The Effect of Timing of Cord Clamping On Neonatal Venous Haematocrite Values

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I. Introduction

When a newborn is born there is lot of difference in opinion, when to clamp the cord,is there any beneficial or harmful effects of clamping the cord early or visa versa.

Hence to know the outcome of delayed cord clamping and early cord clamping this study was undertaken.

Haematocrit/packed cell volume (PCV).

Haematocrit is the volume of red cells expressed as a percentage of volume of whole blood in the sample. The venous haematocrit is almost same as that obtained from a skin puncture. Dried heparin, EDTA or double oxalate are satisfactory anticoagulants that can be used to measure haematocrit.

Normal values of haematocrit

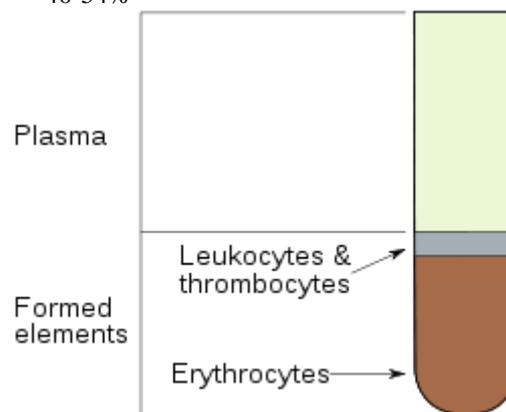|	
In New born	42-65% (51.5±4.5%)
At 3 months	29-54%
Adult female	37-47%
Adult male	40-54%

Fig 1. Wintrobes tube

The term "haematocrit was coined in 1903. Its roots stem from the Greek word haemo-means blood, and keiten-means judge, meaning to gauge or judge the blood. The packed cell volume (PCV) can be determined by centrifuging heparinized blood in a capillary tube (also known as a microhaematocrit tube) at 10000 RPM for five minutes. This separates the blood into 2 layers. Upper layer is occupied by plasma and lower layer occupied by red blood cells. The volume of packed red blood cells divided by the total volume of the blood sample gives the PCV. With modern lab equipment, the haematocrit is calculated by an automated analyzer. Haematocrit is determined by multiplying the red cell count by the mean cell volume. The haematocrit is slightly more accurate as the PCV includes small amount of blood plasma trapped between the red blood cells. An estimated haematocrit as a percentage may be derived by tripling the haemoglobins concentration.

Haematocrit is measured using
1. Wintrobe's tube
2. Microhaematocrit capillaries.

Wintrobes Tube

Fill the Wintrobe's tub'e till the 100 mark on top with a Pasteur pipette ensuring that there are no air-bubbles in the blood column. Centrifuge this tube for 15 minutes at 3500 rpm (or longer at lower speeds) until sedimentation is complete. After centrifuging, the blood is separated into 3 layers, a column of red blood cells at the bottom, a narrow middle layer—buffy coat of WBCs and platelets and the top most fluid column of plasma. The percentage of the height of the blood occupied by packed red cells constitutes the haematocrit. Roughly, the haematocrit value is three times the hemoglobin concentration.

Fig 2. Wintrobes tube.
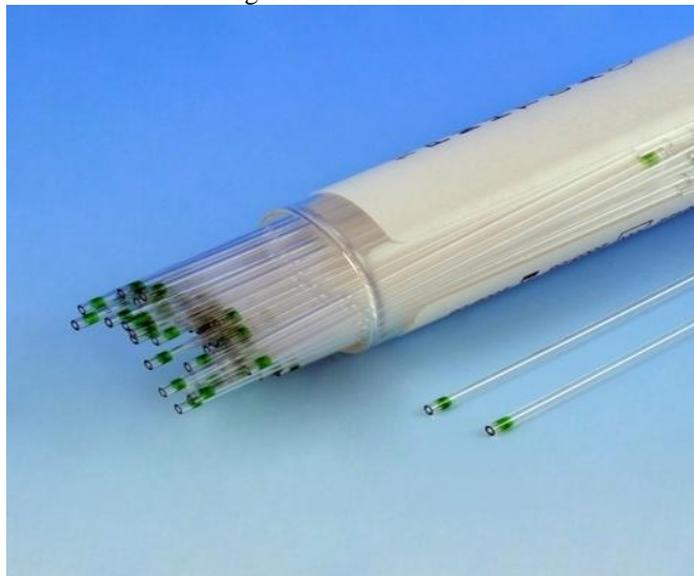

Fig 3. Microhaematocrit

Fig 4. Capillary tubes

Microhaematocrit method is in common use in most well-equipped laboratories. Capillary tubes coated with anticoagulant can be filled with blood obtained from finger puncture or from a venipuncture or with blood already anticoagulated. One end of the filled capillary tube is sealed with sealing wax (e.g. Plasticine) or the empty end is sealed by heating the tube. The sealed tube is centrifuged for 3 minutes in a special high-speed centrifuge. By reading the packed cell height and the total height of the entire specimen, the haematocrit can be determined. Special reading devices are available on the instrument.

For example, if the red cells are of normal size (normocytic), and the red cell count is 5 million, the haematocrit is about 45%.

For men—haematocrit range from 42-52%, average 47%
For women—haematocrit range from 37-47%, average 42%.
For newborn-haematocrit range from 42-65%

Interpretation
In anaemia there is reduced haematocrit ,for men less then 42%,and for women less then 37%.
In polycythemia there is raised haematocrit,that is more then 65%.

Coulter Principle Is Used To Measure Haematocrit.

The Coulter principle states that particles pulled through an orifice, concurrent with an electrical current, produce a change in impedance that is proportional to the size of the particle traversing the orifice. The Coulter principle was named after its inventor, Wallace H Coulter.

Wallace was an electrical engineer by training with a passion for radio technology. During the second world war, Wallace joined the US Navy. While working on a technique to detect submarines using sonar, he frequently detected large echos where no submarines were operating. In an attempt to determine the source, Wallace lowered a series of small bottles with remote trap doors to various depths. The bottles were constructed such that the remote door could be opened and shut at predetermined depths, filling the bottle with seawater from that depth. The source of the false echo turned out to be high concentrations of plankton (mass of tiny animals and plants that live in the surface of the sea). In order to count the number of plankton cells per milliliter of seawater accurately and reproducibly, Wallace created a device that would become the basis for the Coulter principle.

The device consisted of a dual chambered container whose two sides were separated by a thin membrane. A small hole in the membrane called an aperture was the only connection between the two chambers. Electrodes from a battery were placed in the chambers, positive on one side and negative on the other. An ohm meter was connected to the circuit so as to measure the resistance to the flow of current (impedance) from one electrode, through the orifice, and to the other electrode. Both chambers were filled with seawater from the trap bottles. Then one of the two chambers was partially drained, forcing seawater to flow from the opposite chamber, through the orifice to balance the level of liquid in the two sides. As the seawater passed through the orifice so did the plankton cells, which created momentary changes in impedance that were seen on the ohm meter. By counting the number of impedance pulses per unit of seawater, Wallace's device was able to count the number of plankton particles.

