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Impact of Delayed Cord Clamping on Neurodevelopmental Outcomes at 2 Years in Preterm Infants

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ABSTRACT

Background: To assess the effect of delayed versus early cord clamping on neurodevelopmental outcomes at two years of age in preterm infants.

Methods: This study was carried out at People's University of Medical and Health Sciences Nawabshah between June 2023 and June 2024. 73 preterm infants born at < 37 weeks of gestation were included. Participants were divided into DCC (≥30 seconds) and ECC (<30 seconds) groups based on the timing of cord clamping. Some of the outcomes were 'recorded immediately and neurodevelopmental outcomes were assessed at 24 months with the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III)'. The differences of the groups were analyzed using appropriate statistical methods, and a p-value <0.05 was considered significant.

Results: Infants in the DCC group had significantly higher hemoglobin levels at 24 hours ($p < 0.001$) and lower rates of blood transfusion ($p = 0.014$) and intraventricular hemorrhage ($p = 0.037$). At two years, DCC infants showed significantly better cognitive ($p = 0.032$) and motor scores ($p = 0.045$). Language delay and cerebral palsy were lower in the DCC group, though not statistically significant.

Conclusion: Delayed cord clamping is associated with favorable hematological and neurodevelopmental outcomes in preterm infants. Its implementation in delivery practices may contribute to improved long-term developmental trajectories in this vulnerable population

Keywords: *Delayed cord clamping, preterm infants, neurodevelopment, Bayley-III, intraventricular hemorrhage, cognitive outcomes, neonatal care.*

1. INTRODUCTION

Preterm birth remains a leading cause of neonatal morbidity and mortality worldwide, with survivors often facing challenges related to neurological and developmental health. Among the various strategies aimed at improving early outcomes, delayed cord clamping (DCC) has gained attention for its potential to enhance placental transfusion, stabilize circulatory parameters, and reduce complications in preterm neonates [1-3].

The transition from intrauterine to extrauterine life is particularly fragile in preterm infants. Immediate cord clamping (ECC), traditionally practiced for decades, may compromise blood volume and oxygen delivery during this critical period. In

contrast, DCC allows continued blood flow from the placenta, which may enhance neonatal hemodynamics and reduce the risk of intraventricular hemorrhage (IVH), anemia, and subsequent need for transfusion. 'While several studies have explored these early benefits, limited data exist on the long-term neurodevelopmental impact of DCC, especially in low-resource or regional healthcare settings' [4-6].

This study was designed to assess whether delayed cord clamping influences neurodevelopmental outcomes at two years of age in preterm infants, using a structured and standardized evaluation [7, 8]. By comparing outcomes between infants who underwent DCC and those who received ECC, we aimed to contribute meaningful evidence to support safe and effective practices in neonatal care.

2. METHODOLOGY

This prospective observational study was conducted over a one-year period, from June 2023 to June 2024, at People's University of Medical and Health Sciences Nawabshah. The primary objective was to evaluate the effect of delayed cord clamping (DCC) on neurodevelopmental outcomes at two years of age in preterm infants.

A total of 73 preterm infants born before 37 completed weeks of gestation were enrolled in the study. Eligibility criteria included live-born preterm neonates delivered in the hospital and followed up regularly at the pediatric outpatient clinic. Infants with major congenital anomalies, chromosomal abnormalities, or those who died before hospital discharge were excluded. Written informed consent was obtained from parents or legal guardians before enrollment.

Participants were divided into two groups based on the timing of umbilical cord clamping:

Delayed Cord Clamping (DCC): Clamping performed ≥30 seconds after birth.

Early Cord Clamping (ECC): Clamping performed within 30 seconds of birth.

The timing was determined by the delivery team and documented immediately after birth. Both groups were otherwise managed using standard neonatal care protocols.

At birth, baseline information including gestational age, birth weight, gender, mode of delivery, Apgar scores, maternal age, and antenatal steroid use was recorded. Early neonatal outcomes such as hemoglobin levels at 24 hours, need for blood transfusions, intraventricular hemorrhage (IVH), sepsis, necrotizing enterocolitis (NEC), and respiratory distress syndrome (RDS) were monitored during the hospital stay. IVH was diagnosed using cranial ultrasonography, and sepsis was confirmed through clinical and microbiological evidence.

