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Effect of Umbilical Cord Milking on Selected Maternal and Premature Neonatal Outcomes among Women with Placental Insuffiency

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Abstract: Background: Placental insufficiency is one of the highly prevalent clinical concerns in obstetrics. It is becoming increasingly obvious that its presence significantly affects fetus and placenta, with ramifications on the metabolic, cardiovascular, and neurological development until adulthood. **Purpose:** To assess the effect of umbilical cord milking (UCM) on selected maternal and premature neonatal outcomes among women with placental insufficiency. **Design:** Quasi experimental design. **Setting:** Obstetrics and Neonatal Intensive Care Units (NICU) in Menoufia University Hospital at Shebin El-Koom. **Sampling:** A purposive sample of 80 pregnant women diagnosed with placental insufficiency and their premature neonates was included. **Instruments:** For data collection three instruments were used. Instrument one: Characteristics of pregnant women and premature neonates' assessment sheet. Instrument two: maternal health outcomes assessment sheet. Instrument three: preterm neonates' health outcomes assessment sheet. **Results:** Premature neonates in the study group had elevated CD34 (1.13 ± .65 vs .40 ± .20), hematocrit percentage (48.25 ± 5.71vs 40.47 ± 3.37), and hemoglobin (Hb) (17.37 ±.95 vs 14.18 ± .78) within 24 h of life than premature neonates in the control group. No statistical significant differences were found between studied women in relation to duration of third stage of labor or occurrence of postpartum hemorrhage (PPH). **Conclusion:** Performing UCM for premature neonates elevated CD34 percentage and Hb levels (at birth and at 2 months), reduced their need for PRBCs transfusion and reduced the duration of oxygen management. However, it did not influence the length of third stage of labor or maternal PPH. **Recommendations:** Further studies related to UCM should be developed to a larger number for pregnant women and neonate in other units assure the generalizability of the research results.

Keywords: *Umbilical Cord Milking, Women with Placental Insuffiency, Selected Maternal Outcomes, Selected Premature Neonatal Outcomes*

Introduction

Placental insufficiency is a disorder that results in a decompensated hypoxia and acidosis by causing a gradual deterioration in placental functioning. It leads to fetal hypoxemia, which slows fetal metabolism in order to preserve the nutrients that are currently available. This results in intrauterine fetal growth restriction (IFGR) (Gagnon, R., 2018). IFGR, the second-leading cause of infant mortality after preterm, may complicate 4% to 6% of pregnancies (Sehgal et al., 2019). When compared to fetuses that grow normally, fetuses with IFGR have a three-fold higher chance of spontaneous preterm birth and a five- to six-fold increased risk of perinatal mortality (Carr, D., 2020).

Preterm neonates with intrauterine growth retardation (IUGR) are more prone to perinatal conditions such hypothermia, hypoglycemia, necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), sepsis, hyperbilirubinemia, polycythemia, and even death. Moreover, they are more likely to experience cognitive delay and long-term neurodevelopmental disability (Sacchi et al., 2020). Hence, for preterm neonates to survive, they must establish efficient circulation and have enough blood volume.

During pregnancy one of the most dangerous issues is placenta insufficiency, which is linked to a number of harmful maternal disorders. A large number of them are the immediate results of maternal antepartum, intrapartum, and postpartum hemorrhage. According to reports, placenta insufficiency during pregnancy was 1-5 / 10 000. However, the prevalence of placenta insufficiency, has been rising as much as the increase in the rate of cesarean deliveries. It varies throughout the world and has become a serious maternal and pediatric nursing problem. (Hunt et al., 2022; Yousuf et al., 2022).

Recent research has shown that placental transfusion may be required enhance and stabilize mother’s and neonatal outcomes (Basile et al., 2019; Jasani et al., 2021). Placental transfusion is the transfer of a newborn's leftover placental blood from the beginning of delivery until the umbilical cord is clamped and cut. Prematurely born neonates who received placental transfusion could have a lower death rate and fewer requirements for blood transfusions. Umbilical cord milking (UCM) this extra blood volume might have positive impacts on health by increasing the amount of iron-rich cell in neonates, promoting cardiovascular hemodynamics, and transferring progenitor stem cells which could repair defective cells and enhance immune competence (Katheria et al., 2017; Katheria et al., 2020; Seidler. T., 2021).

Significance of the study

Placental insufficiency is a disorder which occurs in 10 % in all pregnancies. It causes IUGR, prematurity, or, unfortunately, fetal death (Agarwal et al., 2019; Mazarico et al., 2020). Some research trails were done to assess the effect of umbilical cord milking on maternal as well as neonatal outcomes. Although some researches proved the positive health impact of umbilical cord milking for women with placental insufficiency and their premature neonates, others did not. However, there are few researches that investigated the effect of UCM on newborns with IUGR or placental insufficiency and their mothers. Therefore, this study was developed to assess the effect of UCM on selected maternal and premature neonatal outcomes.

