



Research Article

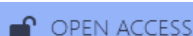
DELAYED CORD CLAMPING AND ITS EFFECT ON SERUM BILIRUBIN LEVEL: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

In high- and low-resource environments, it is advised to postpone cord clamping in healthy term infants for at least 60 and 180 seconds, respectively, as this enhances neurodevelopment, cardio respiratory stability immediately after birth and reduces the likelihood of anaemia and iron deficiency. Hemodynamic measures like cerebral oxygenation, heart rate, cardiac output, and peripheral arterial oxygen saturation.

AIMS AND OBJECTIVES: To assess delayed cord clamping at 3 minutes and their effects on serum bilirubin level.

METHODOLOGY: Time of birth was noted and babies were positioned between the mother's abdomen (for babies delivered through vaginal route) or on the mother's thigh (for babies delivered by caesarean section). Umbilical cord was clamped and cut 2-3 cm distance from the umbilical stump at 3 minutes of life. The timing of delayed clamping at 3 minutes was measured by a stop clock. At 24 and 72 hours of life, one ml of venous sample was obtained from the baby for estimation of hemoglobin and hematocrit using Sysmex KX21 cellcounter and serum bilirubin level was assessed by Diazo method using ROBONIK semi analyzer. Babies were started on phototherapy when their serum bilirubin level were in the phototherapy range. All the study neonates were daily assessed for clinical jaundice till discharge and serum bilirubin was measured if clinical assessment of jaundice is significant.

RESULTS: The mean gestational age of babies in our study was 38.51 ± 0.89 weeks. Mean total serum bilirubin in our study population at 24 hours was $0.94 \pm 0.6\text{mg/dL}$ and at 72 hours was $6.62 \pm 5.52\text{mg/dL}$. Mean hemoglobin concentration of the neonates at 24 hours was $16.61 \pm 0.95\text{gm/dL}$ and at 72 hours after delivery was $16.38 \pm 0.97\text{gm/dL}$. Mean hematocrit of the neonates at 24 hours was $49.52 \pm 2.91\%$ and at 72 hours after delivery was $48.95 \pm 2.9\%$. There was no significant difference in mean bilirubin level according to gender and mode of delivery. The mean serum total bilirubin level was statistically significantly high in low birth weight babies at 72 hours after delivery. In our study the incidence of hyperbilirubinemia was 44%. Only 1.1% of the babies required phototherapy for neonatal jaundice at 72 hours of life ($p < 0.962$) that is statistically not significant.

CONCLUSION: Delayed Cord Clamping (DCC) does not increase the incidence of hyperbilirubinemia, need for phototherapy and chance of polycythemia.

Keywords: delayed cord clamping, bilirubin, haematocrit, phototherapy, neonatal jaundice

INTRODUCTION

Umbilical cord clamping is considered early if it occurs within one minute of birth and late if it occurs more than five minutes following birth. Within the first three minutes of life, the placenta distributes 80–100 mL of blood to the baby, causing a shift in the baby's blood volume.^{1,2} Within the first few breaths, healthy term newborns were able to transport

up to 90% of their blood volume.^{3,4} The early findings and lack of explicit advice on the best time to clip the umbilical cord led to a shortening of the gap between delivery and clamping, and it became routine practice to do so within 15-20 seconds, typically, following birth.⁵⁻⁷

Babies, whether born prematurely or at full term, seem to benefit from delayed umbilical cord clamping. A possible benefit to developmental outcomes in full-term infants may result from delayed umbilical cord clamping, which raises hemoglobin levels at delivery and enhances iron storage in the first few months of life⁸⁻¹¹. Fewer neonates need transfusions and fewer cases of intraventricular hemorrhage and necrotizing enterocolitis occur in preterm infants when the umbilical cord is clamped later¹². Delaying umbilical cord clamping in both full-term and premature infants has been recommended by several professional organizations in light of this mounting data. Clamping the umbilical cord before one minute after birth is not recommended by the World Health Organization for term or preterm babies who do not need positive pressure breathing^{13,14}.

Most active term and preterm children should have their umbilical cords delayed for 30-60 seconds, according to recent guidelines from the American Academy of Pediatrics' Neonatal Resuscitation Programme. Additionally, it is recommended by the Royal College of Obstetricians and Gynaecologists to wait at least 2 minutes after birth before clamping the umbilical cord, even for healthy preterm and term infants. Also, for the first two to five minutes following birth, both full-term and premature babies should not have their umbilical cord clamped, according to the American College of Nurse-Midwives¹⁵.

