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Original Research Article

Effect of Delayed Cord Clamping on Neonatal Hemoglobin and Maternal Outcomes: A Randomized Controlled Trial

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Abstract

Background: Delayed cord clamping (DCC) allows continued placental transfusion after birth, which may improve neonatal blood volume, hemoglobin concentration, and iron stores. This study was conducted to evaluate the effect of delayed cord clamping on neonatal hematological outcomes and maternal safety parameters compared with early cord clamping (ECC).

Methods: This randomized controlled trial included 170 pregnant women who were allocated into two groups of 85 participants each. The DCC group underwent umbilical cord clamping after a predefined delay, whereas the ECC group underwent immediate cord clamping. Neonatal hemoglobin, hematocrit, RBC count, serum ferritin levels, neonatal anemia, and immediate neonatal outcomes were assessed. Maternal outcomes including duration of the third stage of labour, estimated blood loss, postpartum hemorrhage, and need for additional interventions were compared between groups.

Results: Neonates in the DCC group showed significantly higher hemoglobin levels (17.2 ± 1.8 vs 15.8 ± 1.7 g/dL; $p<0.001$), hematocrit (52.6 ± 5.4% vs 48.9 ± 5.1%; $p<0.001$), RBC count (5.1 ± 0.5 vs 4.7 ± 0.5 million/µL; $p<0.001$), and serum ferritin levels (96.4 ± 18.5 vs 82.1 ± 17.2 ng/mL; $p<0.001$). Neonatal anemia was significantly lower in the DCC group (9.4% vs 22.4%; $p=0.018$). Maternal blood loss and postpartum complications were comparable between groups. Multivariate analysis identified delayed cord clamping as an independent predictor of higher neonatal hemoglobin levels (AOR 3.82; 95% CI: 1.82–8.04; $p<0.001$).

Conclusion: Delayed cord clamping significantly improves neonatal hematological status without increasing maternal morbidity and should be considered a safe and effective obstetric intervention.

Keywords: Delayed cord clamping; Early cord clamping; Neonatal hemoglobin; Hematocrit; Iron status; Placental transfusion; Maternal outcomes; Randomized controlled trial.

Introduction

The transition from intrauterine to extrauterine life involves complex cardiovascular and respiratory adaptations as the newborn shifts from placental-dependent circulation to independent pulmonary circulation. This process is not immediate, and continued blood flow through the umbilical vessels after birth allows additional placental transfusion, influencing neonatal blood volume, red blood cell mass, and iron status. Therefore, the timing of umbilical cord clamping plays an important role in neonatal physiological adaptation and early hematological outcomes [1].Umbilical cord clamping is generally categorized as early or delayed. Early cord clamping is performed within 10–15 seconds after delivery, whereas delayed cord clamping (DCC) is usually performed after 30 seconds to 3 minutes or after cessation of cord pulsations. During this period, continued placental transfusion increases neonatal circulating blood volume, hemoglobin concentration, and iron stores. Physiological studies have demonstrated that placental blood transfer continues for several minutes after birth, supporting improved neonatal oxygen delivery and hematological status [2].Delayed cord clamping has gained importance due to its potential benefits in preventing neonatal anemia and improving infant health. Increased hemoglobin levels, hematocrit values, and iron reserves following DCC may contribute to better growth and neurodevelopment, as early-life iron deficiency is associated with impaired cognitive and developmental outcomes. This intervention is particularly relevant in low- and middle-income countries where childhood anemia remains a major public health concern [3].Evidence from randomized controlled trials and systematic

reviews suggests that DCC provides significant neonatal advantages, especially among preterm infants. Reported benefits include improved circulatory stability, reduced requirement for blood transfusion, better hematological parameters, and decreased risk of complications such as intraventricular hemorrhage and necrotizing enterocolitis. The Cochrane review concluded that delaying cord clamping for one to three minutes after birth improves neonatal outcomes without increasing major adverse effects [4].International organizations, including the American College of Obstetricians and Gynecologists (ACOG) and the World Health Organization (WHO), recommend delayed cord clamping in vigorous term and preterm infants due to its beneficial effects on neonatal hemoglobin and iron status [5]. However, concerns regarding maternal safety, including increased postpartum blood loss, prolonged third stage of labour, and postpartum hemorrhage, have influenced its implementation. Available evidence indicates that DCC does not significantly increase maternal blood loss or postpartum complications compared with early cord clamping [6].Despite established neonatal benefits, variations in timing protocols, study populations, and assessment of maternal outcomes continue to influence clinical practice. Further randomized controlled studies are required to evaluate the balance between neonatal advantages and maternal safety in different healthcare settings [7,8].Therefore, the present randomized controlled trial, entitled **"**Effect of Delayed Cord Clamping on Neonatal Hemoglobin and Maternal Outcomes: A Randomized Controlled Trial,"

Materials and Methods

The present study was conducted as a randomized controlled trial to evaluate the effect of delayed cord clamping on neonatal hemoglobin levels and maternal outcomes. The study was carried out in the Department of Obstetrics and Gynaecology.