Purpose

To assess the effect of UCM on selected maternal and premature neonatal outcomes among women with placental insufficiency.

Operational definitions

- **Selected maternal outcomes: -** In this study, selected maternal outcomes are postpartum hemorrhage and duration of woman 's third stage of labor. It will be assessed using instrument two.
- **Selected premature neonate's outcomes: -** In this study, selected premature neonate's outcomes are levels of CD34 in peripheral blood, incidence of early polycythemia (hematocrit level ≥ 65%), Hb at 2 months of age, peak serum bilirubin, frequency of packed red blood cells (PRBCs) transfusion during NICU stay, phototherapy requirement, (hypothermia, hypoglycemia, and hypotension in the first 24 hours), duration of oxygen therapy, the presence of neonatal complications such as bronchopulmonary dysplasia (BPD), intraventricular hemorrhage (IVH) or necrotizing enterocolitis (NEC) as well as duration of hospitalization. It will be assessed using instrument four.

Research hypotheses

1) Premature neonates who undergo umbilical cord milking (UCM) are expected to have higher hematological indices than premature neonates who do not undergo umbilical cord milking.

2) Premature neonates who undergo umbilical cord milking (UCM) are expected to have improved selected clinical outcomes than premature neonates do not undergo umbilical cord milking

3) Pregnant women with placental insufficiency whose premature neonates undergo umbilical cord milking (UCM) are expected to have less evidence of postpartum hemorrhage than pregnant women with placental insufficiency who do not undergo umbilical cord milking.

4) Pregnant women with placental insufficiency whose premature neonates undergo umbilical cord milking (UCM) are expected to have shorter duration of the third stage of labor than pregnant women who do not undergo umbilical cord milking.

Methods:

Design:

Quasi- experimental design (study and control groups) was used.

Setting:

This research was applied at Obstetrics and Neonatal Intensive Care Units (NICU) in Menoufia University Hospital at shebin El-Koom, Menoufia Governorate, Egypt.

Sampling:

A purposive sample of 80 pregnant women diagnosed with placental insufficiency and their premature neonates (n=85) were included. A simple random sample was done to distribute them into a study an control groups:

- **Study group:** Pregnant women diagnosed with placental insufficiency (n=40) and their premature neonates (n=43) underwent umbilical cord milking (UCM).
- **Control group:** Pregnant women diagnosed with placental insufficiency (n=40) and their premature neonates (n=42) had not umbilical cord milking.

Inclusion criteria:

Preterm neonates were delivered before 34 weeks of gestation with placental insufficiency during pregnancy.

Exclusion criteria:

Preterm neonates with chromosomal abnormalities, hydrops fetalis, or probable significant congenital anomalies. Preterm neonates in whom resuscitation could not be postponed at birth and who required prompt resuscitative measures. Pregnant women with vaginal bleeding from placental abruption or placental tearing.

Instruments

The researchers utilized four instruments to collect data. These instruments included:

<u>**Instrument one:**</u> **Characteristics of pregnant women and premature neonates' assessment sheet.**

It was designed by the researchers after reviewing related literature (Song et al., 2017; Katheria et al., 2019; Nagy et al., 2021; George & Isac, 2022). It contained two parts:

- **Part one: Characteristics of pregnant women**. Data were obtained through face to face interview. It involved questions about maternal age, presence of any diseases (diabetes, hypertension, renal disease, immune disease or others), prenatal complications (UTI, chorioamnionitis or premature rupture of membranes), any prescribed medications during pregnancy (steroid or magnesium sulfate), history of PPH, maternal Hb level, parity and number of gestation.
- **Part two: Characteristics of premature neonates**. It included characteristics of the neonates. It involved data about the neonate's gender, method of delivery, gestational age (weeks), birth weight (gr), size, in addition 1-min as well as 5-min APGAR scores.

<u>**Instrument two**</u>**: Maternal health outcomes assessment sheet.**

It was designed by the researchers after revising related literature (George & Isac, 2022) to assess the selected maternal health outcomes (signs of hemorrhage after delivery and quantity of blood loss, and the duration of the third stage of labor).

<u>**Instrument three:**</u> **Preterm neonates' health outcomes assessment sheet.** Researcher was designed it after reviewing the relevant literature (Nagy et al., 2021; George & Isac, 2022) to assess selected neonatal health outcomes and duration of hospitalization.

- **Part one:** Measurement of selected hematologic parameters. It included measurement and documentation of

CD34 (%), Hb (g/dl), hematocrit %, WBCs (103 cells/ml), platelets count (103 cells/ml), peak TSB (mg/dl) within 60 minutes after birth and Hb (g/dl) level after two months.

