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Original Research Article

A prospective study of effect of delayed cord clamping in term babies as well as in preterm babies

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ABSTRACT

Background: Delayed cord clamping (DCC) is lengthening the time between delivery of newborn and the clamping of their umbilical cord. It is usually performed 25 seconds to 5 minutes after birth, which increases the newborn's iron storage, vital for healthy brain development.
Methods: This prospective observational study was conducted on 100 late preterm and term newborns delivered in the obstetrics and gynaecology department of Calcutta national medical college and hospital, Kolkata over a period of one and half years (March 2019 to August 2020). The umbilical cord was clamped between 60 to 90 seconds after birth of baby. Babies' weight measurement and blood investigations (Haemoglobin (Hb) level, total serum bilirubin (TSB) and serum ferritin) were performed at birth, after 24 hours of birth and at 6 weeks of age.
Results: In this study after DCC, there is significant increase in Serum Ferritin levels after 24 hours and 6 weeks as compared to the birth values. As far as the values of TSB and hemoglobin is concerned, the values first showed increment after 24 hours and then decreased at 6 weeks, which is statistically significant (p=0.001). Birth weight which first decreased after 24 hours, increased at 6 weeks. None of the babies needed blood transfusion during the study period. Out of 100 cases, 9 were admitted in NICU and required phototherapy which was not directly associated with umbilical cord clamping time or bilirubin values at birth.
Conclusions: Based on the results of this study, we conclude that newborns with DCC had statistically significant higher levels of Hb and ferritin after birth. This may ensure better iron status throughout infancy along with reduced need of blood transfusion and its related adversities. Delaying cord clamping seems to be beneficial in late preterm and term neonates without causing additional morbidities in the first 6 weeks of life.

Keywords: Delayed cord clamping, Total serum bilirubin, serum Ferritin, Hemoglobin, Birth weight, Phototherapy

INTRODUCTION

Delayed cord clamping (DCC) is lengthening time between delivery of newborn and clamping of their umbilical cord.[1] It is usually performed 25 sec-5 min after birth, allowing more blood (hence improved oxygenation, better organ perfusions, prevention of hypothermia), stem cells and other necessary substances to transfer from placenta to baby.[1-4] DCC increases haematocrit levels and improves newborn's iron storage, which is crucial for healthy brain growth and development.[5-8]

The American college of obstetricians and gynecologists (ACOG) guidelines based on the current neonatal resuscitation program (NRP) guidelines from the American academy of pediatrics (AAP) recommends delaying the umbilical cord clamping for 30 to 60 seconds for most active term and preterm newborns.[9]

The Royal college of obstetricians and gynaecologists (RCOG) also recommends delaying umbilical cord clamping in healthy term and preterm neonates for a minimum of 2 minutes after birth.[9]

The world health organization (WHO) recommends that in term or preterm neonates not requiring positive pressure ventilation, the umbilical cord should not be clamped before one minute after birth or until the cord pulsations has stopped.[10]

Ideally, providers should wait until the umbilical cord is completely drained of its blood, becomes limp and pale. The optimal timing of clamping the umbilical cord has been debated a lot and the cord clamping timing continues to vary according to clinical policy and practice. "Early" cord clamping is generally done within the first minute after birth (mostly within 15–30 seconds), while "delayed" (also called as "late") cord clamping is generally done 1 minute after the birth or when the umbilical cord pulsations has ceased.[10]

According to the timing of umbilical cord clamping, the baby will be receiving 50% of the cord blood (approximately 80 mL of blood gets transferred from the placenta to the baby at the end of 1 minute after birth).[9,11] After 3 minutes, the baby will receive 90% of the cord blood (approximately 100 mL at 3 minutes after birth).[9] At end of 5 minutes, baby gets all of the necessary cord fluids.[11] This additional blood supplies physiologic quantities of iron which is beneficial to the newborn as well as amounting to the 40 to 50 mg/kg of their body weight.[9]

Aim and objectives

Aim and objectives were to show the effect of DCC in term as well as in preterm babies in relation to weight, Hb, TSB, serum ferritin estimation, assessing phototherapy requirement thereby assessing neonates at birth, after 24 hours and at 6 weeks of age.

METHODS

This prospective observational study was conducted on 100 late preterm and term newborns delivered in the obstetrics and gynaecology department of Calcutta national medical college and hospital, Kolkata over a period of one and half years (March 2019 to August 2020). After approval of institutional ethics committee (IEC), proper informed consent was taken from pregnant mothers and DCC was performed on these newborns. Their weight measurement and blood investigations (Hb level, TSB and serum ferritin) were performed at birth, after 24 hours of birth and at 6 weeks of age.

