ORIGINAL RESEARCH

Effects of umbilical cord milking on premature neonates' and mothers' outcomes

Nahed Thabet Mohamed[1], Atyat Mohammed Hassan*[1], Heba Mostafa Mohamed[2], Amal A. Abdelhafez[3], Eman Abd Elaziz Mohamed[4], Safwat Mohamed Abdel Aziz Ali[5], Ahmed M. Abbas[6]

[1] *Pediatric Nursing Department, Faculty of Nursing, Assiut University, Egypt*
[2] *Maternity and Neonatal Health Nursing Department, Faculty of Nursing, Assiut University, Egypt*
[3] *Obstetrics and Gynecological Nursing Department, Faculty of Nursing, Minia University*
[4] *Pediatric Nursing Department, Faculty of Nursing, South Valley University, Egypt*
[5] *Pediatrics and Neonatology Department, Faculty of Medicine, Assiut University, Egypt*
[6] *Obstetrics & Gynecological Department, Faculty of Medicine, Assiut University, Egypt*

Received: April 22, 2019 **Accepted:** July 8, 2019 **Online Published:** July 25, 2019
DOI: 10.5430/jnep.v9n11p1 **URL:** https://doi.org/10.5430/jnep.v9n11p1

ABSTRACT

Background: Umbilical Cord Milking (UCM) is a safe and likely technique for both the mothers and their neonates which improve the neonatal outcomes. The aim of the study was to assess the effects of umbilical cord milking on premature neonates' and mothers' outcomes.

Methods: Design: Quasi-experimental research design was utilized. Setting: Emergency and Labor Unit of Women's Health University Hospital and Neonatal Intensive Care Unit (NICU) in Assiut University Children Hospital were the setting which the study was implemented. Subjects: It included 80 mothers and their premature neonates. The subjects were divided randomly into two groups (40 premature neonates who were received the UCM as a study group and 40 premature neonates as a control group who received the Immediate Cord Clamping [ICC]). Tool: One structured interview questionnaire was designed especially for this study. It included two parts: Personal and clinical data of the studied mothers and premature neonates.

Results: The Hemoglobin (Hb) level significantly increased in the study group when compared to the control group within 6 hours of birth (12.11 vs. 10.61) and at 36-48 hours after UCM (12.27 vs. 11.32). Also, UCM had significantly improved the need for blood transfusion, death rate, and length of hospital stay among premature neonates in the study group.

Conclusions and recommendations: UCM improved preterm neonates' outcomes as increasing Hb level, less need for blood transfusion, and decline incidence of death, lowers length of hospital stay. Recommendations: Increasing awareness of neonatology, pediatric, and obstetric nurses about benefits and technique of UCM through health education program.

Key Words: Mothers, Premature neonates, Outcomes, Umbilical cord milking

1. INTRODUCTION

Rising the survival rates of premature infants are mainly relying on developing health care facilities in the Neonatal Intensive Care Unit (NICU) in the last 20 years. The scientific research is directed on discharging of these neonates with the least possible morbidity.[1] One important objective of neonatal critical care is to provide sufficient oxygen. It is to meet the tissues by its requirements and enhancing the

*Correspondence: Atyat Mohammed Hassan; Email: atyathassan@aun.edu.eg; Address: Pediatric Nursing Department, Faculty of Nursing, Assiut University, Egypt.

Hb level of the fetus. This can be achieved by Umbilical Cord Milking (UCM) or (placental transfusion). Placental transfusion is a synonymous definition for UCM. It is the removal of remaining placental blood to the neonate during the first few minutes of birth. So, it is a very efficient technique to improve the content of arterial oxygen, increase cardiac output, and enhance oxygen distribution.[2]

UCM is an option to Delay Cord Clamping (DCC) which defined as "the unclamped Umbilical Cord (UC) is grasped and blood is pushed (stripped) toward the infant two to four times before it is clamped". This technique transmits the blood to the preterm infant within 20 seconds.[3] World Health Organization[4,5] advises that the UC should not be clamped immediately. But if it is required for utilizing cord traction can be clamped to decrease post-partum bleeding and haste ejection of the placenta.[6,7]

Notwithstanding new advancements in perinatal and neonatal medicine that have promoted the survival of high-risk neonates, anemia of prematurity is still one of the most complications to the care of these neonates; who often need RBCs transfusions. Consequently, several researchers as March et al.[8] and Rabe et al.[9] recommended that evidence-based practice of UCM after birth have a significant effect on the volume of blood transfused to the neonate from the placenta. The blood volume increases from 5 to 15 ml/kg in the first 5 to 15 second after delivery. This extra blood could promote the hemodynamic stability of preterm neonates. Also, it may decrease the risk of Intra-Ventricular Hemorrhage (IVH) and the susceptibility of neonates to inflammatory processes.[10] Moreover, this blood contains stem cells that are essential in rebuilding tissue and raising immunocompetence.[11]

