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## **Effect of duration of delayed cord clamping on serum bilirubin hematocrit and hemodynamic status in neonates**

**Dr. Ankita Dubey**

Junior Resident, MBBS, Department of Paediatrics, Shyam Shah Medical College Rewa (M.P.) India  
Email: [dewhot17@gmail.com](mailto:dewhot17@gmail.com)

**Dr. Kshama Vishwakarma**

MD, Associate Professor, Department of Obstetrics and Gynaecology, Shyam Shah Medical College Rewa (M.P.) India  
Email: [kshamavishwakarma86@gmail.com](mailto:kshamavishwakarma86@gmail.com)

**Dr. Saurabh Kumar Patel**

MD, Assistant Professor Department of Paediatrics, Shyam Shah Medical College Rewa (M.P.) India  
\*Corresponding author email: [dr.patelsaurabh@gmail.com](mailto:dr.patelsaurabh@gmail.com)

**Dr. Sunil Kant Guleri**

Associate Professor, Department of Community Medicine, Birsa Munda Government Medical College Shahdol (M.P.) India  
Email: [drsunilmdpsm@gmail.com](mailto:drsunilmdpsm@gmail.com)

**Dr. Naresh Bajaj, MD**

Professor Department of Paediatrics, Shyam Shah Medical College Rewa (M.P.) India  
Email: [naresh30405@gmail.com](mailto:naresh30405@gmail.com)

**Abstract**--Introduction:DCC is a common practice with several benefits. The benefits of DCC are decreased risk of anemia, less incidence of periventricular leukomalacia, less incidence of NEC. This study tries to compare the effect of different duration of delayed cord clamping on serum bilirubin, hematocrit and hemodynamic status of a neonate. Material and method:A prospective study was done over a span of one year comprising of 150 full term neonates. After obtaining consent prior before delivery females who met the inclusion criteria were randomly assigned to 3 groups.For group 1 the cord was clamped at a duration of 30 sec, 60 sec for group 2 and 120 sec for group 3. Exact time of delayed clamping was recorded using a stop

watch. Serum bilirubin and hematocrit level and parameters like respiratory rate, pulse rate, capillary refill time and temperature was assessed at day three. Results: Group 1 showed a mean hematocrit % of 41.51 (SD 10.28). Group 2 showed mean hematocrit % of 45.11 (9.4) and mean hematocrit % of group 3 was 45.64 (8.37). The group 3 showed a higher hematocrit level when compared with group 2 and 1. The mean serum bilirubin of group 1 was found to be 11.16 mg/dl (SD 3.17). Mean bilirubin of group 2 was 13.30 mg/dl (SD 4.57) and the mean bilirubin of group 3 was 13.89 mg/dl (SD 3.70). Higher serum bilirubin levels were observed in neonates of group 3 when compared group 2 and group 1. Conclusion: This study was conclusive that greater the duration of DCC higher the hematocrit. There is also increase in bilirubin level with no significant effect was seen on the hemodynamic parameters.

**Keywords**--cord-clamping, haematocrit, haemodynamics.

## **Introduction**

Umbilical cord is a part of placenta is the connection between fetus and mother. Infant is usually separated from the placenta by clamping the cord. Clamping of cord is usually part of third stage of labor. Timing of clamping of umbilical cord varies. Delayed cord clamping is usually preferred as several studies have shown its beneficial effects such as rise in hemoglobin, less incidence of anemia and improved hemodynamic status. DCC is shown to have increase in hematocrit level and lesser incidence of anemia in preterm infants. (1)(2) The physiologic transfusion is on average between 19 and 40 ml/kg of birth weight which is equal to as much as 2% of the newborn final birth weight. Delayed cord clamping at birth increases neonatal mean venous hematocrit within a physiologic range. (2) Though there is no single consensus about the most appropriate duration of delayed clamping. In 2010, the International Liaison Committee on Resuscitation (ILCOR) recommended that the cord should not be cut for at least 1 min after birth in infants not requiring resuscitation.(3) The American College of Obstetricians and Gynecologists now recommends a delay in umbilical cord clamping in vigorous term and preterm infants for at least 30–60 seconds after birth. In term infants benefits of DCC include increased hemoglobin levels at birth and improves iron stores in the first months of life. Benefits of DCC in preterm infants include improved transitional circulation, decreased requirement for blood transfusion, and decreased incidence of necrotizing enterocolitis and intraventricular hemorrhage. In term infants undergoing DCC there is a small increase in the incidence of jaundice requiring phototherapy. DCC is not shown to increase the risk of postpartum hemorrhage in mother(4) According to National Institute for Clinical Excellence (NICE) in vigorous neonate umbilical cord is not to be clamped earlier than 1 min from birth of the baby.(5) This study tries to compare the effect of different duration of delayed cord clamping on serum bilirubin, hematocrit and hemodynamic status of a neonate.