- **Part two**: Measurement of selected physiological and metabolic parameters for women with placental insufficiency. It included assessment and documentation of temperature, blood pressure, blood glucose level, boluses administered or inotrope support for management of hypotension in the first 24 hrs of life.
- **Part three:** Assessment of preterm neonate's needs during NICU stay. It involved assessment and documentation of the need and frequency of PRBCs transfusion, phototherapy requirements, oxygen therapy need and its duration (days).
- **Part four:** Assessment of presence of neonatal complications such as bronchopulmonary dysplasia (BPD), IVH, or NEC.
- **Part five:** Assessment of the length of hospital stays (days) and number of deaths.

Reliability

The reliability of instruments one, two, and three appraised in 10 participants utilizing the test-retest technique with a two-week interval amongst them. Then, Cronbach's alpha was computed in the midst the two scores, and 0.85, 0.91, and 0.78 respectively, were determined.

Validity

The three instruments were handed to a panel of 5 experts, comprising 2 professors of pediatric nursing, 2 professors of maternity and newborn health nursing, and one professor of pediatrics, for modification of any necessary components. The adjustments were made to ensure their applicability and comprehensiveness.

Ethical consideration

Formal permission was attained from the Ethical Research Committee at the Faculty of Nursing, Menoufia University (Code no. 867). Mothers' acceptance to participate in the study was documented in written consent forms. To explain the goal and research methodology to mothers, a preliminary interview was done. Mothers were informed that participation was optional and that they could end their contribution in the study at any moment short of suffering slightly repercussions.

Pilot study

After the instruments were established and previously the data gathering commenced, it was carried out on eight pregnant women during labor and eight premature neonates admitted to the NICU (10% of the sample) on the way to gauge the instruments' applicability and to regulate how long it would take to complete them. No necessary modifications were performed. The whole sample was not included in the pilot study.

Procedure

- Following submitting an endorsed letter from the Dean of the Faculty of Nursing, Menoufia University, the study aim with the data collections measures were outlining, written authorization to perform the study was acquired from the director of the obstetrics and NICUs prior to the collection of data. The six-months collection of data period for this study ran from September 2022 till February 2023. Pregnant women in the study and control groups were introduced to the researcher, who also went through the study's objectives and data gathering procedures.

- In order to complete the instrument one, part one assessment sheet, the researcher questioned each mother in in the study and control groups. The length of each data gathering interview ranged from 20 to 30 minutes. To execute well, all attending nurses underwent numerous demonstrations and re-demonstration of this UCM technique. Under the researcher's guidance, the nurses were asked to practice the UCM technique.
- After that preterm neonates in the study group who underwent UCM were kept beneath the cesarean incision level (or beneath the introitus level for vaginal birth). The umbilical cord was then gently milked from the placenta toward the umbilicus while being held at a distance of 20 to 25 cm from the neonate. The cord was released after each milking motion to allowed to re-fill with blood through a second break. The milking was done three times at a median pace of ten cm per sec before cutting the cord after clamped. The procedure had to be finished in less than 30 seconds, hence a regular stopwatch was employed.
- Next, neonates in the control group their umbilical cords were clamped immediately (without peeling, 2-3 cm from the umbilical stump) after birth of the whole body. All newborns in the study and control groups were given to the resuscitation team after the cord was clamped and cutted. Then they were transported to the NICU for admission because of prematurity. Now, the researcher recorded time from the delivery of the baby until expulsion of the placenta (duration of 3rd stage of labor). A digital clocks hanged on the wall of the room was observed.
- Also, mothers were closely examined for signs of postpartum hemorrhage (PPH). PPH (after delivery more than 500 ml loss of blood in normal vaginal delivery compared to more than 1000 ml among caesrean section), and this blood loss was weighed all of the blood-soaked delivery pads and mops, along with the blood in the delivery pan. Blood transfusions and further uterotonics requirements were recorded.
- In the NICU, the researchers completed neonatal assessment sheet (instrument one, part two). All enrolled infants had 1 ml peripheral blood specimen taken within 60 minutes of birth in order to determine the CD34 percentage. Samples were delivered to an outside specialist lab. The research groups' allocation was unknown to the lab personnel. Within the first 60 minutes of life, all newborns in the study and control groups had blood drawn for complete blood count (CBC).

- In line with unit protocol, all enrolled babies got the same standard intense supportive care in terms of fluid management, inotropic support, phototherapy, transfusion thresholds, and respiratory support. Incidence of hypoglycemia, hypothermia, hypotension, treatment of hypotension, inotrope support needed, frequency of PRBCs transfusion during NICU stay, phototherapy requirement, the length of time under oxygen therapy, the presence of neonatal complications such as BPD, IVH, or NEC were closely monitored and documented. The length of time spent in the NICU and deaths were also assessed.
- After 2 months, Hb levels were measured. The researcher called the mothers of the premature infants and collected blood samples from studied infants for Hb testing at the time of routine vaccination.

