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Comparison of Neonatal Arterial Blood Oxygen Saturation Rate Immediately After Birth in Normal and Elective Cesarean Delivery

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Abstract

Objective: Ninety percent of neonates pass the transition from fetal life to outside uterus successfully, and only 1% needs intensive support for survival. The quantity of oxygen saturation immediately after birth shows the need for resuscitation immediately after birth. The present research was carried out with the objective of comparing saturation rate of arterial blood hypoxia in neonates born with normal vaginal delivery and cesarean method.

Materials and Methods: 220 neonates born with elective cesarean section and normal delivery were studied in an analytical-descriptive study. Demographic questionnaire was completed. Then a pulse oxymeter with its sensor fixed on the right wrist of the neonates was used. Heart rate was recorded and the level of oxygen saturation (SaO_2) under 90% was considered as hypoxia. To compare the quantitative and qualitative variable between the two groups, paired *t* test and chi-square test was used, respectively. Pearson correlation test was used to study the correlation between the variables.

Results: The age range of mothers was 16-38 years. The mothers' average age, gestational age and neonates' weight were not significantly different between groups. The average SaO_2 in minutes 1, 3 and 5 was 72%, 81% and 89%, respectively in vaginal delivery, which showed a significant difference compared to cesarean neonates with average of 65%, 75% and 83%, respectively. No significant difference was observed after10 minutes. Also there were not significant statistical correlation between mothers age, number of pregnancies, sex and weight of neonate with SaO2 of arterial blood after 1, 3, 5 and 10 minutes after birth.

Conclusion: With respect to the results of the present research SaO_2 was higher in neonates of vaginal delivery in comparison to cesarean neonates. Encouraging mothers to delivery vaginally and also using aid-oxygen is proposed for the cesarean neonates at birth.

Keywords: Cesarean, Delivery, Neonate, Oxygen saturation

Introduction

Nearly 90% of neonates pass from fetal life to outside of uterus successfully and do not need any aid. Around 9% of them need some kind of support for survival (1). All over the world every year one million neonates need advanced resuscitation. The saturation rate of oxygen immediately after birth indicates the need for resuscitation immediately after birth. Oxygen aid is considered for 5%-10% of newborn infants and 1% needs advanced resuscitation at the time of birth (2,3). With respect to the fact that the need for desired concentration of fraction of inspired oxygen (Fio_2) for stabilizing the status of newborn infants has not been proved, Fio_2 is usually regulated with regard to oxygen saturation (SaO_2) of infants (4). At an acceptable level Fio_2 over 60 shows SaO_2 to be over 90% and under this figure infants are exposed to hypoxia (5). Asphyxia could cause remarkable changes during the first minutes of infant's life. Postpartum asphyxia and mental disability in the developing countries are because of hypoxia upon birth, so that annually 1.2 million infants lose their lives because of moderate to serious hypoxia (6).

Pulse oxymeter as a non-invasive instrument immediately after birth, shows the diagnosis of hypoxia 19 times faster in the infants for whom the instrument is used in comparison to infants for whom the instrument is not used (7). The result of a research by Dimich et al on SaO2 showed arterial blood to be 43 to 77% in the full term newborn infants in the first minute of life. The researcher also has reported that SaO_2 increased to 88% during the first 5 minutes and to 90% in 10 minutes (5,8). Numer-

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ous studies have been carried out in Canada and Australia on the SaO_2 of arterial blood in the newborns (infants) using pulse oxymeter. The results showed that in infants with pregnancy age of 31-34 weeks, without oxygen aid and ventilation the SaO_2 of arterial blood rise within 5-10 minutes after birth and the time of arterial SaO2 has been reported to be 5 minutes in Canada and 8 minutes in Australia (9,10). Now a days in normal deliveries presence of one informed midwife or anesthesia technician is necessary to perform primary care after birth of infants and by using non-invasive devices 19% of mortality rate caused by suffocation immediately after birth could be prevented (5,11).

Based on numerous studies, the delivery affects secretion from thorax which causes the facilitation of lung oxygenation and control of respiratory maturity (surfactant) which in turn increases cardiac muscle functioning and saturation of blood oxygen. The present research was carried out with the objective of comparing the saturation rate of arterial blood oxygen in the infants after normal and cesarean delivery.

Materials and Methods

The arterial blood SaO_2 rates of 220 infants were studied in this observational-analytical work. The research was carried out by taking informed written consent from parents based on the fact that no intervention will take place except fastening pulse oxymeter sensor probe on the wrist of the neonates. Data collection research subjects were selected based on inclusion criteria which were the age of full term pregnancy, pregnancy without complications (under supervision of one gynecologist and one anesthesiologist).

