EFFECT OF DELAYED UMBILICAL CORD CLAMPING ON HEMOGLOBIN LEVELS IN TERM INFANT

Maulidia Zahida[1*], Ida Widiawati [2]
[1,2] Midwifery Departement, Polytechnic Health Ministry of Bandung, Indonesia
*Corresponding author : maulidiazahida@gmail.com

Abstract, Background: For the first few minutes after birth, there is still placental transfusion. Infants who were assigned to a 5-min delay in cord clamping time received a significantly larger placental transfusion. Several studies show that delayed umbilical cord clamping can improve physiological transfer of placental blood to the infant, so that it can increase hemoglobin levels until 6 months after birth.
Objective: The aim of this case study was to examine the effect of delayed umbilical cord clamping on hemoglobin levels in term infant.
Methods: An evidence based case report of eligible parturient were assigned to a 5-min delay in cord clamping. The primary outcome measures hemoglobin levels of the newborn measured at 48 hours of life. Literature search was conducted on April 4th, 2022 in the PubMed database, Google Scholar and Cochrane Library to identify relevant articles.
Result: There were three articles related to this study, fulfilled the criteria and fully accessible. Three articles showed that there were a significant differences in hemoglobin levels between delayed umbilical cord clamping group and immediate cord clamping group.
Conclusion: Delayed umbilical cord clamping has been shown to increase hemoglobin levels in term infant.

Keywords : Delayed umbilical cord clamping, hemoglobin levels, term infant.

Background

Iron deficiency anemia in infants is one of the nutritional health problems in Indonesia. According to Riset Kesehatan Dasar 2018. 1 of 3 Indonesian children under five years are anemic.[1] Worldwide, 47.4% children under five years are anemic. WHO estimates that around 300 million children in the world suffering anemia because iron deficiency.[2] A study shows the incidence of iron deficiency anemia in term infants aged 0-6 months old is 40.8%. Iron deficiency anemia is most common in infants aged 0, 1, and 2 months.[3]

Physiologically few minutes after birth, transfer of blood from placenta to the infant or it is called placental transfusion still continues for 3 minutes. Meanwhile, the transfer of blood from the baby to the placenta only lasts for 20-25 seconds after birth. When the umbilical cord is clamped immediately after birth, the placental transfusion that should still be in progress is stopped. The baby will lose 25 mg/kg or 33% iron. This can increase the risk of iron deficiency in infants up to 4 months of age.[4]

2-3 minutes delay in cord clamping, or until the pulsation of the cord stops, allows physiological transfer of placental blood to the infant. This provides the benefit of increasing hemoglobin levels in the first 6-8 months of life.[5] A study in term infants aged 3-5 months old showed that delayed umbilical cord clamping during labor for 3 minutes can reduce the prevalence of iron deficiency.[6]

For the first few minutes after birth, the infant still received placental transfusion. Few minutes delay in cord clamping give time to improve physiological transfer of placental blood to the infant. Placental transfusion is an

DOI 10.34011/icihcce.v4i1.205

extremely effective method of enhancing arterial oxygen content, increasing cardiac output and improving oxygen delivery.[5]Immediate cord clamping (ICC) is an in physiologic intervention that prevents the natural process of placental transfusion. ICC is a routine practice without a scientific evaluation of the potential impact on infant health, growth and development.[7,8] In term infants, delayed umbilical cord clamping increases hemoglobin levels at birth and improves iron stores in the first several months of life, which may have a favorable effect on developmental outcomes.[8]

Seeing that the number of iron deficiency anemia mostly occurs at the age of 0 months,[3] delayed umbilical cord clamping is necessary to prevent the incidence of anemia in infants. The exact timing of delaying umbilical cord clamping has been the subject of considerable debate. But actually, this refers to the condition of the baby. If the baby's condition is stable for clamping the umbilical cord, then a delay can be done.[9] Based on the background above, the author would like to discuss the effect of delayed umbilical cord clamping on hemoglobin in term infant.

