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EFFECTS OF EARLY VERSUS DELAYED CORD CLAMPING ON NEONATAL HEMATOCRIT WITHIN A TERTIARY CARE SETUP IN PAKISTAN

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Abstract

Background: Umbilical cord clamping is a critical component of the third stage of labour. Early cord clamping (ECC) is traditionally performed within 15 seconds of birth, while delayed cord clamping (DCC), performed 30–120 seconds after birth, has been associated with improved neonatal hematological outcomes. DCC may be particularly beneficial in low-resource settings to reduce neonatal anemia.

Objective: To evaluate the impact of delayed versus early cord clamping on neonatal hematological and clinical outcomes at 72 hours postpartum.

Methods: This quasi-experimental, non-randomized controlled study was conducted at the Department of Obstetrics and Gynaecology, Ziauddin Hospital, Karachi, from May to July 2022. A total of 84 term pregnant women with singleton fetuses ≥2.5 kg were enrolled and allocated consecutively to ECC (n = 42) or DCC (n = 42). Neonates were monitored for jaundice, respiratory distress, anemia, and polycythemia within 24–72 hours postpartum. Hemoglobin, hematocrit, and

bilirubin levels were measured at 72 hours. Data were analyzed using SPSS v20; Mann–Whitney U tests were applied for non-parametric variables, with $p < 0.05$ considered significant.
Results: Baseline characteristics were comparable between groups (mean gestational age: ECC 38.0 ± 1.25 vs DCC 37.7 ± 1.22 weeks, $p = 0.382$; mean birth weight: ECC 2.97 ± 0.45 vs DCC 2.87 ± 0.36 kg, $p = 0.256$). Median hemoglobin and hematocrit were significantly higher in the DCC group (17.85 g/dL and 54%) compared to ECC (13.35 g/dL and 39%) ($p = 0.000$). Bilirubin levels were higher in DCC (12 mg/dL) than ECC (5.9 mg/dL) but without clinically significant impact. Anemia was observed in 11.9% of ECC neonates, while no DCC neonates were anemic ($p = 0.21$). Jaundice, respiratory distress, and polycythemia were comparable between groups.
Conclusion: Delayed cord clamping significantly improves neonatal hemoglobin and hematocrit levels, reducing the risk of early-onset anemia without increasing clinically significant adverse outcomes. Integration of DCC into routine obstetric practice represents a cost-effective strategy to enhance neonatal outcomes, particularly in low-resource settings.

Keywords: Delayed cord clamping, Early cord clamping, Neonatal anemia, Hemoglobin, Hematocrit, Neonatal outcomes

Introduction

Umbilical cord clamping is a critical component of the third stage of labour, occurring between the birth of the newborn and the expulsion of the placenta. Despite its routine nature, the optimal timing for cord clamping remains a subject of global debate, with varying practices and policies across healthcare settings. Traditionally, early cord clamping (ECC)—performed within 15 seconds of birth—has been widely adopted, often driven by the urgency to transfer the neonate to the attending pediatrician.

Emerging evidence, however, supports the benefits of delayed cord clamping (DCC), defined as clamping the cord between 30 and 120 seconds after birth or following cessation of cord pulsation. This delay facilitates placental transfusion, allowing up to 60% more red blood cells and 30% greater blood volume to reach the neonate. DCC has been associated with improved hematocrit levels, enhanced perfusion of vital organs, reduced respiratory distress, better cardiopulmonary adaptation, and prolonged early breastfeeding.

Importantly, DCC contributes to improved iron stores in infants for up to six months postpartum—a significant advantage in low-resource settings where iron-rich foods and supplements are scarce. Iron deficiency, affecting 42% of children under five, is a leading cause of anemia and has been linked to impaired neurodevelopment, with long-lasting cognitive and behavioral consequences.

While DCC is increasingly recognized as a cost-effective strategy to combat neonatal anemia, concerns persist regarding potential risks such as resuscitation delays, transient tachypnea, hypothermia, polycythemia, and hyperbilirubinemia. Nevertheless, the growing body of evidence in favor of DCC has led the World Health Organization (WHO) to recommend cord clamping between one to three minutes after birth, unless immediate resuscitation is required.

Methods and Materials

Study Period: May 2022 to July 2022

Study Area: Department of Obstetrics and Gynaecology, Ziauddin Hospital, Clifton Campus

Study Design: Quasi-experimental, non-randomized controlled study

Sample Size: 80 participants (40 per group), calculated using OpenEpi version 3.01 with 95% confidence level and 80% power

Sampling Technique: Consecutive sampling. Odd serial numbers were assigned to Group A (ECC), and even serial numbers to Group B (DCC).