The exclusion criteria were diabetic mothers, abnormal position of fetus, hypertension, eclampsia, oligohydramnios, active bleeding in the third trimester, placenta previa, dubious infection or when the infants need resuscitation or have received oxygen aid and expilation of meconium from mothers uterus. The data pertaining to mothers were age, number of pregnancies, age of pregnancy, type of delivery, and the data pertaining to infants included SaO_2 of arterial blood in minutes 1, 3, 5 and 10, sex of infant, infants rank of birth and infants weight which were extracted from patients medical records.

SaO_2 was measured using pulse oxymeter set of Novametix brand made by Mesium factory of California, code 502 which showed the SaO_2 of arterial blood within 30 seconds by fastening the sensor or probe on the right wrist of infants immediately after cutting the umbilical cord and the data were noted down continuously by the researcher. The pulse oxymeter monitor was covered and the alarming was on or off to prevent the effects of audible indices such as heart beat and SaO_2 on midwifery actions. The rate of SaO_2 of arterial blood was visible on monitor after 30 seconds and showed figures in an interval of 2 seconds. Then the data were collected and noted by the researcher for 10 minutes. SPSS software version 19 was used for analysis of results, bilateral *t* test was used for comparing quantitative variables between the two groups, chi-square test was used to study the qualitative data and correlation of data were studied using correlation test.

Results

The averages age of mothers in the normal delivery and the cesarean groups were 26.79 ± 5.314 and 26.16 ± 4.705 years, respectively, who were in the age-range of 16-38 years. The averages of pregnancy age of mothers in normal and cesarean delivery were 39.01 ± 0.99 and 38.70 ± 0.60 weeks, respectively. Also the weight of the infants born in normal delivery and elective cesarean were 3369 ± 359 and 3445 ± 361 g, respectively. Mothers' age, pregnancy age and infants weights were close two each other in the two groups and no significant difference was observed.

Also based on the findings of the research, the highest numbers of pregnancy with normal delivery were in the second gravid (36.5%) and in the third gravid (23.6%), and the lowest were in the fifth gravid (4.5 %) and the sixth one (6.5%), although, in the cesarean group, number of pregnancy included the first gravid (30%) and the second one (33.7%). The average number of delivery in the normal delivery group was 1.66 ± 1.169 and in the elective cesarean group 0.985 ± 8.76; in the cesarean group majority of women (75.8%) was their first, or they had experienced one delivery, while in the normal delivery group, they had a background of one or two deliveries (63.7%). A significant difference was observed between the two groups while comparing number of pregnancies and delivery in the research samples ($P < 0.01$). The average number of abortions in the normal delivery group was 0.2±0.4 and in the cesarean group 0.29 ± 0.153, and average number of dead infants or dead fetus in the normal delivery group was 0.109 ± 0.31 and in the cesarean group 0.127 ± 0.33, showing no significant difference between them.

52.7% of infants born in normal delivery were male and 47.3% were female. In the cesarean group 47.3% were male and the rest were female. No significant difference was observed between the two groups using chi- square test ($P = 0.68$).

The range of SaO_2 of arterial blood of infants at the times of 1, 3, 5 and 10 minutes in the two groups is shown in Table 1. Performing paired *t* test we found that there is a significant difference in minutes 1, 3 and 5 between the

Table 1. Comparison of the Average of SaO_2 of Arterial Blood in the Two Groups of Normal Delivery and Cesarean

Sao_2 of Arterial Blood	Normal Delivery		Cesarean		*P* Value
	Average and Standard Deviation		Average and Standard Deviation		
SaO_2 minute-1	72	72.05±6.043	65	64.95±6.65	t=8.27, *P*=0.001
SaO_2 minute-3	81	81.41±3.89	75	75.17±5.044	t=10.59, *P*=0.001
SaO_2 minute-5	89	88.88±3.01	83	83.01±3.17	t=14.08, *P*=0.001
SaO_2 minute-10	96	95.8±1.83	95	94.57±1.66	t=1.84, *P*>0.05

Table 2. Rate of Cohesion Between SaO_2 of Arterial Blood With the Type of Delivery

	Type of delivery (Normal=o, Cesarean=1)	ANOVA	*P* Value
SaO_2 minute-1	Y=72.04-7.09 (0 or 1)	F=37.2	P=0.001
SaO_2 minute-3	Y=81.60-6.43 (0 or 1)	F=112.17	P=0.001
SaO_2 minute-5	Y=88.88-5.86 (0 or 1)	F=196.73	P=0.001
SaO_2 minute-10	-	-	-

averages ($P > 0.05$). Studies in the present research showed that 37.3% of infants of normal delivery reached SaO_2 of arterial blood over 90% in minutes, but neither of the infants of elective cesarean reached over 90%, but in minute 10 both groups reached SaO_2 of over 90% and no significant difference was found using chi-square test ($P = 0.001$, $\chi^2 = 60.1$) showing that longer time is necessary for cesarean infants to reach arterial blood SaO_2 of over 90%. Also correlation was found between SaO_2 of arterial blood and other variables such as number of delivery, pregnancy, live birth and sex of infants. Table 2 also shows the cohesion model between normal delivery and cesarean in minutes 1, 3 and 5 while there was no model in minute 10.