Study Population: The study included pregnant women undergoing vaginal delivery at term gestation who fulfilled the predefined eligibility criteria. Eligible participants were randomly allocated into two groups: the delayed cord clamping group and the early cord clamping group.

Maternal demographic characteristics, obstetric details, delivery-related parameters, neonatal outcomes, and maternal outcomes were assessed and compared between the two groups.

The study was conducted at ESIC Medical College and PGIMSR, Kalaburagi, over a period of six months, from March 2024 to August 2024.

Inclusion Criteria

Pregnant women were included in the study if they met the following criteria:

- Singleton pregnancy with cephalic presentation
- Term gestation (≥37 completed weeks)
- Planned vaginal delivery
- Live fetus with reassuring fetal heart rate pattern before delivery
- Mothers willing to participate and provide written informed consent

Exclusion Criteria

Participants were excluded if they had:

- Multiple pregnancy
- Placenta previa or placental abnormalities
- Severe maternal anemia or significant maternal medical disorders
- Antepartum hemorrhage
- Fetal growth restriction or major congenital anomalies
- Fetal distress requiring immediate delivery intervention
- Requirement for immediate neonatal resuscitation after birth
- Refusal to provide informed consent

Randomization and Study Groups: After enrolment, participants were randomly assigned into two groups using a computer-generated randomization sequence.

- Delayed Cord Clamping Group (DCC Group): Umbilical cord clamping was performed after [30–180 seconds/2–3 minutes] following birth or after cessation of cord pulsations, provided the newborn remained clinically stable.
- Early Cord Clamping Group (ECC Group): Umbilical cord clamping was performed within 10–15 seconds after delivery as per conventional practice.

Allocation concealment was maintained using sequentially numbered, sealed opaque envelopes, which were opened immediately before delivery by the attending healthcare provider.

Procedure of Cord Clamping: All deliveries were conducted according to standard obstetric protocols. Immediately after birth, the newborn was placed on the mother's abdomen or at the level of the placenta whenever feasible. In the delayed cord clamping group, the umbilical cord was left intact for the predetermined duration before clamping and cutting. Routine newborn care, including drying, assessment of breathing, and thermal protection, was provided during this period.

In the early cord clamping group, the umbilical cord was clamped and cut shortly after delivery, followed by routine neonatal care. Active management of the third stage of labour was

performed in both groups according to institutional guidelines.

Assessment of Neonatal Outcomes: Neonatal outcomes were assessed immediately after delivery and during the early neonatal period. The primary neonatal outcome assessed was hemoglobin concentration. Umbilical cord blood and/or peripheral venous blood samples were collected at [specified time interval] after birth, and hemoglobin levels were measured using an automated hematology analyzer. Additional neonatal parameters, including birth weight, Apgar scores at 1 and 5 minutes, requirement for resuscitation, and neonatal complications, were recorded.

Assessment of Maternal Outcomes: Maternal outcomes were evaluated in both study groups. The parameters assessed included:

- Duration of the third stage of labour
- Estimated blood loss during and after delivery
- Incidence of postpartum hemorrhage
- Requirement for additional uterotonic agents
- Maternal hemodynamic changes
- Duration of hospital stay
- Other postpartum complications

Blood loss was estimated using standard institutional methods, including visual estimation and/or measurement of collected blood where applicable.

Data Collection: Baseline maternal characteristics, including age, parity, gestational age, antenatal complications, and mode of delivery, were recorded using a structured data collection proforma. Delivery details, cord clamping timing, neonatal parameters, laboratory investigations, and maternal outcomes were systematically documented for statistical analysis.

Statistical Analysis: The collected data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 27. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables were presented as frequencies and percentages. The independent t-test/Mann–Whitney U test was used for comparison of continuous variables between groups, while the Chi-square test or Fisher's exact test was applied for categorical variables. A p-value of <0.05 was considered statistically significant.

