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# The effect of cord clamping time on cord blood gas in term newborn babies delivered by cesarean section

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## Abstract

**Objective:** Umbilical cord clamping time is a situation that should be planned before delivery. It is recommended that the umbilical cord be clamped for at least 30–60 seconds after birth in healthy preterm and term newborns. There are few studies investigating the effect of umbilical cord clamping time on cord blood gas. If the umbilical cord is clamped before 30 seconds after birth, it is considered early clamping, and if it is clamped after 30 seconds, it is considered late clamping. In this study, we aimed to compare the early or late clamping time of the umbilical cord with the acid-base parameters and lactate values of babies.

**Methods:** A total of 217 term newborn infants who were delivered by cesarean section between December 2020 and December 2021 in our hospital, whose umbilical cord clamping times were recorded and who had cord blood samples, were included in our study retrospectively. pH, $pCO_2$, $pO_2$, $HCO_3$, BE, lactate, Hb and bilirubin values in cord blood gas samples were compared between the two groups.

**Results:** Two hundred seventeen term newborn babies were included in the study. Cord clamping time of infants was delayed in 125 (57.6%) and early in 92 (42.4%) infants. The mean pH in cord blood gas was 7.37±0.07 (7.16–7.57), $pCO_2$ was 39.73 ±8.97 (20.3–65.4) mmHg, $pO_2$ was 53.42±41.95 (14.8–198) mmHg, BE was -2.18±2.90 (-11.9–13.6) mmol/L, lactate was 2.12±0.88 (0.50–5.90) mmol/L, Hb was 14.57± 2.54 (10–23.7) g/dl, and bilirubin was 1.71±1.33 (0–3.7) mg/dl.

**Conclusion:** There was no significant relationship between early and late clamping of the umbilical cord and acid-base parameters, and hemoglobin values in cord blood gas in term newborn babies delivered by cesarean section.

**Keywords:** Umbilical cord, clamping, blood gas.

## Introduction

The clamping time of the umbilical cord is a situation that should be planned with the obstetrics team in prenatal preparation in the newborn resuscitation program. Delayed cord clamping in term infants is defined as clamping after 3 minutes according to some authors,[1,2] while according to some authors, it is defined as clamping after cessation of cord pulsation.[3,4] According to the results of the studies, delaying cord clamping in term infants for at least 30–60 seconds (there are publications extending up to 120 seconds) is beneficial in keeping the hemoglobin level and iron stores high in the first months. Therefore, in the recommendations of ACOG updated in 2020, it is recommended that the cord be clamped in term babies after waiting for at least 30–60 seconds after delivery.[5–8]

A delay of 30 to 60 seconds in the umbilical cord can affect cord blood gas values and cause changes in acid-base balance. Cord blood gas analysis is a routine practice that provides information about the condition of the newborn baby before and during birth and is recommended especially in high-risk deliveries.[9–11] There are few studies investigating the effect of delayed clamping of the umbilical cord on cord gas analysis values.[11,12] The aim of this study is to compare the cord blood acid-base parameters and lactate values of infants whose umbilical cord was clamped early and late.

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## Methods

Our study is a retrospective study. Between December 2020 and December 2021, 901 deliveries occurred in our hospital. Six hundred eighty one of the deliveries were cesarean section. Four hundred six of the cesarean deliveries were term newborns. These 406 babies were screened retrospectively. Of these term babies, 217, whose umbilical cord clamping times were recorded and who had cord blood gas samples, were included in the study. For the remaining 189 babies, cord blood gas analyzes were missing or absent, and the time of cord clamping was unknown. Multiple pregnancies, preterm births, babies who need resuscitation, babies with intrauterine growth restriction were not included in the study. Since placental transfusion may be different between normal vaginal delivery and cesarean delivery, only cesarean deliveries were included in our study. Those who had cord clamping done within the first 30 seconds after birth were considered as the early cord clamped group (ECC), and those who were done after 30 seconds were considered as the late cord clamped group (LCC).

Since it was a retrospective study, it was written as early and late clamping in the newborns' files. If the umbilical cord clamping time was less than 30 seconds, it was accepted as early clamping, and if it was longer than 30 seconds, it was accepted as late clamping. Clamping times were not written. There were 92 babies in the ECC group and 125 babies in the LCC group. Demographic and antenatal characteristics of the babies were compared. Cord blood gas analysis was evaluated. pH, $pCO_2$, $pO_2$, $HCO_3$, BE, lactate, Hb, and bilirubin values in cord blood gas samples were compared between the two groups. A limitation of the present study is the unavailable hematological values of the mothers. Our retrospective study was approved by the hospital's ethics committee.

In our hospital, the umbilical cord is clamped for at least 30 seconds after birth in healthy term babies. Umbilical blood acid–base and gas analyses are carried out after delivery at our hospital.

Statistical analysis of the data was carried out by using the SPSS (Statistical Package for Social Sciences) 25.0 for Windows (IBM Corp., Armonk, NY, USA) software. Categorical variables were given as numbers and percentages. Intergroup analyzes of categorical variables were performed using the chi-square test by creating cross tables. Comparisons of two groups in numerical variables were done using the t-test and Mann-Whitney U test. A p-value <0.05 was considered statistically significant.