This technology found commercial success in the medical industry where it revolutionized the science of hematology. Red blood cells, white blood cells and platelets make up the majority of the formed elements in the blood. The average salinity of human blood is very close to that of seawater, and mixture of salt (NaCI) and water with the same salinity as seawater is said to be isotonic with whole blood. When whole anti-coagulated human blood is diluted with isotonic saline, the Coulter principle can be applied to count and size the various cells that make up whole blood. The first commercial application of the Coulter principle to hematology came in 1954 with the release of the Coulter Model A (developed by Wallace and brother Joseph R. Coulter). Within a decade, literally every hospital laboratory in the United States had a Coulter Counter, and today every modern hematology analyzer depends in some way on the Coulter principle.[1,2]

Fig 5.Coulter automated analyser

II.   Aims And Objectives Of Study

The purpose of this randomized control trial is to determine the effect of timing of cord clamping on neonatal venous haematocrit values.

III.   Review Of Literature

In some studies[3] done by Jose M Ceriani Cernades MD, it was observed that delayed cord clamping could contribute to preventing iron deficiency anaemia in first year of life. The reason for this effect is based on the fact that after birth the newborn is delivered with a placental transfusion of about 80 ml of extra blood at 1 min after birth and 100 ml of extra blood at 3 min after birth. This volume will supply 40 to 50 mg/kg of extra iron to the 75 mg/kg of body iron that newborn term infant have, reaching a total of 115 to 120 mg/kg, which might prevent iron deficiency anaemia in the first year of life. Iron deficiency early in life may have pronounced central nervous system effects such as cognitive impairment, delayed milestones, learning difficulties. Iron deficiency also the main cause of anaemia, which is one of the most common condition in childhood, especially in developing countries like India. The public health magnitude of anaemia amongst children in India has been brought to the force by the recent NFHs survey. [4] Which has recorded that almost 70% of infants between 6-11 months are anaemic. It has also demonstrated a strong association between maternal haemoglobin levels and prevalence of anaemia amongst their childrens. Iron stores at birth is a major factor influencing growth and the occurrence of iron deficiency anaemia during infancy. These stores are determined by the transplacental iron transferred to the foetus and the blood transferred from the placenta at delivery. The iron content of human milk is low, and also the absorption of iron is also poor during 4 to 10 months of age, thus making this period vulnerable to iron deficiency anaemia. The recent NFHs survey has reported very high prevalence of anaemia both in mothers and their childrens in India, with almost a quarter of children of severely anaemic mothers being also severely anemic. Iron stores at birth correlates with iron stores at 6-12 months. Studies have observed that infants of mothers with moderate to severe anaemia has significantly lower cord serum ferritin level and hence lower iron stores at birth. Iron stores at birth is an important determinant of anaemia in infancy. Delayed clamping of cord at birth has been suggested as a possible strategy to prevent anaemia in infants between 4-11 months of age. At two months after delivery the group with delayed cord clamping has significantly high haemoglobin and haematocrit.Thus it appears that infants born to anaemic mother benefit more than those born to non-anaemic mothers from the additional iron they derive from the blood passed from the placenta as a result of delayed clamping. These benefits appears to outweigh any risk that may result from delayed clamping (such as polycythemia or volume overload). More of the trials have demonstrated increase risk of these potential side effects. There is a need to incorporate delayed clamping as a component of routine active labour management this strategy can impact upon the existing high prevalence of anaemia in infancy and early childhood.[5,6]

When cord clamping was delayed for at least 2 min, benefits over 2 to 6 months include increased haematocrit, raised serum ferritin levels, and a clinically important reduction in risk of anaemia. Neonates with late clamping were at risk of experiencing asymptomatic polycythemia. Previous research has suggested that early clamping of cord (within 5 to 10 secs) compared with late clamping, result in decease to the neonate of 20

to 40 ml of blood per kg of body weight, which would provide the equivalent of 30 to 35 mg of iron. It has been argued that early cord clamping puts the newborn at increased risk of hypovolemia as well as of several blood disorders and type 2 diabetes, as a consequence of loss of hematopoietic stem cells. Early cord clamping has been postulated as a major cause of anaemia in infancy, that held some investigators to recommend late clamping as a low-cost intervention to reduce anaemia in the first 6 months of life. Other believe that the increase in blood volume to the neonate resulting from delay in clamping may be harmful and could result in overloading the neonate, thus increasing the likelihood of respiratory distress, neonatal jaundice, and polycythemia.[7]

"If delayed cord clamping is adopted as a means to reduce the incidence of respiratory distress syndrome in premature births, there will be an accompanying augmentation of hyperbilirubinemia to deal with". True, hyperbilirubinemia might be prevented in premature and medicated infants by early clamping; however, in a normal delivery of full-term, un-medicated infant, there are untold advantages to delayed cord clamping until after the placenta has delivered itself.[8]

In recent Cochrane review of cord clamping in preterm population, late clamping is potential benefit in terms of decrease need of blood transfusion and lower risk of intraventricular hemorrhage.Iron deficiency anaemia is a serious health problem that affects the physical and cognitive development of children, therefore it is important to develop cost effective interventions (i.e. delayed cord clamping) to improve the hematologic status to the millions of children affected by this conditions worldwide.[9]

No significant differences between early and late cord clamping were seen for postpartum hemorrhage. Delaying cord clamping until the pulsation stops increases the red cell mass in term infants. It is safe and simple and low cost delivery procedure that should be incorporated in integrated programmes aimed at reducing iron deficiency anaemia in infants in developing countries. No significant differences were found in clinical jaundice. These infants in delayed cord clamping group had polycythemia without symptoms, for which no partial exchange transfusion was necessary.[10]

Clamping the cord in seconds after birth cuts off the blood flow from mother to baby, while not necessarily harmful, the common practice in delivery room potentially robs newborns of those last precious minutes of cord blood. The researchers said, cord blood contains stem cells that have regenerative properties and can grow into different types of cells. Delayed clamping for an extra minute or two may help prevent anaemia in full term infants according to the study cited by researchers. Studies on preterm infants have found delayed clamping the cord for 30 sec, or more reduced the incidence of anaemia, intraventricular hemorrhage, late onset sepsis and decrease need for blood transfusions. The clamping of umbilical cord of newborns in full term pregnancies two minutes after birth shown to increase a haematocrit. Thus the study shows that early clamping is not justified. This study also found that the partial pressure of oxygen in the umbilical artery of the late clamped newborn babies is high there by there was a lesser need of oxygen therapy after birth. Other advantages of delayed cord clamping are, reduced concentration of triacylglyceride in umbilical veins of delayed clamped group.[11,12]

Outcome measures:

The primary outcome measures was the neonatal venous haematocrit values found to be more in delayed clamped group.

Secondary outcome measures

- Jaundice
- Admission to NICU(for phototherapy)
- Newborn length of hospital stay
- Any neonatal disease that occurred between birth and 1 month of age
  All these secondary outcomes are not significant.[13]

Delayed cord clamping for at least 3min in healthy newborn improves their iron level at 4 months.[14,15,16,17]

Delayed cord clamping is not linked to neonatal jaundice or other adverse health effects and should be standard care after uncomplicated pregnancy.[18,19,20]

Cord blood contains many valuable stem cells, making this transfer of stem cells a process that might be, considered 'the original stem cell transplant.[21,22,23,24]

Delayed cord clamping is beneficial in extremely low birth weight neonates, and in preterm neonates in preventing intraventricular hemorrhage, late onset sepsis, increases the immunological tolerance and also decreased need for blood transfusion.[25,26,27,28,29,30]

Delayed cord clamping also has a role in postnatal cerebral oxygenation in preterm neonates.[31,32,33,34,35,36,37]

IV.   Materials And Methods:

Source of data - Neonates with Full term normal delivery in JSS Hospital-from November 2010 to July 2012.
Method collection of data: Is by randomized control trial.
Study design - Randomized control trial.
Sample Size: 100 neonates in each group i.e. control and study group
Inclusion criteria:
Healthy women with uneventful full term, cephalic presentation, singleton pregnancy, vaginal delivery at JSS Hospital from November 2010 to July 2012.
Exclusion criteria:
Patients with following conditions are excluded,
Preeclampsia.
Eclampsia.
Chronic hypertension.
Rh negative pregnancy.
Moderate to severe anaemic mothers.
Meconium stained amniotic fluid.
Fetal anomalies.
Infants requiring operative delivery by forceps and vacuum.
Group 1
Study group
New born who's cord is clamped at cessation of pulsation.
Group 2 – control group
New born who's cord is clamped immediately after birth.
Blood of neonate is drawn for
PCV (haematocrit) at 18-24 hours after birth and at 1 and half months of life.