Data analysis

SPSS (Statistical Package for Social Science) version 22 was used to enter and analyze the data. The graphics were created using the Excel application. The t-test was used to compare quantitative data given as mean and standard deviation (SD). The chi-square (X2) test was used to compare qualitative data reported as frequency and percentage. Level of significance was set as P value <0.05 for all significant tests.

Results

Table 1: clarified that more than half of studied neonates in the study and control groups were females (65.1% & 57.1% respectively). Regarding type of delivery, the majority of studied neonates in the study and control groups were delivered by cesarean section (90.7% & 92.9% respectively). The majority of studied neonates in the study and control groups were small for gestational age (95.3% & 95.2% respectively). There were no statistical significant differences among both groups as regards APGAR score at 1-min and 5- min at 5% level of statistical significance.

Table 2: showed that mean age of studied mothers was 26.65 ± 3.12 in the study group and 25.75 ± 2.61 in the control group. Mean Hb level of studied mothers was 11.52 ± 0.29 in the study group and 11.71 ± 0.27 in the control group. Regarding maternal diseases, less than half of studied mothers in the study group (42.5%) and half of studied mothers in the control group had hypertension. More than one third of the mothers in the study group (17.5%) had premature rupture of membranes and more than one third of them in the control group (17.5%) had chorioamnionitis. In relation to medications which were taken during pregnancy, the majority of mothers in the two groups received steroids. Only one mother in the study group had a history of PPH. Three mothers in the study group paralleled to two mothers in the control group had twins.

Table 3: illustrated that neonates in the study group had greater CD34 and hematocrit percentage, Hb level and peak TSB within 24 h of life (1.13 ± 0.65, 48.25 ± 5.71, 17.37 ± 0.95, and 12.03 ± 1.63 respectively) compared to those in the control group (0.40 ± 0.20, 40.47 ± 3.37, 14.18 ± 0.78 and 7.43 ± 3.30 respectively). Only three neonates had a hematocrit > 65 in the study group, but none of them were symptomatic for polycythemia-

hyperviscosity syndrome. At 2 months of age, hemoglobin levels were 11.45 ± 0.81 in the study group compared to 10.1767 ± 0.86 in the control group. Therefore, there were highly statistical significant differences at 1% level of statistical significance.

Figure 1: clarified that peripheral blood CD34 percentages was significantly higher in the study group than the control group ($p < 0.0001$).

Table 4: showed that no statistical significant difference was found in the two groups (vital signs and needed support during NICU stay) at 5% level of statistical significance.

Table 5: illustrated that neonates in the study group needed PRBCs transfusion less frequently than neonates in the control group (83.7% vs 45.2% respectively). More neonates in the study group required phototherapy than the control group (88.4% vs. 69.0% respectively). There was a statistical significant decrease in the duration of oxygen treatment for neonates in the study group than the control group (14.25 ± 6.27 vs 21.76 ± 4.55 respectively). However, the duration of hospitalization for neonates in the study group was significantly higher than the control group. No statistical significant differences were noted among both groups regarding postnatal complications and deaths at 5% level of statistical significance.

Table 6: displayed that there was a statistical significant correlation between peripheral blood CD34 percentage and hemoglobin level at 2 months of age of studied infants in the study group.

Figure 2: sowed a statistical significant positive correlation was existing between CD34 percentage and level of hemoglobin in studied infants aged 2 months in the study group.

Table 7: clarified that there were no statistical significant differences among mothers in the two groups regarding the duration of third stage of labor and occurrence of PPH. Moreover, only one mother in the study group had PPH, which was well managed with uterotonics.

Table (1): Characteristics of studied neonates in the study and control groups.

Items	Study group (n=43)		Control group (n=42)		Test	P-value
	No.	%	No.	%		
Gender						
Male	15	34.9%	18	42.9%	X2= .56 ns	.451
Female	28	65.1%	24	57.1%		
Type of delivery						
Vaginal delivery	4	9.3%	3	7.1%	X2= .13 ns	.717
Cesarean section	39	90.7%	39	92.9%		
Gestational age (weeks) (M ± SD)	31.13 ± 1.16		30.00 ± 0.79		t test= 5.247 HS	.000
Weight (M ± SD)	982.98 ± 166.12		859.99 ± 86.01		t test= 4.271 HS	.000
Small for gestational age	41	95.3%	40	95.2%	X2= .00 ns	.981
1-min APGAR score (M ± SD)	5.44 ± 1.74		4.97 ± 1.40		t test= 1.351 ns	.180
5-min APGAR score (M ± SD)	8.13 ± 1.47		7.92 ± 1.43		t test= .668 ns	.506

Note: (ns): not significant (p>0.05) **HS**: High significant (p<.001)

Table (2): Medical and obstetric history of studied mothers in the study and control groups.

