Effect of Early Versus Delayed Cord Clamping on Hematocrit and Serum Bilirubin Levels

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Abstract

Background: Placental transfusion reduces the risk of anemia and iron deficiency in low-birth-weight (LBW) neonates, based on the time of cord clamping.

Aim: To compare the effect of early cord clamping (ECC) and delayed cord clamping (DCC) on hematocrit and serum bilirubin levels in term LBW neonates

Materials and Methods: Pregnant women who gave consent were enrolled and randomized into 2 groups: ECC and DCC. In the ECC group, cord clamping was done at 15 seconds, and in the DCC group, it was done at 1 minute. LBW neonates (< 2500 g) with an Apgar score > 7 at 5 minutes and normal heart rate were included (*N* = 200) in the study. Hematocrit levels at the fourth hour and the third day of life were measured. Serum bilirubin level was measured on the third day of life. The data collected were analyzed using the RStudio software (version 1.2.5001).

Results: The hematocrit levels at the fourth hour and the third day of life were significantly high in the DCC group (*P* = 2e-16 and *P* = 2e-16, respectively). The hematocrit level at the fourth hour of life was significantly associated with the time of cord clamping (ECC and DCC) and parity (*P* = 2e-16 and *P* = .02903, respectively). The serum bilirubin level at the third day of life was significantly high in the DCC group, and it was significantly associated with the time of cord clamping (ECC and DCC; *P* = .002), mother's age (*P* = .8), birth weight (*P* = .67), and mode of delivery (*P* < .85).

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Conclusion: Comparatively, DCC is beneficial to the hematologic status in LBW neonates.

Key Words: Anemia, Apgar score, bilirubin, hematocrit, cord clamping, placental transfusion

Introduction

During birth, the neonate remains attached to its mother through the umbilical cord.[1] A large amount of blood remains behind in the umbilical cord as well as the placenta, which could be the source for placental transfusion.[2] Neonates who receive a placental transfusion during birth, either through delayed cord clamping (DCC) or cord milking, gain about 30% more blood volume compared with neonates whose cord was cut soon after birth.[3] Receiving a sufficient volume of blood through placental transfusion during birth protects distressed neonates.[4]

Early cord clamping (ECC) is practiced as a part of labor management at hospitals in the United States of America and in London.[5-7] In developing countries, the routine practice of ECC led to major health problems such as iron deficiency due to placental vascular insufficiency.[8-11] ECC deprives a neonate of nearly a quarter of its blood and iron.[12]

The WHO recommends DCC as the standard of care in the delivery room.[13] DCC improves hemoglobin, iron status, hematocrit level, serum bilirubin level, and hemodynamic stability and reduces the requirement of blood transfusion.[14] Despite the WHO recommendations and supportive evidences documenting the benefits of DCC, the opinion remains divided, and currently, there are no clear practice guidelines that delineate when DCC should be performed.[15,16] Many studies on DCC and ECC have been performed on term and preterm neonates, but there are fewer studies performed on term low-birth-weight (LBW) neonates.

Aim

To compare the effect of ECC and DCC on hematocrit and serum bilirubin levels in term LBW neonates

Materials and Methods

Study design

This was a comparative study conducted in the Pediatric Department of DY Patil Hospital & Research Institute (Kolhapur, Maharashtra, India), which is a tertiary care hospital. It was conducted between September 2016 and August 2018 and was approved by the Institutional Ethics and Research Committee. The purpose and details of the methods used in this study were explained to all the parents. A written informed consent was obtained before the study. The sample size of the study was calculated using a sample size calculator of The Survey System (Creative Research Systems, CA, USA) considering a confidence level of 95% and margin error of 7.[17]

A total of 200 term LBW neonates (< 2500 g) with an Apgar score > 7 at 5 minutes and normal fetal heart rate during the intrapartum and the postpartum periods were included in the study.

Neonates who were preterm, had Rh and ABO incompatibility, had cyanotic congenital heart disease and birth asphyxia, were twins, or whose mothers had diabetes were excluded from this study.

Study procedure

Maternal parameters such as age, blood group, obstetric history and history related to the present pregnancy, general medical history, medications taken during pregnancy, gestational age, parity, and details of labor and delivery were recorded in a semistructured case proforma. During delivery, neonates were randomized into 2 groups (ECC and DCC groups) using a random allocation software program RandomAlloc.exe (Random Allocation Software 2.0; M Saghaei, Department of Anesthesia, Isfahan University of Medical Sciences, Isfahan, Iran).

Umbilical cord clamping was done as described by Mercer et al[12] at 15 seconds for ECC group and at 1 minute for DCC group. A stopwatch was used for recording the time. The time of cord clamping, Apgar score at 1 and 5 minutes, time of birth, weight at birth, and sex of the neonate were recorded. A mercury thermometer was used to record the axillary temperature. The neonates were shifted to the NICU and managed as per the standard protocol after stabilization in the labor room.[18]

For the hematocrit measurement at the fourth hour of life, 2 mL of venous blood sample was drawn using a syringe in an ethylenediaminetetraacetic acid vial, and was analyzed using the Coulter method.[19] On the third day of life, the hematocrit and serum bilirubin levels were estimated using the Coulter method and the Diazo method, respectively.[19,20] Results were compared between neonates in the ECC and the DCC groups. The hematocrit level at 4 hours of life was considered as the primary outcome, and the hematocrit and serum bilirubin levels on the third day of life between the 2 groups were the secondary outcomes.