Statistical methods applied
Frequencies
        The Frequencies procedure provides statistics and graphical displays that are useful for describing many types of variables. The Frequencies procedure is a good place to start looking at your data.

Crosstabs (Contingency coefficient test)
        The Crosstabs procedure forms two-way and multiway tables and provides a variety of tests and measures of association for two-way tables. The structure of the table and whether categories are ordered determine what test or measure to use.
Independent-Samples T Test
        The Independent-Samples T Test procedure compares means for two groups of cases. Ideally, for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not to other factors.

All the statistical calculations were done through SPSS 16.0 (2007) for windows.

V.   Observations And Results

        Neonates of full term normal delivery at J.S.S Hospital from November 2010 to July 2012 were included in the study.
Variables included are,
Age.
Gravida.
Duration of pregnancy.
Maternal haematocrit.
Neonatal haematocrit.
Neonatal birth weight.
Neonatal sex.
Neonatal birth weight and development of jaundice.
Neonatal birth weight and development of jaundice for which phototherapy was needed
Length of hospital stay.
Follow up at one and half months of life.

Table 1. Age distribution of women

Variable			GROUP		Total
			Case	Ctrl	
AGE in years.	18-20	frequency	30	29	59
		%	30.0%	29.0%	29.5%
	21-25	frequency	49	48	97
		%	49.0%	48.0%	48.5%
	26-30	frequency	17	19	36
		%	17.0%	19.0%	18.0%
	31-35	frequency	4	4	8
		%	4.0%	4.0%	4.0%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.987 (Not significant)

The above table shows the age distribution of 200 women, who are included in the study in between the ages 18-35 years.100 women in each group. They are divided into 4 sub groups, with maximum number of women belonging to age group between 21-25 years in both case and control group.

Graph 1. Age distribution of women
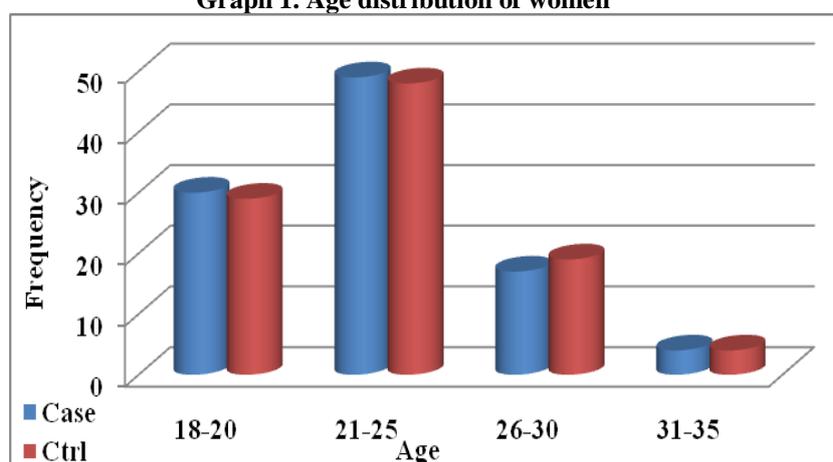
Table 2. Gravida

Variables			GROUP		Total
			Case	Ctrl	
GRAVIDA	Primi	Frequency	58	55	113
		%	58.0%	55.0%	56.5%
	Multi	Frequency	42	45	87
		%	42.0%	45.0%	43.5%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.669(Not significant)

- The above table shows the gravida status of 200 women100 women in each group, and the maximum women are primigravida,58% were primigravida in cases and 55% were primigravida in controls. And 42% were multigravida in cases and 45% in control.
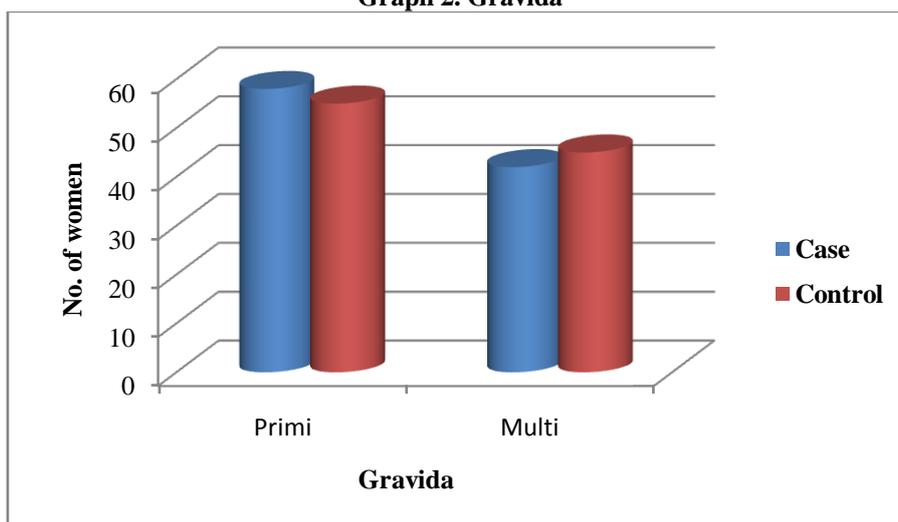
Graph 2. Gravida

Table 3. Gestational age of women.

Variable			Case	Ctrl	Total
			GROUP		
			Case	**Ctrl**	**Total**
GA in weeks	37-39	Frequency	64	66	130
		%	64.0%	66.0%	65.0%
	40-42	Frequency	36	34	70
		%	36.0%	34.0%	35.0%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.767(Not significant)
- The above table shows duration of amenorrhoea in weeks. Maximum women are in gestational age between 37 to 39 weeks in both groups.64% women were in cases, and 66% women were in control.

Graph 3. Gestational age of women.