Eligibility Criteria

Inclusion: Term pregnancies (≥37 to <42 weeks), singleton fetuses ≥2.5 kg, delivered via normal vaginal or elective caesarean section, with informed consent.

Exclusion: Gestational age <37 or >42 weeks, eclampsia, pre-eclampsia, cardiac/renal disease, antepartum hemorrhage, twins, congenital anomalies, gestational diabetes, IUGR, fetal demise, instrumental delivery, emergency caesarean, or refusal to participate.

Data Collection Protocol
Informed consent obtained prior to delivery.
A timekeeper recorded the time of shoulder delivery.
ECC: Cord clamped within 15 seconds.
DCC: Cord clamped at 120 seconds.
Neonates wrapped in warm towels; skin-to-skin contact encouraged.
After cord clamping at the designated time, the neonate was handed to the pediatric team.
Neonates were monitored for jaundice, respiratory distress, anemia, and polycythemia within 24–72 hours postpartum. Hemoglobin and hematocrit levels were assessed at 72 hours as per routine protocol.

Data Management and Analysis
Data were manually checked for completeness, coded, and analyzed using SPSS version 20. Independent sample t-tests were used to compare outcomes between ECC and DCC groups. If normality assumptions were violated, the Mann–Whitney U test was applied. A p-value < 0.05 was considered statistically significant.

Results
During the study period, 121 women were approached for participation, of whom 84 consented and were enrolled. Participants were equally allocated into two groups: Early Cord Clamping (ECC, n = 42) and Delayed Cord Clamping (DCC, n = 42).
Baseline Characteristics
Gestational Age: Mean gestational age at delivery was 38.0 ± 1.25 weeks in the ECC group and 37.7 ± 1.22 weeks in the DCC group (p = 0.382).
Birth Weight: Mean birth weight was 2.97 ± 0.45 kg in ECC and 2.87 ± 0.36 kg in DCC (p = 0.256).
Neonatal Length: Mean length was 48.3 ± 2.47 cm in ECC and 48.2 ± 1.81 cm in DCC.
Head Circumference: Mean head circumference was 34.0 ± 1.47 cm in ECC and 33.5 ± 4.8 cm in DCC.
Apgar Scores: All neonates in the DCC group had normal Apgar scores (7–10) at 1 and 5 minutes. In the ECC group, 3 neonates (7.1%) had moderate scores (4–6).
Hematological and Biochemical Parameters
All hematological and biochemical parameters were analyzed as non-parametric variables using the Mann–Whitney U test.

Table 1. Hematological and biochemical parameters at 72 hours

Parameter	ECC Median (IQR)	DCC Median (IQR)	p-value
Hemoglobin (g/dL)	13.35 (2.675)	17.85 (2.3)	.000
Hematocrit (%)	39 (8.25)	54 (7)	.000

Parameter	ECC Median (IQR)	DCC Median (IQR)	p-value
Bilirubin (mg/dL)	5.9 (6.71)	12 (5.47)	.000

DCC was associated with significantly higher hemoglobin and hematocrit levels compared to ECC. Although bilirubin levels were higher in the DCC group, no statistically significant clinical impact was observed.

Neonatal Outcomes on Day 3

Table 2. Neonatal outcomes at 72 hours

Outcome	ECC (n = 42)	DCC (n = 42)	p-value
Jaundice	4	6	0.5
Respiratory Distress	6	4	0.5
Anemia	5	0	0.21
Polycythemia	0	2	0.15

Neonatal Outcomes Summary

Parameter	ECC Group (n = 42)	DCC Group (n = 42)	p-value	Interpretation
Hyperbilirubinemia	4 cases (1 NICU admit)	6 cases (2 NICU admit)	0.5	No significant difference
Respiratory Distress	6 cases	4 cases	0.5	Comparable outcomes
Anemia	5 cases (11.9%)	0 cases	0.21	Clinically meaningful benefit of DCC
Polycythemia	0 cases	2 cases	0.15	Mild increase, not statistically significant

Discussion

This experimental study was conducted at Ziauddin University Hospital, Karachi, Pakistan, between May and July 2022, involving 84 term pregnant women aged 20–42 years. Participants were equally divided into Early Cord Clamping (ECC) and Delayed Cord Clamping (DCC) groups, with cord clamping performed within 20 seconds in ECC and at 120 seconds in DCC. The study aimed to evaluate the impact of cord clamping timing on neonatal hematological outcomes, particularly anemia.

