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# Assessment and evaluation of pulse oximetry in Newborns

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***Abstract:***
***Introduction:*** *Oxygen is essential for adequate cellular functioning and highly specialized systems have developed to maintain a delicate balance during conditions of relatively low to high levels of oxygen availability. However, despite such sophisticated controls prolonged or severe exposures to both excessively low and high oxygen levels may lead to tissue damage. Recent studies have suggested that SpO2 measured during the first hours of life may be an effective screening tool for congenital heart disease as well as detecting the early onset ofsepsis. If the measurement of SpO2 is performed as a routine in newborns, we can assess the normal variation of SpO2 during the first day of life. Present study was conducted to study the influence of birth weight, gestational age, mode of delivery and gender on levels of SpO2 in healthy newborn.*

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## I. Introduction

Oxygen is essential for adequate cellular functioning and highly specialized systems have developed to maintain a delicate balance during conditions of relatively low to high levels of oxygen availability. However, despite such sophisticated controls prolonged or severe exposures to both excessively low and high oxygen levels may lead to tissue damage. The fetus normally exists in an environment of relatively low oxygen exposure and the mechanisms for managing high oxygen levels are not yet completely developed [2]. Several studies evaluated the normal reference values for SpO2 during the first 24 h of life. During this period newborn infants adapt their circulation to extrauterinelife, there is transition from fetal to neonatal, After which there is initial increase in SpO2 during the firstminutes of life, SpO2 seems to be stable until 20–24 h of life [3,8,9]. Most studies find that mean SpO2 is about 97–98%, with the normal range from 94 to 100% [6]. However, SpO2 is lower in children born at high altitude [4]. Recent studies have suggested that SpO2 measured during the first hours of life may be an effective screening tool for congenital heart disease [7,10], as well as detecting the early onset of sepsis.

If the measurement of SpO2 is performed as a routine in newborns, we can assess the normal variation of SpO2 during thefirst day of life. Several perinatal factors such as birth weight, gestational age (GA), gender or mode of delivery could influence the levels of SpO2 in newborns. There are many studies having large data base also confirm that these variables correlate with the levels of SpO2 during the first 24 h of life.The objective of the present study was to include birth weight, GA, mode of delivery and gender, to analyze if these variables have any influence on levels of SpO2 in healthy newborns.

## II. Materials & Methods

A hospital based prospective observational study was conducted at a tertiary care hospital. All 212 consecutive patients satisfying the inclusion criteria were taken in the study after informed consent. SpO2 was measured postductally (foot) by the pulse oximeter RAD-5v at birth and after 24 hours. The value of SpO2 as well as gender, birth weight, mode of delivery, gestational age and the time of measurement (hours after delivery) were noted and analysed. Data was analysed using statistical software SPSS ver. 21.

## III. Observation

Mean saturation at birth and after 24 hours was 62.1% and 98% respectively. A significantly low oxygen saturation at birth was seen in babies delivered by caesarean section as compared to normal delivery (53.8% vs 66.6%; $p<0.01$). No difference was observed in mean saturation levels at birth and at 24 hours with respect to gender, gestational age and birth weight ($p>0.05$). A significant correlation was observed between oxygen saturation at 24 hours and cord haemoglobin (p-0.24; $p<0.01$).

## IV. Discussion

Our data are comparable to other studies reporting SpO2 measurements in term infants not receiving resuscitation in the first minutes after birth [9-14]. Our study supports the assertion that during neonatal transition oxy hemoglobin saturation does not reach 90% until approximately 5 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 [15].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 [16]. Hence it is only logical not to actively intervene with the aim of overcorrecting SpO2 values until required, given that there is enough evidence that excessive administration of oxygen may lead to prolonged oxidative injury [15]. As a resuscitation strategy, reproducing the normal rate of increase in SpO2 observed in healthy newborns is likely to reduce this injury.