Outcome Measures: The primary outcome measure of the study was the difference in neonatal hemoglobin concentration between the delayed and early cord clamping groups. The secondary outcome measures included maternal blood loss, duration of the third stage of labour, postpartum hemorrhage, need for additional interventions, neonatal Apgar scores, birth weight, and other maternal and neonatal complications.

Results

A total of 170 pregnant women fulfilling the eligibility criteria were enrolled in the study and randomly allocated into two groups of 85 participants each. The Delayed Cord Clamping group (DCC Group) underwent umbilical cord clamping after the predefined delay period, whereas the Early Cord Clamping group (ECC Group) underwent conventional cord clamping shortly after birth. All enrolled participants completed the study protocol and were included in the final analysis. The baseline maternal demographic and obstetric characteristics were comparable between both groups. The mean maternal age was 26.8 ± 4.2 years in the DCC group and 27.1 ± 4.5 years in the ECC group (p=0.65). Distribution according to age categories, parity, gestational age, BMI, maternal anemia status, hypertensive disorders of pregnancy, and gestational diabetes mellitus showed no statistically significant differences between groups (p>0.05), indicating adequate comparability of baseline characteristics (Table 1).

Delayed cord clamping demonstrated a significant beneficial effect on neonatal hematological parameters. Neonates in the DCC group had significantly higher hemoglobin concentration compared with the ECC group (17.2 ± 1.8 g/dL vs 15.8 ± 1.7 g/dL; p<0.001). Similarly, neonatal hematocrit levels were significantly higher in the DCC group (52.6 ± 5.4% vs 48.9 ± 5.1%; p<0.001), along with higher RBC counts (5.1 ± 0.5 vs 4.7 ± 0.5 million/µL; p<0.001).Serum ferritin levels assessed at 6 weeks were also significantly higher among neonates receiving delayed cord clamping (96.4 ± 18.5 ng/mL vs 82.1 ± 17.2 ng/mL; p<0.001).

Furthermore, the incidence of neonatal anemia during follow-up was significantly lower in the DCC group compared with the ECC group (9.4% vs 22.4%; p=0.018) (Table 2).The immediate neonatal outcomes were comparable between the two study groups. The mean birth weight was slightly higher in the DCC group compared with the ECC group (3.02 ± 0.38 kg vs 2.91 ± 0.36 kg; p=0.048). However, no statistically significant differences were observed in Apgar scores at 1 minute (7.8 ± 0.8 vs 7.7 ± 0.9; p=0.42) and 5 minutes (8.9 ± 0.6 vs 8.8 ± 0.7; p=0.35).The requirement for neonatal resuscitation (7.1% vs 9.4%; p=0.57), NICU admission (5.9% vs 8.2%; p=0.55), and neonatal jaundice requiring phototherapy (8.2% vs 7.1%; p=0.78) were comparable between the groups (Table 3). The comparative distribution of immediate neonatal

outcomes between DCC and ECC groups is depicted in Figure 1. Maternal outcomes were assessed to determine the safety of delayed cord clamping.

The duration of the third stage of labour was comparable between the DCC and ECC groups (7.8 ± 2.6 minutes vs 7.5 ± 2.4 minutes; p=0.46). Similarly, estimated blood loss showed no significant difference between groups (286 ± 74 mL vs 279 ± 70 mL; p=0.52).The incidence of postpartum hemorrhage was comparable between the DCC and ECC groups (5.9% vs 7.1%; p=0.75). There were no significant differences in the requirement for additional uterotonics (9.4% vs 11.8%; p=0.62), blood transfusion (2.4% vs 3.5%; p=0.65), or duration of maternal hospital stay (2.4 ± 0.6 days vs 2.5 ± 0.7 days; p=0.31) (Table 4).The duration of umbilical cord clamping was significantly different between the two groups. The mean cord clamping time was 146 ± 32 seconds in the DCC group compared with 12 ± 5 seconds in the ECC group (p<0.001). Delayed cord clamping resulted in significantly greater estimated placental transfusion volume (92 ± 18 mL vs 32 ± 12 mL; p<0.001).The increased placental transfusion was associated with improved neonatal hematological parameters, including higher hemoglobin levels (17.2 ± 1.8 g/dL vs 15.8 ± 1.7 g/dL; p<0.001) and hematocrit values (52.6 ± 5.4% vs 48.9 ± 5.1%; p<0.001) (Table 5). The relationship between timing of cord clamping and neonatal hematological outcomes is illustrated in Figure 2.Multivariate logistic regression analysis was performed to identify independent predictors associated with higher neonatal hemoglobin levels. After adjustment for maternal and neonatal factors, delayed cord clamping remained a significant independent predictor of improved neonatal hemoglobin status.

