International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 28-12-2022, Accepted: 14-01-2023, Published: 30-01-2023
Volume 9, Issue 1, 2023, Page No. 40-43

Oxygen saturation trends immediately after birth in healthy newborns born in a tertiary care centre

Dr. Ujwal[1*], Dr. Praveen Kumar Sindhor[2], Dr. Amrita Koti[3]
[1] Junior Resident, Department of Paediatrics, K.V.G. Medical College, Sullia, Karnataka, India
[2] Professor and Head, Department of Paediatrics, K.V.G. Medical College, Sullia, Karnataka, India
[3] Senior Resident, Department of Paediatrics, K.V.G. Medical College, Sullia, Karnataka, India

Abstract
Background: A neonate undergoes major physiologic changes during transition from intrauterine to extra-uterine period. In most of the babies this transition is smooth; however, 5- 10% needs some assistance in breathing, while 1% requires extensive resuscitation.
Objectives: 1. To determine the length of time required to reach 90% or more in preductal saturation
2. To corelate maximum oxygen saturation to the Mode of delivery, Gestational Age, Gender and Weight.
Methods: All healthy singleton full-term neonates delivered vaginally (n=50) and by caesarean section (n=50) who fall under inclusion and exclusion criteria are selected for the study. Neonates with good tone, spontaneous breathing with no need for supplemental oxygen and resuscitation are enrolled in the study. BPL SMARTSIGN S12 monitor is used to measure SpO_2. After delivery, the pulse oximeter probe was placed at the right wrist or palm (pre-ductal) of the neonates lying in the servo controlled radiant heater. The probe of the pulse oximeter was attached for at least 1 min until the highest stable level with a good waveform is registered. Data was recorded from 5 to 15 mins of life and also the time taken for oxygen saturation to reach >=90% was recorded and compared to the mode of delivery, gestational age, gender and birthweight.
Conclusion: In healthy term newly born infants, oxygen saturation rises slowly and does not usually reach 90% in the first 5 minutes of life and moreover, it was similar to the other studies reported earlier. SpO2 monitoring may help in infants requiring resuscitation to avoid overexposure to high O2 concentrations after birth. There is statistically significant difference in terms of mode of delivery and gestational age. However, a clinically insignificant statistical significance was observed with gender and with birth weight.

Keywords: oxygen saturation, term, preterm, asphyxia

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]

Although asphyxia is the most common cause of perinatal distress [4, 5], the severity of asphyxia has been difficult to quantify. Virginia Apgar's widely used evaluation of the newborn was devised in an attempt to objectively quantify the clinical manifestations of the nonspecific depressant effects of neonatal asphyxia [6]. These clinical signs are still relied upon because of the difficulty in obtaining direct measurements of oxygenation.

Introduction of pulse oximetry to assess the new-born's oxygenation status has revolutionized the world of paediatricians. Before that, assessment of new-born's colour was the sole indicator of new-born's oxygenation status and which had its own limitations [7]. In 2010, The International Liaison Committee on Resuscitation (ILCOR) has introduced the concept of pulse oximetry in place of visual assessment of colour for both term and preterm newborns in the algorithm for neonatal resuscitation. Also ILCOR has provided the reference ranges for oxygen saturation which are calculated on the basis of existing data on oxygen saturation in healthy term newborns in the first few minutes of life [8, 9].

The indications and timing of supplemental oxygen therapy to assist the newborn in this transition has been a matter of debate [10]. The percentage oxygen saturation of hemoglobin takes about 10 minutes to reach a level of more than 90%. [11] This fact is to be borne in mind while resuscitating a newborn with physiologically low oxygen saturation to avoid oxygen toxicity. The 2015 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 [11].