## Material and Method

A prospective study was done over a span of one year comprising of 150 full term neonates born at ShyamShah Medical College and Hospital Rewa by normal vaginal delivery. After obtaining informed consent prior before delivery the females who met the inclusion criteria were randomly assigned to three separate groups. For group 1 the cord was clamped at a duration of 30 sec for group 2 at 60 sec and group 3 at 120 sec. Exact time of delayed clamping was recorded using a stop watch with complete expulsion of neonate as starting point. These neonates were then assessed at day three of life. Blood sample were withdrawn to assess serum bilirubin and hematocrit level. The neonates were also assessed for clinical parameters like respiratory rate, pulse rate, capillary refill time and temperature. After reviewing the records data was filled in proforma. The data was entered MS Excel sheet and analyzed with appropriate statistical method. The collected data were analysed with IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY: IBM Corp). To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference in the multivariate analysis the one way ANOVA with Tukey's Post-Hoc test was used. To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value .05 is considered as significant level.

## Results and Discussion

A total 150 full term neonates born by normal vaginal delivery were included in the study. Out of the 150 neonates 56 were male making a total of 37.3% and 94 were female making 62.7% of the total neonate. Out of the 150 neonates included in the study 105 that is 70% belonged to rural area and 45 that is 30% belonged to urban area. (Table 1). In our work we compared the hematocrit level of neonates who underwent varied duration of cord clamping on day three of life. A significant difference between hematocrit and duration of delayed cord clamping at p value <0.05 was observed. Group 1 showed a mean hematocrit % of 41.51 (SD 10.28). Group 2 showed mean hematocrit % of 45.11 (9.4) and mean hematocrit % of group 3 was 45.64 (8.37). The group 3 showed a higher hematocrit level when compared with group 2 and 1. (Table 2). These findings were consistent with study of Qian et al who found that delayed cord clamping of term newborn infants at 1 or 3 min improved venous hematocrit levels measured at 6 h after birth within a physiologic range and decreased the prevalence of neonatal anemia. The results showed that DCC for at least 60 s could significantly increase neonatal hematocrit levels at 24 h of life, infants with DCC had the higher hematocrit and hemoglobin levels at 24 to 48 h without an increase in adverse effects. and the mean infant hematocrit increased with the increasing duration of DCC. (1) According to McDonald et al a trial with 180 infants reported haematocrit values for infants at 24 hours and at three to five months of age. Haematocrit at 24 hours was significantly higher in the late, compared with the early clamping group but this effect did not persist at three to five months. (6)

The study found a positive statistical difference between delayed cord clamping and serum bilirubin level as seen on day three of their life. (Table 3) The mean serum bilirubin of group 1 was found to be 11.16 mg/dl (SD 3.17). Mean bilirubin

of group 2 was 13.30 mg/dl (SD 4.57) and the mean bilirubin of group 3 was 13.89 mg/dl (SD 3.70). Higher serum bilirubin levels were observed in neonates of group 3 when compared group 2 and group 1. Increased requirement of phototherapy was seen in group 2 and group 3. Group 137.3% were found to be clinically icteric when assessed on day three. 61.8% were found to be clinically icteric in group 2 and 56.8% were found to be clinically icteric in group 3. In study done by Ghirardello et al it was found that infant with DCC needed phototherapy more and were admitted longer after implementation of DCC policy.(7) Study done by Fogarty et al also showed an increased incidence of jaundice in preterm neonates who underwent delayed cord clamping.(8)

The groups with delayed clamping were also clinically assessed for hypothermia. (Table 4) A total 8.7% neonates were found to be hypothermic. In group 1 17.6% were found to be hypothermic. 3.6 % in group 2 were found to be hypothermic 4.5% were found to be hypothermic in group 3. A significant association was seen with hypothermia and duration of delayed clamping. No significant statistical difference was seen with duration of delayed cord clamping and capillary refill time with a p value of 0.628. (Table 5) On comparison of pulse rate between different group of delayed clamping by unpaired t test the t value = 0.243. p value = 0.784 > 0.05 which shows no statistical difference at p > 0.05 level. (Table 6). On comparison of respiratory rate between groups by unpaired t test the t value = 0.415 p value = 0.661 > 0.05 which shows no statistical significance difference at p > 0.05. (Table 7) Study done by Dipak et al on delayed clamping in preterm neonates found that delayed clamping for 60 sec was associated with less incidence of hypothermia on NICU admission and improved blood pressure.(9) According to the study of delayed cord clamping in premature infants by Sommers et al found that DCC resulted in higher superior vena cava blood flow, higher right ventricle output and right ventricular stroke volumes at 48 hours. No significant differences were noted in middle cerebral artery BFV, mean superior mesenteric artery BFV, shortening fraction, or the incidence of a persistent ductus arteriosus in premature infants.(10) According to Fogarty the increased red cell mass on delayed clamping of cord increases total oxygen carrying capacity and oxygen saturation.(8) According to study done by Qian et al DCC (60 s) was associated with less hypothermia of admission in NICU compared to ECC (10 s). (1)