Neonates exposed to delayed cord clamping had 3.82 times higher odds of achieving higher hemoglobin levels compared with early cord clamping (Adjusted OR: 3.82; 95% CI: 1.82–8.04; p<0.001). Other factors, including maternal age ≥35 years (AOR 0.82; p=0.68), maternal anemia (AOR 0.74; p=0.49), primigravida status (AOR 1.14; p=0.70), gestational age ≥39 weeks (AOR 1.56; p=0.24), and birth weight ≥3 kg (AOR 1.92; p=0.07), were not statistically significant predictors (Table 6). The forest plot demonstrating the adjusted odds ratios and confidence intervals for predictors of higher neonatal hemoglobin levels is presented in Figure 3.

Table 1: Baseline Maternal Demographic and Obstetric Characteristics of Study Participants (n=170)

Variables	DCC Group (n=85)	ECC Group (n=85)	p-value
Maternal age (years), Mean ± SD	26.8 ± 4.2	27.1 ± 4.5	0.65
Age group, n (%)			
<25 years	34 (40.0%)	31 (36.5%)	0.74
25–34 years	46 (54.1%)	49 (57.6%)	
≥35 years	5 (5.9%)	5 (5.9%)	
Primigravida, n (%)	48 (56.5%)	45 (52.9%)	0.63
Multigravida, n (%)	37 (43.5%)	40 (47.1%)	
Gestational age (weeks), Mean ± SD	38.6 ± 1.1	38.5 ± 1.2	0.58
BMI (kg/m²), Mean ± SD	23.8 ± 2.6	24.1 ± 2.8	0.47
Maternal anemia, n (%)	18 (21.2%)	20 (23.5%)	0.71
Hypertensive disorders of pregnancy, n (%)	6 (7.1%)	7 (8.2%)	0.78
Gestational diabetes mellitus, n (%)	5 (5.9%)	6 (7.1%)	0.75

Table 2: Comparison of Neonatal Hematological Parameters between Study Groups (n=170)

Neonatal Parameters	DCC Group (n=85)	ECC Group (n=85)	p-value
Hemoglobin at birth (g/dL), Mean ± SD	17.2 ± 1.8	15.8 ± 1.7	<0.001
Hematocrit (%), Mean ± SD	52.6 ± 5.4	48.9 ± 5.1	<0.001
RBC count (million/µL), Mean ± SD	5.1 ± 0.5	4.7 ± 0.5	<0.001
Serum ferritin at 6 weeks (ng/mL), Mean ± SD	96.4 ± 18.5	82.1 ± 17.2	<0.001
Neonatal anemia at follow-up, n (%)	8 (9.4%)	19 (22.4%)	0.018

Table 3: Comparison of Immediate Neonatal Outcomes Between Study Groups (n=170)

Neonatal Outcome	DCC Group (n=85)	ECC Group (n=85)	p-value
Birth weight (kg), Mean ± SD	3.02 ± 0.38	2.91 ± 0.36	0.048
Apgar score at 1 minute, Mean ± SD	7.8 ± 0.8	7.7 ± 0.9	0.42
Apgar score at 5 minutes, Mean ± SD	8.9 ± 0.6	8.8 ± 0.7	0.35
Requirement of resuscitation, n (%)	6 (7.1%)	8 (9.4%)	0.57
NICU admission, n (%)	5 (5.9%)	7 (8.2%)	0.55
Neonatal jaundice requiring phototherapy, n (%)	7 (8.2%)	6 (7.1%)	0.78