Recent review done by Katheria et al.[12] indicated that all available trials in human infants comparing UCM to Immediate Cord Clamping (ICC) or DCC report no adverse effect of milking. UCM has been studied in term and preterm infants in many studies and documenting its safety and efficacy. It shouldn't be counted as experimental rather than a proven intervention. It is confirms that preterm neonates can be given an adequate placental transfusion at birth.[3,13]

1.1 Significance of the study

Prematurity is one of the main health problems that lead to infant mortality.[14] It is responsible for a large number of admissions to NICU. Also, their body system immaturity puts them at a greater threat to developing neonatal complications and it may prone them to harms into adulthood.[15] Recent studies support that UCM for preterm neonates is a safe technique and practical approach for both the mother and neonate to improve neonatal outcomes.[16,17]

1.2 Aim of the study

This study aimed to assess the effects of UCM on premature neonates' and mothers' outcomes.

1.3 Hypotheses

1) Premature neonates who receive the UCM have better outcomes (e.g. Hb level, the need for blood transfusion and mechanical ventilation, incidence of jaundice and phototherapy used, incidence of death, and the length of hospital stay) than those in the control group who receive ICC.
2) Mothers of premature neonates who receive the UCM have better outcomes (e.g. length of third stage of labor and presence of post-partum hemorrhage than those in the control group who receive ICC.

2. MATERIALS AND METHODS

2.1 Study design

Quasi-experimental research design was used in this study.

2.2 Study setting

The study was conducted at two University Hospitals in Assiut City, Egypt: At the Emergency and Labor Unit of Women's Health University Hospital and at NICU in Assiut University Children Hospital. The Woman's Health University Hospital serves the rural and urban areas. Likewise, the NICU in Assiut University Children Hospital; it services more than one governorate from El-Minia to the Red Sea. It included 50 incubators. Nearly 1511 neonates admitted in 2018 with an average of 127 cases at the month. It had special rooms for high risk neonates who delivered at the Woman's Health University Hospital.

2.3 Study subjects

The study subjects were included 80 mothers and their premature neonates. The subjects were divided into two groups randomly (40 premature neonates who were received the UCM as a study group and 40 premature neonates as a control group who received the ICC).

2.3.1 *Sampling technique*

The researchers were randomly assigned the premature neonates into a study or control group by using a coin immediately before delivery. The researchers used a coin to distribute the subjects which the "king face" was the study group while the "write face" was the control group according to the inclusion and exclusion criteria. No one of the NICU's nurses or the attending neonatologists was aware of this randomization.

2.3.2 *Inclusion Criteria*

1) Gestational age between 30-36 weeks.
2) Apgar score >7 at 1 and 5 minutes with no resuscitation

required at birth.
3) Admitted to the NICU.

2.3.3 *Exclusion criteria*

1) Mothers who had history of chronic illness.
2) Mothers who had obstetrical conditions as: Pre-eclampsia, eclampsia, diabetes, severe anemia, abruption placenta, placenta previa, and multiple gestation.
3) After delivery, the preterm neonate was excluded if there was a confirmed diagnosis of intrauterine growth restriction, congenital anomalies, and meconium stained non-vigorous babies. Infants known to be at risk of anemia due to isoimmunization (mother has red blood cell antibodies). Cord anomalies like true knots or cord prolapse.
4) Mothers who refused to participate in the study.

2.3.4 *Sample size calculations*

A power calculation estimated that in order to detect an effect size of 1.7 g/dl mean difference of hemoglobin level between of two independent groups, with a p-value < .05 and 80% power, confidence level 0.95, a sample size of 15 patients for each group was needed. However, 40 patients in each group were attempted in this research work to avoid non-response rate. This calculated using G Power 3.1.[18]

2.4 Tool of data collection

One tool was used in this study:

A structured interview questionnaire was designed especially for this study; it included two parts:

Part One: Personal and clinical data of the mothers were collected; it included the following: Age, parity, vitamin and/or mineral supplementation in current pregnancy, Hb level at admission, length of third stage of labor, and occurrence of post-partum hemorrhage.

Part Two: Personal and clinical data of the preterm neonates were collected; it included the following: Gender, type of delivery, gestational age, birth weight, Hb levels within 6 hours and after 36-48 hours of birth, neonates' condition during hospital course as oxygen therapy, Heart Rate (HR), Respiratory Rate (RR), Blood Pressure (BP) after 6 hours of UCM, any complications as received blood transfusion, IVH, used Mechanical Ventilation (MV), Respiratory Distress (RD), jaundice, requiring phototherapy, jitteriness in 48 hours, death, and length of hospital stay.

