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Effects of cord clamping time on hemoglobin levels in neonates

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ABSTRACT

Background: *Delaying cord clamping can increase the baby's hemoglobin levels. Most of these studies compared delayed cord clamping with a baby's hemoglobin levels at a few months of birth and not with hemoglobin levels in newborns. After the baby is born, the baby's circulatory system is no longer related to the mother's circulatory system. In the fetus, nutrients are obtained directly from the mother's blood circulation through diffusion, so all the substances from the diffusion may enter the fetus's body. Thus, if the baby's hemoglobin level is not measured immediately after birth, the results will likely differ. This study checked the baby's hemoglobin levels within 48 hours after birth.*
Objectives*: This study aims to determine the relationship between the timing of cord clamping and newborn hemoglobin levels.*
Methods*: This study is correlational research. The study population consists of medical records of maternity mothers and newborns from the Midwife's Independent Practice in the Bantul area. There were 118 records total, with 84 meeting the inclusion criteria. Data analysis employs Spearman's Rank correlation.*
Results*: Of the 84 newborns, one had a hemoglobin level of 12.3 g/dL, indicating anemia. In this baby, cord clamping was performed 11 minutes after birth or after the umbilical cord stopped pulsating.* The rest have levels above 20 g/dl, ranging from 20.3 to 25.9 g/dl, which includes 65 babies (77.4%). When referencing normal newborn hemoglobin levels, the largest range appears in the polycythemia category. *The Spearman Rank test showed a p-value of 0.271.*
Conclusions*: The timing of cord clamping was unrelated to newborn hemoglobin levels.*

KEYWORD*: anemia; hematocrit; hemoglobin; newborn baby; polycythemia*

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INTRODUCTION

Based on Basic Health Research data from 2018, the anemia rate among pregnant women in Indonesia was 48.9% (1). Pregnant women with anemia can affect their babies' health. However, other studies have shown no relationship between maternal and newborn hemoglobin levels (2). To prevent maternal anemia, pregnant women are given 30-60 mg iron supplements along with 0.4 mg of folic acid daily (3,4). Besides iron tablets, maintaining a balanced diet during pregnancy also plays a crucial role in preventing anemia.

Previous research found that anemia in pregnant women can affect the fetus they carry. It is also noted that anemia in pregnant women negatively impacts the fetus (5). Anemia during pregnancy can lead to babies being born with low birth weight, shorter gestation periods, and more diminutive stature. However, it does not affect the baby's head circumference. In previous studies, blood samples from newborns were collected from babies over 1 month old. As a result, there is a high risk of bias regarding the baby's hemoglobin levels during the examination because the levels are not checked right after birth. Therefore, preventing and treating anemia in pregnant women is very important. The policy for monitoring the incidence of anemia in mothers is implemented at least three times during pregnancy, specifically in the first, second, and third trimesters. Normal hemoglobin levels in pregnant women are at least 11 g/dl, while normal newborn levels range from 13 to 20 g/dL. Another measure believed to prevent anemia in newborns is delaying cord clamping. It has been stated that delaying cord clamping can also boost neurological development in infants (6). Delaying cord clamping can prevent anemia in 8- and 12-month-old babies.

Although there has been research on delaying cord clamping and its effect on anemia in infants, it is still believed that further research is needed. This is because previous studies did not specify in detail how long cord clamping was delayed or report the hemoglobin levels of each newborn with delayed clamping and cutting the cord. Therefore, it is difficult to clearly understand the relationship between the duration of cord clamping and the newborns' hemoglobin levels. Additionally, the blood samples taken were not from the newborns themselves. This study aims to determine the duration of cord clamping in minutes and its relationship with newborn hemoglobin levels.

MATERIALS AND METHODS

The design of this study is correlational. In this study, we examined whether the duration of cord clamping is related to hemoglobin levels in newborns. Data were collected from the medical records of mothers who gave birth and the medical records of newborns at the Midwife's Independent Practice in the Bantul area. The population in this study consisted of the medical records of 118 mothers who gave birth between 2020

and 2023. Out of these, 84 records with complete documentation were used. The sampling method employed was total sampling. The data collected included maternal hemoglobin levels measured during childbirth, specifically during the first stage of labor. In this case, the hemoglobin levels of the newborns were determined from tests conducted on babies less than 48 hours old. The tool used in this study was an observation sheet, which recorded data from the medical records of mothers in labor and their newborns.