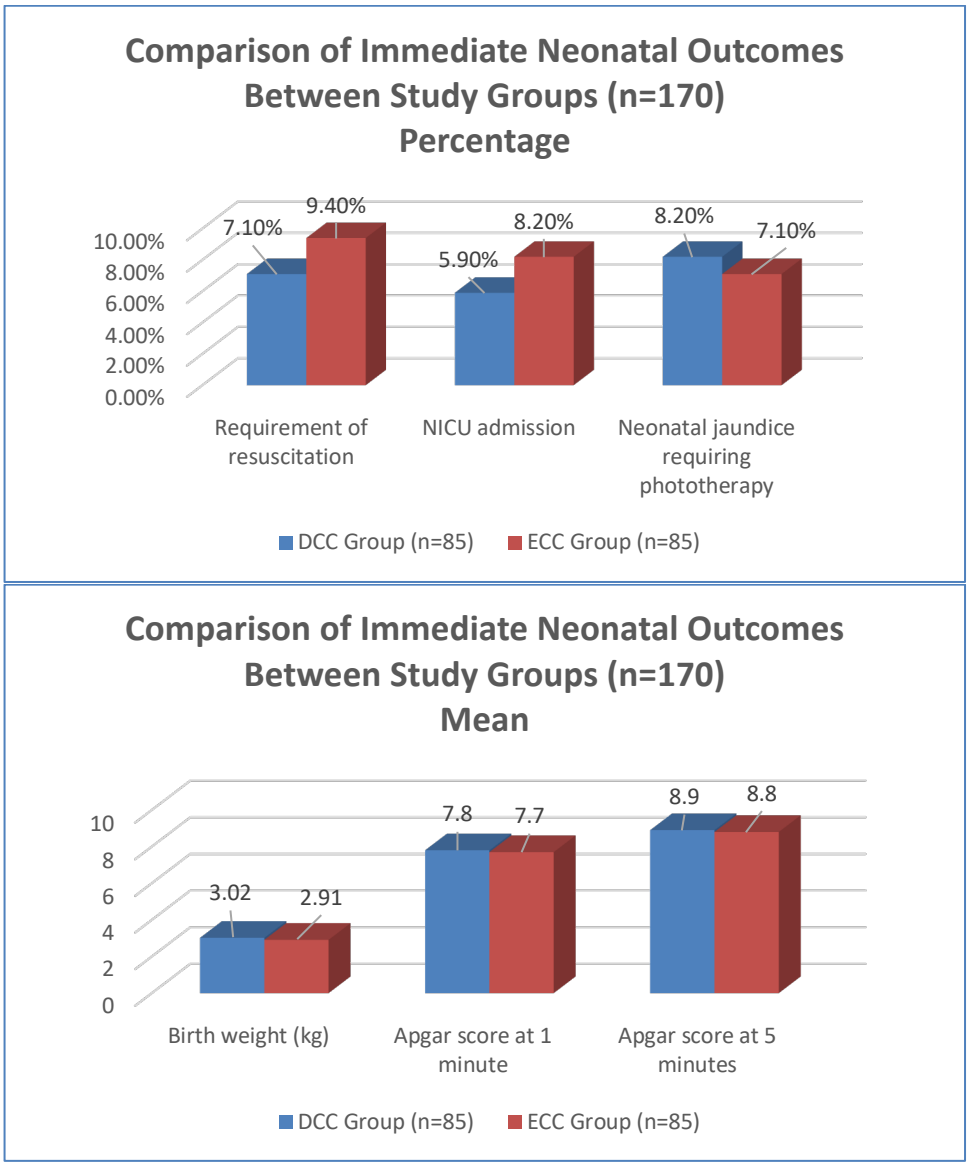

Figure 1: Comparison of Immediate Neonatal Outcomes between Study Groups (n=170)

Table 4: Comparison of Maternal Delivery Outcomes between Study Groups (n=170)

Maternal Outcome	DCC Group (n=85)	ECC Group (n=85)	p-value
Duration of third stage of labour (minutes), Mean ± SD	7.8 ± 2.6	7.5 ± 2.4	0.46
Estimated blood loss (mL), Mean ± SD	286 ± 74	279 ± 70	0.52
Postpartum hemorrhage, n (%)	5 (5.9%)	6 (7.1%)	0.75
Requirement of additional uterotonics, n (%)	8 (9.4%)	10 (11.8%)	0.62
Blood transfusion required, n (%)	2 (2.4%)	3 (3.5%)	0.65
Maternal hospital stay (days), Mean ± SD	2.4 ± 0.6	2.5 ± 0.7	0.31

Table 5: Association between Timing of Cord Clamping and Neonatal Outcomes (n=170)

Parameter	DCC Group	ECC Group	p-value
Cord clamping time (seconds), Mean ± SD	146 ± 32	12 ± 5	<0.001
Estimated placental transfusion volume (mL), Mean ± SD	92 ± 18	32 ± 12	<0.001
Neonatal hemoglobin (g/dL), Mean ± SD	17.2 ± 1.8	15.8 ± 1.7	<0.001
Neonatal hematocrit (%), Mean ± SD	52.6 ± 5.4	48.9 ± 5.1	<0.001