## Results

A total of 217 infants were included in the study, 125 of which were ECC and 92 LCC. When the demographic characteristics of the babies are examined, the mean gestational age was 38.35±0.73 (38–41) weeks, mean birth weight was 3230.99±529.07 (2010–4690) g, mean birth length was 47.68±2.47 (41–54) cm, and mean head circumference was 34.15±1.89 (30–38) cm. Of the babies, 113 (52.1%) were boys and 104 (47.9%) were girls. Maternal age was 30.34±5.74 (19–44) years. The reason for cesarean delivery was elective (86%). Of the cesarean deliveries, 186 (86%) received spinal anesthesia and 31 (14%) general anesthesia.

Mean pH in cord blood gas was 7.37±0.07 (7.16–7.57), $pCO_2$ was 39.73±8.97 (20.3–65.4) mmHg, $pO_2$ was 53.42±41.95 (14.8–198) mmHg, BE was -2.18±2.9 (-11.9–13.6) mmol/L, lactate was 2.12±0.88 (0.50–5.90) mmol/L, Hb was 14.57±2.54 (10–23.7) g/dl, and bilirubin was 1.71±1.33 (0–3.7) mg/dl.

Forty-eight (22.1%) of the babies needed intensive care, and 10 (4.6%) received phototherapy treatment. Twenty-six (21%) of the babies in the ECC group needed intensive care and 5 (4%) of the babies received phototherapy. Twenty-two (26%) of the babies in the LCC group needed intensive care and 5 (4%) of the babies received phototherapy.

When the demographic, clinical and antenatal characteristics of the infants in the ECC and LCC groups were examined, no significant relationship was found between birth weight, type of anesthesia applied during birth, maternal age, Apgar scores, hospitalization in the neonatal intensive care unit within the first 24 hours, and receiving phototherapy treatment (**Table 1**).

No significant correlation was found between pH, $pCO_2$, $pO_2$, $SaO_2$, $HCO_3$, BE, lactate, Hb, bilirubin, and glucose values in the cord blood of infants in the ECC and LCC groups (**Table 2**).

## Discussion

Delaying the clamping of the umbilical cord for at least 30–60 seconds in term and healthy preterm infants has been found to have many beneficial effects in the early

**Table 1.** Demographic and antenatal characteristics of ECC and LCC groups.

| | ECC group (n=125) | LCC group (n=92) | p-value |
|---|---|---|---|
| Gender, n (%) | | | 0.260 |
| Girl | 64 (51%) | 40 (43%) | |
| Boy | 61 (49%) | 52 (67%) | |
| Birth weight (g) | 3242.72±509.17 (2010–4370) | 3215.05±557.40 (2100–4690) | 0.708 |
| Birth height (cm) | 47.76±2.27 (42–54) | 47.58±2.73 (41–53) | 0.611 |
| Head circumference at birth (cm) | 34.19±1.85 (30–40) | 34.09±1.96 (30–38) | 0.706 |
| Gestational age (weeks) | 38.36±0.74 (38–41) | 38.35±0.73 (38–41) | 0.905 |
| Type of anesthesia in cesarean delivery, n (%) | | | 0.104 |
| General | 22 (18%) | 9 (10%) | |
| Spinal | 103 (82%) | 83 (90%) | |
| Cesarean delivery indication, n (%) | | | 0.116 |
| Elective | 105 (84%) | 82 (89%) | |
| Emergency | 20 (16%) | 10 (10%) | |
| 1-minute Apgar score | 7 (5–9) | 7 (5–10) | 0.327 |
| 5-minute Apgar score | 9 (7–10) | 8 (6–10) | 0.137 |
| Maternal age | 30.44±5.65 (19–44) | 30.21±5.89 (19–44) | 0.770 |
| Number of maternal pregnancies | 3 (1–9) | 2 (1–8) | 0.345 |
| Number of maternal births | 2 (0–7) | 2 (0–7) | 0.281 |
| Need for phototherapy, n (%) | 5 (4%) | 5 (4%) | 0.618 |
| Admission to neonatal intensive care unit, n (%) | 26 (21%) | 22 (24%) | 0.585 |

and late postnatal period. Therefore, in the recommendations of the ACOG updated in 2020, it is recommended to clamp the cord after waiting for at least 30–60 seconds after delivery in term and healthy preterm babies.[5–8] In our hospital, the umbilical cord is clamped at least 30 seconds after birth in healthy term and preterm babies.