2.5 Methods of data collection

Official permission was obtained from the chairmen of NICU in Assiut University Children Hospital and Women's Health University Hospital. Tool one was developed by the researchers and was tested for its content validity by five experts in the pediatric and obstetric nursing, neonatology, pediatrics, and obstetric medicine field; it was 0.90. Tool reliability was 0.88.

Ethical considerations: Firstly, the study researchers prepared a proposal and it was accepted from the Ethical Committee of the Faculty of Nursing. Then, formal permission was obtained from the chairmen of NICU in Assiut University Children Hospital and Women's Health University Hospital. After that; the researchers told the study mothers that there was no risk for them or their neonates during the implementation of the study. Also, the researchers confirmed that the research paper was following the common ethical principles in clinical research. Written consent from the mothers that were willing to participate in the study, after clarifying the nature and purpose of the study. The confidentiality and anonymity were ensured. Finally, the mothers informed that they had the right to refuse the participation or withdraw from the study at any time without any rational. And their privacy was also considered during the data collection.

The pilot study was implemented on 8 premature infants (10%). It was done to assess the clarity and applicability of the tool. It incorporated in the total sample because no changes were performed. The technique of UCM was done as the following: one of the delivering obstetricians holding the neonate lower than "mother's introitus at vaginal delivery" or lower than the incision' level at cesarean delivery. Also, another assistant was milking near 20 cm of UC over 2 seconds (counting aloud). Likewise, repeating 2 further times as described previously.[19] The premature neonates' physiological parameters as; HR, RR, and BP were measured for the two groups by the premature neonates' digital monitor within 6 hours of UCM after admission to the NICU and recorded by the researchers. The premature neonates' Hb level was assessed for the two groups within 6 hours and at 36-48 hours of UCM.

Concerning RD, jaundice, jitteriness, and IVH (diagnosed using bedside head ultrasound); it was diagnosed and recorded by the attending neonatologist at NICU in the premature neonates' record based on clinical and laboratory investigations. Data was collected during the period of nine months from January 2018 to September 2018. The data was also collected depending on self-reporting method from the mothers and some of these data were retrieving from the patients' record (premature neonates' record or mothers' record).

2.6 Limitations of the study

There were some important limitations for this study as: Presence of third group DCC to compare between UCM vs. DCC by the ICC (control group). Also, according to the inclu-

sion criteria there was no premature neonates had gestational age less than 30 weeks. Likewise, there was other variables could be measured later as its effects on neurobehavioral development of these infants.

2.7 Statistical analysis

The researchers used the statistical package for social science (SPSS) version 19 to enter and analyze the data. The data was offered as number, percentage, mean, median and standard deviation. Chi-square and fisher exact tests were used to compare qualitative variables. While the Mann-Whitney test was used to compare between two quantitative variables in case of non-parametric data. *P*-value considered statistically significant when $p < .05$.

3. Results

As shown in Table 1, the mean ± SD of mother's age/years was 25.17 ± 4.06 in the study group compared to 26.80 ± 4.45 in the control group. Also, most of the mothers in both groups (87.5% & 92.5% respectively) were taken vitamins during pregnancy. Likewise, the mean ± SD of hemoglobin level at admission were 10.85 ± 1.00 vs. 10.65 ± 0.88 in the study and control group. In addition; the incidence of postpartum hemorrhage was 5.0% compared to 10.0% respectively in the study and control group. No statistically significant differences were detected between the two groups related to all maternal variables.

Table 1. Maternal clinical data and their outcomes in the study and control groups

Data	Study (n = 40)		Control (n= 40)		*p*-value
	No.	%	No.	%	
Mother age (years)					
Mean ± SD	25.17 ± 4.06		26.80 ± 4.45		.090
Range	20.0-35.0		20.0-36.0		
Maternal clinical data					
1) Number of parities					
Mean ± SD	2.38 ± 1.35		3.30 ± 2.30		.106
Range	1.0-6.0		1.0-11.0		
2) Vitamins and minerals taken					
Yes	35	87.5	37	92.5	.712
No	5	12.5	3	7.5	
3) Hemoglobin level at admission					
Mean ± SD	10.85 ± 1.00		10.65 ± 0.88		.34
Range	9.0-13.5		9.0-12.5		
Maternal outcome					
1) Length of third stage: (min)					
Mean ± SD	1.25 ± 0.54		1.53 ± 0.91		.169
Range	1.0-3.0		1.0-4.0		
2) Postpartum hemorrhage					
No	38	95.0	36	90.0	.675
Yes	2	5.0	4	10.0	

Table 2 revealed that 52.5% of the premature neonates in the study group were males compared to 65.0% in the control group. Also, 80.0% and 72.5% of the premature neonates in the study and control groups were delivered by C.S. Moreover; the mean ± SD of premature neonates' birth weight was 2077.50 ± 257.69 vs. 1953.50 ± 587.46 in the study and control groups. Regarding gestational age; it was found that mean ± SD was 32.97 ± 1.61 vs. 33.60 ± 2.67 in the study and control groups. There was no variation between the both groups related to premature neonates' data.