Statistical analyses

The data collected were tabulated, and descriptive analysis was done in Microsoft Excel 2010 (Microsoft Corporation, WA, USA). The Mann–Whitney *U* test was used to study the difference between the hematocrit level at the fourth hour of life and the hematocrit level and serum bilirubin level on the third day of life, for both the groups. The association between the hematocrit level and serum bilirubin level with different variables (ie, time of cord clamping [DCC or ECC], parity, mode of delivery, sex of the neonate, birth weight, and gestational age) was analyzed using the analysis of covariance test with the RStudio software (version 1.2.5001; RStudio, Boston, MA, USA).

Results

Demographic distribution

Each group comprised 100 term LBW neonates. The average age of the mother and gestational age in both the groups were almost similar (Table 1). The average Apgar score in the ECC group was 9.43 at 1 minute and in the DCC group, it was 9.32 at 5 minutes. The distribution of maternal age, parity, and mode of delivery are given in Table 2.

Table 1. Distribution of the Neonatal Sample Size

Characteristic	ECC (*n* = 100)	DCC (*n* = 100)
Average Gestational Age, wk	39.39	39.06
Birth Weight, g	1982.99	1976.45
Sex		
Male	53%	56%
Female	47%	44%

DCC, delayed cord clamping; ECC, early cord clamping.

Table 2. Distribution of Maternal Sample Size

Characteristic	ECC (*n* = 100)	DCC (*n* = 100)
Average Age, y	24.44	24.66
Parity		
Primigravida	67%	66%
Multigravida	33%	34%
Mode of Delivery		
LSCS	18%	16%
Vaginal	82%	84%

DCC, delayed cord clamping; ECC, early cord clamping; LSCS, lower segment cesarean section.

Hematocrit level

At the fourth hour of life, the mean hematocrit levels in the ECC and the DCC groups were 48.14% and 57.38%, respectively. On the third day, the hematocrit levels in the ECC and the DCC groups were 46.11% and 54.92%, respectively. The Mann–Whitney *U* test showed that the hematocrit levels at the fourth hour and the third day of life were significantly high in the DCC group (P = 2e-16 and P = 2e-16, respectively). The hematocrit level at the fourth hour was significantly associated with the time of cord clamping (ECC and DCC) and parity (P = 2e-16 and P = .02903, respectively). The hematocrit level on the third day of life was significantly associated only with the time of cord clamping (ECC and DCC) (P = 2e-16). A significant difference between hematocrit levels at the fourth hour and third day of life was observed in both the groups (P = 2e-16). This difference in the groups was not significantly associated with any demographic variables (P > .05).

Serum bilirubin level

On the third day of life, the mean serum bilirubin levels in the ECC and the DCC groups were 5.69 and 6.98 mg/dL, respectively. The Mann–Whitney *U* test showed that the serum bilirubin level was significantly high in the DCC group ($P = .0005$). The serum bilirubin level on the third day of life was significantly associated with maternal age, time of cord clamping, birth weight, and mode of delivery ($P < .05$).

Discussion

LBW neonates are more easily susceptible to various blood-related conditions such as anemia. DCC increases the placental transfusion and hence reduces the risks associated with LBW.

The characteristics of the mother (ie, age, mode of delivery, and parity) and neonate (ie, sex, birth weight, gestational age, and Apgar score) in this study are comparable to those described in a few earlier studies.[12,21,22]

The hematocrit levels at the fourth hour and third day of life were significantly higher in the DCC group (P = 2e-16 and P = 2e-16, respectively) compared with the ECC group. At the fourth hour, the hematocrit level was significantly associated with the time of cord clamping and parity (P = 2e-16 and $P = .02903$, respectively). However, on the third day, the hematocrit level was only associated with the time of cord clamping (ECC and DCC) (P = 2e-16). This finding is similar to the findings of the previous studies in showing that DCC improves the hematocrit level.[23-26]

A significantly high level of serum bilirubin was seen in the DCC group ($P = .0005$), similar to other studies.[1,26] The serum bilirubin level was significantly associated with other characteristics such as maternal age, mode of delivery, and birth weight ($P < .05$). However, previous studies have not reported these associations. The increase in serum bilirubin level did not require phototherapy.

As the neonates in this study were followed up for a short period, it does not provide information on the long-term effect of ECC and DCC. Hence, the effectiveness of time of cord clamping could not be generalized. A similar study with a long period of follow-up would provide better insights on the effect of time of cord clamping in term LBW neonates.

Conclusion

DCC is beneficial to the hematologic status of LBW neonates compared with ECC.

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