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ORIGINAL RESEARCH ARTICLE

Maternal and Neonatal Outcomes of Delayed Cord Clamping vs Early Cord Clamping in Term Delivered Newborns

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ABSTRACT

Introduction: During the first minutes after birth, the newborn infant receives a substantial blood transfusion from the placenta. Delayed cord clamping (DCC) is associated with decrease incidence of anemia in childhood, less intraventricular hemorrhage and lower risk of necrotizing enterocolitis as compared to early cord clamping. The present study was conducted to study maternal and neonatal outcomes of delayed cord clamping (DCC) vs early cord clamping (ECC) in term-delivered newborns.

Material and Methods: This prospective study was conducted in terms of low-risk pregnant women admitted for safe confinement in the labour room of SRMS IMS Bareilly, between August 2022 to January 2024. A total of 60 patients, who fulfilled the inclusion-exclusion criteria, were subjected to the study and divided into two groups of 30 each: Group A with ECC and Group B with DCC. Mothers and their newborns were evaluated with reference to maternal and neonatal outcomes. Statistical analysis was carried out using Microsoft Excel and Epic Info 7.1 software.

Results: In this study, ECC was performed on 30 (Group A), and DCC was performed on 30 (Group B). A significant increase in haemoglobin level without any significant increase in neonatal serum bilirubin level in the case of DCC, as compared to ECC. On the basis of this study, the delayed cord clamping shows significant positive effects on infants' health.

Conclusion: Delayed cord clamping improves haemoglobin levels and iron stores in term infants, which have major positive effects on infants' health and development and decrease incidence of childhood anaemia.

Keywords: Early cord clamping, Delayed cord clamping, Postpartum hemorrhage.

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INTRODUCTION

The World Health Organization (WHO) has revised its stance on the practice of clamping, primarily due to findings that show it does not significantly contribute to preventing postpartum hemorrhage (PPH). This change in guidance was notably reflected in WHO's 2014 recommendations, which advocate for delayed cord clamping in all childbirth scenarios, except in cases where the newborn requires urgent and advanced resuscitation.[1,2] The National Institute for Health and Care Excellence(NICE) in the UK aligns with this view, advising that the umbilical cord should not be cut for at least one minute post-birth unless the newborn's heart rate falls below 60 beats per minute.[3]

The physiological implications of delayed cord clamping are significant. In the initial minutes following birth, a newborn can receive a considerable amount of blood from the placenta. Studies have shown that holding a full-term newborn approximately 10cm below the uterus for the first three minutes can increase the infant's blood volume by an average of 32%.[4,5] This process has notable benefits for the infant's health. For full-term infants, there is a positive impact on iron levels that can last for up to 4 to 6 months. In preterm infants, delayed cord clamping has been linked to a reduction in the need for blood transfusions due to anemia, a decrease in the incidence of intraventricular hemorrhage, and a lowered risk of necrotizing enterocolitis. Moreover, benefits like improved blood pressure, enhanced oxygen transport, increased urine output, and stabilized body temperature have been observed.[6] However, it's important to consider the potential drawbacks and balance them against the benefits. For the mother, delayed cord clamping could increase the risk of postpartum hemorrhage (PPH) and its associated complications. For the newborn, there are concerns about delayed resuscitation, hypothermia, polycythemia, hyperbilirubinemia, and a potential increase in the risk of neonatal jaundice. These factors necessitate a careful and individualized approach to each birth, weighing the benefits against the potential risks.[7-9] The present study was conducted to study the fetomaternal outcome in both DCC and ECC in active management of 3rd stage of labour and to compare different maternal and neonatal parameters.

MATERIAL AND METHODS

The research was conducted at the Department of Obstetrics & Gynecology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly. This study was structured as a prospective comparative observational study. The study spanned from Aug 2022 to January 2024. Prior to the initiation of the study, clearance was obtained from the scientific committee and the ethical committee of Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly. The study included participants who met the following criteria: Singleton pregnancy, term gestational age, i.e., between 37 and 42 weeks of gestation, low-risk pregnancy, and who underwent spontaneous normal vaginal deliveries.

Subjects were excluded from the study if they: underwent a Caesarean section, required an instrumental delivery, were diagnosed with anemia, experienced preterm labor, or had known medical or surgical co-morbidities. Newborns were excluded from the study if they: required neonatal resuscitation, had major congenital abnormalities, presented with a tight nuchal cord that necessitated early cord clamping, experienced fetal distress, or suffered from birth asphyxia. The study protocol was explained in detail to the patients, and informed written consent was obtained from them.