Inclusion criteria

Term newborns included babies born between 37-41 weeks of gestation and weighing ≥2 kg. Late preterm newborns comprised babies born between 34-37 weeks of gestation and weighing ≥1.8 kg. Mode of delivery included uncomplicated vaginal deliveries and uncomplicated caesarean deliveries.

Exclusion criteria

Severely ill mothers, assisted vaginal deliveries (Ventouse deliveries, Forceps deliveries), placenta acreta syndrome, placenta previa and ABO-Rh incompatibility cases were excluded from the study. Babies born to seropositive mothers (Hep B, Hep C, VDRL, TORCH positive cases), severe birth asphyxia, newborns with congenital anomalies, IUGR with abnormal colour doppler USG, birth weight more than 4 kg, tight nuchal cord which cannot be reduced, disrupted placental circulation like placental abruption, cord avulsion, cord prolapse and true knots, and the sick neonates who were admitted in NICU for conditions not directly related to DCC were also excluded.

Method of delayed umbilical cord clamping

After vaginal delivery of the newborn, the newborn was placed on the maternal abdomen or chest initiating immediate skin-to-skin contact (SSC) while awaiting umbilical cord clamping (Figure 1). In the case of caesarean delivery, the newborn was placed on the maternal abdomen or legs or held by the surgeon or assistant until the umbilical cord is clamped (Figure 2).

DCC did not interfere with active management of the third stage of labour. While delaying the umbilical cord clamping, early newborn care was initiated, including drying the baby and stimulating for first breath or cry, and maintaining normal temperature with SSC, covering the newborn with dry clean prewarmed linen cloth. A timer was used to monitor elapsed time and ensure at least 60 seconds between birth and the cord clamping.

Figure 1: Initiation of newborn care while delaying cord clamping during vaginal delivery.

Figure 2: DCC done by placing the newborn on mother's abdomen and initiating early newborn care during caesarean delivery.

Statistical analysis

The data was coded and entered into Microsoft excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The repeated measures analysis of variance (ANOVA) [for quantitative data within three groups] with post hoc Bonferroni test (intra-group comparison) was used for quantitative data comparison of all clinical indicators. Level of significance was set at $p \leq 0.05$.

RESULTS

The umbilical cord was clamped between 60 to 90 seconds after birth of the baby. In 7% neonates who did not cry immediately after birth, also underwent DCC along with resuscitative measures performed with intact cord. Most of the neonates i.e., 93% cried immediately after birth and therefore did not require any resuscitation. The results obtained in the study showed statistically significant improvement is values of birth weight, TSB, hemoglobin and serum ferritin levels (p=0.001) after DCC (Table 1).

None of the babies needed blood transfusion during the study period. It is hypothesized that DCC babies will have a greater incidence of hyperbilirubinemia due to increased RBCs and their consequent breakdown. So, there are concerns they will need phototherapy for jaundice. In our study, out of 100 cases, 9 neonates were admitted in NICU and required phototherapy which was not directly associated with umbilical cord clamping time or bilirubin values at birth (Figures 3 and 4). Delaying cord clamping seems to be beneficial in late preterm and term neonates without causing additional morbidities in first 6 weeks of life.

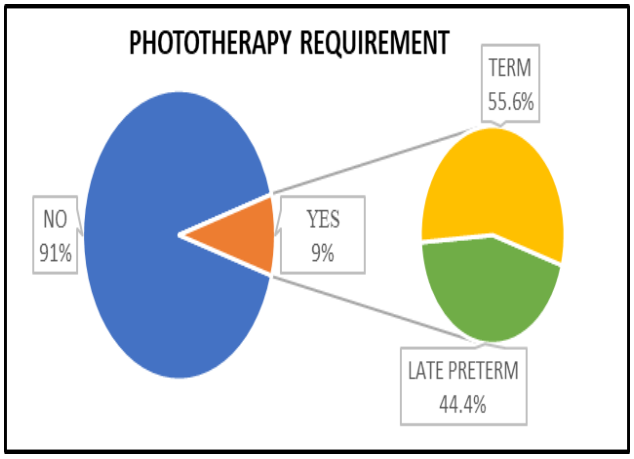

Figure 3: Phototherapy requirement.