Methods

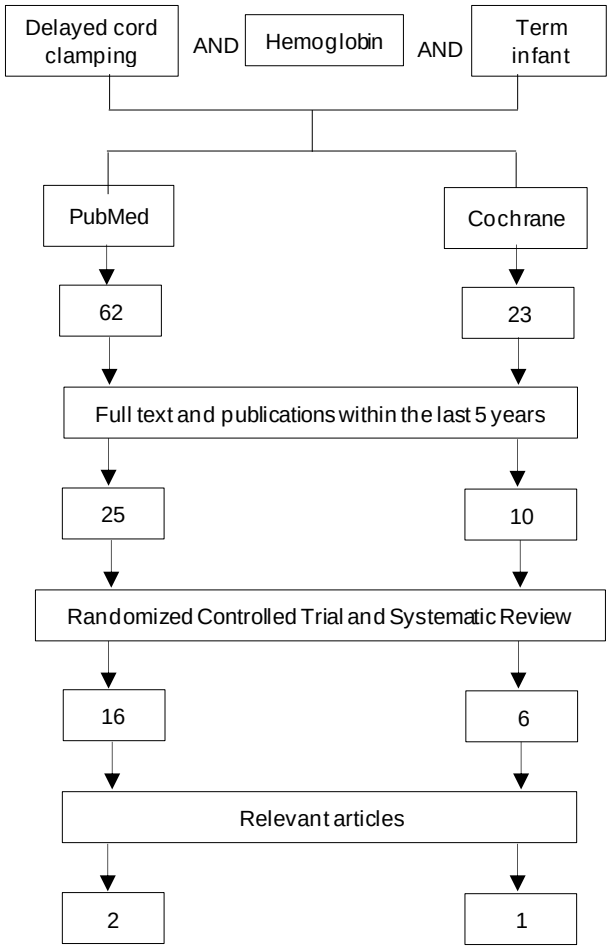
The literature used in this evidence based case report was conducted by searching articles with the PubMed, Google Scholar, and Cochrane Library databases used “OR” and “AND” Boolean operator on April 4, 2022. The keywords used are words that represent the topic, namely delayed umbilical cord clamping, hemoglobin, and term infant. Article search is limited based on the fully accessible and publications in the last 5 years. Design of the study was a randomized controlled trial and a systematic review. After reading the article thoroughly, there are 3 articles that match the required topics, the critical review in table 1.

The exact time of delay in cord clamping used in this case report refers to a study that delayed umbilical cord clamping for 5 minutes after birth.[8] When 24-48 hours after the baby is born, the hemoglobin level is checked using the Easy Touch device on the periphery of the baby's feet. Participants in this case report met the criteria for birth through vaginal birth, term gestational age, no complications during labor, no asphyxia and nuclei cord. This case report aims to see hemoglobin levels without using a comparison group.

Problem formulation in this evidence based case report :

P : Hemoglobin level in term infant
I : Delayed umbilical cord clamping
C : No comparison
O : Effect of delayed umbilical cord clamping on hemoglobin level in term infant

Figure 1. Flow pattern of literature search



Results And Discussion

Delayed umbilical cord clamping was carried out on this study, the clamping is delayed for 5 minutes. The hemoglobin level was checked after 35 hours after birth, using the Easy Touch device on the periphery of the baby's feet in table 2.