Gestational age (in weeks)
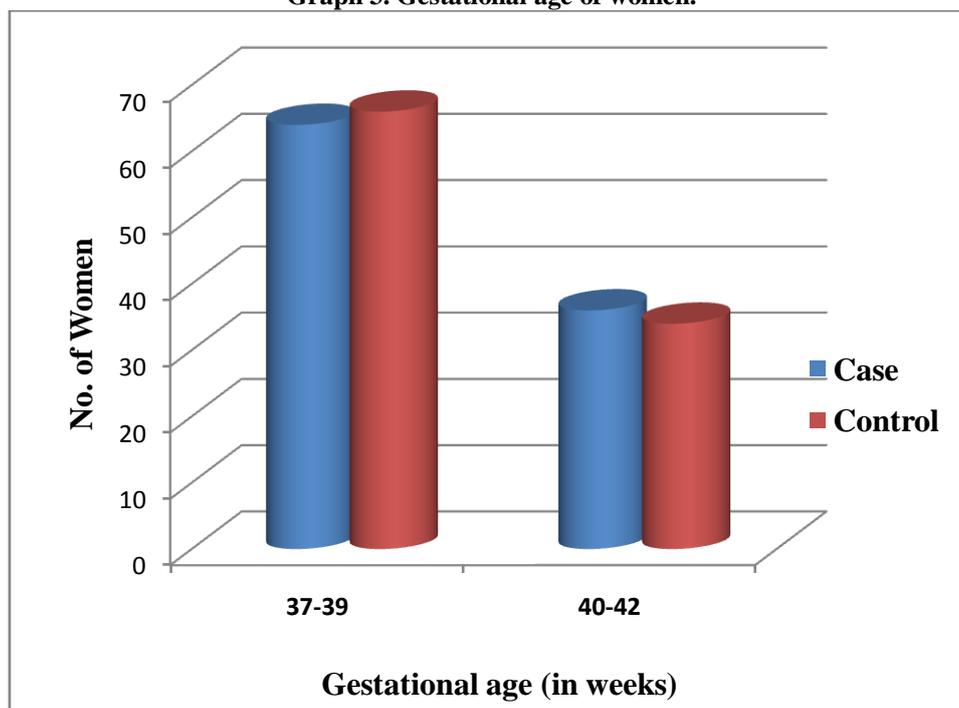
Table 4. Birth weight of newborns in kgs

Variable			Case	Ctrl	Total
			GROUP		
B_WT in kgs	<2.5	Frequency	5	8	13
		%	5.0%	8.0%	6.5%
	2.5-3	Frequency	56	58	114
		%	56.0%	58.0%	57.0%
	3.1-3.5	Frequency	32	25	57
		%	32.0%	25.0%	28.5%
	3.5+	Frequency	7	9	16
		%	7.0%	9.0%	8.0%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.607(Not significant)

The above table shows the birth weight of 200 newborns with mean range varying from 2.5kg to 3kg ,56% of newborns in cases and 58% of newborns in control are in this range

**Graph 4. Birth weight of newborns**
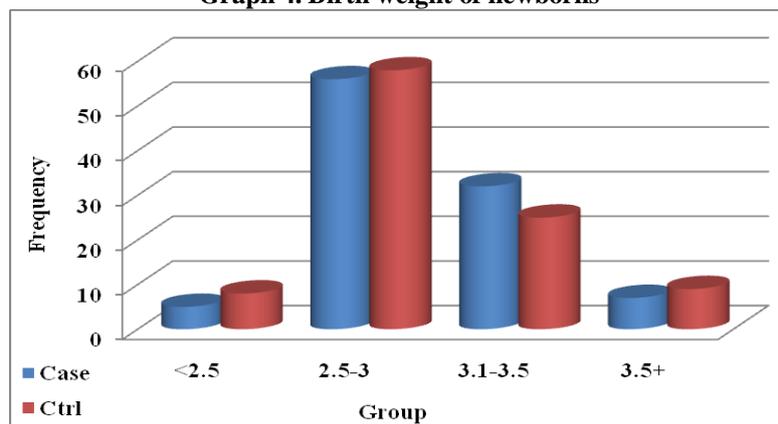
Table 5. Maternal PCV

Variables			Case	Ctrl	Total
			GROUP		
MATPCV in %	30-35.9	Frequency	69	61	130
		%	69.0%	61.0%	65.0%
	36-41.9	Frequency	30	39	69
		%	30.0%	39.0%	34.5%
	41.9+	Frequency	1	0	1
		%	1.0%	.0%	.5%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.264(Not significant)

The above table shows distribution of PCV in 200 women,100 women in each group, maximum women had a PCV in a range varying from 30% to 35.9% in both the group.
69% of women in cases and 61.1% of women in control belongs to this range.

Graph 5. Distribution of maternal PCV
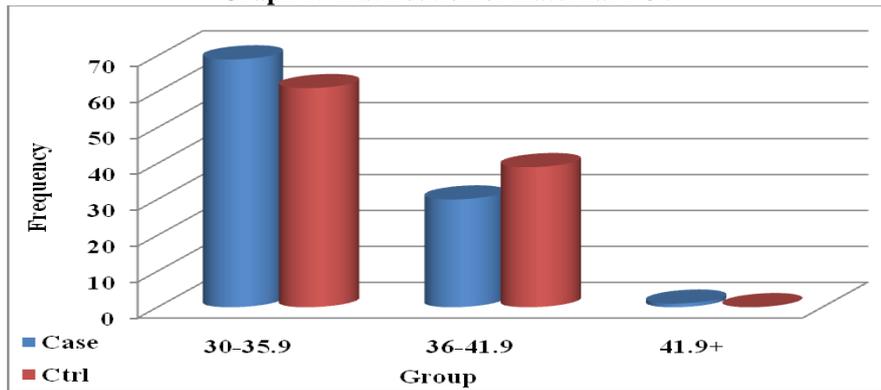
Both study and control groups are comparable in relation to maternal variables like age,parity,duration of amenorrhoea,maternal PCV.

Table 6. Neonatal PCV at 18 to 24 hrs of life

Variable			GROUP		Total
			Case	Ctrl	
NEOPCV in %	42-45	Frequency	0	33	33
		%	.0%	33.0%	16.5%
	45-50	Frequency	0	67	67
		%	.0%	67.0%	33.5%
	50-55	Frequency	29	0	29
		%	29.0%	.0%	14.5%
	55.1-60	Frequency	58	0	58
		%	58.0%	.0%	29.0%
	60.1-65	Frequency	12	0	12
		%	12.0%	.0%	6.0%
	65.1-70	Frequency	1	0	1
		%	1.0%	.0%	.5%
Total		Frequency	100	100	200
		%	100.0%	100.0%	100.0%

P=0.000(Significant)

The above table shows a maximum number of neonatal PCV in case group are in between 51.1% to 60%,with mean of 55.5%.Maximum neonatal PCV in control group are in between 45% to 50%,with mean of 47.5%.

Graph 6. Neonatal PCV at 18 to 24 hrs of life
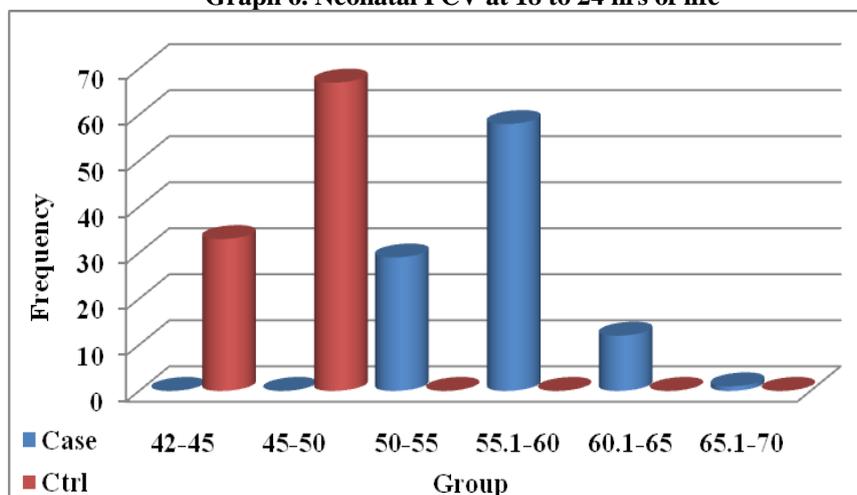
By this observation we can say that there is a significant raise of haematocrit in late clamped groups compaired to early clamped group.

