Oxygen Saturation Levels in Normal Healthy Term Neonates: Normal Vaginal Birth vs. Elective Cesarean Delivery

Thesis

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List of Contents

List of Tables

List of Figures

Fig. No.	Title	Page No.

List of Abbreviations

Abb.	Full term
AHA	*American Heart Association*
CBF	*Cerebral Blood Flow*
CI	*Confidence interval*
CPAP	*Continuous Positive Airway Pressure*
CT	*Computed Tomography*
ERC	*European Resuscitation Council*
ILCOR	*International Liaison Committee on Resuscitation*
IQR	*Interquartile Range*
IUGR	*Intrauterine Growth Retardation*
IUPC	*Internal Uterine Pressure Catheter*
MVU	*Montevideo Unit*
NIRS	*Near-Infrared Spectroscopy*
OA	*Occiput Anterior*
OP	*Occiput Posterior*
OR	*Odds Ratio*
OT	*Occiput Transverse*
PAIS	*Perinatal Arterial Ischemic Stroke*
ROA	*Right Occiput Anterior*
SpO2	*Oxygen Saturation*

ABSTRACT

Background: Annually all over the globe, ranging from 5% to10% of neonates need medical resuscitative efforts. Recently, there is solid clinical evidence that pointless oxygen therapy during the beginning of the process of resuscitation could have negative impact due to oxygen free radicals causing pathophysiological pathways development in neonates causing various diseases.

Aim of the Work: to compare the oxygen saturation levels between neonates delivered by normal vaginal delivery and cesarean section at full term.

Patients and Methods: This is a cross-sectional, prospective, observational research study. The research was conducted at Ain Shams Maternity Hospital and included 200 healthy term newborns born by normal vaginal delivery and elective cesarean section at a tertiary care centre.

Results: In the current research SpO_2 was statistically significantly higher among VD research group than among CS research group at different times (5 min, 10min, 15min, 20min, 25min, 30min, p values =0.001, <0.001, <0.001, <0.001, <0.001, consecutively). There was a statistically significant positive correlations between APGAR scores and SpO_2 among the studied groups at minutes 5 & 10 (p values <0.001).

Conclusion: The oxygen saturation levels is a crucial issue in neonates born by either CS or normal vaginal delivery and according to the current research findings and in harmony with previous research studies it have higher levels in neonates delivered vaginally.

Keywords: *Oxygen Saturation Levels - Normal Vaginal Birth - Elective Cesarean Delivery*

INTRODUCTION

Annually all over the globe, ranging from 5% to10% of neonates need medical resuscitative efforts. Recently, there is solid clinical evidence that pointless oxygen therapy during the beginning of the process of resuscitation could have negative impact due to oxygen free radicals causing pathophysiological pathways development in neonates causing various diseases ***(Beşkardeş et al., 2013)***. A neonate experiences chief changes in physiological system during the time zone of transformation from intrauterine to extrauterine life. The hemoglobin saturation takes around 10 minutes to approach a value of more than 90% in saturation levels of oxygen. This physiological fact have to be considered when performing reseuscitation efforts in a neonate with oxygen therapy to prevent reaching toxic issues. On the other hand it is vague whether the oxygen saturation levels are influenced by racial/ethnic background, birth weight, gender, APGAR scoring or maternal clinical status (e.g age, Hb concentratiopn, mode of delivery) in full term healthy neonates. The switch from a fetal physiology to a neonatal physiology is a composite event. Interestingly the fetal physiological arterial system have an oxygen tension of about 20 mm Hg, that equals an oxygen saturation level of around 40%–60% ***(Hulsoore et al. 2011)***. After umbilical cord clamping, chief adjustments occurs in the physiological system and peripheral neonatal vascular oxygen saturation are elevated within minutes ***(Chauhan et al., 2013).***

There few methodologies available for detecting hypoxia early at the delivery room: the Apgar score, the umbilical arterial and venous cord pH values, and pulse oximetry ***(Bhandankar et al., 2014)***. Additionally clinical evaluation of hypoxia could be defective since it depends on various factors e.g, skin pigmentation, tissue perfusion and hemoglobin levels ***(Wyckoff et al., 2015).***