Items	Study group (n=40)		Control group (n=40)		Test	P-value
	No.	%	No.	%		
Age (M ± SD)	26.65 ± 3.12		25.75 ± 2.61		t-test = 1.396 ns	.167
Hemoglobin (g/dl) (M ± SD)	11.52 ± 0.29		11.71 ± 0.27		t-test = -3.034 ns	.003
Maternal diseases						
Diabetes	10	25.0%	8	20.0%	X2= .53 ns	.912
Hypertension/ pre-eclampsia	17	42.5%	20	50.0%		
Renal disease	8	20.0%	7	17.5%		
Immune disease	5	12.5%	5	12.5%		
Prenatal problems						
UTI	7	17.5%	6	15.0%	X2= .09 ns	.762
Chorioamnionitis	4	10.0%	7	17.5%	X2= .94 ns	.330
Premature rupture of membranes	7	17.5%	6	15.0%	X2= .09 ns	.762
Antenatal medications						
Steroid	37	92.5%	36	90.0%	X2= .15 ns	.692 NS
Magnesium sulfate	33	82.5%	33	82.5%	X2= .00 ns	1.000
History of post-partum hemorrhage	1	2.5%	0	0.0%	X2= 1.01 ns	.314
Number of gestation						
Singleton gestation	37	92.5%	38	95.0%	X2= .21 ns	.644
Multiple gestation (twins)	3	7.5%	2	5.0%		

Note: (ns): not significant (p>0.05)

Table (3): Mean and standard deviation of selected hematologic parameters among studied neonates in the study and control groups.

Items	Study group (n=43)	Control group (n=42)	t-test	P-value
CD34 (%)	1.13 ± 0.65	0.40 ± 0.20	7.025 HS	.000
Admission hemoglobin (g/dl)	17.37 ± 0.95	14.18 ± 0.78	16.911 HS	.000
Admission hematocrit (%)	48.25 ± 5.71	40.47 ± 3.37	7.611 HS	.000
Admission WBCs (103 cells/ml)	12.96 ± 4.99	18.33 ± 5.79	-4.575 HS	.000
Admission platelets (103 cells/ml)	225.78 ± 63.87	238.70 ± 80.29	-.822 ns	.413
Peak TSB (mg/dl)	12.03 ± 1.63	7.43 ± 3.30	8.158 HS	.000
Two months hemoglobin (g/dl)	11.45 ± 0.81	10.17 ± 0.86	7.020 HS	.000
Polycythemia (hematocrit ≥ 65%)	3 (7.0%)	0 (0.0%)	X2 = 3.03 ns	.081

Note: Data are presented as mean ± SD, or number (%)
(ns): not significant (p>0.05) **HS:** High significant (p<.001)
CD34: Peripheral blood hematopoietic progenitor stem cells
WBCs: White blood cells **TSB:** Total serum bilirubin)

Figure (1): - Comparison between peripheral blood CD34 percentages among premature neonates in the study and control groups.

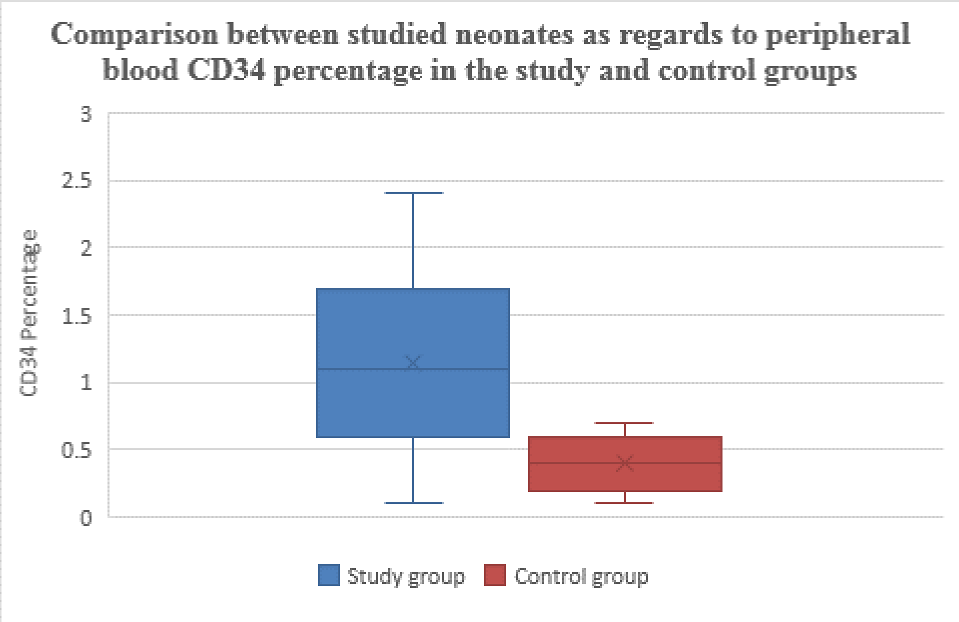

Table (4): Distribution of studied neonates according to their vitals, blood glucose levels and needed support during NICU hospitalization in the study and control groups.