These recommendations are based on the existing data on oxygen saturation of healthy term newborns in the first few minutes of life. While such data exists in abundance in western world, it is lacking as far as Indian population is concerned. Also, it is still less clear whether the oxygen saturation profile could be affected by racial/ethnic variation, mode of delivery, gestational age, gender and birth weight. So it is hypothesized that these recommendations may not have a universal applicability across all populations as the values of 90% of SpO2 may not be attained in the same duration in healthy term Indian newborns, in view of the differences in ethnic, socioeconomic and health parameters of our population. Hence, we want to study the SpO2 pattern of healthy term

Indian newborns to prove or disprove the above hypothesis. We also want to correlate the above values with various variables including mode of delivery, gestational age, gender and weight.

Literature Review

Traditionally, oxygenation levels of newly born infants have been assessed clinically. However, O'Donnell *et al* [12] showed the average SpO2 value in studies in which measurements were available at 1 minute was 60% to 70%, and many infants required 10 minutes to achieve 90%. Jennifer A. Dawson *et al* [13], it required a median of 7.9 minutes (IQR: 5.0 –10.0 minutes) to reach SpO2 values of 90%. At all-time points, the median SpO2 was significantly lower for preterm infants than for term infants. Preterm infants took longer than term infants to reach each SpO2 target.

Shwetha Goutham *et al*, [14] showed on average caeserian delivered newborn had lower SpO2 than infants born vaginally (p 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).

Emel Altuncu *et al*, [15] showed the median SpO2 values in the first, fifth and tenth minutes were 71, 92, and 98% in vaginal deliveries and 70, 79, and 96% in cesarean deliveries, respectively. SpO2 was significantly lower in the cesarean group at any time after the first minute of life (p90% was three times longer in cesarean deliveries. Healthy neonates are poorly saturated immediately after birth. The duration to reach a SpO2>90% was longer in infants born by cesarean deliveries.

An influential practice change in neonatal resuscitation over the past 25 years was prompted by ILCOR consensus on science reviews comparing initiation of neonatal resuscitation in the delivery room with air or the long-standing tradition of using 100% oxygen. This was first considered for term babies in the 2005 [16] (although at that time there was insufficient evidence to make a recommendation) and again in 2010 [17] which led to the world-wide rejection of routinely exposing term newborns to 100% oxygen because of an increased risk of death, delay in onset of spontaneous breathing and oxidative damage to tissues when compared with room air. In 2010there was little evidence about the risks and benefits of 100% oxygen for resuscitation of preterm infants; however, over the next 5 years evidence also demonstrated no benefits for preterm newborns.

By 2015 the ILCOR CoSTR concluded that for preterm infants, resuscitation should be initiated with low concentrations of oxygen and titrated with a blender to meet minute by minute oxygen saturation goals using pulse oximetry[18]. The mandate to monitor and titrate oxygen introduced additional neonatal equipment of oxygen blenders and pulse oximetry into delivery and operating rooms throughout the world.

About 5 to 10% of infants need resuscitation at birth. Many experts recommend that these babies be resuscitated with 100% oxygen, but other experts think that normal room air is as good as or better than 100% oxygen. Too much oxygen can make breathing difficult for babies and can cause other problems such as problems with brain development, an eye condition (retinopathy of prematurity), and a lung condition (bronchopulmonary dysplasia). The authors of the Cochrane review questioned whether resuscitation with room air resulted in fewer deaths or disabilities than 100% oxygen.

For term and late preterm newborns (≥ 35 weeks gestation) receiving respiratory support at birth, we suggest starting with 21% oxygen (weak recommendation, low certainty evidence). We recommend against starting with 100% oxygen (strong recommendation, low certainty evidence). For the critical outcome of all cause short-term mortality (in-hospital or 30 days), the evidence of low certainty (downgraded for risk of bias and imprecision) from 7 RCTs (and quasi RCTs) involving 1469 term and late preterm newborns (≥ 35 weeks gestation) receiving respiratory support at birth showed benefit of starting with 21% compared to 100% oxygen (RR=0.73 95% CI 0.57-0.94, I^2=0%); 46/1000 fewer babies died when respiratory support at birth was started with 21% compared to 100% oxygen [95% CI: 73/1000 fewer to 10/1000 fewer].

