

STUDY OF PRE-DUCTAL AND POST-DUCTAL OXYGEN SATURATION LEVELS IN HEALTHY LATE PRETERMS IN FIRST TEN MINUTES OF LIFE

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Abstract

Background: This study is to determine the pre-ductal and post-ductal oxygen saturation levels in healthy late preterm neonates in first ten minutes on life.

Method: Healthy late preterm newborns between 34weeks to 37 weeks, who do not require any resuscitation measures were included in the study. Continuous recording was done using pulse oximetry in first ten minutes of life.

Result: Out of the 71 babies, 39 (54.9%) were male babies and 32 (45.1%) were female babies, out of which 38 (55%) was delivered via normal vaginal delivery and 32 (45%) was via LSCS. Preductal target oxygen saturation level was achieved faster when compared to postductal oxygen saturation levels. Both preductal and postductal oxygen saturation levels is significantly lower in babies delivered via LSCS.

Conclusion: All newborns, especially preterm infants, should be resuscitated using low oxygen concentrations. Additionally neo-natal resuscitation stages be determined based on clinical findings as well as oxygen saturation monitoring. Pulse oximetry screening in all newborns at time of birth helps in detecting various underlying congenital heart diseases and other causes of respiratory distress.

Keywords: late preterm, pulse oximetry, oxygen saturation, neonatal resuscitation.

Introduction

Healthy newborns undergoing normal transition usually take several minutes to increase their blood oxygen saturation from approximately 60%, which is the normal intrauterine state, to more than 90%, which is the eventual state of air-breathing healthy newborns. Ventilation of the newborn's lungs is the single most important and effective step in neonatal resuscitation. Approximately 10% of healthy infants, even higher rates of premature infants require some form of resuscitation at birth. In preterm infants immaturity of the thoracic cage and weak respiratory muscles affect extrusion of alveolar fluids to the interstitium which subsequently hinders lung aeration. Preterm infants are predisposed to respiratory insufficiency in the first minutes after birth and frequently need respiratory support in the delivery room. The Neonatal Resuscitation Program (NRP) recommends targeted pulse oxygen saturation (SpO₂) levels for only term neonates. However, data on changes in SpO₂ in preterm infants are very limited and are not included in the NRP. The expected oxygen saturation levels are slightly lower for preterm

neonates compared with term neonates and for neonates delivered via cesarean compared with those delivered vaginally. Oxygen saturation levels measured in pre-ductal sites are 5-10 % higher than those measured in post-ductal sites for 10-15mins of life. Worldwide, one of the most common causes of neonatal death is preterm birth and its related complications. The European Consensus guidelines state, target oxygen saturation for preterm babies to be between 90% - 94%. At birth, placental gas exchange is substituted by breathing of newborn. The PaO₂ will rise from 25-30mmHg to 75-85mmHg. Preterm infants have poor antioxidant defence mechanisms which increases their susceptibility to oxidative stress with long term effects. Oxidant injury can lead to acute conditions such as intracranial haemorrhage, bronchopulmonary dysplasia or retinopathy of prematurity. The antioxidant enzyme defences mature during late gestation, which parallels the maturity of pulmonary surfactants with significant amount of Super Oxide Dismutase (SOD), catalase, which prevents surfactant inactivation by free radicals. In 2010, the international liaison committee on resuscitation (ILCOR) recommends that resuscitation can be initiated with room air or blended oxygen but should be guided by measurement of SpO₂, using pulse oximetry. Pulse oximeter uses a light source and sensor to measure the absorption of red light passing through capillaries in the skin and estimates percentage of haemoglobin that is carrying oxygen. Pre-ductal saturation is measured by placing the pulse oximeter in the right hand or wrist. Post-ductal saturation is measured by placing the pulse oximeter over both the lower limbs.

Methodology:

Study design: Comparative cross-sectional study

Study duration: 11 months from June 2021 to May 2022

Study population: 71 healthy late preterm newborns getting delivered in Meenakshi medical college Hospital.

Study area: Labour ward, Operation Theatre and NICU in the Department of Paediatrics, Meenakshi medical college Hospital and Research Institute, Kanchipuram.