**Oxygen Saturation**

In present study, mean oxygen saturation at birth and after 24 hours was 62.1% and 98% respectively. Hulsoore et al. determined the normal arterial oxygen saturation (Spo2) trend during first 30 min of life. The mean SpO(2) at 1, 5, 10, 15, 20, 25 and 30 min were approx.

65.5%, 77%, 87.2%, 90.8%, 91.43%, 91.78% and 93%, respectively [17]. In a study by Kamlin CO et al. the median (interquartile range) SpO2 at 1 minute was 63% (53%-68%) in healthy infants. There was a gradual rise in SpO2 with time, with a median SpO2 at 5 minutes of 90% (79%-91%) [18]. Similarly, in a study by Lu YC et al. median SpO2 was 67% and 89% at the 1st and 4th minute, respectively. On average, SpO2 values reached >90% at the 5th minute [19]. Gautam S et al. observed the mean (SD) oxygen saturation values for term babies at 1 minute, 5 and 10 minutes after birth as 63.66 ± 8.13 (40 to 75), 82.9±7.24 (60 to 95) and 95.7±2.87 (65 to 98) respectively [20]. It has been shown by various studies that SpO2 rises during the first minutes of life to reach stable levels within few minutes [16,18]. O'Brien et al. found that levels of SpO2 were stable after 20–24 hour of age [21]. Levesque et al. found a slight increase in SpO2 from admission to the nursery to 24 h postnatally [22].

**Oxygen saturation and Mode of Delivery**

In present study, significantly low oxygen saturation at birth was seen in babies delivered by caesarean section as compared to normal delivery (53.8% vs 66.6%; $p<0.01$). While no difference was observed in levels of oxygen saturation at 24 hours (98% vs 97.96%). Various studies has demonstrated that children born by cesarean section have lower levels of SpO2 during the first minutes of life. This is probably due to increased amount of lung fluid [12,20]. However, this difference was equalized within a few minutes [23,24]. Our results demonstrate that increased lung fluid after cesarean section does not led to persistent lower levels of SpO2 and saturation levels reach the same levels to those delivered vaginallywithin one hour after delivery. Shweta S et al. in their study conclude 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% [20]. Lu YC et al. observed no statistical differences in the SpO2 values between the cesarean and vaginal delivery groups after 5 minutes; however, a trend of higher SpO2 was observed in the vaginal group [19]. Swattanaphim et al. in a study on 553 infants born in CharoenkrungPracharakHospital, Bangkok, Thailand concluded that babies born via cesarean route takes significantly longer time than the vaginal route to achieve SpO2 ≥ 90% [25]. HoweverHulsoore et al. observed no statistical differences in the SpO2 values between the CS and NVD groups from birth [17]. Similar results were also observed by Holt A et al. and Shah PS et al [26,27].

**Oxygen Saturation and Other factors**

In present study, no significant difference was observed in mean saturation levels at birth with respect to gestation age, birth weight and gender of baby ($p> 0.05$). In a similar study by Holt A et al., 321 health infants were studied. Daat analysis revealed no statisticallysignificant difference was noted with respect to gestation age, birth weight and gender of baby for oxygen saturation [26]. Shah et al. also observed no association of oxygen saturation with gender but lower gestation birth weight were associated with higher time at SpO2 </= 90% [27]. Rosvik et al. in a similar study observed no relationship between SpO2 and gestational age or gender, but levels of SpO2 measured between 2 and 24 h of life were negatively related to birth weight. However, the variation was within a small range and probably has few implications for the routine use of SpO2 in newborns [28].

**Oxygen Saturation and Cord Blood Hemoglobin**

In present study a significant association was observed between oxygen saturation at 24 hours and cord haemoglobin (p-0.24; p<0.01). A study was conducted by Mahato et al. to
determine the influence of maternal and fetal factors on levels of SpO2 in healthy newborns. A significant correlation of cord blood hemoglobin with SpO2 was noted in both vaginal and cesarean births, respectively [29]. In a study Lakshminrusimha S et al. also observed similar results with higher hemoglobin concentration results in higher arterial oxygen content [30].

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