Items	Study group (n=43)		Control group (n=42)		Test	P-value
	No.	%	No.	%		
Admission temperature	36.52 ± 0.40		36.58 ± 0.431		**t** = -.721 ns	.473
Hypothermia episodes within the first day of life						
None	26	60.5%	25	59.5%	X^2 = .52 ns	.770
Single	12	27.9%	10	23.8%		
≥2	5	11.6%	7	16.7%		
Hypoglycemia episodes within the first day of life						
None	28	65.1%	23	54.8%	X^2 = 1.13 ns	.568
Single	9	20.9%	10	23.8%		
≥2	6	14.0%	9	21.4%		
Hypotensive episodes within the first day of life						
None	28	65.1%	22	52.4%	X^2 = 2.17 ns	.336
Single	9	20.9%	9	21.4%		
≥2	6	14.0%	11	26.2%		
Intravenous volume expander therapy within the first day of life	5	11.6%	6	14.3%	X^2 = .13 ns	.715
Inotropic support within the first day of life	3	7.0%	4	9.5%	X^2 = .18 ns	.669

Note: (ns): not significant (p>0.05)

Table (5): Distribution of studied preterm neonates in relation to needed care and postnatal complications during NICU stay, length of hospitalization and in-hospital mortality in the study and control groups.

Items	Study group (n=43)		Control group (n=42)		Test	P-value
	No.	%	No.	%		
Frequency of PRBCs transfusion						
None	36	83.7%	19	45.2%	X^2 = 16.24 S	.003
One time	4	9.3%	12	28.6%		
Two times	2	4.7%	2	4.8%		
Three times	1	2.3%	3	7.1%		
More than 3 times	0	0.0%	6	14.3%		
Phototherapy need	38	88.4%	29	69.0%	X^2 = 4.75 S	.029
Duration of oxygen therapy(days) (M ± SD)	14.25 ± 6.27		21.76 ± 4.55		**t** = -6.297 HS	.000
Postnatal complications						
Necrotizing enterocolitis	1	2.3%	2	4.8%	X^2 = .37 ns	.543
Severe intraventricular hemorrhage (Grade III or IV)	1	2.3%	1	2.4%	X^2 = .00 ns	.987
Bronchopulmonary dysplasia	3	7.0%	5	11.9%	X^2 = .60 ns	.437
Length of hospital stay (days) (M ± SD)	33.46 ± 5.62		26.85 ± 3.73		**t** = 6.360 HS	.000
Deaths	2	4.7%	4	9.5%	X^2 = .76 ns	.381

Note: (S): significant (p <0.05) **HS:** High significant (p<.001) **ns:** not significant (p>0.05)

PRBCs: Packed red blood cells

Table (6): Pearson correlation between CD34 percentage and hemoglobin level at 2 months of age in studied infants in the study group.

	CD34 percentage	
	R	P- value
Hemoglobin level at 2 months of age	.423**	.000

** Correlation is significant at the 0.01 level (2-tailed)

Figure (2): Pearson correlation between CD34 percentage and hemoglobin level at 2 months of age in studied infants in the study group.

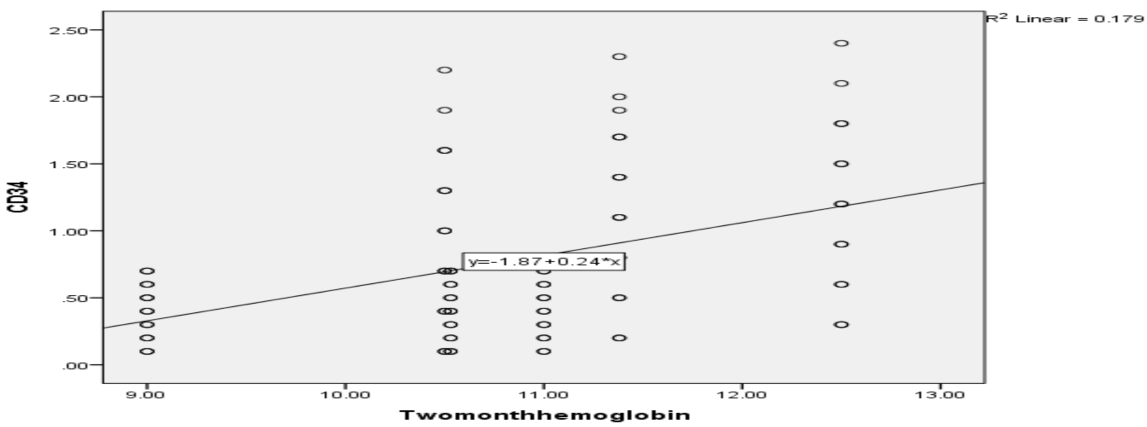

Table (7): - Comparison between studied mothers in relation to duration of the third stage of labor and postpartum hemorrhage in the study and control groups.