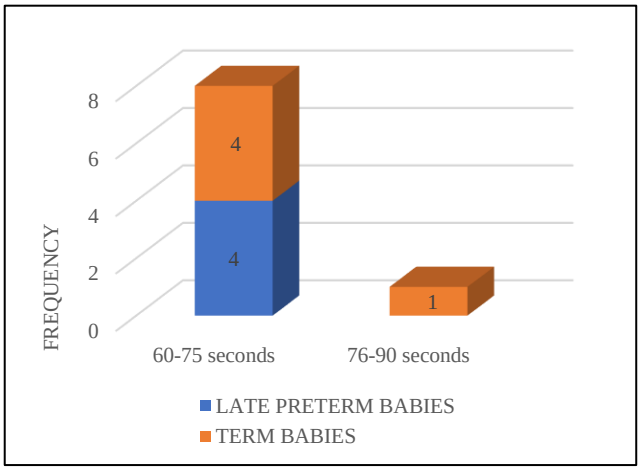

Figure 4: Duration of DCC in neonates receiving phototherapy.

Table 1: Results obtained in the study at birth, after 24 hours and at 6 weeks.

Parameters			Total neonates, n=100	Late preterm, n=21	Term, n=79
Weight (kg)	At birth	Mean	2.67 ± 0.44	2.13±0.16	2.81±0.38
	After 24 hours	Mean	2.502±0.42	2.01±0.20	2.63±0.36
		Change from birth	6.29% decrease	5.6% decrease	6.4% decrease
		P value	0.001	0.001	0.001
	At 6 weeks	Mean	3.63±0.49	3.07±0.32	3.78±0.42
		Change from birth	35.95% increase	44.1% increase	34.5% increase
		P value	0.001	0.001	0.001

Continued.

Parameters			Total neonates, n=100	Late preterm, n=21	Term, n=79
Hb (gm/dL)	At birth	Mean	15.42±1.704	16.00±1.38	15.27±1.76
	After 24 hours	Mean	19.99±1.97	20.86±1.81	19.75±1.97
		Change from birth	29.63% increase	30.4% increase	29.3% increase
		P value	0.001	0.001	0.001
	At 6 weeks	Mean	12.15±1.07	11.95±0.93	12.21±1.11
		Change from birth	21.2% decrease	25.3% decrease	20.04% decrease
		P value	0.001	0.001	0.001
TSB (mg/dL)	At birth	Mean	2.53±1.63	2.09±0.47	2.65±1.81
	After 24 hours	Mean	7.58±3.57	8.46±3.65	7.35±3.55
		Change from birth	199% increase	304.8% increase	177.4% increase
		P value	0.001	0.001	0.001
	At 6 weeks	Mean	0.87±0.28	0.93±0.37	0.85±0.26
		Change from birth	65.6% decrease	55.5% decrease	67.9% decrease
		P value	0.001	0.001	0.001
Serum ferritin (ng/mL)	At birth	Mean	228.26±202.28	237.43±97.12	225.83±222.46
	After 24 hours	Mean	488.19±263.39	471.77±196.33	492.56±279.43
		Change from birth	114 % increase	98.7% increase	118.1% increase
		P value	0.001	0.001	0.001
	At 6 weeks	Mean	343.09±57.92	332.61±73.37	345.88±53.30
		Change from birth	50.3% increase	40.1% increase	53.15% increase
		P value	0.001	0.001	0.001

DISCUSSION

The principal aim of this study was to show the effect of DCC in term as well as in preterm babies in relation to Hb, TSB and serum ferritin estimation, preventing neonatal anaemia and decreasing neonatal morbidity and mortality. So, we systematically reviewed various peer studies for effects of DCC on term as well as in preterm infants for the same parameters i.e., Hb, bilirubin and ferritin levels at similar times as in this study (Table 2).

Table 2: Peer articles comparing the same parameters as in the current study.

Study	Birth weight (kg)	Weight after 24 hours (kg)	Hb at birth (gm/dL)	Hb after 24 hours (gm/dL)	Hb at 6 weeks (gm/dL)	TSB (mg/dL)	TSB after 24 hours (mg/dL)	Photo therapy (%)	Mean S. ferritin at birth (ng/mL)	Mean s. ferritin after 24 hours (ng/mL)
Current study	2.81± 0.38	2.63± 0.36	15.27± 1.76	19.75± 1.97	12.21± 1.11	2.65± 1.81	7.35± 3.55	6.3	225.83± 222.46	492.56± 279.43
Rincon et al[12]	3.22	3.04	15.6	18.9	---	---	9.2	3.2	125	254.7 (at 48 hour)
Carvalho et al[13]	3.31± 0.39	---	18.1± 2.4	17.3± 2.5	---	5.8± 5.4	11.6± 3.6	54.4	---	---
Qian et al[14]	3.32± 0.33	---	20.48± 2.16	20.42± 1.99	---	1.81± 0.91	9.24± 2.16	18.8	---	---
Forghani et al[15]	---	---	15.73±1.46	12.91± 1.0	---	---	2.17± 5.76	---	---	---
Alzaree et al[16]	---	---	15.9±0.6	---	10.4± 0.5	---	---	---	---	---
Akram et al[17]	---	---	---	16.45± 0.84	---	---	---	---	---	265.79± 52.85

The weight and Hb levels of the newborn not only reflects the nutritional status of the baby, but also that of the mother specially during pregnancy. The variations in the mean birth weight and Hb levels can be accounted to the demographic and maternal nutritional variations in the study areas. The difference in ferritin levels can be attributed to variation in iron stores in pregnant mothers and their compliance to iron therapy during pregnancy. Hence, the current study is at par not comparable to the other peer studies (Table 2).