The normal hemoglobin level in term infants is 14.9 g/dL-23.7 g/dL, this indicates that the hemoglobin level of this study is within normal levels. This case is in line with a study which showed that there was a significant difference in hemoglobin levels between delayed umbilical cord clamping group and immediate cord clamping group. Where the average hemoglobin in (delayed umbilical cord clamping) DCC group was 16.51gr/dL and in the (immediate cord clamping) ICC group it was 15.16gr/dL.[10]

DOI 10.34011/icihcce.v4i1.205

Table 1. Critical Review

No	Journal	Validity	Important	Applicable
1.	1. **Tittle** *Effects of delayed cord clamping on residual placental blood volume, hemoglobin and bilirubin levels in term infants: a randomized controlled trial* 2. **Authors** JS Mercer, DA Erickson-Owens, J Collins, MO Barcelos, AB Parker, JF Padbury 3. **Year** 2017 4. **Journal** Journal of Perinatology 5. **Database** PubMed	1. **Design study** *Prospective Randomized Controlled Trial* 2. **Sampel** 73 women with term (37 to 41 weeks) singleton fetuses were randomized to DCC (⩾5 min; n = 37) or ICC (o20 s; n = 36) 3. **Inclusion criteria** healthy singleton pregnancy in the vertex position at term (37 to 416/7 weeks), were planning on breastfeeding, spoke English and were at least 18 years of age 4. **Exclusion criteria** Had evidence of medical or obstetrical complications (that is, hypertension, pre-eclampsia, diabetes, smoking, substance abuse and suspected intrauterine growth restriction), infants with evidence of intrauterine growth restriction and serious congenital anomalies 5. **Analysis** two-sided Pearson's χ 2 -square tests, t-tests and Wilcoxon rank sum tests	- there were no significant differences between the DCC and ICC groups with respect to maternal demographics or clinical variables - there were significant differences in hemoglobin (P-values 0.002) and hematocrit (P-value 0.001) - there were no significant differences in bilirubin level (P-value 0.45) - no association between DCC and hyperbilirubinemia or symptomatic polycythemia	DCC significantly improve hemoglobin level in term infant, and no association with hyperbilirubinemia and polycythemia.
2.	1. **Tittle** *A randomized controlled clinical trial on peripartum effects of delayed versus immediate umbilical cord clamping on term newborns* 2. **Authors** Chukwuemeka Jude Ofojebe, George Uchenna Eleje, Joseph Ifeanyichukwu Ikechebelu, Boniface Chukwuneme Okpala, Binyelum Adaobi Ofojebe, Emmanuel Onyebuchi Ugwud, Emeka Philip Igbodike, Arinze Anthony Onwuegbuna, David Chibuike Ikwuka, Chidebe Christian Anikwe, Toochukwu Benjamin Ejikeme 3. **Year** 2021 4. **Journal** European Journal of Obstetrics & Gynecology and Reproductive Biology 5. **Database** Pubmed	1. **Design study** *Randomized Controlled Trial* 2. **Sampel** 204 Mother-newborn pairs undergoing labor or childbirth in NAUTH, Nnewi, Nigeria between July 1, 2019 and September 30, 2020. Randomization was done by permuted blocks using *handy virtual software* in to: DCC (>60 detik) and ICC (<15 detik) 3. **Inclusion criteria** Women with singleton pregnancy in labor at a gestational age from 37 weeks to 42weeks and having vaginal delivery. 4. **Exclusion criteria** Women with chronic medical disease like human immune deficiency virus I and II, diabetes mellitus and rhesus isoimmunisation, postpartum hemorrhage, preeclampsia, and prolonged rupture of fetal membranes, congenitally malformed babies and those whose new-borns had fetal asphyxia 5. **Analysis** Data analysis was done using the IBM SPSS package version 22 (Chicago, Illinois, USA)	- The average age, parity and gestational age of the two groups of mothers were the same (p > 0.05) - There was a significant difference in hemoglobin at birth and at 48 hours after birth in the intervention and control groups (p <0.001) - There was no significant difference in bilirubin levels in the two groups	The practice of delayed cord clamping is more beneficial for term neonates in terms of hemoglobin level than immediate cord clamping.
3.	1. **Tittle** *Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes (Review)* 2. **Authors** Susan J McDonald, Philippa Middleton, Therese Dowswell, Peter S Morris 3. **Year** 2013 4. **Journal** - The Cochrane Collaboration - *Published by* John Wiley & Sons, Ltd. 5. **Database** Cochrane	1. **Design study** Cochrane journal review 2. **Sampel** A randomized controlled trial journal that applies the practice of delaying cord cutting. Quasi-experimental research was excluded. 3. **Exclusion criteria** - Aterm pregnancy (>37 minggu) - Have been involved in a birth where cord clamping was applied (including a caesarean section) 4. **Inclusion criteria** - Malpresentation - Multiple pregnancy	- There was no significant difference in infant mortality in the two groups - The average baby weight in the intervention group was higher than the control group - Infants who were given phototherapy were higher in the control group compared to the intervention group - Hemoglobin levels in the control group were lower than the intervention group	The practice of delaying cord clamping has benefits in increasing hemoglobin levels and iron stores in newborns. It is recommended to do this if phototherapy treatment is available.