It was clear from Figure 1 that the Hb level significantly increased in the study group when compared to the control group within 6 hours of birth and at 36-48 hours after UCM (12.11 vs. 10.61 and 12.27 vs. 11.32).

Figure 2 revealed that the results of the present study reported that physiological parameters as HR, RR, systolic and diastolic BP didn't found statistical significant difference between the study and control groups (p = .088, .22, .31, and .30 respectively).

ISSN 1925-4040 E-ISSN 1925-4059

Table 2. Neonatal data of the study and control groups

Data	Study (n = 40)		Control (n = 40)		*p*-value
	No.	%	No.	%	
Gender					
Female	19	47.5	14	35.0	.256
Male	21	52.5	26	65.0	
Types of delivery					
Normal	8	20.0	11	27.5	.43
C.S	32	80.0	29	72.5	
Birth weight: (g)					
Mean ± SD	2,077.50 ± 257.69		1,953.50 ± 587.46		.798
Range	1,400.0-2,800.0		1,000.0-2,900.0		
Gestational age: (weeks)					
Mean ± SD	32.97 ± 1.61		33.60 ± 2.67		.112
Range	30.0-36.0		30.0-36.0		

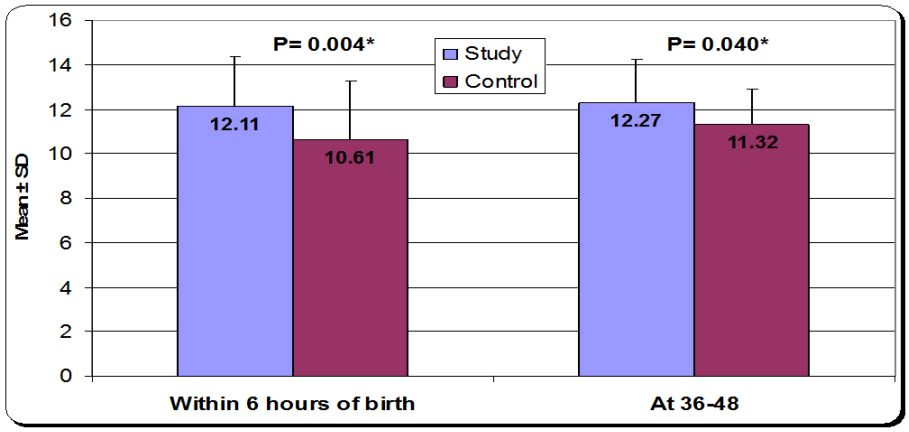

Figure 1. Comparison between Hb level after UMC among the study and control groups

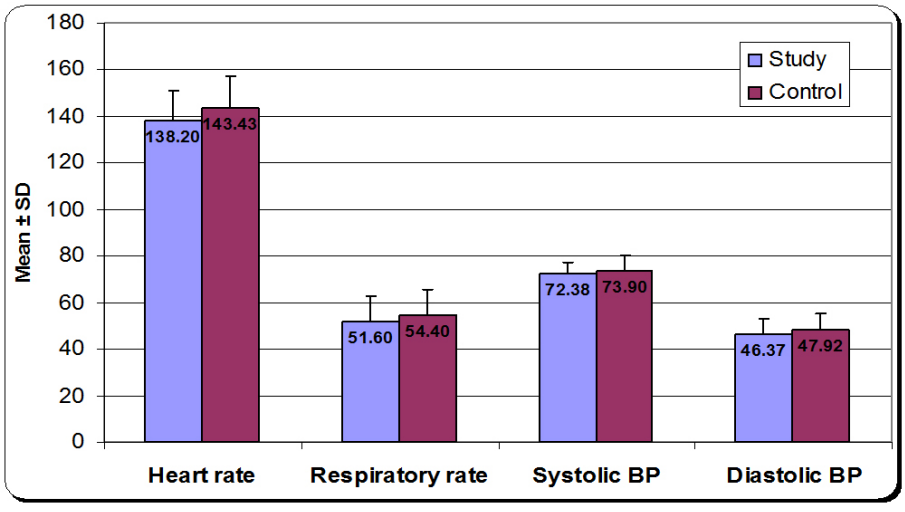

Figure 2. Comparison between physiological parameters within 6 hours of UCM among the study and control groups

As shown in Table 3, statistical significant differences were detected between the study and control groups as regards the need for blood transfusion (p = .012*), used of MV (p = .01*), the presence of jaundice (p = .000*), phototherapy used (p = .000*), death (p = .01*), and hospital stay (days) (p = .000*). While no statistical significant differences were detected between the study and control groups as regards the need to oxygen therapy, IVH, RD, and Jitteriness.