Data analysis included univariate and bivariate methods. Bivariate analysis was conducted to determine if there was a relationship between cord clamping time and newborn hemoglobin levels. The analysis used a computer-assisted Spearman Rank test. This research has obtained ethical approval. The ethics commission of Aisyiyah University of Yogyakarta issued the ethical permit for this study with the number 3066/KEP-UNISA/VII/2023.

RESULTS AND DISCUSSION

RESULTS

Univariate Analysis

Univariate analysis aims to determine the frequency distribution of the time it takes for the umbilical cord to cease pulsating. The duration is measured in minutes. The data on the time for clamping the umbilical cord can be found in **Table 1**.

Table 1 shows that the length of cord clamping time varies from less than 1 minute for 4 infants (4.8%) to 60 minutes for 1 infant (1.2%). The most common times for cord clamping were at the 5th and 10th minutes after birth, each with 9 babies (10.7%).

Table 1. Duration of cord clamping time

Cord clamping time (minutes)	Total	%
<1	4	4.8
1	2	2.4
2	6	7.1
4	3	3.6
5	9	10.7
6	5	6
7	2	2.4
8	2	2.4
10	9	10.7
11	2	2.4
13	1	1.2
14	1	1.2
15	2	2.4
16	2	2.4
17	2	2.4
19	3	3.6
20	5	6
21	1	1.2
22	2	2.4
23	1	1.2
24	1	1.2
25	1	1.2
28	1	1.2
29	1	1.2
30	5	6
32	1	1.2
35	1	1.2
39	1	1.2
40	2	2.4
43	1	1.2
50	2	2.4
51	1	1.2
55	1	1.2
60	1	1.2
Total	**84**	**100**

Table 2. Classification of hemoglobin levels in newborn

Hb Classification	Total	%
<13 g/dl	1	1.2
13-20 g/dl	18	21.4
>20 g/dl	65	77.4
Total	84	100

Table 2 shows that only one newborn (1.2%) has a hemoglobin level below 13 g/dl, specifically 12.3 g/dl. The rest have levels above 20 g/dl, ranging from 20.3 to 25.9 g/dl, which includes 65 babies (77.4%). When referencing normal newborn hemoglobin levels, the largest range appears in the polycythemia category.

Bivariate Analysis

Bivariate analysis indicates whether a relationship exists between the duration of umbilical cord clamp time and newborns' hemoglobin levels.

Table 3. Long relationship of cord clamping with newborn hemoglobin levels

Center string clamping time (minutes)	Classification of Newborn Hemoglobin Levels						*Spearman Rank*
	<13 g/dl	%	13-20 g/dl	%	>20 g/dl	%	(p)
<1	0	0	0	0	4	4.8	
1	0	0	0	0	2	2.4	
2	0	0	2	2.4	4	4.8	
4	0	0	2	2.4	1	1.2	
5	0	0	1	1.2	8	9.6	
6	0	0	0	0	2	2.4	
7	0	0	0	0	2	2.4	
8	0	0	0	0	2	2.4	
10	0	0	3	3.6	6	7.1	
11	1	1.2	0	0	1	1.2	
13	0	0	0	0	1	1.2	
14	0	0	1	1.2	0	0	
15	0	0	0	0	2	2.4	0.271
16	0	0	0	0	2	2.4	
17	0	0	0	0	2	2.4	
19	0	0	0	0	3	3.6	
20	0	0	2	2.4	3	3.6	
21	0	0	0	0	1	1.2	
22	0	0	1	1.2	1	1.2	
23	0	0	0	0	1	1.2	
24	0	0	0	0	1	1.2	
25	0	0	0	0	1	1.2	
28	0	0	0	0	1	1.2	
29	0	0	0	0	1	1.2	
30	0	0	1	1.2	4	4.8	
32	0	0	1	1.2	0	0	