Infants were followed up regularly until the age of two years. At the 24-month follow-up visit, neurodevelopmental evaluation was performed using the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III). Assessments were conducted by a trained pediatric neurologist blinded to the cord clamping status. Domains assessed included cognitive, motor, and language development. In addition, screening 'for cerebral palsy, hearing loss, and visual impairment was also performed using standard clinical criteria and referral where needed'.

'Neurodevelopmental delay was defined as a score of <85 in any domain. Severe delay was considered when scores were <70. Any child with a diagnosis of cerebral palsy, sensorineural hearing loss, or significant visual impairment was recorded accordingly'.

Data analysis was performed using SPSS version 25.0. Continuous variables were presented as 'mean ± standard deviation and compared using the independent t-test'. Categorical variables were expressed as frequencies and percentages, and associations between groups were tested using the chi-square or Fisher's exact test, where appropriate. A p-value <0.05 was considered statistically significant.

3. RESULTS

A total of 73 preterm infants were included in the study, with 38 receiving delayed cord clamping (DCC) and 35 undergoing early cord clamping (ECC). Both groups were comparable in terms of demographic and clinical characteristics. The mean gestational age in the DCC group was 31.4 ± 2.1 weeks, while it was 31.1 ± 1.9 weeks in the ECC group ($p = 0.418$). Birth weights were also similar, with a slightly higher mean in the DCC group (1585 ± 320 g) compared to the ECC group (1490 ± 295 g), but this difference was not statistically significant ($p = 0.221$). There was no significant difference in gender distribution, mode of delivery, antenatal steroid administration, or maternal age across both groups, confirming well-matched baseline profiles.

Table 1: Baseline Demographic and Clinical Characteristics of Preterm Infants (n = 73)

Variable	Delayed Cord Clamping (n=38)	Early Cord Clamping (n=35)	p-value
Mean Gestational Age (weeks)	31.4 ± 2.1	31.1 ± 1.9	0.418
Mean Birth Weight (grams)	1585 ± 320	1490 ± 295	0.221
Male Gender	22 (57.9%)	19 (54.3%)	0.761
Cesarean Delivery	25 (65.8%)	23 (65.7%)	0.991
Antenatal Steroids Given	33 (86.8%)	30 (85.7%)	0.891
Maternal Age (years)	28.6 ± 4.3	27.9 ± 4.7	0.532

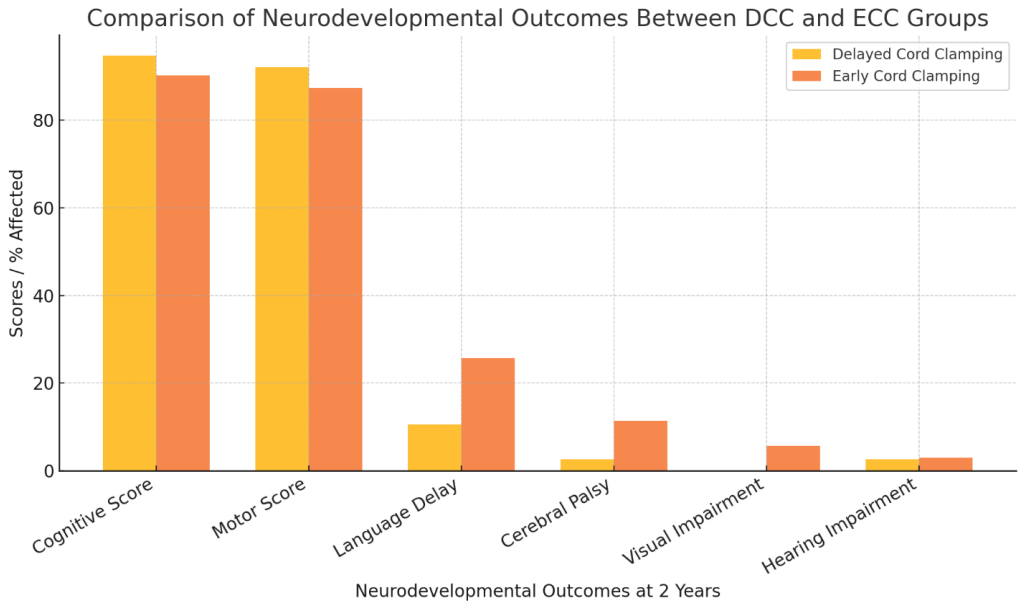
When evaluating early neonatal outcomes, infants in the DCC group had significantly higher mean hemoglobin levels at 24 hours of life '(16.9 ± 1.4 g/dL) compared to those in the ECC group (15.1 ± 1.3 g/dL, $p < 0.001$)'. Furthermore, the need for blood transfusion during NICU stay was significantly lower in the DCC group (15.8% vs 40.0%, $p = 0.014$). The incidence of intraventricular hemorrhage (IVH) was also significantly reduced in infants who had delayed cord clamping (7.9% vs 25.7%, $p = 0.037$). Although rates of sepsis, necrotizing enterocolitis (NEC), and respiratory distress syndrome (RDS) were lower in the DCC group, the differences were not statistically significant.