Sampling method: convenience sampling

Inclusion criteria: healthy late preterm newborns between (34-37 weeks) both male and female babies, APGAR score >7 in 1st and 5th minute, any mode of delivery.

Exclusion criteria: early preterms <34weeks, terms (37-42 weeks) post terms >42weeks, multiple pregnancies, birth asphyxia and trauma, major congenital malformations, MSL, PROM, babies requiring resuscitative measures.

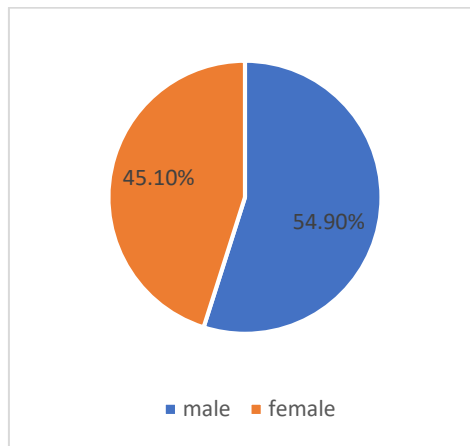
Data collection: 1 pulse oximeter (CMS 500) is placed at the right wrist or palm and 1 more is placed at the left foot lying in server controlled radiant warmer. 1st minute reading is noted and subsequently 2nd, 3rd, 4th, 5th and 10th minute readings are recorded with protocol included criteria.

Statistical analysis: The data collected were entered in MS Excel and analyzed using SPSS 22 version. Categorical determinant variables were given as proportions. The continuous variables were given in mean with S.D. The ANOVA was used to compare the means of SpO₂ between gender, mode of delivery and term.

Results:

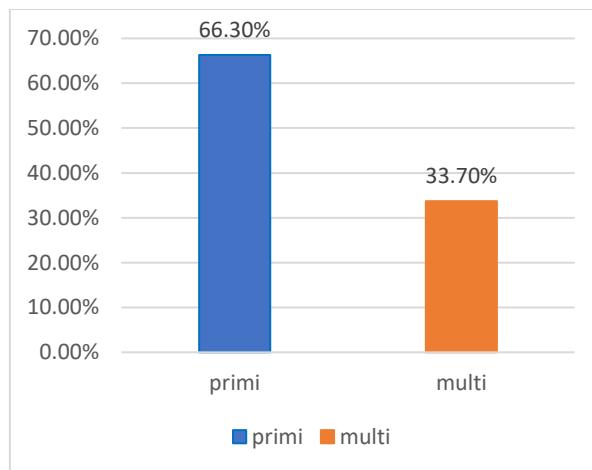
In figure 1, Out of the 71 babies, 39 (54.9%) were male babies and 32 (45.1%) were female babies.

Figure 1: Gender distribution



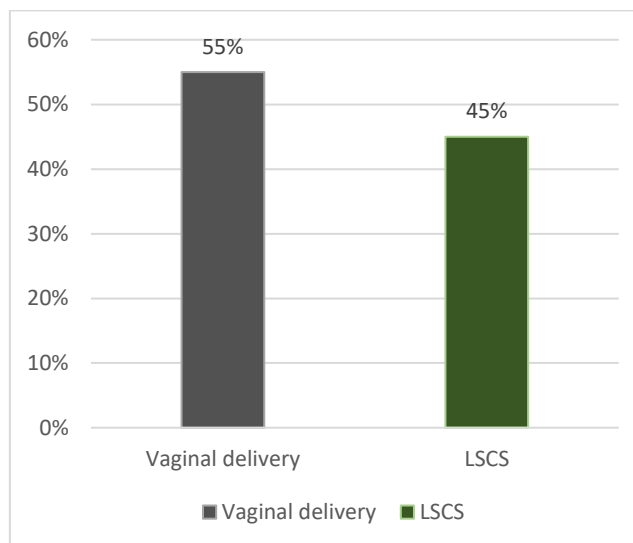
In figure 2, 66.3% of the mothers were primi and 33.7% were multiparous.

Figure 2: parity of mothers



In figure 3, 38 (55%) was delivered via normal vaginal delivery and 32 (45%) was via LSCS.