35	0	0	0	0	1	1.2	
39	0	0	1	1.2	0	0	
40	0	0	1	1.2	1	1.2	
43	0	0	0	0	1	1.2	
50	0	0	1	1.2	1	1.2	0.271
51	0	0	0	0	1	1.2	
55	0	0	0	0	1	1.2	
60	0	0	1	1.2	0	1.2	
Total	**1**	**1.2**	**18**	**21.4**	**65**	**77.4**	

Table 3 shows that with cord clamping less than 1 minute, four babies (4.8%) had hemoglobin levels in the category of polycythemia. The longest cord clamping was 60 minutes, and one infant (1.2%) had normal hemoglobin levels. Infants with anemia numbered 1 (1.2%) and had a cord clamping duration of 11 minutes. From the Spearman Rank test, it was found that the length of cord clamping was not related to the newborn's hemoglobin level, with p=0.271.

DISCUSSION

Frequency Distribution of Umbilical Cord Clamping Duration and Classification of Newborn Hemoglobin Levels

One of the steps in newborn care is clamping and cutting the umbilical cord. The timing of this process varies widely in practice. Some cut the cord immediately after birth, while others delay until it no longer pulses. Some infants' cords are left to detach naturally without cutting (7,8). This delayed clamping aims to increase the hemoglobin levels in newborns, helping to prevent or reduce the risk of anemia. Anemia in newborns is a serious concern because it affects growth and development. Newborn hemoglobin levels are classified into three categories: anemia (<13 g/dl), normal (13-20 g/dl), and polycythemia (>20 g/dl) (5).

Table 1 shows that the timing of umbilical cord clamping varies with each newborn. Some are less than 1 minute, while others can last up to 60 minutes. Table 2 indicates that out of 84 newborns, only one baby had anemia, with a hemoglobin level of <13 g/dL. The babies with the highest hemoglobin levels are those who experience polycythemia. This suggests that clamping the umbilical cord in less than 1 minute does not cause anemia in the baby. In fact, most babies have excess hemoglobin or polycythemia. Interestingly, the umbilical cord continues to pulse even after the placenta has detached from the uterine wall and been born. This raises a question: is it still possible for substances to be exchanged between mother and fetus once the placenta has separated? Policies on delayed cord clamping should be further examined.

In the uterus, the mother's blood vessels and the fetal blood vessels in the placenta are completely separate, meaning they are not directly connected. Therefore, once the placenta detaches from the uterus,

the process of diffusion for exchanging substances and gases between the mother and fetus will stop automatically. In other words, the blood flow between the baby and the placenta is the same in both directions. Consequently, the theory that delayed clamping and cutting of the umbilical cord will increase hemoglobin levels in newborns requires further research.

Additional duct closure in the fetus is naturally expected to occur shortly after birth. This process helps prevent potential issues in the baby caused by delayed closure of these ducts. The ductus venosus in the liver connects the left portal vein and the umbilical cord vein to the inferior vena cava. It also plays a role in protecting the fetus from excessive placental circulation. Failure of the venosus duct to close can lead to galactosemia, hypoxemia, encephalopathy with hyperammonemia, and liver dysfunction (9). According to various literature, the closure of the ductus venosus generally occurs within a few hours after birth. Therefore, it is better to clamp the umbilical cord once the baby's blood circulation shifts from fetal to neonatal circulation, ensuring the baby receives adequate oxygen (10).

Therefore, it can be concluded that the appropriate time to clamp the umbilical cord is when the baby has breathed on its own, in other words, if the baby is born healthy. A healthy baby is characterized by strong crying and good muscle tone (11). The assumption is that this indicates that the fetal blood circulation has transitioned to the baby's circulation. In addition to the duration of umbilical cord closure, **Table 2** shows the hemoglobin levels in newborns. Most newborns have hemoglobin levels above 20 g/dl, indicating they fall into the polycythemia category. Polycythemia is a condition characterized by hemoglobin levels that are higher than normal. It is also called erythrocytosis. Polycythemia is classified into two types: (1) False polycythemia, which results from low blood volume, and (2) True polycythemia, caused by low serum erythropoietin (EPO) levels (primary polycythemia) or high levels (secondary polycythemia). Polycythemia in newborns is normal and represents a standard compensatory response to the relatively high hypoxia experienced by the infant in the intrauterine environment, in addition to the high oxygen affinity of fetal hemoglobin (12).