Materials & Methods

After taking informed consent from parent / guardian, healthy singleton full-term neonates delivered vaginally (n=50) and by caesarean section (n=50) who fall under inclusion and exclusion criteria were selected for the study. Neonates with good tone, spontaneous breathing with no need for supplemental oxygen and resuscitation were enrolled in the study. Relevant data of mother, mode of delivery and details of the newborn were recorded. Gestational age was determined by Modified Ballard's score. BPL SMARTSIGN S12 monitor (which uses Photoelectric Oxyhemoglobin Inspection Technology combining Capacity Pulse Scanning & Recording Technology for SpO2) was used to measure SpO2. After delivery, the pulse oximeter probe was placed at the right wrist or palm (pre-ductal) of the neonates lying in the servo controlled radiant heater.

The probe of the pulse oximeter will be attached for at least 1 min until the highest stable level with a good waveform is registered. Data was recorded from 5 to 15 mins of life and also the time taken for oxygen saturation to reach >=90% was recorded and compared to the mode of delivery, gestational age, gender and birthweight.

Inclusion criteria

A. Singleton neonates with Normal APGAR.
B. Full term with Gestational Age>=37weeks & <=42weeks.
C. Birth weight > 2500 grams & < 4000 grams.
D. Delivered by uncomplicated Vaginal as well as Caesarean section.

Exclusion criteria

1. Babies born through Vacuum or Forceps assisted delivery.
2. Rupture of membranes > 18hours.
3. Meconium-Stained Amniotic Fluid.
4. Babies requiring active resuscitation and supplemental oxygen.
5. Major congenital anomalies.
6. Caesarean Sections done under General Anesthesia.
7. Deliveries where sedating analgesics and /or other sedation is used.
8. Newborns affected by the complications of placenta, cord and membranes of pregnancy.

Statistical Analysis

All the data was put on Microsoft excel file and further analyzed using SPSS software version 21. The variables are summarized as percentages, frequencies, mean standard deviation. Paired student t test is applied and analyzed.

Result

Among the study subjects, mean time taken to reach 90% saturation in minutes was 6.63 (Table 1). Among the subjects, 45(45%) were gestational aged between 39to 40 weeks, 44(44%) were gestational aged between 37 to 38 weeks and 11 (11%) were gestational aged between 41 to 42 weeks. Mean and Standard deviation of gestational age were 38.72 (1.37). maximum number of gestational weeks were 42 and minimum number of gestational weeks were 37.

Table 1: Demographic Details of the Study

Demographic Data					
	N	Minimum	Maximum	Mean	Std. Deviation
Gestational age	100	37.00	42.00	38.72	1.37
Birth weight	100	2.50	3.71	2.91	.31
Time at 90% saturation minutes	100	4	9	6.63	1.41
SpO_2 at 5 minutes	100	71.00	92.00	83.65	5.69
SpO_2 at 10 minutes	100	90.00	95.00	93.05	1.72
SpO_2 at 15 minutes	100	95.00	100.00	97.5	1.60
Valid N (listwise)	100				

Time at 90% oxygen saturation in minutes vaginal delivery group was 5.39 ±0.22, Caesarian delivery group oxygen saturation is increasing 7.87±0.706. On applying the independent t- test to find the mean difference between each group was 2.48 there was statistically significant ($p<0.05$). (Table 2)

Table 2: Comparison of Mode of Delivery with Oxygen Saturation

Oxygen saturation	Mode of delivery	Mean	S. D	Mean Difference	t-test	p-value
Time at 90% saturation in min	Vaginal delivery	5.39	.622	2.48	18.69	0.000
	Cesarian delivery	7.87	.706			

Time at 90% oxygen saturation in minutes 37 to 40 gestational weeks was 6.50 ±1.40, more than 40 weeks of gestational was oxygen saturation is increasing 7.71±1.0. On applying the independent t- test to find the mean difference between each group was 1.12 there was statistically significant ($p<0.05$). (Table 3)

