delivery room. The American Heart Association [7] suggests that “administration of a variable concentration of oxygen guided by pulse oximetry may improve the ability to achieve normoxia more quickly”. Leone and Finer [8] advocate a target “SpO₂ of 85 to 90% by three minutes after birth for all infants except in special circumstances”—for example, diaphragmatic hernia or cyanotic congenital heart disease. International surveys show that oximetry is increasingly used during neonatal resuscitation [9].

Pulse oximetry measures SpO₂ continuously and non-invasively, without the need for calibration, and correlates closely with arterial oxygen saturation [10]. Pulse oximetry is based on the red and infrared light-absorption characteristics of oxygenated and deoxygenated hemoglobin. A sensor is placed around a hand or foot and two light-emitting diodes send red and infrared light through to a photo detector on the other side. The changes in absorption during the arterial pulsatile flow and non-pulsatile component of the signal are analyzed. SpO₂ is estimated from the transmission of light through the pulsatile tissue bed. With each heartbeat, there is a surge of arterial blood that momentarily increases arterial blood volume. This results in more light absorption during surges. As peaks occur with each heartbeat, heart rate can also be measured.

In early studies, investigators placed the sensor over the right Achilles tendon [11] the forefoot [12] or midfoot [13,14]. Later studies found that measurements were obtained fastest from the right hand, probably owing to better perfusion, higher blood pressure and oxygenation in preductal vessels “Preductal readings were significantly higher than postductal readings soon after birth ($p < 0.05$). By 17 min after birth, there was no longer a significant difference between preductal and postductal measurements ($p < 0.05$) [5,15].

Some studies report the range of SpO₂ at 1, 5 or 10 min others report the time taken to reach a predetermined SpO₂. These studies show increases in SpO₂ from about

Results

Below table show that SpO₂ was much lower in caesarean-section deliveries, when compared with infants delivered vaginally. The mean (standard error, SEM) SpO₂ at 1 min was 66.3% in the caesarean group and 74.5% in the vaginal delivery group ($p < 0.001$), but by 5 min there was no significant difference in the median for vaginal births.

At 5 min median was 84.4% and that for caesarean delivery was 82.65%. This postulated that the difference was due to the increased amount of lung fluid after caesarean section.

60% at 1 min, but the levels vary widely, with some infants taking >10 min to exceed 90%. Therefore, it may not be appropriate to identify specific SpO₂ levels at certain times after birth, which can be used as a trigger to alter an infant's treatment.

Aim of study was to compare the SpO₂ of healthy newborn term baby born by normal vaginal delivery and elective cesarean section using newer generation pulse oximeter during first 30 minutes of life. Secondary objective is to determine the relation of SpO₂ levels of term newborn with birth weight irrespective of mode of delivery.

Materials and Methods

Present study was conducted in the Department of Paediatric Medicine, SMS Medical College and Hospital, Jaipur. This was a cross-sectional, prospective, observational study. Subjects were newborns of mother who underwent normal vaginal delivery ($n=110$) and elective caesarean section ($n=80$) who were not under general anesthesia.

Inclusion criteria were healthy term newborns between gestational age of 37 weeks to 42 weeks, irrespective of gender difference, delivered normal vaginally or by elective caesarean. Newborns with congenital malformations, twin deliveries, retarded growth and Apgar ≤ 6 at 1 min of life who required resuscitation and oxygen supplementation were excluded. Mothers taking any treatment or with prolonged illness or with severe anemia were excluded.

SpO₂ pulse oximeter probe (Ohmeda Tru Sat pulse oximeter) was applied continuously to right palm after thorough wiping and serial recording of pre-ductal arterial oxygen saturation was carried out at intervals of 1, 5, 10, 15, 20, 25, 30 minutes. Apgar scoring was continued simultaneously along with SpO₂ recordings. After 30 minutes of study newborns were weighed. Statistical analysis with z-test was done for different mean and standard deviation and p value was derived.

Table-1: The SpO2 levels recorded at different timings in newborns of NVD and ECS.