By one minute after birth, term newborns undergo a placental blood transfer of about 80 mL, which increases to about 100 mL by three minutes after birth, according to physiological studies. It seems that the placental transfusion is facilitated by the first breaths that a newborn takes¹⁶.

Even in high-income nations, iron insufficiency in children is widespread, with rates ranging from 5–25%. This is especially true in low-income countries. The transfer of immunoglobulins and stem cells, which are vital for tissue and organ repair, is also made easier with a prolonged duration of placental transfusion after birth. Because of the high prevalence of cellular damage, inflammation, and organ failure following preterm delivery, stem cell and immunoglobulin transplantation may be an effective treatment. Additional research is needed to determine the extent of these advantages, but this innate supply of hematopoietic and pluripotent stem cell lines could have therapeutic benefits for the baby in the future^{16,17}.

It is concerning that delayed umbilical cord clamping has been universally used. Particularly in premature newborns, a delay in umbilical cord clamping could postpone the commencement of necessary resuscitation procedures^{15,16}. Additional blood volume from continuous placental transfusion is likely to assist unwell and preterm infants the most, though, because the placenta continues to perform gas exchange after delivery. An additional worry is that there is a higher risk of excessive placental transfusion if the umbilical cord clamping is delayed. Although there is a slightly greater rate of jaundice that satisfies criteria for phototherapy in term newborns, there is no evidence of an increased risk of polycythemia or jaundice in the literature at this time.

Thus, we conducted this research to evaluate the effects of delayed cord clamping on serum bilirubin levels.

MATERIALS AND METHODS

AIM

To assess delayed cord clamping at 3 minutes and their effects on serum bilirubin level

PRIMARY OBJECTIVES

To compare hyperbilirubinemia and need for phototherapy in first week of life in babies where cord clamping was delayed for 3 minutes.

SECONDARY OBJECTIVE

Hematocrit and Hemoglobin at 72 hours of postnatal age

Study design: Prospective observational study

Study site: Department of Paediatrics and Gynaecology, Janana Hospital, Ajmer. Attached to Jawaharlal Nehru Medical college, Ajmer, Rajasthan, India.

Study period: March 2023 to February 2024

Inclusion criteria:

- All neonates ≥ 37 weeks up to 41 weeks + 6 days of gestation delivered either by Lower Segment Caesarean section or Vaginal delivery during the presence of trained person for intervention.

Exclusion Criteria:

- Mother fetus pair with following characteristics will be excluded from the study
- Multiple gestation
- Rh negative mother
- Those who have hyperbilirubinemia neurotoxicity risk factors
- Antenatally diagnosed major congenital malformation
- Hydrops fetalis
- Placenta previa
- Placental abruption
- Maternal transfusion for anemia
- Babies who are not breast fed at least 8 - 10 times per day after birth
- Those who require resuscitation at birth.
- Those who have not given consent for the study
- Those who got discharged before 72 hrs.

Sample size ¹⁸:

For estimation of sample size, the following formula has been used $n = [Z\alpha^2 P Q]/d^2$

Where: $Z\alpha$ = Value of standard normal variate corresponding to α level of significance

P = Likely value of parameter

Q = 1 – P

d = Margin of errors which is a measure of precision Assumptions:

P = 0.5

$Z\alpha = 1.96$ (Corresponding to 95% confidence interval) Precision (d) = $\pm 5\%$

Starting with an initial sample size of 380 and factoring in a 10% margin of error, the adjusted final sample size is determined to be 342. This adjustment ensures that the sample remains statistically representative while accounting for potential variability within the error margin. Under these assumptions the minimum sample size works out as 350.

Delayed cord clamping:

After delivery, time of birth was noted and babies were positioned between the mother's abdomen (for babies delivered through vaginal route) or on the mother's thigh (for babies delivered by caesarean section). Umbilical cord was clamped and cut 2-3 cm distance from the umbilical stump at 3 minutes of life. The timing of delayed clamping at 3 minutes was measured by a stop clock.

Delayed cord clamping procedure



According to our local protocol, after delivery, intramuscular oxytocin was given to vaginally delivered mother and intravenous oxytocin was given to mother who will be delivered through caesarean section. All neonates were managed as per our unit protocol.

Measurement of outcomes:

At 24 and 72 hours of life, One ml of venous sample was obtained from the baby for estimation of hemoglobin and hematocrit using Sysmex KX21 cell counter and serum bilirubin level was assessed by Diazo method using ROBONIK semianalyzer.