Discussion

Measurement of SaO_2 using pulse oxymeter creates a quick ability for improvement of anoxia. Therefore normal value of SaO_2 after birth using pulse oxymeter is of vital importance in survival of infants from anoxia complications. The present research showed that a lot of changes are observed in the first 10 minutes after birth by evaluation of SaO_2. Measurement of SaO_2 of arterial blood was performed in the infants who did not need oxygen aid and included only warming and drying. It should be noted that it had been performed in many research cases (8,12-14).

Based on the results obtained in this research, SaO_2 of arterial blood in the infants of vaginal delivery (normal) in minutes 1, 3 and 5 has been significantly higher than the infants born by cesarean ($P = 0.001$). Average arterial SaO_2 of the first minute in cesarean group was 65% and 72% in the normal delivery group. In a study by Altuncu et al on 150 infants of normal delivery and 50 infants of elective cesarean, the average SaO_2 of arterial blood in the first minute was 71% in normal delivery and 70% in cesarean (13). The results are in consistency with the present research but it is not consistent with a study in Australia in which the average SaO_2 of the first minute was reported to be 54% in the cesarean group and 67% in normal delivery; the measurement reasons of SaO_2 in preterm and full term infants were obtained at a lower average regarding minutes 3 and 5. Moreover, a significant difference was observed in comparison of averages in the research samples (minutes 1, 3 and 5) by using paired *t* test ($P = 0.001$). The results of a research by Harris et al which was carried out on 44 cesarean infants and 32 infants of vaginal delivery during the first 10 minutes after birth showed that there was a significant difference between the average SaO_2 arterial blood of the two groups in minute 3 ($P < 0.05$) (15) which is in consistency with the results of the present research.

Also in a cohort research, Rabi et al compared the average SaO_2 of arterial blood in the first 5 minutes between two groups of cesarean and normal delivery on 115 infants with pregnancy age of over 35 weeks. The results of the research showed that there was a significant difference between the average SaO_2 of arterial blood of the first 5 minutes after birth for the vaginal delivery group (87%) with the range of 80%-95% and for the cesarean group (81%), with the range of 75%-83% ($P > 0.05$) (10).

The results of their research were inconsistent with the present research. Average SaO_2 of arterial blood of minute 10 showed that the average of SaO_2 of normal delivery group and elective cesarean has been 94% and 96% respectively in which no significant difference was observed, using paired *t* test ($P > 0.05$).

In a research by Rao et al the average of SaO2 in minute 10 in the two groups of cesarean and normal delivery was obtained 91 and 94% respectively, showing a significant difference by $P > 0.05$ (16), which is slightly different from the results of the present research; the reason of the difference maybe the study of the infants suffering from asphyxia.

Also in a study by Dawson et al, average SaO_2 of arterial blood of minute 10 has been 96% in the infants of normal delivery group and 94% in the infants of elective cesarean group (4) showing no significant difference by $P = 0.02$ which are in consistency with the present research. The present research showed that in minute 5, 37.3% of infants had an SaO_2 of over 90%, and SaO_2 of 62.7% of infants was between 80%-90% and neither was under 80%.

In the elective cesarean group SaO_2 of neither infants had reached over 90% but in 86.4% of infants SaO_2 was between 80%-90%, showing no significant difference between the two groups using chi-square statistical test ($P = 0.001$) showing that a longer time is necessary for the infants of elective cesarean to reach SaO_2 of over 90%.

The results of a research by Rabi et al showed that the time needed for SaO_2 of over 90% is 8 minutes (10). Also Altunıcu et al have reported that the time of reaching SaO_2 in the infants born by cesarean is 3 minutes longer than infants of normal delivery and in the cesarean infants, on the average 5.8 minutes is necessary to reach SaO_2 of over 90% (13). The results of the above-mentioned research cases are in consistency with the results of the present research.

Regarding the importance of pulse oxymetery, Singh et al assessed the application of pulse oxymeter and ECG in labor room and NICU and concluded that they are very useful and important, but application of electrocardiography in newborns is problematic with respect to delicateness and thinness of their skin, and inability of quick installation of its probes. But heart beat and SaO_2 of arterial blood is measured quicker, using infant monitoring by pulse oxymeter set (17).

Conclusion

The present research showed that the time for reaching SaO2 of over 90% in the infants of elective cesarean is longer than vaginal delivery. Therefore putting on the agenda is proposed, giving training to mothers on vaginal delivery and giving oxygen aid to cesarean infants in the operation room and postpartum protections.

Ethical Issues

Ethics of this research work was approved by Yasuj University of Medical Science, Iran.

Conflict of interests

The authors declare no conflict of interests.

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