During the first days after birth, a baby's nutritional intake is primarily through breastfeeding. At this time, breast milk may not have come in yet, and if it has, the amount is still small. Usually, breast milk starts coming in around day 2 or 4 (13). Additionally, newborns have a stomach capacity roughly the size of a marble or can hold 5-7 ml of breast milk. By the third day, the stomach size increases to that of a large marble and can hold 22-27 ml. By one month old, the stomach is about the size of a chicken egg, capable of holding 80-150 ml (14). Conditions in these early days significantly influence the baby's blood volume. These effects are worsened by urination, bowel movements, sweating, and

breathing. Insufficient fluid intake and ongoing fluid loss can thicken the blood, which may cause the baby's hemoglobin levels to rise, potentially leading to polycythemia.

Relationship Between Umbilical Cord Clamping Duration and Hemoglobin Levels in Newborns

In **Table 3**, it is also evident that 77.4% of all respondents had hemoglobin levels in the polycythemia range. Further analysis shows that polycythemia occurs more often in babies whose umbilical cord clamping is less than 5 minutes, and nearly all babies with cord clamping times exceeding five minutes also experience polycythemia. Only one baby developed anemia with a cord clamping time of 11 minutes after birth. Previous research has found that delaying or early cord clamping does not pose a risk of causing polycythemia (15). However, other studies suggest that delaying cord clamping can lead to polycythemia (16).

Previous studies have shown that the delay in cord clamping duration is linked to higher newborn hemoglobin levels. However, the relationship between different cord clamping times and infant hemoglobin levels from these studies has not been established. In this study, **Table 3** demonstrates how the duration of umbilical cord clamping correlates with each newborn's hemoglobin level. The table also indicates that the timing of cord clamping is not associated with the newborn's hemoglobin levels. Whether delayed or not, cord clamping does not affect hemoglobin levels in newborns (17,18). The incidence of anemia in infants is influenced by the hormone hepcidin. If maternal hepcidin levels are lower than fetal levels, more maternal iron is transferred to the baby. Active transport from mother to fetus occurs, so the fetus can receive adequate iron even if the mother is anemic (2). Therefore, it can be concluded that even if the mother has anemia due to this hepcidin mechanism, fetal anemia should not occur unless other factors are involved. However, some studies have found different results, indicating that delayed cord clamping increases the newborn's hemoglobin level (19).

This indicates that whether cord clamping is done early or not is unrelated to the incidence of anemia in newborns. Therefore, it can be concluded that even if the mother has anemia due to this hepcidin mechanism, the fetus's risk of anemia should not occur unless other factors are at play.

This suggests that early cord clamping is not linked to anemia in newborns. However, the stem cells in the umbilical cord are likely to be very beneficial for the baby. Therefore, delaying cord clamping could be important for the baby's health. The presence of stem cells in the umbilical cord can be maximized to transfer to the baby by waiting to clamp the cord until it stops pulsating. Once pulsations cease, the umbilical cord usually becomes less visible because the blood vessels are no longer apparent, or the cord turns completely white and appears wilted (20).

CONCLUSION AND RECOMMENDATION

This study found that the duration of umbilical cord clamping does not affect newborn hemoglobin levels. Babies with cord clamping under 1 minute had hemoglobin levels above normal (polycythemia), while those clamped at 60 minutes after birth had normal levels. The statistical analysis showed no relationship between the timing of cord clamping and the newborns' hemoglobin levels. Therefore, the assumption that mothers with anemia will give birth to babies with anemia is not supported.

It is recommended that pregnant women always maintain good health during pregnancy to prevent complications. Therefore, it is hoped that the mother's hepcidin level remains low, allowing more iron to enter the baby's body and helping the baby avoid anemia.

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