Table 3. Comparison between neonatal outcomes after UCM in the study and control groups

Outcomes	Study (n = 40)		Control (n = 40)		*p*-value
	No.	%	No.	%	
Oxygen therapy					
Yes	22	55.0	27	67.5	.25
No	18	45.0	13	32.5	
Blood transfusion					
Yes	0	0.0	7	17.5	.012*
No	40	100.0	33	82.5	
Intraventricular hemorrhage					
Yes	2	5.0	4	10.0	.675
No	38	95.0	36	90.0	
Mechanical ventilation used					
Yes	5	12.5	15	37.5	.01*
No	35	87.5	25	62.5	
Respiratory distress					
Yes	22	55.0	25	62.5	.496
No	18	45.0	15	37.5	
Jaundice					
Yes	12	30.0	29	72.5	.000*
No	28	70.0	11	27.5	
Phototherapy used					
Yes	12	30.0	28	70.0	.000*
No	28	70.0	12	30.0	
Jitteriness					
Yes	3	7.5	6	15.0	.481
No	37	92.5	34	85.0	
Death					
Yes	3	7.5	8	20.0	.01*
No	37	92.5	32	80.0	
Hospital stay (days)					
Mean ± SD	4.80 ± 2.13		20.90 ± 12.25		.000*
Range	2.0-10.0		2.0-44.0		

*p < .05

4. DISCUSSION

One of the unfavorable effects of premature labor is the exposure to anemia which considered the main cause of neonatal mortality; which often need a blood transfusion. An important method to prevent these negative outcomes is an intervention such as UCM which enhances Hb level and improves neonatal outcomes.[20]

The present study indicated that UCM was significantly increasing Hb level of preterm neonates within 6 hours and at 36-48 hours after birth. Also, it had a positive effect on preterm neonates in the study group concerning their need for blood transfusion than their counterparts in the control group.

The study results were supported with the findings of the previous studies done by Song et al.[17,20–23] who indicated

that UCM was significantly associated with increased Hb level of the neonates at initials, increased blood volume, decreased the need for blood transfusion; which consequently improve preterm neonate's outcomes. Disagree with Nagano et al.[24,25]

With this concern, the study of Upadhyay et al.[26] stated that UCM was a method which was prevented the neonatal anemia through milking the blood towards the neonate. It was restored a large amount of blood and subsequently enhance Hb during the infancy because they had iron storage.

The results attributed that the Hb level was increased because the placenta was the source of fetal blood, and UCM intervention acted as blood transfusion to the neonate at birth because it added an extra volume of blood which might have positive impacts that finally enhance their outcome.

The results indicated that there was a statistically significant difference between the study and control groups as regard MV used. While the statistical significant difference was not found between them as regard oxygen therapy and incidence of RD. However, small number of premature neonates needed oxygen therapy or had RD compared to premature neonates in the control group. These results were continuous with Leal et al.[2,3,8,12,27–29] who mentioned that UCM provide sufficient oxygen to the tissues, improves arterial oxygen, increase cardiac output, and enhance oxygen distribution. The results might be attributed that the UCM was improved breathing pattern early which leading to declining the major complications as MV used.

The study also found that the length of hospital stay decreased significantly in the study than the control groups. This result was concurrent with Bhatt et al.[10,11,30] who mentioned that UCM might decrease the neonates' susceptibility to inflammatory processes. Also, this blood contained stem cells which are necessary for tissue building and increase body immunity and infection resistance and sepsis. Additionally, lower the rate of complications. These might be lead to a short term stay of hospitalization and improve high-risk neonate's outcomes specifically preterm neonates.

Furthermore, the current study indicated that UCM significantly lower incidence of neonatal deaths in the study group. This finding was in the same line with the previous studies by Nagano et al.[24,31,32] who found that UCM could decrease the incidence of complications and mortality in preterm infants. While it was disagree with a study done by Krueger et al.[25]

The study researchers thought that the incidence of neonatal deaths was decreased in the study group because UCM improved their Hg level and decreased blood transfusion times. Hence, lowered the rate of complications as; the rate of sepsis, RD, MV using, jaundice and need for phototherapy, and length of hospital stay. So, the premature neonates in the study group had better outcomes and lower incidence of neonatal deaths.