Baby was diagnosed to have polycythemia when the venous hematocrit recorded is $\geq 65\%$. Babies were started on phototherapy when their serum bilirubin level were in the phototherapy range. (As per AAP 2022 bilirubin nomogram).⁶ All the study neonates were daily assessed for clinical jaundice till discharge and serum bilirubin was measured if clinical assessment of jaundice is significant. Babies were treated with phototherapy if the serum bilirubin levels were in phototherapy range according to AAP 2022 hyperbilirubinemia guidelines¹⁹. Peak serum bilirubin was measured. Babies were discharged home as per our hospital protocol and AAP 2022 guidelines¹⁹ they were advised for follow up when jaundice is noticed.

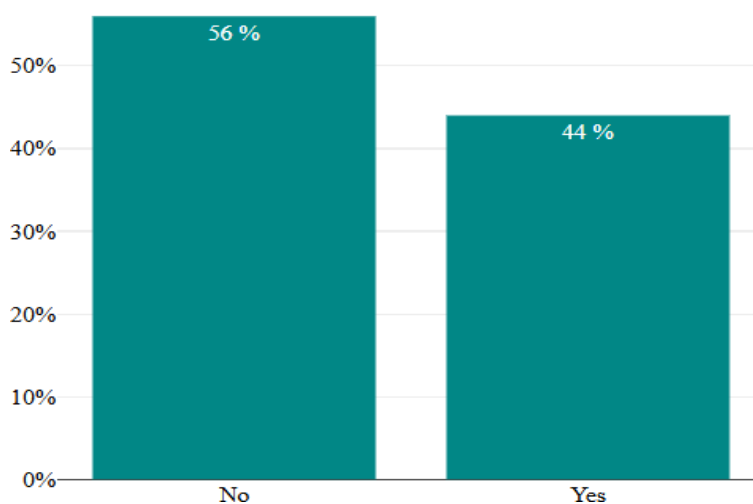
Statistical analysis:

Standard statistical tests were employed. Categorical variables were analysed with chi square test and continuous variables were analysed using student's independent t test. Results on continuous measurements were presented as Mean $\pm$ SD and results on categorical measurements were presented in percentage (%). P value of <0.05 was taken as significant. All statistical tests were two tailed tests. SPSS version 23 was used for data analysis.

RESULTS

Total of 350 neonates were included in our study. After delivery, time of birth was noted and babies were positioned between the mother's abdomen (for babies delivered through vaginal route) or on the mother's thigh (for babies delivered by caesarean section). Umbilical cord was clamped and cut 2-3 cm distance from the umbilical stump at 3 minutes of life. The timing of delayed clamping at 3 minutes was measured by a stop clock.

Graph 1: Hyperbilirubinemia
Hyperbilirubinemia



In our study the incidence of hyperbilirubinemia was 44%.

Table 1: Hyperbilirubinemia with respect to baseline parameters

		Hyperbilirubinemia				p- value
		No		Yes		
		N	%	n	%	
Gender	Female	96	52.46%	87	47.54%	0.162
	Male	100	59.88%	67	40.12%	
Mode of Delivery	Vaginal	135	55.79%	107	44.21%	0.904
	LSCS	61	56.48%	47	43.52%	
Birth weight	Normal	187	58.44%	133	41.56%	0.003
	LBW (IUGR)	9	30%	21	70%	

There was no statistically significant difference in incidence of hyperbilirubinemia with regard to gender and mode of delivery.

There was statistically significantly high incidence of hyperbilirubinemia in Low-birth- weight babies (IUGR-not because of prematurity). (p = 0.003)

Table 2: Phototherapy

Phototherapy	Frequency	%
No	346	98.86%
Yes	4	1.14%
Total	350	100%

4(1.14%) only were treated with phototherapy(p<0.962) for neonatal jaundice.

DISCUSSION

In high- and low-resource environments, it is advised to postpone cord clamping in healthy term infants for at least 60 and 180 seconds, respectively, as this enhances neurodevelopment, cardio respiratory stability immediately after birth and reduces the likelihood of anemia and iron deficiency. Hemodynamic measures like cerebral oxygenation, heart rate, cardiac output, and peripheral arterial oxygen saturation have all improved. Recent data indicates that the association between delayed cord clamping and increased rates of hyperbilirubinemia and phototherapy may no longer exist. In settings with limited resources, postponing cord clamping has the potential to improve neurodevelopmental outcomes by lowering anemia and iron shortage⁶.

It is now well established that delayed cord clamping improves total body iron stores for up to 6 months of age and reduces the need for blood transfusion for anemia. Within the brain, iron is important in myelin production in oligodendrocytes, and decreased availability leads to hypomyelination. Iron deficiency in children most commonly presents with poor school performance, decreased cognitive abilities, and behavioral problems. These clinical outcomes in iron-deficient children can be traced to hypomyelination, and have been shown to persist despite subsequent iron supplementation. Iron deficiency and iron deficiency anemia in infancy are associated with cognitive motor and behavioral deficits as well as persistent neurophysiological differences^{8,9}.