Outcome	Delayed Cord Clamping (n=38)	Early Cord Clamping (n=35)	p-value
Hemoglobin at 24 hrs (g/dL)	16.9 ± 1.4	15.1 ± 1.3	<0.001
Blood Transfusion Required	6 (15.8%)	14 (40%)	0.014
Intraventricular Hemorrhage	3 (7.9%)	9 (25.7%)	0.037
Sepsis	7 (18.4%)	10 (28.6%)	0.311
NEC	2 (5.3%)	4 (11.4%)	0.393
Respiratory Distress Syndrome	10 (26.3%)	13 (37.1%)	0.316

At two-year follow-up, neurodevelopmental outcomes were evaluated using Bayley Scales of Infant Development. The DCC group had significantly better cognitive scores (mean 94.8 ± 7.6 vs 90.2 ± 9.1, $p = 0.032$) and motor scores (92.1 ± 8.3 vs 87.4 ± 10.2, $p = 0.045$) compared to the ECC group. Although language delay was lower in the DCC group (10.5% vs 25.7%), this did not reach statistical significance ($p = 0.097$). Similarly, lower frequencies of cerebral palsy, hearing loss, and visual impairment were observed in the DCC group, but these differences were not statistically significant, likely due to limited sample size.

Neurodevelopmental Outcome	Delayed Cord Clamping (n=38)	Early Cord Clamping (n=35)	p-value
Mean Cognitive Score (Bayley-III)	94.8 ± 7.6	90.2 ± 9.1	0.032
Mean Motor Score (Bayley-III)	92.1 ± 8.3	87.4 ± 10.2	0.045
Language Delay (<85 Score)	4 (10.5%)	9 (25.7%)	0.097
Cerebral Palsy	1 (2.6%)	4 (11.4%)	0.165
Visual Impairment	0 (0%)	2 (5.7%)	0.221
Hearing Impairment	1 (2.6%)	1 (2.9%)	0.943

Figure 1: bar graph comparing neurodevelopmental outcomes at 2 years between the Delayed Cord Clamping (DCC) and Early Cord Clamping (ECC) groups.



4. DISCUSSION

The present study aimed to evaluate whether delayed cord clamping (DCC) offers any measurable advantages over early cord clamping (ECC) in terms of neurodevelopmental outcomes in preterm infants at two years of age. Our findings indicate that DCC was associated with significantly better cognitive and motor scores, as well as a lower incidence of early complications such as intraventricular hemorrhage (IVH) and the need for blood transfusions. These results align with growing evidence that DCC may play a neuroprotective role in preterm neonates [9-11].

Higher hemoglobin levels observed at 24 hours in the DCC group are consistent with the physiologic benefits of placental transfusion. These findings corroborate the conclusions of studies demonstrated that infants with delayed cord clamping tend to have better hematologic indices and reduced transfusion requirements in the neonatal period [12-14]. Similarly, a studies reported improved cardiovascular stability and lower IVH rates in infants who underwent DCC [15, 16].

One of the notable outcomes in our study was the significantly reduced rate of IVH in the DCC group. This supports the hypothesis that improved circulatory stability, resulting from enhanced placental blood flow, may reduce fluctuations in cerebral perfusion, thereby lowering the risk of hemorrhage. Studies reported similar findings, with a reduced incidence of severe IVH and late-onset sepsis in preterm infants who received delayed clamping [17, 18].

At two years of age, neurodevelopmental scores in both cognitive and motor domains were significantly better among infants who underwent DCC. Although the differences in language delay and rates of cerebral palsy did not reach statistical significance, the trend still favored the DCC group. These findings resonate with studies, who showed sustained cognitive benefits in children exposed to delayed clamping, particularly among boys [19].

It is important to note that while the differences in some secondary outcomes (NEC, sepsis, RDS) were not statistically significant, the overall trend still leaned in favor of the DCC group. The lack of statistical significance may be attributed to the limited sample size, a common limitation in neonatal outcome studies.

