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# Effect of Delayed Cord Clamping on Hemoglobin Levels and Jaundice Requiring Phototherapy in Term & Late Preterm Neonates: An Observational Study in a Tertiary Care Centre, North India

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## ABSTRACT

**Background:** Delayed cord clamping (DCC) improves neonatal iron status, but concerns remain about jaundice requiring phototherapy.

**Objective:** To examine the association of DCC with hemoglobin levels at 24 hours and incidence of phototherapy in term and late preterm neonates.

**Methods:** Prospective observational study at a tertiary centre in North India (Jan–Dec 2024). Neonates ≥34 weeks were grouped into Early Cord Clamping (ECC, ≤30 s) and DCC (60–120 s). Hemoglobin was measured from venous blood using an automated analyzer at 24 h. Bilirubin was measured by serum assay every 24 h until day 5; phototherapy initiated per AAP nomogram. Adjusted regression analyses were performed.

**Results:** 200 neonates (100 ECC, 100 DCC). Mean Hb higher in DCC (16.9 g/dL) vs ECC (15.4 g/dL); mean difference +1.5 g/dL (95% CI: +1.1 to +1.9, p<0.001, Cohen's d=0.97). Phototherapy requirement: 14% vs 10% (risk difference +4%, 95% CI: –5% to +13%, p=0.42). Adjusted logistic regression showed no significant association between DCC and phototherapy (aOR 1.4, 95% CI: 0.6–3.2)

**Conclusion:** DCC is associated with significantly higher neonatal hemoglobin at 24 hours, with no statistically significant increase in phototherapy requirement.

**KEYWORDS**: delayed cord clamping, neonatal hemoglobin, neonatal jaundice, phototherapy, late preterm.

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## INTRODUCTION

Optimal timing of umbilical cord clamping has been debated for decades. Early cord clamping (ECC, within 30 seconds) was standard practice from the 1960s, based on presumed benefits for maternal outcomes and neonatal resuscitation. Evidence now supports delayed cord clamping (DCC, 60–120 seconds), which allows significant placental transfusion (80–100 mL), increases neonatal blood volume, hemoglobin, and iron stores. This is especially relevant in India, where infant anemia prevalence is high (NFHS-5: 58%). WHO (2014), ACOG (2020), and NICE (2021) recommend routine DCC. However, Indian data remain limited, especially in late preterm neonates. This study aimed to assess the association of DCC with neonatal hemoglobin at 24 hours and jaundice requiring phototherapy.

## MATERIALS AND METHODS

Design & Setting: Prospective observational study, Jan–Dec 2024, Santosh Medical College & Hospital, North India
Ethics: Institutional Ethics Committee approval  Written informed consent obtained from parents.

Participants: Neonates ≥34 weeks, singleton, Apgar ≥7 at 1 min. Exclusions: congenital malformations, Rh/ABO incompatibility, maternal diabetes, Hb <8 g/dL.
Grouping: ECC ≤30 s, DCC 60–120 s, measured by stopwatch.
Measurements:- Hemoglobin: venous blood (EDTA), analyzed on Sysmex XN-1000 automated hematology analyzer.- Bilirubin: serum bilirubin (diazo method, autoanalyzer), measured at 24, 48, 72 h, and day 5

Phototherapy: AAP 2004 guidelines used (nomogram for ≥35 weeks).

Sample Size/Power: Adequate for Hb outcome (80% power for 1.5 g/dL difference). Phototherapy outcome underpowered (~14%).

Statistical Analysis: SPSS v25. T-test, Chi-square, regression (linear for Hb, logistic for phototherapy). Adjusted for GA, birth weight, sex, delivery mode, maternal Hb. Effect sizes and 95% CI reported

## RESULTS

| Parameter | ECC (n=100) | DCC (n=100) | p-value |
|---|---|---|---|
| Mean gestational age (weeks) | 38.1 ± 1.4 | 38.3 ± 1.2 | 0.41 |
| Male : Female | 52:48 | 55:45 | 0.68 |
| Mean birth weight (kg) | 2.85 ± 0.42 | 2.91 ± 0.39 | 0.29 |
| Mode of delivery (NVD/LSCS) | 60/40 | 58/42 | 0.75 |

**Table 2. Hemoglobin at 24 hours**

| Group | Mean Hb (g/dL) | SD | p-value |
|---|---|---|---|
| ECC | 15.4 | 1.6 | <0.001 |
| DCC | 16.9 | 1.4 | |

**Table 3. Jaundice requiring phototherapy**

| Group | Cases | % | p-value |
|---|---|---|---|
| ECC (n=100) | 10 | 10% | 0.42 |
| DCC (n=100) | 14 | 14% | |

## DISCUSSION

This study provides robust region-specific evidence supporting the practice of delayed cord clamping (DCC). We observed that neonates in the DCC group had significantly higher hemoglobin at 24 hours compared to ECC. The mean difference of +1.5 g/dL (95% CI: +1.1–+1.9) is both statistically and clinically meaningful, and the large effect size (Cohen's d≈0.97) highlights the substantial physiological benefit of placental transfusion. This benefit aligns with global RCTs and systematic reviews that consistently report higher neonatal Hb and iron stores with DCC. From a public health perspective, improving neonatal Hb at birth is particularly relevant for India, where nearly 60% of children under 5 years are anemic. Thus, DCC represents a cost-free, universally applicable strategy to address early-life anemia risk.