An arterial blood oxygen saturation of 75% is needed before central cyanosis appears clinically under optimal circumstances. The implementation of pulse oximetry in clinical management has permitted for a straightforward, non-invasive and precise estimation of oxygen saturation ***(Tiwari et al., 2013).*** After delivery, if the neonate fails to perform the first breath that could consequently lead to hypoxic insult. Hypoxic insults to the neonatal brain in later phases of life could cause cognitive and behavioral issues. In the vast majority of the neonates the physiological transformation goes in a smooth manner; yet 5-10% require some resuscitative assistance in initiation of breathing, while 1% needs much more extensive resuscitative efforts ***(Umut et al., 2011).*** The clinical indications and proper timing of oxygen supplementation therapy to aid the neonate in this critical transitional event is an issue of debate. The transformation from a parallel circulatory system in the intrauterine life to the in series circulatory system after delivery causes a greater total arterial oxygen content. The time required for this process partially depends on the presence

of cardiopulmonary shunts and available oxygen ***(Lague et al., 2016).*** Pulse oximetry is a safe and feasible test that adds a great value to screening and diagnosis of congenital heart disease ***(Beşkardeş et al., 2013)***. Clinical recommendations mention that resuscitative efforts could be started using room air or blended oxygen however it requires guidance by measuring levels of oxygen saturation by means of pulse oximetry and the target saturation level have to be in the interquartile range of preductal oxygen saturation levels obtained from measurements in full term healthy neonates after birth vaginally at sea level ***(Habib, 2013).***

Aim of the Work

This study aims to compare the oxygen saturation levels between neonates delivered by normal vaginal delivery and cesarean section at full term.

Chapter 1

FETAL OXYGENATION

Every year globally around 5% to 10% of neonates require some form of resuscitation. Recently, there is sufficient evidence that unnecessary oxygen supplementation at the initiation of resuscitation may be harmful because oxygen free radicals may be involved in the pathogenesis of many neonatal diseases. The transition from a fetus to a newborn is a complex physiological process ***(Kanayama et al., 2014).***

The fetal arterial oxygen tension is approximately 20 mm Hg, equivalent to an oxygen saturation of 40%–60%. After clamping the umbilical cord, major physiological adjustments occur and peripheral oxygen saturation (SpO2) levels finally rise within several minutes ***(Rashi et al., 2017).***

In neonates, the placental function stops after clamping and cutting the cord, in which there is a transitional phase, from fetus to newborn, starts during which the level of oxygen saturation (SpO2) begins from low intrapartum levels for instance 30-40% and reveals a steady rise afterwards ***(Anderson et al., 2011).***

On the other hand, there are no research data on the specific mechanism of this rise and its normal indices. Even though a chief agent implemented during the resuscitation process is oxygen, there are no clear data on the percentage of oxygen that

should be used. Furthermore, since free oxygen radicals have been revealed to have a corner stone role in the pathophysiology of numerous diseases, unnecessary or excessive oxygen support during resuscitation could have a harmful impact. Recent research studies reveal and display that usage of room air is as effecient as 100% oxygen supplementation in resuscitation of neonates ***(Umut et al., 2011).***

Traditionally, oxygenation levels of newly born infants have been assessed clinically. On the other hand, researchers revealed that there is considerable interobserver and intraobserver variability in assessments of color. Consequently, experts have suggested the usage of pulse oximetry to measure oxygenation in this setting. Numerous research studies mentioned and revealed the pulse oxygen saturation level (SpO2) changes in term or near-term Neonates not demanding resuscitation in the first minutes after delivery ***(Monsieurs et al., 2015).***

Even though the research studies implemented dissimilar oximeters and approaches for application of the sensor, the SpO2 measurements during the first minutes after delivery were remarkably similar. The mean SpO2 value in research studies in which measurements were available at 1 minute were around 60% to 70%, and many infants required about 10 minutes to accomplish levels reaching 90%. Those research

team of investigators displayed data at 1-minute intervals, with the spread of values around the mean or median being described as SE, SD, or interquartile range (IQR) ***(Dawson et al., 2010).***

Oxygen saturation levels from fetus to neonate

Approximately 10% of neonates require some assistance to begin breathing at birth, with <1% needing extensive resuscitation. Prompt diagnosis and treatment are essential for fetuses with severe neonatal asphyxia and fetal hypoxic encephalopathy. Apgar score is currently the most common method used to evaluate the condition of newborns at birth. Although Apgar score is simple and easily available, its accuracy for neonatal asphyxia is limited because it depends on the examiner's decision ***(Wyckoff et al., 2015).***

The guidelines of the International Liaison Committee on Resuscitation (ILCOR), European Resuscitation Council (ERC), and American Heart Association (AHA) recommend that assessments of ventilation or supplementary oxygen be based on three vital characteristics: heart rate; respiration; and oxygen saturation, Pulse oximetry (in the assessment of arterial blood oxygen saturation), however, has sometimes been normal even in the case of cerebral hypoxia–ischemia, indicating that it does not show the brain condition of perfusion resulting from hypoxic encephalopathy or metabolic changes. Therefore, the development of a measurement method that evaluates hypoxia