The socio-demographic form included six items related to the mothers' age, level of education, occupation, blood group, gravidity (number of pregnancies), and parity (number of live births). Participants were selected through random allocation, ensuring an unbiased distribution of subjects between the two study groups. A total of 60 patients were recruited based on the inclusion and exclusion criteria and were divided into two groups of 30 each.

Group A – Early cord Clamping (ECC) consisted of 30 study subjects who underwent early cord clamping, performed within 1-minute post-delivery. Group B - DCC comprised 30 study subjects who experienced delayed cord clamping, conducted within 2 to 3 minutes post-delivery; in a few patients, it was done at 2 & ½ minutes because of expulsion of placenta in active management of 3rd stage (AMTSL done in both groups). Inj oxytocin 10 I.U. IM was administered as a prophylactic uterotonic for all patients at the time of delivery.

In cases of delayed cord clamping, the newborn baby was kept between the lap of the mother, wrapped in a warm towel, which was changed with another warm towel, with routine newborn care ongoing, at a level lower than the level of the placenta to facilitate placental transfusion. Babies were roomed in with their mothers after sthe pediatrician's initial assessment. Any baby admitted to the NICU after delivery, except for a short period of observation or those developing transient tachypnea of the newborn, was excluded from the study.

The maternal outcomes assessed were the occurrence of PPH (yes/no) and the mother's Hb level before as well as 72 hours after childbirth, measured using an electronic portable hemoglobin meter. Neonatal outcomes encompassed the Apgar scores at 1 and 5 minutes after birth, the need for oxygen therapy (yes/no), Hb level at 12 hours of age measured by Hemoglobin meter, and admission to the neonatal intensive care unit (NICU) (yes/no) due to any neonatal morbidity with 1st week of life. Mothers and their newborns were evaluated with reference to maternal and neonatal hemoglobin, hematocrit and neonatal or maternal complications, if any.

Statistical Analysis

Statistical analysis was carried out using Microsoft Excel and Epic info 7.1 software. The data were described in terms of arithmetic mean +/- SD (or median) for quantitative data and frequencies (%) for qualitative (categorical) data. The *p-values* of < 0.05 were considered significant. For comparison of categorical variables (i.e., to examine the associations between qualitative/ quantitative variables), the chi-square test was used if the number of elements in each cell was 5 or higher, and Fisher's exact test was used otherwise.

RESULTS

Figure 1 shows that in the ECC group, the majority of patients, i.e., 17 (57%), fall within the 25 to 34 age bracket and in DCC group, the majority, i.e., 15 (50%), were 25 to 34 years age. This showed that both groups were comparable, i.e., no bias due to age difference. In terms of education (Table 1a), illiteracy rates were slightly higher in DCC group 8 (27%) compared to ECC 6 (20%), while primary education showed a reversal, with a higher percentage in ECC group 4 (13%) than in DCC group 2 (7%). Occupation-wise (Table 1 b), the DCC group had majority of employed individuals, i.e., 19 (63%), compared to ECC 14 (46%), while the unemployed or housewife category was more prevalent in ECC 16 (53%) than in DCC 11(37%).

According to socioeconomic status (Table 2), in group A (ECC), most of the patients, i.e., 12 (40%), were distributed in the lower middle class where whereas in Group B (DCC), most of the patients, i.e.,14 (46%), were in the upper lower class. As per blood grouping in study participants (Table 3) for the ECC category, the distribution was: A+ blood type most prevalent at 40% (12 individuals), and in the DCC category, A+ leading at 37% (11 individuals). According to gravidawise