Likewise, the results revealed that the study and control groups differ significantly as regards the presence of jaundice and phototherapy used. These results were supported with studies of Dang et al.[26,31,33] on the term and near term neonates; who found that UCM group didn't show any increase in serum bilirubin or need for phototherapy. Disagree with Leal et al.[27,34,35] This result might be due to that UCM decreased serum bilirubin in premature neonates in the study group. Because they had fewer packed RBCs transfusion, so less RBCs destruction and decreased bilirubin level in their blood.

Despite, the observable improvement in the physiological parameters (HR, RR, and systolic and diastolic BP) of the premature neonates who receive UCM the difference between the two groups was not statistically significant. Too, the study revealed that the incidence of IVH was lower in the study group than the control group while no statistically significant difference was found between the two groups. These results were in agreement with the findings of Leal et al.[3,17,24,27,31,32] who found that UCM lowers IVH risk/incidence while failed to show a significant difference in IVH incidence between the groups. Also, Bhatt et al.[10] indicated that UCM might reduce the risk of IVH and the vulnerability of neonates to inflammatory processes.

According to National Institutes of Health,[36] IVH is more common in premature neonates who had RDs, unstable BP, and other medical conditions at birth. While the UCM improved these causes in the study group. Thus, premature neonates in the study group had a lower incidence of IVH than their counterparts in the control group.

As respect to maternal outcomes, the current result revealed that the UCM was not shown any significant difference for the risk of post-partum hemorrhage. This result was consistent with other authors as McDonald et al.[7,27,37] Furthermore, regarding the length of third stage of labor, the study indicated that the statistical difference was not significant. The mean values of third stage duration were still within physiologic ranges which on the agreement with Abalos.[38] These results might be due to small sample size or uterotonics agents administered following birth among both groups.

5. CONCLUSION

The study results concluded that UCM improved preterm neonates' outcomes as increasing Hb level, less need for

blood transfusion and MV, decrease incidence of jaundice and phototherapy used, decline incidence of death, lowers length of hospital stay (days). While UCM didn't affect significantly between the study and control groups as regards the oxygen therapy, IVH, RD, and jitteriness, length of third stage of labor and presence of post-partum hemorrhage.

Recommendations

(1) Increasing awareness of neonatology, pediatric, and obstetric nurses about benefits and technique of UCM through health education program.

(2) A replication of this study with a larger sample size, this would increase the generalizability of the data in regards to the safety of UCM.

(3) Developing another study to evaluate the iron stores beyond 36-48 hours of age.

(4) Implement another study to evaluate UCM effects on other variables as; neurobehavioral development and occurrence anemia during the first year of life.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare that there is no conflict of interest.

REFERENCES

[1] Gokalp AS, Gunlemez A, Oguz D. Umbilical Cord Clamping Time in Premature Infants Journal of Neonatal Biology. Journal of Neonatal Biology. 2017; 6: 1.

[2] Katheria A, Garey D, Truong G, et al. A Randomized Clinical Trial of Umbilical Cord Milking vs Delayed Cord Clamping in Preterm Infants: Neurodevelopmental Outcomes at 22-26 months of corrected age. J Pediatr. 2017; 194: 76-80. PMid:29246467 https://doi.org/10.1016/j.jpeds.2017.10.037

[3] Katheria AC, Leone TA, Woelkers D, et al. The effects of Umbilical Cord Milking on Hemodynamics and Neonatal Outcomes in Premature Neonates. J Pediatr. 2014; 164: 1045-50. PMid:24560179 https://doi.org/10.1016/j.jpeds.2014.01.024

[4] The World Health Organization. Guideline: Delayed Umbilical Cord Clamping for Improved Maternal and Infant Health and Nutrition Outcomes. 2017. Available from: http://www.who.int/iris/bitstream/10665/148793/1/9789241508209_eng.pdf?ua=1

[5] World Health Organization. WHO. Guideline: Delayed Umbilical Cord Clamping for Improved Maternal and Infant Health and Nutrition Outcomes. Geneva, World Health Organization; 2014. Available from: http://www.who.int/nutrition/publications/guidelines/cord_clamping/en/

[6] American college of Obstetrician and gynecologist: (AGOG PRACTICE BULLETIN). Clinical Management Guidelines for Obstetrician-Gynecologists Postpartum Hemorrhage. 2017; 130(4): e168-e186. PMid:28937571 https://doi.org/10.1097/AOG.0000000000002351

[7] McDonald SJ, Middleton P, Dowswell T, et al. Effect of Timing of Umbilical Cord Clamping of Term Infants on Maternal and Neonatal Outcomes. Cochrane Database Syst Rev. 2013; 7: CD004074. https://doi.org/10.1002/14651858.CD004074.pub3