Preterm babies have been shown to suffer fewer intraventricular hemorrhages when they have delayed cord clamping compared with immediate cord clamping. This begs the question whether these preterm babies are acting like canaries in the coal mines, with their more fragile bodies showing the damage that occurs to a delicate developing brain when subjected to immediate cord clamping. It is possible that in a more robust full-term infant neurological damage may go unnoticed, despite still occurring¹⁴.

The present study was conducted to assess delayed cord clamping at 3 minutes and their effects on serum bilirubin level, hyperbilirubinemia and need for phototherapy in first week of life and Hematocrit and Hemoglobin at 72 hours of postnatal age.

The following were our observations-

HEMOGLOBIN AND HEMATOCRIT

Mean hemoglobin concentration of the neonates at 24 hours was 16.61 ± 0.95 gm/dL and at 72 hours after delivery was 16.38 ± 0.97 gm/dL in our study. Mean hematocrit of the neonates at 24 hours was $49.52 \pm 2.91\%$ and at 72 hours after delivery was $48.95 \pm 2.9\%$ in our study. In our study hemoglobin levels were higher at 24 hrs. than 72 hrs. And also no incidence of polycythemia was noted Hemoglobin levels were higher in immediate cord clamping compared to delayed

cord clamping according to studies. A higher rate of neonatal polycythemia and a higher neonatal hemoglobin level on day 3 were observed in a study that delayed cord clamping at 30-60 seconds. It was found that Raising the duration of cord clamping from 90 to 120 seconds did not enhance hemoglobin and hematocrit levels any more. The early cord clamping group had a considerably reduced hemoglobin content in babies at 24 to 48 hours. In our study, no incidents of polycythemia was noted. Delaying cord clamping had positive benefits on boosting hemoglobin and hematocrit in babies in past studies. According to Nidhi Rao et al, The mean Hct at 6 weeks was 30.47% in the Early cord clamping group and 38.17% in the Delayed cord clamping group, with a significant difference ($p < 0.001$) favouring the delayed cord clamping group^{18,19}

HYPERBILIRUBINEMIA

In our study the incidence of hyperbilirubinemia was 44%. According to AAP 2022 hyperbilirubinemia guidelines, 50-60% term babies can have hyperbilirubinemia and it is considered to be normal. Hence our study shows that delayed cord clamping does not increase the incidence of hyperbilirubinemia in term healthy babies. We observed that there was statistically significantly high incidence of hyperbilirubinemia in Low-birth-weight (IUGR) babies in our study. The delayed cord clamping group had significantly higher rates of phototherapy and neonatal bilirubin levels on the 2-4 days postpartum compared to the immediate cord clamping group in a study by Shaungjia et al²⁰. In a study by Judith et al there was no statistically significant difference in hyperbilirubinemia in early cord clamping and delayed cord clamping groups²¹. The rates of infant jaundice needing phototherapy, polycythemia, respiratory distress, and admission to the neonatal intensive care unit (NICU) were not significantly different in delayed cord clamping compared to early cord clamping according to Carrie Bennet et al. They recommended to keep babies on delayed cord clamping due to the lack of contraindications²². There was no significant increase in risk of polycythemia and hyperbilirubinemia between the early and delayed cord clamping group according to studies. Similarly, Hyperbilirubinemia was not shown to be more common in the Delayed cord clamping group according to a study by Nidhi Rao et al¹⁸.

NEED FOR PHOTOTHERAPY

In our study of 350 neonates, 4(1.14%) only were treated with phototherapy for neonatal jaundice. In normal pregnancies, there was no statistical difference in bilirubin values and phototherapy rates between the delayed cord clamping group and the immediate cord clamping group ($P > 0.05$) according to Shaungjia et al²⁰. There was no increase in the rate of phototherapy was observed in delayed cord clamping compared to early cord clamping according to a study by Hailing et al⁴⁵. Yiyu et al determined that if healthy term infants have their cord clamped for less than 90 seconds, it could enhance their early hemoglobin status and prevent excessive neonatal jaundice that would require phototherapy²³. The time of cord clamping has no bearing on the risk of hyperbilirubinemia or the necessity for phototherapy when DCC is performed on moderate to late preterm newborns according to Nidhi Rao et al¹⁸.

CONCLUSION

We conclude that Delayed Cord Clamping (DCC) does not increase the incidence of hyperbilirubinemia, need for phototherapy and chance of polycythemia.

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Conflict of interest: Nil

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