Variables	Study group (n=40)	Control group (n=40)	Test	P-value
Duration of the third stage (min) (M ± SD)	5.00 ± 1.43	4.92 ± 1.22	**t- test=** .251^{ns}	.802
Occurrence of Postpartum hemorrhage	1 (2.5%)	0 (0.0%)	X^2= 1.01 ^{ns}	.314

Note: (ns): not significant (p>0.05)

Discussion

Placental transfusion augmentation provides preterm neonates with an added ten to thirty mL/kg of blood and 20 to thirty mg/kg of iron (Sorin & Tosello, 2016). Unlikely, neonates in the control group are deprived of a vital amount of blood. This amount of blood affects the healthy fetal neonatal circulatory transition process (Katheria, A., 2018). Consecutive UCM or stripping was technique used to improve placental transfusion (Dule et al., 2015).

In relation to hypothesis one and two, the findings showed that premature neonates in the study group had higher percentage of peripheral blood hematopoietic progenitor stem cells (CD 34) at birth and Hb levels at birth and at two months of age than premature neonates in the control group. This confirmed the positive effect of umbilical cord milking (UCM) on neonatal' s hematological indices and outcomes and may be due to continuing hematopoiesis that served by extra amount stem cells delivered to neonates by cord milking. This outcome was in line with a study by Song et al. (2017) who reported that neonatal serum Hb levels were discovered to be significantly higher in the study group than the control group at both birth (15.79 vs. 14.69, respectively; P=0.018) and 24 hours of age (14.83 vs. 13.29, respectively; P=0.046). This is due to the fact that this extra volume of blood resulting from milking the umbilical cord may have increase the amount of iron-rich cells and neonatal serum Hb levels.

Also, these results were in the same line with Mohan et al., (2018) who concluded that umbilical cord milking leads to have higher Hb and ferritin levels at 6 weeks of age. In addition, this outcome was consistent with a study by Nagy et al. (2021) who discovered that umbilical cord milking was associated with higher peripheral blood CD34 percentage at birth and Hb levels at both birth and 2 months. This result could be related to the mechanical effect of milking which dislodged more mesenchyme stem cells into cord blood which leads to more effective hematopoiesis. Besides, this finding was consistent with George & Isac's (2022) who stated that umbilical cord milking was a safe, effective strategy to increase Hb levels up to 6 weeks, lowering the percentage of anemic infants.

Also, the results of the current study clarified an occurrence of an elevated percentage of hematocrit at 24 hours of age in the study group than the control group. This result was consistent with Alavi et al, (2018) who concluded that hematocrit levels higher were among the neonates who had umbilical cord milking than neonates who had not (control group). In the same context, George & Isac (2022) noted that at 72 hours and after 6 weeks, hematocrit in the UCM group was significantly elevated than the control. Moreover, Josephsen et al. (2022) found that cord milking raises the neonate's initial hematocrit and may reduce the requirement for transfusion in the neonatal period. However, milking the umbilical cord of a preterm neonate is an easy intervention with the potential to improve the perinatal outcomes. Additionally, milking of the cord increases the neonate's initial hematocrit and may lessen the need for transfusion in the neonatal period. This may be attributed to the fact that umbilical cord milking, increases the total blood volume of the preterm neonate, which in turn raises the hematocrit levels.

The current study demonstrated that there were no statistical significant elevations polycythemia level as a result of umbilical cord milking. Only three neonates out of the entire cohort had hematocrits > 65 in the study group, but no one showed polycythemia-hyperviscosity syndrome symptoms. This was in line with a research by Chiruvolu et al., published in 2021, about the effects of umbilical cord milking on preterm neonates delivered by cesarean section. In neonates delivered by CS, it was discovered that UCM intervention did not contribute to a rise in the prevalence of symptomatic polycythemia. This finding agreed with Nagy et al., (2021) who indicated that very limited number of newborns developed a symptomatic polycythemia (hematocrit >65).

Furthermore, the existing study illustrated that total serum bilirubin levels of preterm neonates in the study group were higher than the control group. So, they needed phototherapy treatment more frequently than preterm neonates in the control group. However, no one in the study group needed exchange transfusion. This outcome was consistent with Leal et al., (2019) who discovered that the milking maneuver group had higher phototherapy needs than the early cord clamping group.