[8] March M, Hacker M, Parson A, et al. The Effects of Umbilical Cord Milking in Extremely Preterm Infants: A Randomized Controlled Trial. Journal of Perinatology. 2013; 33: 763-7. PMid:23867960 https://doi.org/10.1038/jp.2013.70

[9] Rabe H, Jewison A, Alvarez RF, et al. Milking Compared with Delayed Cord Clamping to Increase Placental Transfusion in Preterm Neonates: A Randomized Controlled Trial. Obstet Gynecol. 2011; 117: 205-11. PMid:21252731 https://doi.org/10.1097/AOG.0b013e3181fe46ff

[10] Bhatt S, Alison B, Wallace EM, et al. Delaying cord clamping until ventilation onset improves cardiovascular function at birth in preterm lambs. Journal of Physiology. 2013; 591: 2113e26. PMid:23401615 https://doi.org/10.1113/jphysiol.2012.250084

[11] Tolosa JN, Park DH, Eve DJ, et al. Mankind's First Natural Stem Cell Transplant. J Cell Mol Med. 2010; 14: 488-95.

[12] Katheria A, Garey D, Truong G, et al. A Randomized Clinical Trial of Umbilical Cord Milking vs Delayed Cord Clamping in Preterm Infants: Neurodevelopmental Outcomes at 22-26 Months of Corrected Age. J Pediatr. 2018; 194: 76-80. PMid:29246467 https://doi.org/10.1016/j.jpeds.2017.10.037

[13] Alan S, Arsan S, Okulu E, et al. Effects of Umbilical Cord Milking on the Need for Packed Red Blood Cell Transfusions and Early Neonatal Hemodynamic Adaptation in Preterm Infants Born $\leq$ 1500 Grams: A Prospective, Randomized, Controlled Trial. J Pediatr Hematol Oncol. 2014; 36: e493-8. PMid:24633297 https://doi.org/10.1097/MPH.0000000000000143

[14] Hassan AM, Youssef MM, Hassanein FE, et al. Impact of Tactile Stimulation on Anthropometric Measurements of Premature Infants in Assiut City. Assiut Scientific Nursing Journal. 2014; 2(4): 1-11.

[15] Hockenberg and Wilson. Essential of Pediatric Nursing. The High Risk Newborn and Family. 10th ed. Saunders Elsevier's Company; 2015.

[16] Forghani F, Moghaddam M. Evaluating the Impact of Delayed Cord Clamping and Umbilical Cord Milking on the Level of Hemoglobin, Bilirubin and Ferritin 48 Hours after Delivery in Term Neonates during Caesarean Section. Annals of Medical and Health Sciences Research. 2018; 8: 233-235.

[17] Song SY, Kim Y, Kang BH, et al. Safety of Umbilical Cord Milking in Very Preterm Neonates: A Randomized Controlled Study. Obstet Gynecol Sci. 2017; 60: 527-34. PMid:29184860 https://doi.org/10.5468/ogs.2017.60.6.527

[18] Hsieh FY, Bloch DA, Larsen MD. A Simple Method of Sample Size Calculator for Linear and Logistic Regression. Statistics in Medicine Journal. 1998; 17: 1623-1634. https://doi.org/10.1002/(SICI)1097-0258(19980730)17:14<1623::AID-SIM871>3.0.CO;2-S

[19] Hosono S, Mugishima H, Fujita H, et al. Blood Pressure and Urine Output During the First 120 h of Life in Infants Born at Less than 29 Weeks' Gestation Related to Umbilical Cord Milking. Arch Dis Child Fetal Neonatal Ed. 2009; 94: F328-31. PMid:19221402 https://doi.org/10.1136/adc.2008.142935

[20] Alavi AA, Diuband A, Etaati Z, et al. Investigating the Effect of Umbilical Cord Milking on Neonatal Outcomes among the Preterm

Infants Born in Shariati Hospital of Bandar. Journal of Research in Medical and Dental Science. 2018; 6(1): 133-139.

[21] Basile PS, Micelli E, Caretto M, et al. Milking of the Umbilical Cord in Term and Late Preterm Infants. International Hindawi BioMed Research, Stefano. 2019; 2: 1-10. PMid:30886867 https://doi.org/10.1155/2019/9185059

[22] El-Naggar W, Simpson D, Husain A, et al. Cord milking versus immediate clamping in preterm infants: a randomized controlled trial. Archives of Disease in Childhood–Fetal and Neonatal Edition. 2018; 104(2). PMid:29903720 https://doi.org/10.1136/archdischild-2018-314757

[23] Katheria C, Giang M, Truong G, et al. Umbilical Cord Milking Versus Delayed Cord Clamping in Preterm Infants. American Academy of Pediatrics. 2015; 136(1): 61-69. PMid:26122803 https://doi.org/10.1542/peds.2015-0368

[24] Nagano N, Saito M, Sugiura T, et al. Benefits of Umbilical Cord Milking Versus Delayed Cord Clamping on Neonatal Outcomes in Preterm Infants: A Systematic Review and Meta-analysis. PLOS ONE. 2018.