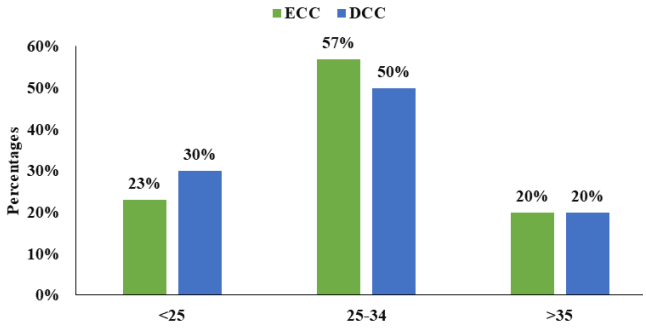

Figure 1: Age distribution in ECC and DCC group

distribution (Table 4), ECC (GROUP A), most of the patients were 2nd /3rd gravida, that is, 14 (47%) and in DCC (GROUP B), i.e., 16(53%) were 2nd/3rdgravida. The *p-value* (0.874) was insignificant, which shows that both groups were comparable. Table 5 shows the distribution of study participants in both groups to division of term gestation i.e. early term(37-38 week)and (38-39week),full term(39-40week) and (40-41 week)and late term(41-42 week). ECC group most patients delivered at gestational age b/w 37-38 weeks i.e. 10 (33%) followed by 38-39 weeks which had 8s (27%). Similarly in DCC groups most patients delivered at gestation. p value(0.435) showed insignificant, implies both groups were comparable. In the ECC group, majority 20 women (66%) had Hb change of mother between 2 and 3 gm before and after delivery. Similarly in the DCC group, majority 24 women (80%) had a Hb change of mother between 2 and 3gm before and after delivery. The difference in Hb change of the mother before and after delivery between the two groups was not statistically significant, with a *p-value* of 0.599 (Table 6).

Table 7 shows that with respect to maternal complications like postpartum hemorrhage(PPH), no significant change in both groups was observed. Table 8 shows the newborn birth weight of both groups, A and B. The mean birth weight for the ECC group was 2.61 ± 0.10 kg, while the mean birth weight for the DCC group was 2.26 ± 0.29 kg. The difference in mean birth weights between the two groups was no statistically significant, with a *p-value* (0.678. The mean Apgar score at 1 minute(Table 9)for the ECC group was 7.81 ± 0.08, compared to a mean score of 8.1 ± 0.00 for the DCC group. This difference in mean APGAR scores between the two groups was statistically insignificant, with a *p-value* of 0.0656. Similarly, the mean Apgar score at 5 minutes (Table 10) for the ECC group was 8.89 ± 0.08, while for the DCC group was 9.0 ± 0.0. The difference in mean APGAR scores between the two groups was statistically

Table 1a: Distribution of Study Subjects according to their education

Education	*GROUP A(ECC)*		*GROUP B(DCC)*	
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*
Illiterate	6	20	8	27
Primary School	4	13	2	7
Middle School	2	7	4	13
High School	8	27	6	20
Intermediate	5	17	6	20
Graduate	5	17	4	13
Total	30	100	30	100

Table 1b: Distribution of Study Subjects according to occupation Status

Occupation	*GROUP A(ECC)*		*GROUP B(DCC)*	
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*
Employed	14	46	19	63
Unemployed/ Housewife	16	53	11	37
Total	30	100	30	100

Table 2: Distribution of study participants according to their Socioeconomic Status

Socioeconomic status	*Number of patients in GROUP A(ECC)*	*Percentage (%)*	*Number of patients in GROUP B(DCC)*	*Percentage (%)*
Upper class	2	6	1	4
Upper middle class	4	14	6	20
Low middle class	12	40	5	16
Upper lower class	8	26	14	46
Lower class	4	14	4	14
Total	30	100	30	100

Table 3: Distribution of study subjects according to their Blood Group

Blood group	*GROUP A(ECC)*		*GROUP B(DCC)*	
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*
A+	12	40	11	37
B+	6	20	7	23
AB+	2	7	3	10
O+	10	33	9	30
Total	30	100	30	100

Table 4: Distribution of study subjects as per the Gravida (No. of pregnancies)

Gravida	*GROUP A(ECC)*		*GROUP B(DCC)*		*P VALE**
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
1stGravida	7	23	6	20	0.874
2nd – 3rd Gravida	14	47	16	53	
4thGravida or more	9	30	8	27	
sTotal	30	100	30	100	

**Chi square test*

Table 5: Gestational age at delivery:

POG	*Group A(ECC)*		*Group B(DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
37- 38 week	10	33	14	47	0.435
38-39 week	8	27	7	23	
39-40 week	6	20	5	17	
40-41 week	4	13	3	10	
41-42 weeks	2	7	1	3	
Total	30	100	30	100	

Table 6: Change in hemoglobin level of mother before and after delivery:

Change in Hb	*Group A(ECC)*		*Group B(DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
<1gm.	0	0	0	0	0.599
1 – 2gm.	10	34	6	20	
2 – 3gm.	20	66	24	80	
TOTAL	30	100	30	100	
Mean + SD	4.07 + 1.05		4.40 + 0.93		0.198

Table 7: Distribution of study subjects as per the maternal outcomes PPH

PPH	*Group A (ECC)*		*Group B (DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
No	26	87	29	97	0.358
Yes	4	13	1	3	
TOTAL	30	100	30	100	

significant, with a *p-value* of 0.0546. Table 11, shows the neonatal haemoglobin level at 12 hours of birth in both groups A and B. The distribution indicates a significants higher proportion of neonates with elevated hemoglobin levels in the DCC group compared to the ECC group with a *p-value* of 0.003.