Table 7. Secondary outcomes

	Variable			GROUP		Total
				Case	Ctrl	
SECOUT	Nil		Frequency	57	65	122
			%	57.0%	65.0%	61.0%
	Jaundice (observation)		Frequency	34	29	63
			%	34.0%	29.0%	31.5%
	Jaun2 (phototheraphy)		Frequency	9	6	15
			%	9.0%	6.0%	7.5%
Total			Frequency	100	100	200
			%	100.0%	100.0%	100.0%

P=0.467 (not significant)

The above table shows,34 neonates of case group and 29 neonates of control group developed jaundice but not required phototheraphy.

9 neonates of case group needed phototheraphy and NICU admission,and 7 neonates of control group needed phototheraphy and NICU admission.

Graph 7. Neonates developing jaundice
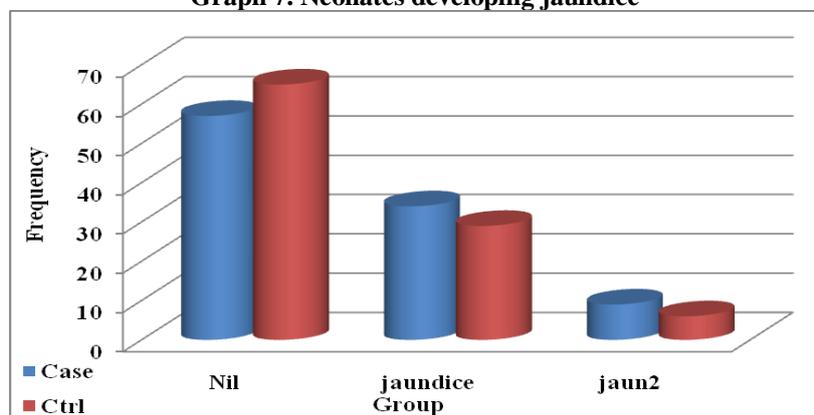
By this observation we can say that there is no statistical significant increase in risk of neonatal jaundice in late clamped group compared to early clamped group.

Table 8. Follow up at 1 and half month

	Variable			GROUP		Total
				Case	Ctrl	
FOLLOW at one and half months.	No		Frequency	89	88	177
			%	89.0%	88.0%	88.5%
	Yes		frequency	11	12	23
			%	11.0%	12.0%	11.5%
Total			Frequency	100	100	200
			%	100.0%	100.0%	100.0%

11 in cases and 12 in Control Came for Followup.
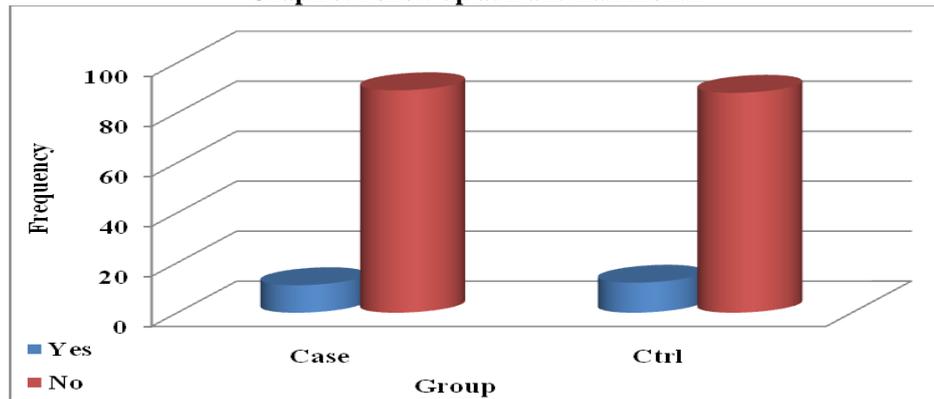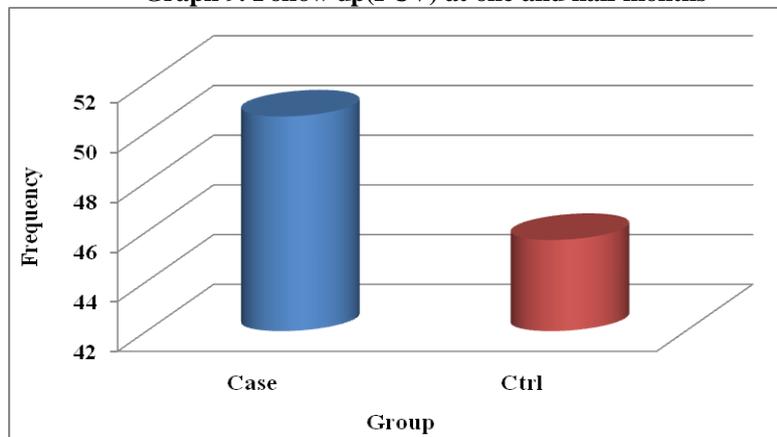
Graph 8. Follow up at 1 and half month

Table 9. Follow up(PCV) at one and half months

Variable	GROUP	No. of Babies	(Pcv%) Mean	Std. Deviation	Std. Error Mean
FOLLOWUP PCV	Case	11	50.6364	2.54058	.76601
	Ctrl	12	45.6667	1.23091	.35533

P=0.000(Significant)

Mean PCV in Cases -50.6%. Mean PCV in Control-45.5% at 1 and half month, which shows there is clinically significant increase in haematocrit in delayed clamped group as compared to early clamped group at one and half months of life.

**Graph 9. Follow up(PCV) at one and half months**

There is a significantly more haematocrit values in delayed clamped group compared to early clamped group during follow up at 1 and half month which is statistically significant.

Table 10. Neonatal birth weight and development of jaundice

Bt.wt	Case -jaundice	Ctrl-Jaundice
2.5-3kgs	19	20
3.1-3.5kgs	15	9

P=0.787(Not significant)

Graph 10. Neonatal birth weight and development of jaundice
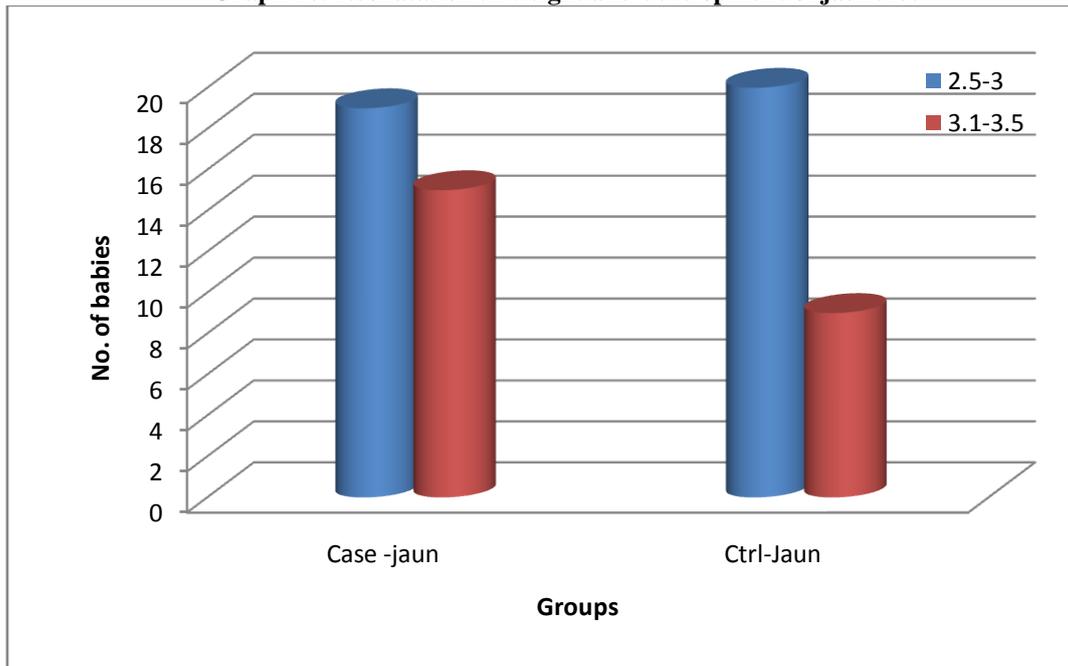
More no. of neonates developed jaundice who has a birth weight between 2.5 to 3 kgs.