DOI 10.34011/icihcce.v4i1.205

Table 2 Newborn demographics and clinical variables

Characteristics	Description
Gender	Female
Birth weight	3470 gram
Hemoglobin level	20.6 g/dL.

A previous study aimed at assessing the benefits and disadvantages of the practice of delayed umbilical cord clamping has shown that delaying the clamping of the umbilical cord is associated with respiratory distress in infants.[11] However, in this case, signs and symptoms of respiratory disorders were not found. This is consistent with studies showing that umbilical cord delay is not associated with the incidence of respiratory distress.[10]

There is a widespread belief that transfer of blood from the placenta with delayed cutting of the umbilical cord may increase the risk of hyperbilirubinemia. It is also mentioned in the WHO guidelines which state that infants with delayed umbilical cord cutting are significantly more likely to require phototherapy for the treatment of jaundice, with a risk difference of <2% between DCC and ICC. However, this has been refuted by various studies. A study showed that delaying umbilical cord cutting did not increase the risk of phototherapy.[8]

Delayed umbilical cord clamping has been shown to increase hemoglobin levels, where hemoglobin is part of red blood cells that has a role in the formation of bilirubin. The breakdown of red blood cells will produce heme and globin. Heme will be oxidized by the enzyme heme oxygenase to form biliverdin (green pigment). Biliverdin is soluble in water. Biliverdin will undergo a process of degradation into the form of bilirubin. One gram of hemoglobin will produce 34 mg of bilirubin.[12]

The end product of this metabolism is indirect bilirubin which is insoluble in water and will be bound by albumin in the blood circulation which will be transported to the liver. Indirect bilirubin is taken up and metabolized in the liver to direct bilirubin. Infants can experience hyperbilirubinemia in the first week of life if there is increased hemolysis of bilirubin, lack of albumin as a transporter, decreased uptake by the liver, decreased conjugation of bilirubin by the liver, and increased enterohepatic circulation.[12]

Total serum bilirubin (BST) level > 5 mg/dL (86 mol/L) is called hyperbilirubinemia. Hyperbilirubinemia is generally normal, only 10% of which are potentially pathological (bilirubin encephalopathy). Bilirubin levels in infants will continue to increase every day. If the increase is rapid (> 5 mg / dL per day) leads to pathological hyperbilirubinemia. Infants who need phototherapy

are infants who have bilirubin levels that reach 20 mg/dL.[13]

In this case, on the fourth day of examination, the baby appeared slightly yellow in the eyes and face. Total bilirubin examination was performed with the result of 10 mg/dL. Based on the results of both physical and laboratory examinations, the baby has physiological jaundice. Based on consultation with a pediatrician, the baby does not need phototherapy therapy for jaundice. This case shows that the case does not support the statement that delaying the cutting of the umbilical cord may increase the risk of phototherapy.