The *p-value* of 0.0678 indicates that there was no statistically significant difference in serum bilirubin

levels (Table 12) between the ECC and DCC groups at 12 hours of age. Cumulative maternal outcome of two groups (Table 13) shows the mean Hb levels post-childbirth were not significantly different, with ECC recording a mean of 4.07g/dL (SD=1.05) and DCC showing a mean of 4.40 g/dL (SD=0.93) with a *p-value* of 0.698. And maternal outcome post-delivery(Table 14) shows a total of 13% (8 infants) required oxygen therapy, while the vast majority, 87% (52 infants), did not need such intervention, out of which only 7 required temporary admission in NICU. Overall, these outcomes reflect the health status and immediate care requirements of the neonates in this sample.

DISCUSSION

Historically, in the period before the mid-20th century, particularly before the 1950s, the medical community defined "early clamping" of the umbilical cord as clamping within the first minute following birth. Conversely, "late clamping" was categorized as the action of clamping the umbilical cord more than five minutes post-delivery. Initial studies, though limited in scale, revealed a significant transfer of blood from the placenta to the newborn within the first three minutes after birth, estimated to be around 80 to 100 mL. Remarkably, it was observed that up to 90% of this blood volume transfer

Table 8: Birth weight of newborns

Birth weight (kg)	*Group A (ECC)*		*Group B (DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
<2.5 kg	5	16	1	4	
2.5 - 3.0 kg	15	50	20	66	
3.0 - 3.5 kg	10	34	9	30	0.567
>3.5 kg	0	0	0	0	
TOTAL	30	100	30	100	
Mean + SD	2.61 + 0.10		2.26 + 0.29		0.678

Table 9: Apgar score at 1 minute of neonates

APGAR at 1 min	*Group A(ECC)*		*Group B(DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
<8	0	0	0	0	
8 - 9	30	100	30	100	0.0745
>9	0	0	0	0	
TOTAL	30	100	30	100	
Mean + SD	7.81 + 0.08		8.1 + 0.00		0.0656

Table 10: APGAR SCORE at 5 minutes of newborn:

APGAR at 5 min	*GROUP A(ECC)*		*GROUP B(DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
<8	0	0	0	0	
8 - 9	0	0	0	0	0.0652
>9	30	100	30	100	
TOTAL	30	100	30	100	
Mean + SD	8.89 + 0.08		9.0 + 0.0		0.0546

Table 11: Hemoglobin level in neonate of early and delayed cord clamping:

Change in hemoglobin in neonate	*Group a (ECC)*	*Percentage (%)*	*Group b (DCC)*	*Percentage (%)*	*p-value*
<13 gm	4	15	1	3	
13–14 gm	2	6	1	3	
14–15 gm	2	6	1	3	
15–16 gm	8	26	6	20	0.003
16–17gm	8	26	18	60	
17–18 gm	4	15	2	8	
>18 gm	2	6	1	3	
Total	30	100	30	100	

Table 12: Comparison of Bilirubin level at 12 hours of age Between Early and Delayed Cord Clamping Groups

Bilirubin level	*Group A (ECC)*	*Percentage*	*Group B (DCC)*	*percentage*	*p-value*
<15 mg/dl	10	34	20	68	0.0678
15–16 mg/dl	15	50	5	16	
>16 mg/dl	5	16	5	16	
TOTAL	30	100	30	100	

Note: Chi square test.

Table 13: Comparison of Maternal outcomes between 2 groups

Maternal Outcomes	*Group A(ECC)*		*Group B(DCC)*		*p-value*
	Frequency (n)	*Percentage (%)*	*Frequency (n)*	*Percentage (%)*	
PPH	4	13	1	43	0.653
	Mean	Standard Deviation	Mean	Standard Deviation	
Hb levels of mother before and after delivery	4.07	1.05	4.40	0.93	0.698

occurred within the first few breaths in healthy, full-term infants.[10]

In all study, both groups were comparable with respect to age, occupation, socioeconomic, gravidity, parity and period of gestation biased due to it.