Table 11. Neonatal birth weight and development of jaundice for which phototherapy was needed

Bt.wt	Case –Phototherapy	Control- Phototherapy
2.5-3kgs	4	4
3.1-3.5kgs	5	3

P=0.706(Not significant)

Graph 11. Neonatal birth weight and development of jaundice for which phototherapy was needed
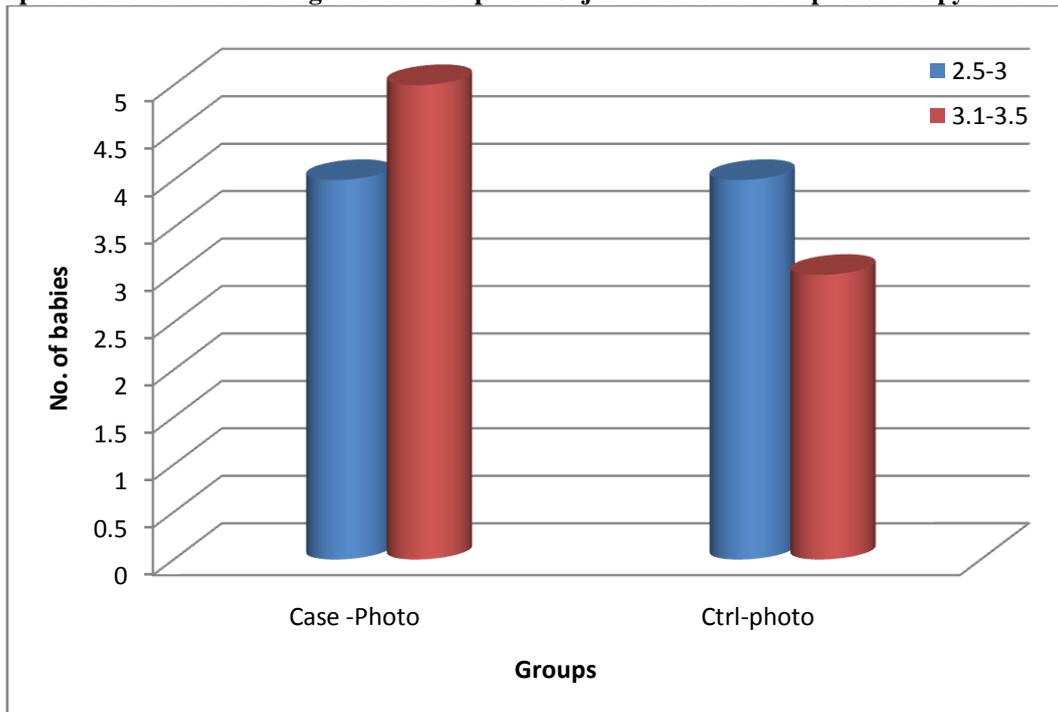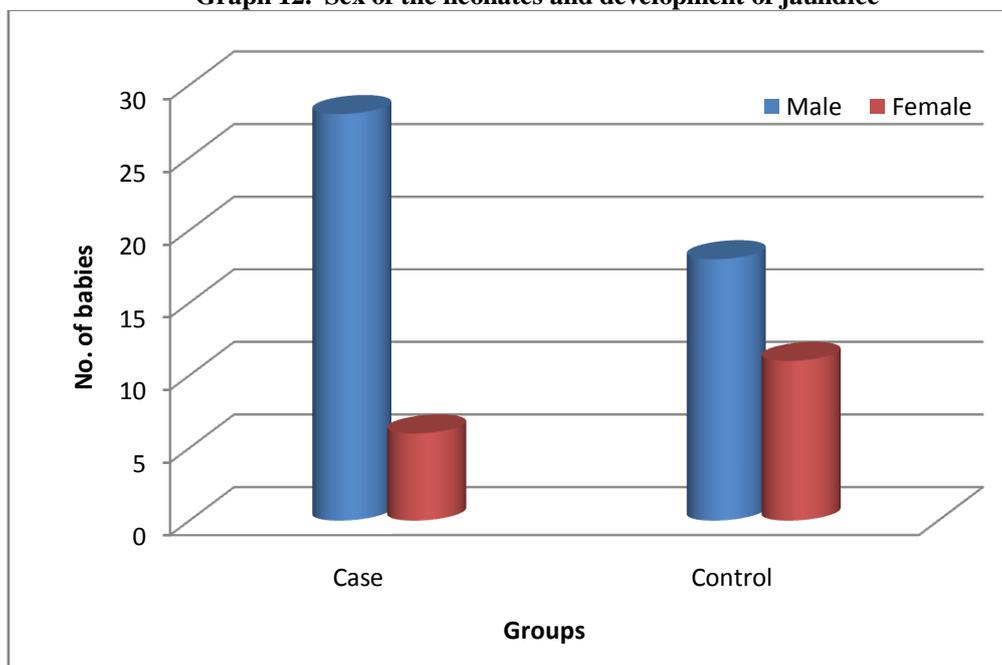
Table 12. Sex of the neonates and development of jaundice

Variable	Male	Female
Case	28	6
Control	18	11

P=0.071(Not significant)

Graph 12. Sex of the neonates and development of jaundice

Comparatively more no. of male babies developed jaundice in both group. But not statistically significant.

VI.   Discussion

Our prospective randomized controlled study evaluated the potential placental transfusion effects on the newborn when cord is clamped after stoppage of pulsation in comparison to early cord clamping. This study was designed to demonstrate that in late cord clamping there is an increase in venous haematocrit which is within physiological ranges(35%-65%)

Comparison with other studies

Comparison of age of women

Variables	Present study (our study)		Ruber Grajeda Rafad perez in Guatemalan infants	
	Early	Late	Early	Late
Age (mean)	21-25 yrs	21-25 yrs	25.8±7 years	25.3±6.3 yrs

The mean age group in our study in both early and late clamped group is 21-25 years.
And in the study done by Ruber Grajeda and others mean age in early clamped group is 25.8±7 yrs and in late clamped group 25.3±6.3 yrs, thus both study have same age group women.