A study showed that delayed umbilical cord clamping does not increase the risk of polycythemia and hyperbilirubinemia.[8],[10] So the belief that the practice of delayed umbilical cord clamping can increase the risk of hyperbilirubinemia does not have justifiable evidence. Bilirubin is also known as an antioxidant.[8] A study shows that elevated levels of bilirubin but still within the normal range (physiologic hyperbilirubinemia) can provide a unique protective antioxidant effect, especially for the developing brain.[14]

The literature in this case report examined two groups so that there were differences in hemoglobin levels between the DCC group and ICC group. However, in this case report, we did not use a comparison group, so we could not see the differences in hemoglobin levels between the two groups.

Conclusion

The application of delayed umbilical cord clamping in this case report shows:

a. The hemoglobin level in this case was within normal levels. This level was above the average hemoglobin level of the group that underwent immediate cord clamping in the previous study.
b. Delayed umbilical cord clamping is not associated with hyperbilirubinemia and the risk of phototherapy.

References

1. Kemenkes RI. *Riset Kesehatan Dasar*

DOI 10.34011/icihcce.v4i1.205

2018.; 2018.

2. World Health Organization. Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia. Published online 2008.
3. Ringoringo HP, Windiastuti E. Profil parameter hematologik dan anemia defisiensi zat besi bayi berumur 0-6 bulan di RSUD Banjarbaru. *Sari Pediatr*. 2016;7(4):214-218.
4. Chaparro CM. Timing of umbilical cord clamping: effect on iron endowment of the newborn and later iron status. *Nutr Rev*. 2011;69 Suppl 1:S30-6. doi:10.1111/j.1753-4887.2011.00430.x
5. WHO. *Guideline: Delayed Umbilical Cord Clamping for Improved Maternal and Infant Health and Nutrition Outcomes*.; 2014. https://www.ncbi.nlm.nih.gov/books/NBK310514/
6. Al-Tawil MM, Abdel-Aal MR, Kaddah MA. A randomized controlled trial on delayed umbilical cord clamping and iron status at 3–5 months in term neonates held at the level of maternal pelvis. *J Neonatal Perinatal Med*. 2012;5(4):319-326.
7. Katheria AC, Lakshminrusimha S, Rabe H, McAdams R, Mercer JS. Placental transfusion: a review. *J Perinatol*. 2017;37(2):105-111.
8. Mercer J, Erickson-Owen D, Barcelos M, Parker A, Padbury J. Effects of Delayed umbilical cord clamping on Residual Placental Blood Volume, Hemoglobin and Bilirubin Levels in Term Infants : a Randomized Controlled Trial. *J Perinatol*. Published online 2016.
9. Hooper SB, Polglase GR, Te Pas AB. A physiological approach to the timing of umbilical cord clamping at birth. *Arch Dis Childhood-Fetal Neonatal Ed*. 2015;100(4):F355-F360.
10. Ofojebe CJ, Eleje GU, Ikechebelu JI, et al. A randomized controlled clinical trial on peripartum effects of delayed versus immediate umbilical cord clamping on term newborns. *Eur J Obstet Gynecol Reprod Biol*. Published online 2021.
11. Qian Y, Ying X, Wang P, Lu Z, Hua Y. Early versus delayed umbilical cord clamping on maternal and neonatal outcomes. *Arch Gynecol Obstet*. Published online 2019.
12. Munasi Z, Nia K. *Air Susu Ibu Dan Kekebalan Tubuh : Bedah ASI*. (Hegar B, Suradi R, Hendarto A, eds.). IDAI; 2009.
13. Maisels MJ, Bhutani VK, Bogen D, Newman TB, Stark AR, Watchko JF. Hyperbilirubinemia in the Newborn Infant _35 Weeks' Gestation: An Update With Clarifications. *Am Acad Pediatr*. Published online 2009.
14. Zahir F, Rabbani G, Khan R, Rizvi S, Jamal M, Abuzenadah A. The pharma_cological features of bilirubin: the question of the century. *Cell Mol Biol Lett*. Published online 2015.

DOI 10.34011/icihcce.v4i1.205