Table 1  
Socio demographic characteristics

Gender distribution		
	Frequency	Percent
Female	56	37.3
Male	94	62.7
Total	150	100.0
Area wise Distribution		
Rural	105	70
Urban	45	30
Total	150	100.0

Table 2  
Comparison of haematocrit in different age groups

Variable	Groups	N	Mean	SD	F-value	p-value
Hematocrit	Group 1	51	41.51	10.28	2.82	0.063 #
	Group 2	55	45.11	9.40		
	Group 3	44	45.64	8.37		
# No Statistical Significance at $p > 0.05$ level						

Table 3  
Comparison of serum bilirubin in different age groups

Variable	Groups	N	Mean	SD	F-value	p-value
SerumBilirubin	1	51	11.16	3.17	6.718	0.002 **
	2	55	13.30	4.57		
	3	44	13.89	3.70		
** Highly Statistical Significant at $p < 0.01$ level						

Table 4  
Comparison of Temperature between DLCC by Fisher's exact test

			DLCC			Total	$\chi^2$ - value	p-value
			30	60	120			
Temperature	Hypothermia	Count	9	2	2	13	7.898	0.019 *
		%	17.6%	3.6%	4.5%	8.7%		
	Normal	Count	42	53	42	137		
		%	82.4%	96.4%	95.5%	91.3%		
Total		Count	51	55	44	150		
		%	100.0%	100.0%	100.0%	100.0%		
* Statistical Significance at $p < 0.05$ level								

Table 5  
Comparison of Capillary refill time between DLCC by Pearson's Chi-Square test

			DLCC			Total	$\chi^2$ - value	p-value
			30	60	120			
Capillary refill time	<3/s	Count	50	53	44	147	2.594	0.628 #
		%	98.0%	96.4%	100.0%	98.0%		
	>3/s	Count	1	1	0	2		
		%	2.0%	1.8%	0.0%	1.3%		
	3/s	Count	0	1	0	1		
		%	0.0%	1.8%	0.0%	.7%		
Total		Count	51	55	44	150		
		%	100.0%	100.0%	100.0%	100.0%		
# No Statistical Significance at $p > 0.05$ level								

Table 6  
Comparison of Pulse Rate between Groups by Oneway ANOVA test

Variable	Groups	N	Mean	SD	F-value	p-value
Pulse Rate	30	51	133.92	16.41	0.243	0.784 #
	60	55	135.71	11.99		
	120	44	134.27	13.15		
# No Statistical Significance at $p > 0.05$ level						

Table 7  
Comparison of Respiratory Rate between Groups by Oneway ANOVA test

Variable	Groups	N	Mean	SD	F-value	p-value
Respiratory Rate	30	51	45.55	5.68	0.415	0.661 #
	60	55	46.75	7.52		
	120	44	46.27	7.00		
# No Statistical Significance at $p > 0.05$ level						

## Conclusion

On the assessment of effect of duration of delayed cord clamping on the serum bilirubin, hematocrit and various hemodynamic parameters of full term neonates at day three of their life it was found that the serum bilirubin level and hematocrit was higher in groups who underwent cord clamping at more delayed time. Hypothermia was seen more in the neonates in group 1 as compared to those in group 2 and group 3. Icterus was seen more in neonate who underwent clamping at more delayed time as compared to those who underwent clamping earlier. No association was seen between pulse rate, respiratory rate, capillary refill time with duration of delayed clamping.

Hemoglobin level mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, total leucocyte count, platelet count shows no association with the duration of delayed cord clamping. Hematocrit level was seen to be higher in group who underwent delayed cord clamping. Serum bilirubin level was also seen to be higher in groups who underwent clamping at delayed time. Hence from this study it can be concluded that delayed cord clamping is a beneficial exercise. The duration of delayed clamping can be varied but the greater the duration the more is the hematocrit which could be beneficial. But it is also associated with higher serum bilirubin level although the bilirubin level requiring exchange transfusion was not higher. From this study we can recommend the beneficial practice of delayed cord clamping in vigorous neonates. Further studies should also be done to further evaluate the effects of delayed clamping on several hemodynamic and clinical parameters.

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