Comparison of birth weights of neonates

Variables	our study		Ruber Grajeda Rafad perez in Guatemalan infants	
	Early	Late	Early	Late
Birth weight	25-3 kgs	2.5-3 kgs	3±0.4 kgs	3.2±0.5 kgs

The mean birth weight of neonates in both early and late clamped group in our study is in between 2.5 kg to 3 kgs and in the study done by Ruber Grajeda is others means birth weight in early clamped group is 3±0.4 kgs in late clamped group is 3.2±0.5 kgs, which is almost same.

Comparison of neonatal PCV at 24 hour of life.

| Variables	our study		Ruber Grajeda Rafad peles Guatemalan infants		Ola Anderson,Dan Anderson in BMJ 2011		Jose M Ceriani Cesuades MD		Jose Tantasean	
	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
Neonatal PCV at 24 hrs of life (mean)	47.5%	55.5%	42%	55%	50%	53%	51.1%	56.5%	51%	57%
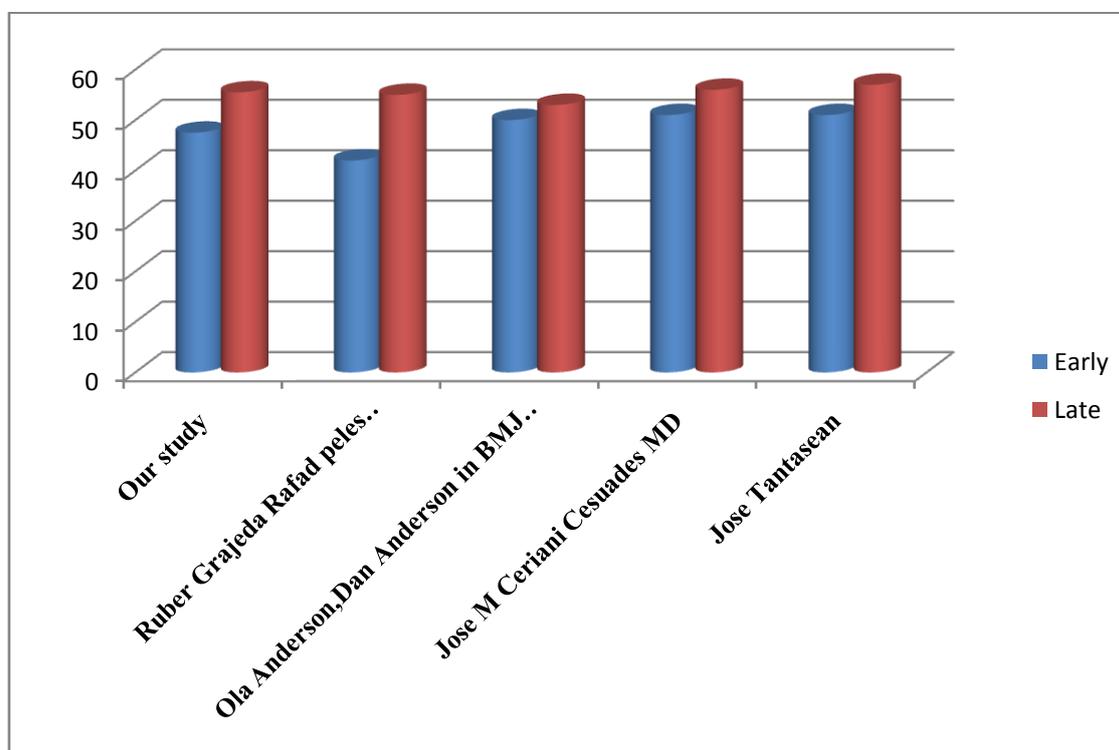
In our study neonatal PCV at 24 hrs of life in early clamped group is 47.5% and in late clamped group is 55.5%.

And in study done by Ruber Grajeda and others the PCV in early clamped group is 42% and in late clamped group is 55%, which is almost similar. And in the study done by Ola Anderson neonatal PCV in early clamped group is 50% and in late clamped group is 53%,which is similar compared to our study.In study done by Jose M Ceriani Cernades PCV in early clamped group is 51.5% and in late clamped group is 56.5%,which is similar to our study. And in study done by Jose Tantalean PCV of neonates in early clamped group is 51% and in late clamped group is 57% .

In all these studies the PCV of neonates in late clamped group is significantly more then the early clamped group, which correlates with our study.

**Comparison of neonates developing jaundice**

Variables	Our study		Ruber Grajeda Rufad Perez		Ola Anderson and Dan Anderson		Jose M Ceriani Cernades		Jose Tantalean	
	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
Jaundice	29%	34%	12%	25%	4%	7%	4%	13%	5.9%	14%
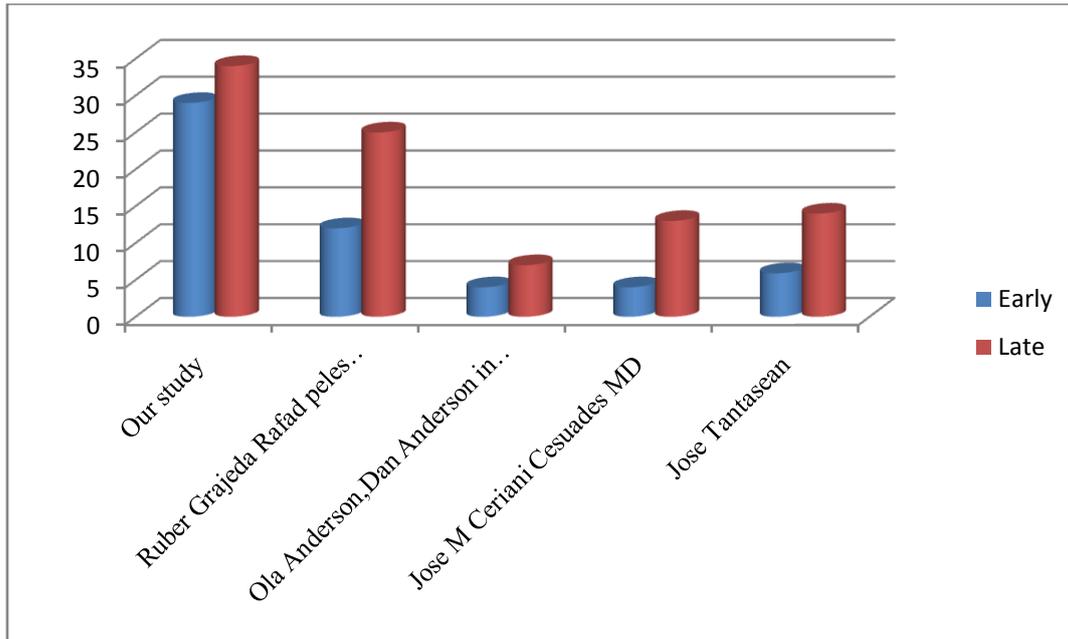
The development of jaundice in early clamped group in our study is 29% and late clamped group in our study is 29% and late clamped group is 34%, where as the study done by Ruber Grajeda the development of jaundice in early clamp group is 12% and late clamped group is 25%,and in study by Ola Anderson in early clamped group is 4% and in late clamped group is 7%,and in study done by Jose M Ceriani Cernades development of jaundice in early clamped group is 4% and in late clamped group is 13%,and in study done by Jose Tantalean development of jaundice in early clamped group is 5.9% and in late clamped group is 14%.

So development of jaundice in our group in both the group is more compaired to above mentioned studies it may be because of active management of labour with use of oxytocin in all our cases.