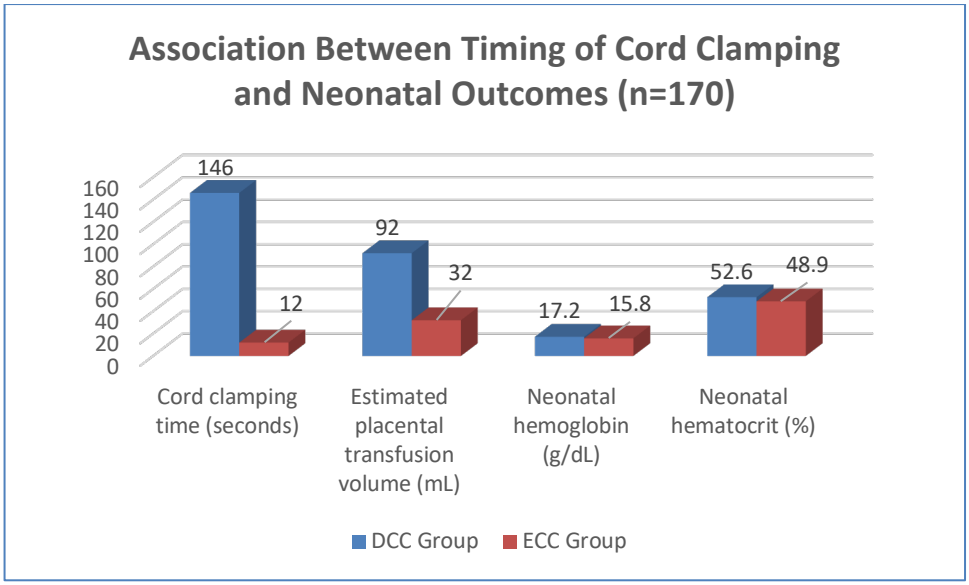

Figure 2: Association between Timing of Cord Clamping and Neonatal Outcomes (n=170)

Table 6: Multivariate Logistic Regression Analysis for Predictors of Higher Neonatal Hemoglobin Levels (n=170)

Predictor Variable	Adjusted Odds Ratio	95% CI	p-value
Delayed cord clamping	3.82	1.82–8.04	<0.001
Maternal age ≥35 years	0.82	0.31–2.14	0.68
Maternal anemia	0.74	0.32–1.72	0.49
Primigravida status	1.14	0.58–2.23	0.70
Gestational age ≥39 weeks	1.56	0.74–3.28	0.24
Birth weight ≥3 kg	1.92	0.94–3.91	0.07