Figure 3: Mode of delivery



Post-ductal saturation levels is significantly lower at 1 min, 2 min, 3 min, 4 min, 5 min and 10 min, depicted in table 1.

Table 1: Comparison of pre-ductal and post-ductal SpO₂ levels in first 10 minutes of life

Spo2 at	Pre-ductal	Post-ductal	p value
1 min	68.4+/-1.6	61.7+/-1.53	<0.001
2 min	70.4+/-1.6	63.7+/-1.53	<0.001
3 min	73.6+/-1.38	70.5+/-1.19	<0.001
4 min	77.1+/-1.34	74.05+/-1.19	<0.001
5 min	85.1+/-1.64	82.1+/-1.51	<0.001
10 min	91.5+/-1.46	89.8+/-1.46	<0.001

The mean preductal SPO₂ is significantly lower in babies delivered by LSCS when compared to babies born by vaginal delivery at all time of measurement. Given in table 2.

Table 2: Preductal SPO₂ vs mode of delivery

Pre-ductal SPO ₂ LEVEL							
Mode of delivery		1 min	2 min	3 min	4 min	5 min	10 min
LSCS	Mean	69.38	71.38	74.4	77.45	84.47	90.10
	S.D	1.67	1.67	1.57	1.57	1.57	2.28
VAGINAL DELIVERY	Mean	69.94	72.94	75.95	79.0	86.28	92.4
	S.D	1.32	1.30	1.08	.82	.80	1.02
p value		<0.001	<0.001	<0.001	<0.001	<0.001	0.199

The mean postductal SPO₂ is significantly lower in babies delivered by LSCS when compared to babies born by vaginal delivery at all time of measurement, given in table 3

Table 3: Postductal SPO₂ vs mode of delivery

Mode of delivery		SPO ₂ LEVEL					
		1 min	2 min	3 min	4 min	5 min	10 min
LSCS	Mean	66.38	68.38	71.45	74.45	81.47	89.30
	S.D	1.67	1.67	1.57	1.57	1.57	.866
VAGINAL DELIVERY	Mean	67.93	69.93	72.93	76.04	83.27	91.43
	S.D	1.327	1.327	1.30	1.08	.80	1.243

p value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
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Discussion:

A total of 71 babies were included in the study which satisfied the inclusion criteria. Out of the 71 babies, 39 (54.9%) were male babies and 32 (45.1%) were female babies. According to Vento et al, preterm female newborns reached target SpO₂ sooner compared to male babies. But in our study, there is no significance among gender to reach target SpO₂ level of 90% or above. Mean age of the mother was 24 years (74.4%). 66.3% of the mothers were primi and 33.7% were multiparous. In our study, on comparing the preductal and postductal SPO₂ level at 1,2,3,4,5 and 10 min in above table, the mean preductal SPO₂ is significantly higher than post ductal SPO₂ and the results are statistically significant by ANOVA test. Preductal SpO₂ levels were lower in preterm babies born by LSCS when compared to vaginal delivery. Postductal SpO₂ levels were also lower in babies delivered via LSCS when compared to normal vaginal delivery. The reason for delay in reaching target SpO₂ levels of 90% or above is secondary to delayed clearance of lung fluid. Other factors such as maternal smoking is associated with preterm delivery and according Schneider et al, infants of non-smoking mothers were compared with smoking exposed mothers during pregnancy, showed target SpO₂ levels are adversely affected. Other factors that affect target SpO₂ levels include location of probe, umbilical artery blood gas values, gestational week. According to recent research, all newborns, especially preterm infants, should be resuscitated using low oxygen concentrations. In addition, published algorithms suggest that neo-natal resuscitation stages be determined based on clinical findings as well as oxygen saturation monitoring.

Conclusion:

In conclusion, in preductal measurements, the time necessary to obtain SpO₂ levels above 90% was longer. In neonates born by caesarean section, reaching a 90 percent SpO₂ level took longer both preductally and postductally. The measurement site and mode of delivery must be taken into consideration for O₂ saturation measurement in healthy newborns.

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Conflict of interest: no conflict of interest.

Ethical approval & informed consent: this study was approved by the Institutional Ethics Committee

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