Moreover, consistent follow-up until two years of age and standardized neurodevelopmental assessment using Bayley-III strengthens the reliability of our findings. However, limitations such as single-center design, non-random allocation, and lack of long-term neuropsychological evaluation beyond age two must be acknowledged.

5. CONCLUSION

Delayed cord clamping in preterm infants is associated with multiple short- and long-term benefits, including higher initial hemoglobin levels, reduced transfusion and IVH rates, and improved neurodevelopmental outcomes at two years of age.

These conclusions bolster prior recommendations supporting DCC as a cost-efficient and non-invasive intervention that may beneficially impact both survival and development in this population with high-risk infants. Further implementation and ongoing surveillance in larger multisite studies may aid in establishing DCC as a standard intervention in the management of preterm neonates

REFERENCES

[1] Berg, J.H.M., et al., Effect of delayed cord clamping on neurodevelopment at 3 years: a randomized controlled trial. 2021. 118(3): p. 282-288.

[2] Armstrong-Buisseret, L., et al., Randomised trial of cord clamping at very preterm birth: outcomes at 2 years. 2020. 105(3): p. 292-298.

[3] Xodo, S., et al., Does delayed cord clamping improve long-term (≥ 4 months) neurodevelopment in term Babies? A systematic review and a meta-analysis of randomized clinical trials. 2021. 9: p. 651410.

[4] Robledo, K.P., et al., Effects of delayed versus immediate umbilical cord clamping in reducing death or major disability at 2 years corrected age among very preterm infants (APTS): a multicentre, randomised clinical trial. 2022. 6(3): p. 150-157.

[5] Seidler, A.L., et al., Deferred cord clamping, cord milking, and immediate cord clamping at preterm birth: a systematic review and individual participant data meta-analysis. 2023. 402(10418): p. 2209-2222.

[6] El-Naggar, W., et al., Neurodevelopmental outcomes of very preterm infants who received cord milking at birth: a randomized controlled trial. 2022. 181(12): p. 4215-4220.

[7] Chaudhary, P., et al., Effects of delayed cord clamping at different time intervals in late preterm and term neonates: a randomized controlled trial. 2023. 182(8): p. 3701-3711.

[8] Mercer, J.S., et al., The effects of delayed cord clamping on 12-month brain myelin content and neurodevelopment: a randomized controlled trial. 2022. 39(01): p. 037-044.

[9] Kumbhat, N., et al., Umbilical cord milking vs delayed cord clamping and associations with in-hospital outcomes among extremely premature infants. 2021. 232: p. 87-94. e4.

[10] Bruckner, M., A.C. Katheria, and G.M. Schmölzer. Delayed cord clamping in healthy term infants: More harm or good? in Seminars in Fetal and Neonatal Medicine. 2021. Elsevier.

[11] Jeevan, A., et al., Umbilical cord milking versus delayed cord clamping in term and late-preterm infants: a systematic review and meta-analysis. 2022. 35(25): p. 5478-5488.

[12] Balasubramanian, H., et al., Umbilical cord milking in preterm infants: a systematic review and meta-analysis. 2020. 105(6): p. 572-580.

[13] Katheria, A., et al., Umbilical cord milking versus delayed cord clamping in infants 28 to 32 weeks: a randomized trial. 2023. 152(6): p. e2023063113.

[14] Mina, N.S. and A.K.J.H.N. Mohammed, Effects of delayed neonate cord clamping on oxygen saturation, Apgar Score, and respiratory distress syndrome at Maternity Teaching Hospital in Sulaimani City. 2023. 23(1): p. 962-968.

[15] Kilicdag, H., et al., Umbilical cord management in late preterm and term infants: a randomized controlled trial. 2022. 39(12): p. 1308-1313.

[16] Gire, C., et al., Impact of early hemoglobin levels on neurodevelopment outcomes of two-year-olds in very preterm children. 2023. 10(2): p. 209.

[17] Isacson, M., et al., Neurodevelopmental outcomes of a randomised trial of intact cord resuscitation. 2021. 110(2): p. 465-472.

[18] Jasani, B., et al., Association of umbilical cord management strategies with outcomes of preterm infants: a systematic review and network meta-analysis. 2021. 175(4): p. e210102-e210102.

[19] Gomersall, J., et al., Umbilical cord management at term and late preterm birth: a meta-analysis. 2021. 147(3): p. e2020015404..