Table 3: Comparison of Gestational age with Oxygen Saturation

Oxygen saturation	Gestational age	Mean	S. D	Mean Difference	t-test	p-value
Time at 90% saturation in min	37 to 40 Weeks	6.50	1.40	1.21	2.76	0.007
	>40 Weeks	7.71	1.00			

Time at 90% saturation (minutes) birth weight of less than 3 kgs neonatal was 6.45±1.4, more than or equal to 3 kg neonatal birth weight oxygen saturation is increasing 6.98±1.2. On applying the independent t- test to find the mean difference between each group was 0.53 there was no statistically significant (p=0.0078). (Table 4)

Table 4: Comparison of Birth Weight with Oxygen Saturation

Oxygen saturation	Birth weight	Mean	S. D	Mean difference	t-test	p-value
Time at 90% saturation in min	<3 kg	6.45	1.4	0.53	1.815	0.078
	≥3 kg	6.98	1.2			

Time at 90% oxygen saturation in minutes male group was 6.49 ±1.12, female group oxygen saturation is increasing 6.78±1.6. On applying the independent t- test to find the mean difference between the both group was 0.29 there was no statistically significant (p=0.300). (Table 5)

Table 5: Comparison of Gender with Time At 90% Saturation

Oxygen saturation	Gender	Mean	S. D	Mean Difference	t-test	p-value
Time at 90% saturation in min	Male	6.49	1.12	0.29	1.04	0.300
	Female	6.78	1.6			

Discussion

In the first minutes of life, major physiological adjustments occur as the fetus becomes a neonate. During this period, the neonate is in a precarious position with regard to tissue oxygen delivery. The combination of persistent right to left shunt at the arterial level, bi-directional shunting through the ductus arteriosus, and ventilation-perfusion mismatching all provide for limited oxygen reserve. Early detection of hypoxia is, therefore, the most important aspect of neonate evaluation in the delivery room.

This is a cross sectional observational study including 100 newborns born in KVG medical college and hospital during the period 2021 – 2022 and after taking informed consent from parent / guardian, healthy singleton full-term neonates delivered vaginally (n=50) and by caesarean section (n=50) who fall under inclusion and exclusion criteria were selected for the study. Neonates with good tone, spontaneous breathing with no need for supplemental oxygen and resuscitation were enrolled in the study. Relevant data of mother, mode of delivery and details of the newborn were recorded. Gestational age was determined by Modified Ballard’s score. BPL SMARTSIGN S12 monitor (which uses Photoelectric Oxyhemoglobin Inspection Technology combining Capacity Pulse Scanning & Recording Technology for SpO2) was used to measure SpO2. After delivery, the pulse oximeter probe was placed at the right wrist or palm (pre-ductal) of the neonates lying in the servo controlled radiant heater.

Our findings are consistent with those of Altuncu, [19] from 1-10 min newly born infants >36 weeks gestation. 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]. It is believed that this delay in reaching normal SpO2 values is physiological, as there are residual cardiopulmonary shunts. 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 lead to prolonged oxidative injury. As a resuscitation strategy, reproducing the normal rate of increase in SpO2 observed in healthy newborns is likely to reduce this injury.

In our study, we supported the 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. It has been shown in a study 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%.

In our study, we observed that the time at 90% oxygen saturation in male group and female group was indifferent with no statistical significance. We also observed that time at 90% saturation in different gestational ages were statistically significant being babies born at 37-40 wks. took less time to reach maximum 02 concentration that babies born 40-42 weeks. ILCOR guidelines have no separate cut off values for normal saturation depending on gestational age. Dawson and co-workers also presented reference ranges of SpO2 values for term, pre term and extremely pre term infants.

We also observed that there was no statistical significance in the time taken to reach 90% saturation in different birth weights of the babies. 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. 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 new-born babies

Conclusion

In healthy term newly born infants, oxygen saturation rises slowly and does not usually reach 90% in the first 5 minutes of life and it took a mean time of 6.63 minutes to reach 90% oxygen saturation in our study moreover, it was similar to the other studies reported earlier. SpO2 monitoring may help in infants requiring resuscitation to avoid overexposure to high O2 concentrations immediately after birth. There is statistically significant difference in terms of mode of delivery and gestational age. However, a clinically insignificant statistical significance was observed with gender and with birth weight.