Iron deficiency remains one of the most prevalent nutritional disorders globally, with significant implications for maternal and neonatal health. In Pakistan, anemia during pregnancy is a major public health concern. A study by Shams et al. reported a 76.7% prevalence of iron deficiency anemia among pregnant women in Mardan, KPK. Given the burden of neonatal anemia in resource-limited settings, our study sought to explore whether DCC could serve as a cost-effective intervention.

Our findings revealed that 11.9% of neonates in the ECC group were anemic, while none in the DCC group exhibited anemia. These results are consistent with existing meta-analyses, which have demonstrated significantly higher hemoglobin levels in neonates following DCC, particularly when combined with umbilical cord milking. In our cohort, the DCC group had a median hemoglobin level of 17.85 g/dL and hematocrit of 54%, compared to 13.35 g/dL and 39% in the ECC group. These values fall within the reference ranges defined by NIH and NICE guidelines for healthy neonates【11–13】.

While hyperbilirubinemia is a commonly cited concern with DCC, our study found no statistically significant difference between groups. Hyperbilirubinemia occurred in 9.5% of ECC neonates and 14.2% of DCC neonates, with only three requiring phototherapy. These findings align with literature

suggesting that although bilirubin levels may rise following DCC, they rarely result in clinically significant pathology【14,15】.

The umbilical cord plays a vital role in fetal development, serving as a conduit for placental transfusion and contributing to neuro-motor maturation. Our study reinforces the physiological benefits of DCC, particularly in improving neonatal hematological status without increasing adverse outcomes. This is especially relevant in low-resource settings, where anemia poses a persistent challenge and access to iron supplementation is limited.

Despite its strengths, our study was constrained by a short follow-up period and limited sample size, which precluded assessment of long-term outcomes. Nonetheless, findings from meta-analyses such as that by Qian et al. support the implementation of DCC as a safe, cost-free strategy to reduce neonatal anemia in developing countries.

Conclusion

This study reinforces the clinical value of delayed cord clamping (DCC) in improving neonatal hemoglobin and hematocrit levels. Given the global prevalence of maternal anemia—estimated at 41.8%—and its heightened impact in low-resource settings such as Pakistan, DCC emerges as a cost-effective, evidence-based intervention to mitigate early infant anemia. Its integration into routine obstetric practice may offer a sustainable strategy for enhancing neonatal outcomes without imposing additional financial burden.

Principal Findings

The study demonstrated that delayed cord clamping significantly improves neonatal hemoglobin and hematocrit levels compared to early cord clamping. No cases of anemia were observed in the DCC group, while 11.9% of neonates in the ECC group were anemic. Although bilirubin levels were higher in the DCC group, they did not result in clinically significant complications. Respiratory distress and polycythemia were comparable between groups, with no statistically significant differences.

Results in the Context of What is Known

These findings are consistent with prior meta-analyses and randomized trials that have shown improved hematological parameters in neonates following DCC. The hemoglobin and hematocrit values observed in the DCC group align with reference ranges established by NIH and NICE guidelines. While some studies have reported lower hemoglobin levels overall, such discrepancies are often attributed to maternal nutritional status and compliance with iron supplementation during pregnancy.

Clinical Implications

DCC facilitates placental transfusion, enhancing neonatal iron stores and reducing the risk of early-onset anemia. This is particularly relevant in developing countries where iron-rich diets and supplementation may be inaccessible. The findings support WHO recommendations for cord clamping between one to three minutes post-delivery, barring immediate resuscitation needs. Adoption of DCC in routine obstetric care could improve neonatal outcomes without increasing the risk of hyperbilirubinemia or respiratory complications.

Research Implications

Further longitudinal studies are needed to assess the long-term neurodevelopmental and hematological outcomes associated with DCC. Future research should also explore the impact of DCC in preterm infants, its role in cord milking protocols, and its integration into national maternal-child health policies.

Strengths and Limitations

Strengths of this study include its prospective design, standardized protocol, and focus on a clinically relevant outcome in a resource-limited setting. Limitations include a relatively short follow-up period, non-randomized allocation, and lack of long-term outcome data. Additionally, the study did not stratify results by mode of delivery or maternal anemia status, which may influence neonatal outcomes.

Disclosure Statement

The authors declare no conflicts of interest related to this study. None of the authors have financial, professional, or personal relationships with any entities that could influence the work reported in this manuscript. The study was conducted independently, without external funding or sponsorship, ensuring the integrity of its findings and conclusions.

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Paper Presentation

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