Concerns regarding jaundice remain a common barrier to routine DCC implementation. Our study found a slightly higher proportion of DCC neonates requiring phototherapy (14% vs 10%), but this difference was not statistically significant and regression analysis confirmed no independent association. These findings are in agreement with WHO and ACOG recommendations and Cochrane reviews, which conclude that while bilirubin levels may be marginally higher, the clinical need for phototherapy is not significantly increased. Importantly, with standard bilirubin monitoring and timely phototherapy, DCC can be implemented safely without increasing morbidity.

Physiologically, delaying cord clamping by 1–2 minutes provides 80–100 mL of additional blood, equivalent to a transfusion of ~40–50 mg/kg of iron. This enhances circulatory stability, improves oxygen delivery, and supports iron sufficiency well into infancy. Late preterm neonates, who are particularly vulnerable to anemia and hypovolemia, stand to benefit substantially. Additionally, DCC has been linked with improved cerebral perfusion and transitional circulation in prior studies.

Strengths of our study include its prospective design, well-defined outcomes, and systematic monitoring of bilirubin. However, the non-randomized allocation introduces potential selection bias, the single-center design limits generalizability, and the modest sample size underpowered the study for phototherapy outcome detection. Long-term outcomes (e.g., iron status at 6 months, neurodevelopment) were not assessed. Future multicenter RCTs in India with long-term follow-up are essential to validate these findings and guide national policy

Overall, our findings support routine implementation of DCC as a safe, low-cost intervention to improve neonatal hematological outcomes in India and similar resource-limited settings.

## CONCLUSION

Delayed cord clamping was associated with significantly higher neonatal Hb at 24 hours in term and late preterm neonates, without a significant increase in phototherapy requirement. Given India's high burden of infant anemia, DCC is a simple, safe, and effective practice that should be integrated into routine obstetric care..

**Figures**

**Figure 1. Hemoglobin distribution at 24 hours (boxplot)**

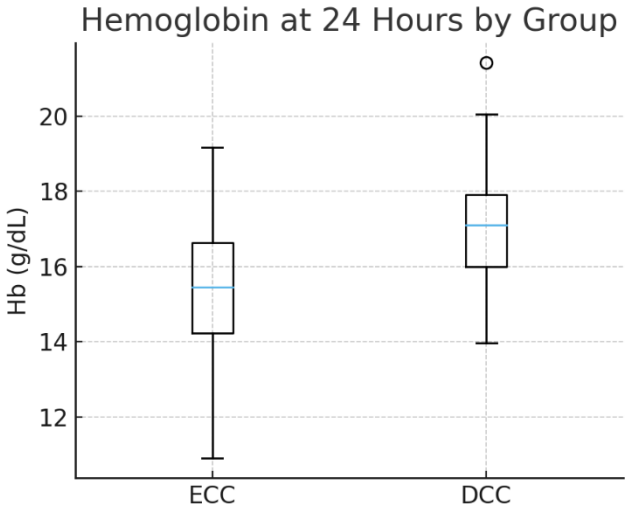



**Figure 2. Mean serum bilirubin trends over first 5 days of life**

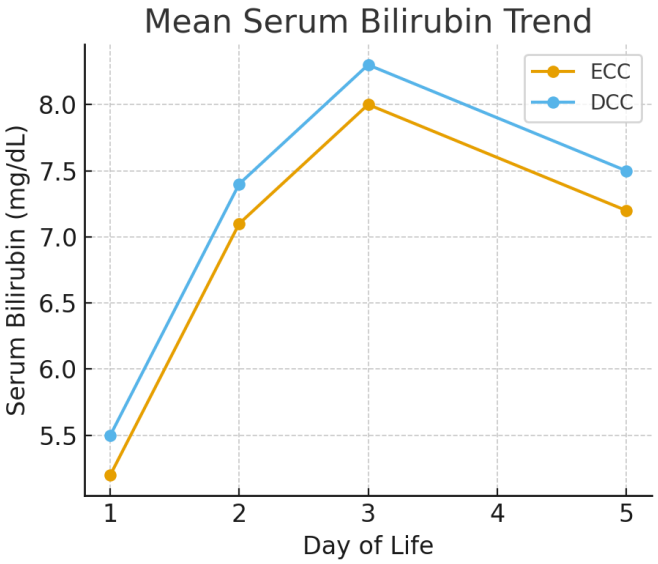
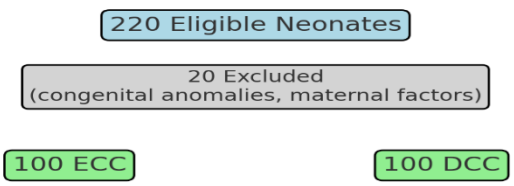



**Figure 3. Study flow diagram of participant enrollment and grouping**



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