Comparison of neonates needing NICU admission

Variables	Our study		Ola Anderson Dan Anderson		Jose M Ceriani Cernades	
	Early	Late	Early	Late	Early	Late
NICU admission	7%	9%	2%	1%	4%	8%
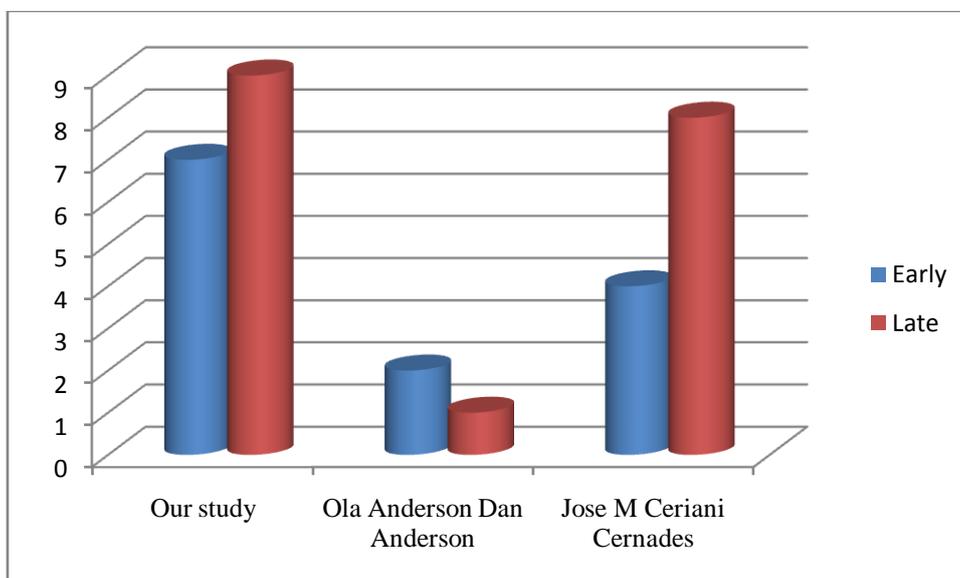
In our study the neonates requiring NICU admission for phototherapy in early clamped group is 7% and that of late clamped group is 9%, whereas in study done by Ola Anderson the neonates requiring NICU

admission for phototherapy in early clamped group is 2% and that of late clamped group is 1%,and in study done by Jose M Ceriani Cernades neonates requiring jaundice in early clamped group is 4% and in late clamped group is 8% , which shows a large number of babies in our study needed NICU admission in both group compared to study done by Ola Anderson and Jose M Ceriani Cernades.

Comparison of length of hospital stay

Variables	Our study		Jose M Ceriani Cernades	
	Early	Late	Early	Late
Length of hospital stay	2%(normal)	2%(normal)	3%(phototherapy)	3.5%(phototherapy)
	4%(phototherapy)	4%(phototherapy)		

The length of hospital stay in both early and late clamped neonates in our study is 2% in neonates who not developed jaundice and is 4% in babies who developed jaundice and needed phototherapy and NICU admissions, and in study done by Jose M Cerianis Cernades the length of hospital stay in both early clamped neonates is 3% and late clamped neonates is 3.5% who developed jaundice, which is almost similar.

Our study is comparable to almost all studies like study done by Ruber Grajeda Rafad perez, Ola Anderson Dan Anderson,Jose M Ceriani Cernades,Jose Tantalean.

In our study number of neonates developing jaundice was more in both early and delayed clamped group in compared to other studies, and this increase in neonatal jaundice may be explained because more use of oxytocin during delivery. The neonatal admission was also more in our study because of increased incidence of neonatal jaundice in our study.

The rest of the parameters were almost same in our study as compared to other study.And haematocrit is more in followup at one and half months in delayed clamped grouped neonates in compaired to early clamped group.

VII.   Conclusion

Our study clearly indicates that late clamping is definitely helpful in increasing haematocrit of newborn and also haematocrit at one and half months. There is slight increase in neonatal jaundice which is not much significant. Hence according to our study it is advisable to advice late cord clamping for newborn babies.

VIII.   Summary

The study was conducted in J.S.S.Hospital, Mysore from November 2010 to July 2012, on 200 newborns, in 100 newborns cord is clamped immediately after delivery and in 100 newborns cord is clamped when pulsations are stopped, and the venous blood of newborn is drawn within 24hours of life for measurement of haematocrit. And the neonates are followed at one and half months and again haematocrit of neonates are measured.
Our study included the following variables,
Age
Gravid
Duration of pregnancy
Maternal PCV
Neonatal PCV
Neonatal birth weight
Neonatal sex
Neonate birth weight and babies developing jaundice.
Neonatal birth weight and babies developing jaundice for which phototherapy was needed
Length of hospital stay
Follow up at 1 ½ months of life.

Variables	Cases (n=100)	Controls (n=100)
Age	21-25 years	21-25 yrs
Gravid	Primi (58)	Primi (55)
Duration of pregnancy	37-39 weeks	37-39 weeks
Maternal PCV	30-35.9%	30-35.9%
Neonatal PCV in 24 hrs of life	55.5%	47.5%
Neonatal birth weight	2.5-3 kgs	2.5-3 kgs
Neonatal secondary outcome Jaundice (observation) Phototherapy	34% 9%	29% 7%
Neonatal birth weight with babies developing Jaundice (observation)	2.5-3 kgs	2.5-3 kgs
Neonatal birth weight with babies developing	3 to 3.5 kgs	2.5-3 kgs

Jaundice (phototherapy)		
Mean PCV for which babies developing jaundice	55-60%	46-50%
Neonatal sex and development of jaundice	Male-28,Female-6	Male-18,Female-11
Length of hospital stay	2 days (without jaundice) 4 days (with jaundice)	2 days (without jaundice) 4 days (with jaundice)
Follow up at 1 ½ months (PCV)	50.6%	45.6%

Cases (delayed clamped group),control(early clamped group)

Maximum number of women were in the age group 21-25years in both the groups

And maximum women in both groups are primigravidas, 58% were primigravidas in cases and 55% were in control group.

Maximum number of women presented at gestational age 37-39% in both the groups.

Maternal haematocrit in both the groups range from 30-35.9%.

Mean neonatal haematocrit at 24 hours of life in delayed clamped neonates was 55.5%, and in early clamped neonates was 47.5%, by this its clear that there is a significant increase in neonatal haematocrit by delayed cord clamping.

Maximum neonates birth weight in both group were 2.5-3kgs.

34% neonates in delayed clamped group and 29% neonates in early clamped group developed jaundice but not needed phototherapy.

9% neonates in delayed clamped group and 7% in early clamped group developed jaundice and who required phototherapy and NICU admission.

Maximum number of neonates who developed jaundice were in birth weight 2.5-3kgs in both groups.

Maximum number of neonates who developed jaundice are male babies, 28 neonates in delayed clamped group of total 34 neonates who developed jaundice, and 18 neonates in early clamped group of total 29 were male.

Length of hospital stay is 2 days in both the groups in neonates who not developed jaundice, and 4 day who developed jaundice.

11 neonates in delayed clamped group, and 12 neonates in early clamped group came for followup at one and half months. Mean haematocrit in delayed clamped neonates was 50.6% and that in early clamped group was 45.6%,which demonstrates haematocrit in delayed clamped group is more than early clamped group at one and half months of life

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