On the other hand, the current study illustrated that neonates in the study group needed PRBCs transfusion less frequently than neonates in the control group (83.7% vs 45.2% respectively). Hosono et al. (2018) found similar results. It was discovered that UCM group had a lower number of RBC transfusions (milked group 1.7 (3.0) vs controls 4.0 (4.2; p = 0.02) and they did not require red blood cells transfusion. In the same line, Song et al. (2017) observed that within the first 24 days of life, newborns in the milking group required fewer packed red blood cell transfusions than newborns in the clamping group (0.93 in milking vs. 1.78 in clamping, respectively; P=0.049). This may be explained as milking the umbilical cord raises the Hb level in premature neonates, which may reduce the requirement for transfusions.

Also, the present study found that there was a highly significant reduction in the duration of oxygen therapy for neonates in the study group than the control group (14.25 ± 6.27 vs 21.76 ± 4.55). This finding was consistent with Hosono et al. (2018), who discovered that the milked group required ventilation or supplemental oxygen for a shorter period of time than the control group. On the other hand, according to Song et al. (2017), there were no statistically significant differences between the clamping group and the milking group in terms of the demand for oxygen delivery (82.4% vs 96.9; p= 0.106) or the need for assisted ventilation (70.6% vs 75.0%; p= 0.688). This confirms that umbilical cord milking is a safe technique, which reduce the need for

RBC transfusions, as well as the need for respiratory and circulatory support.

Furthermore, the existing study illustrated that no statistical significant differences were noted between the study and control groups regarding occurrence of necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), and bronchopulmonary dysplasia (BPD). This finding was contradicting with Dang et al., (2015) who listed that, UCM in preterm birth was safe and linked to a decreased incidence of IVH, NEC, as well as BPD. This result was corresponding to Shirk et al., (2019) who noted that the incidences of IVH (15.5% vs. 10.1%; P=.35) and NEC (5.8% vs. 3.0%; P=.49) were both lower in the milking group than in the delayed cord clamping group. This result was along with Jasani et al. (2021) in their systematic meta-analysis study. Furthermore, it was discovered that neonates having UCM had decreased risk for IVH than other neonates have not. From the researcher's point of view, UCM increase systemic blood volume, stabilize cerebral oxygenation and perfusion, and consequently decrease the incidence of IVH.

Our study also illustrated that no statistical significant differences were found between both groups regarding number of deaths. This outcome was in keeping with Hosono et al. (2018), who exposed no statistically significant difference between the control group and the milked group in terms of mortality. On the contrary, Song et al. (2017) noted that the mortality rate in the milking group was significantly lower than in control group (6% vs. 28%; P=0.015).

Moreover, the present study clarified a significant positive correlation between peripheral blood CD34 percentage and hemoglobin level at 2 months in the study group. Nagy et al. (2021) discovered a moderately positive association between Hb levels at 2 months in preterm neonates in the UCM group and peripheral blood CD34 percentage (r = 0.44, p = 0.001) supported by this outcome. This indicated how much more UCM was effective on increasing neonatal haemoglobin, haematocrit, decreasing anaemia, on top of lowering neonatal polycythaemia and clinical jaundice. Additionally, according to the researcher's viewpoint, as a result of the mechanical effect of milking, the stroma into the cord blood releases more mesenchyme stem cells which led to more effective hematopoiesis. In newborns with placental insufficiency managed by cord milking, ongoing hematopoiesis resulted in higher hemoglobin levels at 2 months postnatal age.

In relation to hypothesis three and four, the findings showed that there were no statistical significant differences between studied mothers in in the study and control groups regarding duration of third stage and presence of postpartum hemorrhage (PPH). In a review of five trials that included more than 2,200 women, McDonald et al. (2018) found that delayed umbilical cord clamping was not linked to an increased risk of intrapartum or postpartum hemorrhage, a difference in postpartum hemoglobin level, or the requirement for blood transfusions. In the same context, George & Isac (2022) observed that there were no statistical differences between mothers in the UCM group and mothers in the control group in terms of the frequency of PPH and the length of the third stage. Also, this outcome was consistent with Song et al., (2017) who observed that there were no differences in maternal hemoglobin levels after delivery and incidence of PPH due to cord milking.

Conclusion:

Performing UCM for premature neonates elevated CD34 percentage and level of Hb (at birth and at 2 months), reduced their need for PRBCs transfusion and reduced the duration of oxygen management. However, it did not influence the duration of third stage of labor or maternal PPH.

Recommendations

The study recommended that further studies related UCM should be conducted in other settings and on a larger number of neonates to assure the generalizability of the research results. UCM procedure should be implemented in all Obstetrics & Gynecology departments to improve hematological and clinical outcomes of prematures. Nurses should also be trained to perform UCM.

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