Similarly, blood group A+ was common in both the ECC and DCC groups, with 40 and 37%, respectively. Comparing these results to a previous study by Abd El-Moneim Fawzy *et al*.,[9,] which also looked at blood group distributions across ECC and DCC categories, with 30 observations in each, reveals a similar pattern.

The difference in hemoglobin level change of the mother before and after delivery between the two groups was not statistically significant, with a *p-value* of 0.599. This shows that the timing of cord clamping does not affect the hemoglobin level of women, post-delivery, i.e., there is no significant loss of maternal blood if we opt for early or delayed cord clamping. Deviations from this average might require further attention and intervention to ensure positive outcomes for mothers.

Another maternal outcome in terms of postpartum hemorrhage, it was found that in the ECC group, 13% of mothers experienced postpartum hemorrhage (PPH) and in the DCC group 3% of mothers experienced postpartum hemorrhage (*p-value* 0.358). This highlights the need to closely monitor and manage PPH, a significant childbirth-associated complication, not related to the timing of cord clamping. Comparing this study to one by Khitam Mohammed *et al*.,[2] it's clear that the rates of PPH and Hemoglobin levels after 12 hours of childbirth differed.

The differences in neonatal birth weight in both groups of early cord clamping and delayed cord clamping were not statistically significant (*p-value* 0.567). These results correlate with a study by Therese *et al*.[10], it can be concluded that neonatal weight was not affected by the choice of procedure, potentially pregnancy outcome.

Table 14: Distribution of study subjects as per the Neonatal Outcomes

Neonatal outcomes		*Frequency (n)*	*Percentage (%)*
Need For Oxygen Therapy	YES	8	13
	NO	52	87
Admission To NICU	YES	4	7
	NO	56	93
	Total	60	100

In this study, it was found that newborns assessed using the APGAR scoring system at 1 minute after birth had an average score of 8, indicating they were generally healthy right after birth. By the 5-minute mark, the average score increased to 9.0, showing even better adaptation to life outside the womb. These findings align with a study by Erickson K *et al*.[14] Comparing these findings with Andersson *et al*.'s[15] study, both studies found no differences in APGAR scores at 1 and 5 minutes between ECC and DCC groups. Thus It can be concluded that neonatal outcomes with respect to APGAR score was not affected by early or delayed cord clamping.

Regarding neonatal hemoglobin level at 12 hours of birth,it was found that a higher proportion of neonates with elevated hemoglobin levels in the DCC group compared to the ECC group with p value This finding align with a study by Andersson *et al*.'s[15] study, which also looked at neonatal hemoglobin outcomes levels in both ECC and DCC group, favoring more hemoglobin in case of DCC groups. Thus, delayed cord clamping benefits the newborn babies by significantly increasing their hemoglobin level due to placental transfusion.

There was no statistically significant difference in bilirubin levels between the ECC and DCC groups.

These findings align with a study by Erickson *et al*.,[14,] which also looked at newborn outcomes with respect to bilirubin levels.

Overall,13% of newborns needed oxygen therapy, while 87% didn't. Also, 7% were admitted to the Neonatal Intensive Care Unit (NICU), while 93% didn't require NICU admission. These results emphasize the importance of assessing newborn health to tailor medical interventions effectively. By comparing with a study by Hellström-Westas L *et al*.,[3] which had similar findings, the study underscores the consistency of these outcomes in neonatal care. In both studies, a small percentage needed oxygen therapy or NICU admission, highlighting the overall health status and care needs of the newborns.

This study discovered that babies whose cords were clamped early needed oxygen therapy more often compared to those with delayed cord clamping. Specifically, 20% of babies in the early clamping group needed oxygen therapy, while only 7% did in the delayed clamping group. Although the *p-value* of 0.12 suggests a possible trend, showing this difference might not be significant statistically, it's still important to note because it could have clinical implications. In terms of NICU admissions, 10% of babies in the early clamping group were admitted compared to 3% in the delayed clamping group. However, with a *p-value* of 0.30, there's no significant difference between the two groups in NICU admissions. These findings indicate that delayed cord clamping might be beneficial in reducing the need for oxygen therapy and NICU admissions, but more research is needed to confirm these potential benefits. These results differ from a previous study by Tailakh *et al*.,[4,1] highlighting the importance of further exploration into cord clamping practices and their impact on newborn health.

CONCLUSION

This study concludes that DCC should be preferred as compared to ECC, as it significantly increases neonatal hemoglobin level without any affect on the serum bilirubin. But, due to low sample size and short-term follow-up, further large-scale studies are required to corroborate these findings.

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