In a randomized controlled trial conducted by Ranjit et al on preterm infants, the mean serum ferritin at 6 weeks of age was found to be 178.9 ng/mL after DCC (>2 min in his study), which was significantly higher than the infants randomized to early cord clamping (ECC) group.[18] In this

study, the mean serum ferritin level in the late preterm group of infants was found to be 237.43 ng/mL with SD of 97.12 ng/mL at birth and 332.61 ng/mL with SD of 73.37 ng/mL at 6 weeks of age. This difference can be accredited to the difference in selection of study population and difference in duration of DCC. Hence, the current study is at par not comparable to the other peer study done by Ranjit et al for comparison of serum ferritin in preterm infants.

In the current study, out of 100 neonates, none required blood transfusion during their first 6 weeks of life. In the study done by Van Rheenen et al they found that in preterm infants, the proportion who required blood transfusion in the first 6 weeks after birth was lower after DCC as compared to ECC.[19]

DCC is said to cause neonatal hyperbilirubinemia and increase the need for phototherapy.[1,11,20] In the study conducted by Carvalho et al 54.4% neonates required phototherapy, and concluded that clamping time of the umbilical cord showed no association with jaundice, bilirubin dosage, or phototherapy needs in neonates at normal risk.[13] In the study conducted by Qian et al 18.8% neonates required phototherapy.[14] They concluded that DCC for <90 seconds was enough to improve hemodynamic outcomes in term infants with avoiding more neonatal jaundice requiring phototherapy. In the current study, out of 79 term neonates on whom DCC was performed, only 6.3% (5 out of 79) required phototherapy upto the age of 6 weeks, despite hyperbilirubinemia in most cases after 24 hours of birth and out of 21 late preterm neonates on whom DCC was performed, only 19% (4 out of 21) required phototherapy upto the age of 6 weeks. The difference in need for phototherapy can be accredited to protocols followed in the different institutions for phototherapy as treatment for hyperbilirubinemia. Hence, the current study is at par not comparable to the other peer studies.

In the study done by Rincon et al, none of the neonates with either ECC or DCC of any duration needed admission in NICU during the study period.[12] Comparable results were also seen in the study conducted by Carvalho OM et al, in which only 0.4% neonates were admitted in NICU amongst the group who underwent DCC of 1-3 minutes.[13] In the current study, 9% neonates were admitted in NICU for receiving phototherapy. This difference could be most probably due to the differences in NICU protocols for admission and management of complications in the various institutes. Hence, the current study is at par not comparable to the other peer studies in respect to NICU admission of neonates during the study period.

The limitations of the current study can be attributed to the short span of follow up which could not verify the long-term beneficial effects of DCC on the infants. This study included only the normal population, therefore, the effect of this practice in populations with higher neonatal risk, such as premature and very low birth weight could not be demonstrated. This study however, showed that there were higher values of Hb, bilirubin and ferritin after 24 hours of life without any adverse effect on the neonates. The need for phototherapy was apparently not associated with umbilical cord clamping time or bilirubin values at birth. DCC can reduce the number of blood transfusions needed in the first 6 weeks of life. DCC is thus a safe procedure without causing significant increase in jaundice and need of phototherapy or other neonatal morbidities.

CONCLUSION

Based on the results of this study, we conclude that newborns with DCC had statistically significant higher levels of Hb and ferritin after birth. This may ensure better iron status throughout infancy along with reduced need of blood transfusion and its related adversities. Although these neonates had increased levels of serum bilirubin after 24 hours of birth, the rate of clinical complications did not increase due to increased time of cord clamping. Few neonates developed jaundice which resolved successfully after phototherapy and did not cause additional morbidities.

DCC does not involve any extra cost in this intervention but provides numerous benefits to the infant. Waiting for cord clamping is difficult, especially waiting without action for a process that is largely invisible. Active provision of routine care or the initial steps of resuscitation of the newly born infant on mother's abdomen to safely prolong the delay and set the stage for early initiation of breastfeeding, turn passive waiting into action. This only demands considerable change in attitude to provide adequate support and monitoring of mother and baby. DCC is thus a safe procedure which can reduce the morbidities during infancy.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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