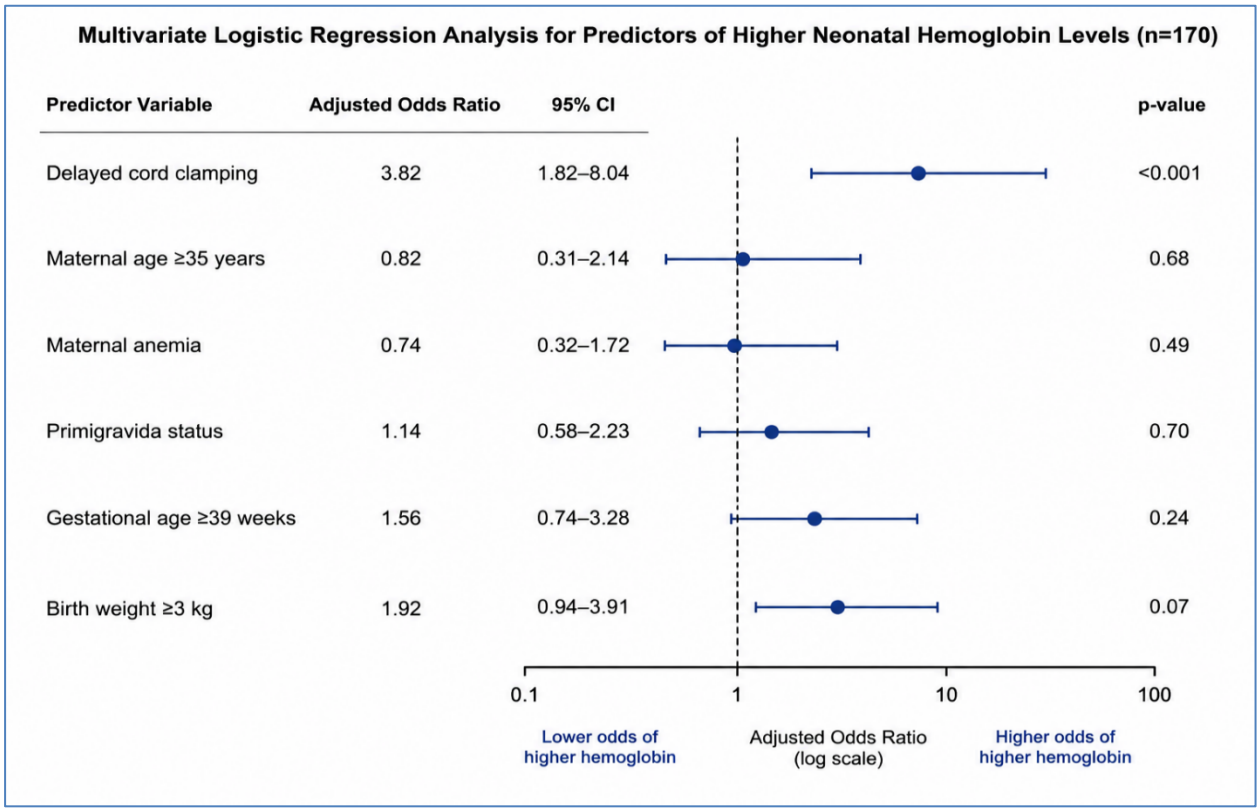

Figure 3: Multivariate Logistic Regression Analysis for Predictors of Higher Neonatal Hemoglobin Levels (n=170)

Discussion

Delayed cord clamping (DCC) is increasingly recognized as a physiological intervention in obstetric practice because it allows continued placental transfusion after birth, thereby improving neonatal blood volume, red cell mass, and iron stores. In the present randomized controlled trial involving 170 pregnant women (85 in DCC group and 85 in early cord clamping [ECC] group), delayed cord clamping significantly improved neonatal hematological parameters, including hemoglobin, hematocrit, RBC count, and serum ferritin levels, without increasing maternal blood loss, postpartum hemorrhage, or other adverse outcomes.

Both groups were comparable regarding maternal age, parity, gestational age, BMI, anemia status, hypertensive disorders, and gestational diabetes mellitus ($p>0.05$), indicating successful randomization and minimizing confounding factors. Similar baseline comparability was reported by Jaiswal et al. [9], who found no significant differences in maternal characteristics between early and delayed cord clamping groups, supporting the validity of neonatal outcome comparisons.

The present study demonstrated significantly higher neonatal hemoglobin levels in the DCC group compared with ECC (17.2 ± 1.8 vs 15.8 ± 1.7 g/dL; $p<0.001$). Hematocrit (52.6 ± 5.4% vs 48.9 ± 5.1%; $p<0.001$) and RBC count (5.1 ± 0.5 vs 4.7 ± 0.5 million/μL; $p<0.001$) were also significantly increased among neonates receiving delayed clamping. These findings reflect improved placental transfusion and increased neonatal circulating blood volume. Similar results were reported by Jaiswal et al. [9], who observed progressive increases in neonatal hemoglobin with increasing duration of cord delay, and by Shirvani et al. [4], who demonstrated higher hemoglobin and hematocrit levels in delayed clamping groups compared with early clamping groups.

The improved hematological status following DCC is primarily attributed to continued blood transfer from the placenta to the newborn after delivery. In the present study, placental transfusion volume was significantly greater in the DCC group (92 ± 18 mL vs 32 ± 12 mL; $p<0.001$), explaining the superior neonatal blood parameters. Jaiswal et al. [9] similarly emphasized that longer cord clamping intervals allow greater placental transfusion and improved neonatal hematological outcomes.

Delayed cord clamping also demonstrated beneficial effects on neonatal iron status. Serum ferritin levels at 6 weeks were significantly higher in the DCC group (96.4 ± 18.5 vs 82.1 ± 17.2 ng/mL; $p<0.001$), with lower neonatal anemia rates (9.4% vs 22.4%; $p=0.018$). Ceradas et al. [10] reported that iron deficiency anemia occurred more frequently after early cord clamping compared with three-minute delayed clamping, highlighting the long-term benefits of DCC in preventing early infancy iron deficiency .

Early neonatal outcomes remained comparable between groups. Although birth weight was slightly higher in the DCC group, Apgar scores, resuscitation requirement, NICU admission, and phototherapy requirement showed no significant differences. Fogarty et al. [8] in a systematic review and meta-analysis reported that DCC increased neonatal hematocrit and reduced transfusion requirements without increasing complications such as intraventricular hemorrhage, necrotizing enterocolitis, sepsis, or chronic lung disease.