It has been observed that delayed clamping of the cord increases the newborn's blood volume by 30%.[13] It has been shown that more placental transfusion is achieved by delayed clamping, and higher hemoglobin values without any change in peripheral perfusion.[14]

In our study, we found no difference between the cord hemoglobin levels of infants with early and late

**Table 2.** Cord blood gas values of ECC and LCC groups.

| | ECC group (n=125) | LCC group (n=92) | p-value |
|---|---|---|---|
| pH | 7.37±0.06 (7.20–7.57) | 7.37±0.07 (7.16–7.57) | 0.741 |
| $pCO_2$ (mmHg) | 39.88±8.97 (20.30–61) | 39.52±9.01 (20.40–65.40) | 0.777 |
| $pO_2$ (mmHg) | 57.22±46.71 (17.1–198) | 48.44±34.38 (14.8–192) | 0.118 |
| $SaO_2$ (%) | 78.68±17.36 (29–100) | 74.47±20.40 (27.1–100) | 0.118 |
| $HCO_3$ (mmol/L) | 22.23±2.28 (14.1–37) | 22.28±2.28 (12.9–2.1) | 0.856 |
| BE (mmol/L) | -2.32±2.99 (-11.10–13.6) | -1.99±2.80 (-11.90–10) | 0.407 |
| Lactate (mmol/L) | 2.12±0.88 (0.90–5.70) | 2.13±0.89 (0.50–5.90) | 0.949 |
| Hb (g/dl) | 14.77±2.63 (10.2–23.7) | 14.37±2.45 (10–22.1) | 0.253 |
| Bilirubin (mg/dl) | 1.66±1.30 (0–3.7) | 1.74±1.38 (0–3.6) | 0.638 |
| Glucose (mg/dl) | 65.99±19.90 (18–151) | 68.13±21.93 (29–147) | 0.469 |

cord clamping. The reason for this was thought to be related to elective cesarean section and delayed clamping time.

Delayed cord clamping is also suitable for respiratory and cardiovascular changes that occur in the first minutes of extrauterine life. In extrauterine life, gas exchange must pass from the placenta to the lungs. Since the airways are filled with fluid during fetal life, gas exchange does not occur in the lungs. A delay in cord clamping allows the neonate to continue receiving a supply of blood, including iron and oxygen. A longer delay has been shown to deliver no extra hematological benefits.[15] Pulmonary blood flow in the fetus is minimal, and high vascular resistance forces blood from the right ventricular outlet to divert blood to the ductus arteriosus and then to the systemic circulation. Clamping the cord separates the fetus from the placenta, reducing venous return to the right atrium and increasing systemic vascular resistance.[14,16] A delay of 30 to 60 seconds in the umbilical cord clamping can affect cord blood gas values and cause changes in acid-base balance.[11] In our study, we observed no change in the acid-base balance of babies with early or late cord clamping. There was no significant difference between pH, $pCO_2$, $pO_2$, $SaO_2$, $HCO_3$, BE, and lactate values in cord blood gas of babies whose umbilical cord was clamped early and late. In the study conducted by Anderson et al., the authors showed that there was no difference between early and late clamping of the umbilical cord and the values of pH, $pCO_2$, lactate, $HCO_3$, and BE values in the cord blood gas, but the $pO_2$-value was significantly higher in the late clamped group. In addition, blood samples taken from one of the pulsating umbilical arteries in the late-clamped group and blood samples taken from the cut umbilical cord created with the double-clamp technique were found to have similar pH and acid-base values in blood gases.[12] In the study of Valero et al., the authors found that pH, $HCO_3$, BE, and $SaO_2$-values were lower, lactate and $pCO_2$-values were higher, and blood glucose values were lower in patients with delayed cord clamping than those with early clamping, and no difference was found between $pO_2$-values.[11] Similarly, Wilberg et al. observed a tendency to metabolic and respiratory acidosis in the blood gas of those who were clamped late, while they found an increase in lactate and $pO_2$-values.[17] On the other hand, De Paco et al. observed in their study that only the $pO_2$-value was significantly higher in the group whose umbilical cord was clamped late, and there was no difference between other blood gas parameters.[18] In their study, Künzel et al. found no difference between the acid-base levels of cord blood gas in term newborn babies who underwent early and late cord clamping.[19]

Cord blood gas analysis is a routine practice that provides information about the condition of the newborn baby before and during birth and is recommended especially in high-risk deliveries.[9–11] Blood gas taken from the umbilical cord provides information about fetal physiology at the time of delivery. Cord blood gas analysis is one of the best indicators of the respiratory status of the baby at the time of birth.[20] There are few studies investigating the effect of delayed clamping of the umbilical cord on cord gas analysis values.[11,12] Delayed clamping of the umbilical cord may cause changes in the infant's respiration and acid-base balance.[11] In our study, we found no significant difference in the cord blood gas analyzes of babies whose umbilical cord was clamped early and late. We performed our study in term healthy neonates with a cesarean delivery and 1- and 5-minute Apgar scores of >5, which would explain the absence of significant differences in acid–base findings between the groups.

Cord blood gas analysis is one of indicators of the metabolic status of the baby at the time of birth.[20] In our study, there was no significant difference between hemoglobin, bilirubin, and glucose values measured in cord blood gas. The need for intensive care admission and phototherapy treatment in the first 24 hours were also similar. Since the hemoglobin values between the two groups were similar, the need for phototherapy was also similar.

## Conclusion

In conclusion, we found in our study that delayed cord clamping did not cause a significant change in acid-base parameters and hemoglobin values in cord blood gas in term babies delivered by cesarean section.

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