[25] Krueger MS, Eyal FG, Peevy KJ, et al. Delayed Cord Clamping with and without cord Stripping: A Prospective Randomized Trial of Preterm Neonates. American Journal of Obstetrics and Gynecology. 2015; 212(3): 394.e1-5. PMid:25526873 https://doi.org/10.1016/j.ajog.2014.12.017

[26] Upadhyay A, Gothwal S, Parihar R, et al. Effect of Umbilical Cord Milking in Term and Near Term Infants: A Randomized Control Trial. Am J Obstet Gynecol. 2013; 208: 120.e1-6. PMid:23123382 https://doi.org/10.1016/j.ajog.2012.10.884

[27] Leal V, Bueno L, Vilaplana L, et al. Effect of Milking Maneuver in Preterm Infants: A Randomized Controlled Trial. Fetal Diagn Ther. 2019; 45(1): 57-61. PMid:29506014 https://doi.org/10.1159/000485654

[28] Daskalakis G, Papapanagiotou A, Siristatidis C, et al. The influence of delayed cord clamping and cord milking on inflammatory cytokines in umbilical vein and neonatal circulation. Acta Obstet Gynecol Sc. 2018; 97: 624-8. PMid:29338067 https://doi.org/10.1111/aogs.13294

[29] Al-Wassia H, Shah PS. Efficacy and Safety of Umbilical Cord Milking at Birth: A Systematic Review and Meta-analysis. JAMA Pediatr. 2015; 169: 18-25. PMid:25365246 https://doi.org/10.1001/jamapediatrics.2014.1906

[30] Rashid N, Al-Sufayan F, Seshia MM, et al. Post Transfusion Lung Injury in the Neonatal Population. Journal of Perinatology. 2013; 33: 292-6. PMid:22955289 https://doi.org/10.1038/jp.2012.114

[31] Dang D, Zhang C, Shi S, et al. Umbilical cord milking reduces need for red cell transfusions and improves neonatal adaptation in preterm infants: meta-analysis. J Obstet Gynaecol Res. 2015; 41: 890-5. PMid:25656528 https://doi.org/10.1111/jog.12657

[32] Backes CH, Rivera BK, Haque U, et al. Placental Transfusion Strategies in Very Preterm Neonates: A Systematic Review and Meta-analysis. Obstetrics and Gynecology. 2014; 124: 47-56. PMid:24901269 https://doi.org/10.1097/AOG.0000000000000324

[33] Jaiswal P, Upadhyay A, Gothwal S, et al. Comparison of Two Types of Intervention to Enhance Placental Redistribution in Term Infants: Randomized Control Trials. Eur J Pediatr. 2015.

[34] Ranjit T, Nesargi S, Rao PN, et al. Effect of Early Versus Delayed Cord Clamping on Hematological Status of Preterm Infants at 6 wk of age. Indian Journal of Pediatric. 2015; 82: 29-34. PMid:24496587 https://doi.org/10.1007/s12098-013-1329-8

[35] Nakagawa M, Ishida Y, Nagaoki Y, et al. Correlation between Umbilical Cord Hemoglobin Values and Rates of Jaundice Requiring Phototherapy in Healthy Newborns. Pediatr Int. 2014.

[36] National Institutes of Health. Medical Encyclopedia → Intraventricular hemorrhage of the newborn. U.S. National Library of Medicine 8600 Rockville Pike, Bethesda, MD 20894 U.S. Department of Health and Human Services National Institutes of Health Page last updated: 03 June. At Medline Plus. Available from: https://medlineplus.gov/ency/article/007301.htm

[37] Piyadigama I, Devasurendra L, Dissanayake A, et al. Effects of Umbilical Cord Milking Compared to Differed Cord Clamping in Term Infants, A Randomized Controlled Trial, Journal of Obstetrics and Gynecology. Colombo, Sri Lanka. 2017. https://doi.org/10.4038/sljog.v39i4.7824

[38] Abalos E. Effect of Timing of Umbilical Cord Clamping of Term Infants on Maternal and Neonatal Outcomes: RHL Commentary. The WHO Reproductive Health Library; Geneva: World Health Organization. 2009.