SpO2 LEVELS	NVD		CS		P value
	MEAN	SD	MEAN	SD	
1 st min	74.5	13.8	66.35	11.37	0.001
5 th min	84.4	6.37	82.65	4.97	0.118
10 th min	89.14	5.5	87.95	7.94	0.303
15 th min	94.02	3.1	92.5	4.17	0.017
20 th min	95.87	3.73	94.17	4.05	0.017
25 th min	97	3.22	95.52	3.02	0.012
30 th min	97.4	2.44	96	2.79	0.003

Table-2: The SpO2 levels recorded according to birth weight

Weight	Total	1 st min		5 th min	
		Mean	Sd	Mean	Sd
1.5 – 2.49	35	75.96	10.9	85.56	5.95
2.5 – 3.49	131	72	12.8	83.53	6.44
3.5- 4.49	24	73	9.8	84	4.22

The above table show that Mean SpO2 was higher in newborn with low birth weight and varied from 75.96 and 85.56 at 1st and 5th minute of life in those with a birth weight of 1.5 - 2.49 kg to 72 and 83.53 at 1st and 5th minute of life in those with a birth weight above 2.49 kg.

Discussion

As the foetus becomes a neonate, a transition from placenta to lung respiration and circulatory changes occur in first few minutes of life. The Apgar score, dependant on the subjective estimation of the examiners, the umbilical arterial and venous cord pH values, and the pulse oximetry as a non-invasive method for arterial oxygen saturation measurement are only few methods for early detection of hypoxia in the delivery room.

This study was conducted with a sample size of [n=110 NVD; n=80 CS] in the city of Jaipur defines the normal arterial oxygen saturation levels (SpO2) in normal term newborns within first 30 min of life. The mean SpO2 At 1, 5, 10, 15, 20, 25 and 30 minutes among the NVD babies were 74.5%, 84.4%, 89.14%, 94.02%, 95.87%, 97%, 97.4%, while among the CS babies were 66.35%, 82.65%, 87.95%, 92.5%, 94.17%, 95.52%, 96% respectively. Values are statistically significant for 1st and 30th min (p- 0.001 and -0.003 respectively).

In our study, results demonstrates that infants born by caesarean section have modestly lower oxygen saturations and required prolonged time to reach stable oxygen saturation of 90% in immediate neonatal period as compared to a newborn born by normal vaginal delivery. This is most likely related to delayed clearance of lung fluid during operative delivery

without adequate period of labour. Similar results were obtained in a study done by Yacov et al [16] which said that infants born by caesarean delivery had a 3% lower SpO2 than infants delivered by vaginal delivery. other states infants delivered by caesarean section exhibited prolonged values in terms of time to reach SpO2 levels >90% as compared to those infants born by vaginal delivery. Ravikumar Hulsoore et al [11] stated that there is no significant difference in SpO2 among NVD and CS whereas Alet Rosvik et al [15] stated SpO2 was higher in children born by caesarean section than in those delivered vaginally.

Mean SpO2 was higher in newborn with low birth weight and varied from 75.96 and 85.56 at 1st and 5th minute of life in those with a birth weight of 1.5 - 2.49 kg to 72 and 83.53 at 1st and 5th minute of life in those with a birth weight above 2.49 kg. Similar results were obtained in study done by Alet Rosvik et al [15] which states that in healthy newborns, levels of SpO2 measured between 2 and 24 hour of life are negatively related to birth weight.

The reason for relation between birth weight and SpO2 in this study is not known. As weight increases with gestational age, differences in SpO2 could possibly be related to hemodynamic differences related to gestation age. SpO2 levels are negatively related to birth weight.

Kopotic and Lindner [17] studied 50 infants at risk for respiratory failure; 25 infants were managed without oximetry and compared with 25 managed with oximetry. Infants managed with oximetry were less likely to be admitted to the special care nursery (32% v 52%; p=0.04).

The studies by Kopotic and Deckardt, although non-blinded and non-randomised, suggest that oximetry can improve short-term outcomes—for example, admission to nursery, the use of oxygen or CPAP. We could find no reports on whether the use of SpO₂ measurements immediately after birth alters long-term outcomes.

Conflict of Interest-The author declares no conflict of interest.

Conclusion

The study concludes that there is a statistically significant difference of O₂ saturations between the neonates born by normal vaginal delivery and caesarean section at 1st and 30th minute of life.

SpO₂ levels are negatively related to birth weight.

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