Maternal safety was not compromised by delayed cord clamping. Estimated blood loss (286 ± 74 vs 279 ± 70 mL; $p=0.52$), duration of third stage of labour, postpartum hemorrhage, uterotonic requirement, and transfusion rates were comparable between groups. These findings are consistent with McDonald et al. [2], who reported no significant increase in maternal hemorrhage or adverse maternal outcomes following delayed cord clamping.

The present study also demonstrated that longer cord clamping duration was associated with improved neonatal hematological parameters. Mean cord clamping time was significantly higher in the DCC group (146 ± 32 vs 12 ± 5 seconds; $p<0.001$). Multivariate analysis confirmed DCC as an independent predictor of improved neonatal hemoglobin levels (AOR 3.82; 95% CI: 1.82–8.04; $p<0.001$). Similar findings were reported by Chiruvolu et al. [12], who demonstrated higher neonatal hematocrit levels with delayed clamping without increased phototherapy requirement or NICU stay.

Conclusion

The present randomized controlled trial demonstrated that delayed cord clamping significantly improved neonatal hematological outcomes compared with early cord clamping. Neonates in the delayed cord clamping group showed significantly higher hemoglobin concentration, hematocrit levels, RBC count, and serum ferritin levels, with a lower incidence of neonatal anemia during follow-up. Delayed cord clamping was not associated with increased maternal blood loss, postpartum hemorrhage, or prolongation of the third stage of labour. Therefore, delayed cord clamping represents a safe, simple, and cost-effective intervention that can be incorporated into routine obstetric practice to

enhance neonatal iron status and overall health outcomes.

Limitations

The study was conducted among term singleton pregnancies; therefore, the findings may not be directly applicable to preterm births or high-risk pregnancies. The follow-up duration was limited, and long-term outcomes such as neurodevelopmental status and infant iron status beyond early infancy were not evaluated.

References

1. Chaparro CM. Timing of umbilical cord clamping: effect on iron endowment of the newborn and later iron status. Nutr Rev. 2011;69(Suppl 1):S30-36.
2. McDonald SJ, Middleton P, Dowswell T, Morris PS. Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes. Cochrane Database Syst Rev. 2013;(7):CD004074.
3. American College of Obstetricians and Gynecologists Committee. Delayed umbilical cord clamping after birth. Am J Obstet Gynecol. 2020;136:100-106.
4. Hutton EK, Hassan ES. Late vs early clamping of the umbilical cord in full-term neonates: systematic review and meta-analysis of contr olled trials. JAMA. 2007;297(11):1241-1252.
5. Mercer JS, Vohr BR, McGrath MM, Padbury JF, Wallach M, Oh W. Delayed cord clamping in very preterm infants reduces the incidence of intraventricular hemorrhage and late-onset sepsis: a randomized controlled trial. Pediatrics. 2006;117(4):1235-1242.
6. Kc A, Rana N, Målqvist M, Jarawka Ranneberg L, Subedi K, Andersson O. Effects of delayed umbilical cord clamping in a rural Nepalese setting on neonatal outcomes and maternal postpartum hemorrhage: a randomized controlled trial. BMC Pregnancy Childbirth. 2016;16:319.
7. Tang J, Tan X, Huang H, et al. Effect of delayed umbilical cord clamping on neonatal hematological parameters and maternal blood loss: a randomized controlled trial. J Matern Fetal Neonatal Med. 2021;34(19):3185-3191.
8. World Health Organization. Guideline: delayed umbilical cord clamping for improved maternal and infant health and nutrition outcomes. Geneva: World Health Organization; 2014.
9. Jaiswal J, et al. Effect of delayed cord clamping on neonatal hemoglobin and hematocrit levels: a randomized controlled study. Int J Reprod Contracept Obstet Gynecol. 2021;10(6):2268-2274.
10. Ceriani-Cernadas JM, Carroli G, Pellegrini L, Ferreira M, Ricci C, Casas O, et al. Effect of timing of umbilical cord clamping on neonatal hemoglobin and iron deficiency anemia. Arch Argent Pediatr. 2010;108(3):201-208.
11. Ranjit T, Nesargi S, Rao PN, Sahoo JP, Ashok C, Chandrakala BS, et al. Effect of delayed cord clamping on neonatal hematocrit and clinical outcomes. Indian J Pediatr. 2015;82(1):29-34.
12. Chiruvolu A, Daoud Y, Inzer RW. Effect of delayed cord clamping on hematocrit and neonatal outcomes. Early Hum Dev. 2018;124:22-25.