Acknowledgement: None

Conflict of Interest: None

Source of Funding: None

Ethical Approval: Approved

References

1. Baldwin HS, Dees E. Embryology and physiology of cardiovascular system. In: Avery's Diseases of the Newborn 9th ed. Philadelphia: Elsevier Saunders,2012:699-713.
2. Kattwinkel J, Perlman JM, Aziz K, Colby C, Fairchild K, Gallagher J *et al*. Part 15: neonatal resuscitation: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation,2010:122(18 Suppl 3):S909-919.
3. Perlman JM, Risser R. Cardiopulmonary resuscitation in the delivery room. Associated clinical events. Arch PediatrAdolesc Med.,1995:149(1):20-25.
4. Walsh LA, Clarke TA. Stabilization of the newborn. In: Ziai M, Clarke TA, Merritt TA, eds. Assessment of the newborn. Boston: Little, Brown, 1984, 20-31.
5. Welch KA, Philips JB III. Management of the depressed newborn. Clin Obstet Gynecol.,1984:27:125-133.
6. Apgar V. A proposal for a new method of evaluation of the newborn infant. Curr Res Anesth Analg.,1953:32:260-267.
7. O'Donnell CP, Kamlin CO, Davis PG, Carlin JB, Morley CJ. Clinical assessment of infant colour at delivery. Arch Dis Child Fetal Neonatal Ed.,2007:92(6):F465-7.
8. Perlman JM, Wyllie J, Kattwinkel J, Atkins DL, Chameides L, Goldsmith JP *et al*. Neonatal Resuscitation: International Consensus on Cardiopulmonary Resuscitation and Emergency cardiovascular Care Science with Treatment recommendations. Pediatrics,2010:126(5):1319-1344.
9. Kattwinkel J, Perlman JM, Aziz K, Colby C, Fairchild K, Gallagher J, Hazinski MF *et al*. Part 15: neonatal resuscitation:2010 American Heart association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation,2010:122:(18Suppl3):909-919.
10. Toth B, Becker A, Seelbach-Gobel B. Oxygen saturation in healthy newborn infants immediately after birth measured by pulse oximetry. Arch Gynecol Obstet.,2002:266(2):105-107.
11. Wyckoff MH, Aziz K, Escobedo MB, Kapadia VS, Kattwinkel J, Perlman JM *et al*. Part 13: neonatal resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation,2015:132(2):S543–S560
12. O'Donnell CP, Kamlin CO, Davis PG, Carlin JB, Morley CJ. Clinical assessment of infant colour at delivery. Arch Dis Child Fetal Neonatal Ed.,2007:92(6):F465–F467.
13. Dawson *et al*, Defining the Reference Range for Oxygen Saturation for Infants After Birth.
14. Gautam S, Agrawal A. Oxygen saturation trends in newborn after birth. Journal of Evolution of Medical and Dental Sciences,2015:4(63):11037-43.
15. Altuncu E, Özek E, Bilgen H, Topuzoglu A, Kavuncuoglu S. Percentiles of oxygen saturations in healthy term newborns in the first minutes of life. European journal of pediatrics,2008:167(6):687-8.
16. International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Part 7: Neonatal Resuscitation. Resuscitation,2005:67:293-303.
17. Wyllie J, Perlman JM, Kattwinkel J *et al*. Part 11: Neonatal Resuscitation: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation,2010:81:e260-87.
18. Wyllie J, Perlman JM, Kattwinkel J *et al*. Part 7: Neonatal Resuscitation: International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation,2015:95:e169-201.
19. Porter KB. Evaluation of arterial oxygen saturation of the newborn in the labor and delivery suite. J Perinatol,1987:7:337-9.