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Delayed umbilical cord clamping in cesarean section reduces postpartum bleeding and the rate of severe asphyxia

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Summary

Purpose of investigation: To explore the effect of delayed umbilical cord clamping in cesarean section on outcomes of mothers and newborns. *Materials and Methods:* A total of 338 pregnant women under cesarean section were randomly divided into two groups: study group with delayed umbilical cord clamping after pulsation loss, and control group with early clamping within 60 seconds after birth. *Results:* There were no significant differences in hemoglobin and hematocrit in newborn cord blood, the highest bilirubin after birth, Apgar scores at one and five minutes after birth, and in the occurrence of neonatal hyperbilirubinemia or application of phototherapy. There were significant differences in placental residual blood, the amount of postpartum bleeding, hemoglobin and hematocrit in newborn heel blood, and the rate of neonatal resuscitation after ten minutes in both groups. *Conclusion:* Umbilical cord clamping should be employed after pulsation loss to avoid adverse effect of early clamping.

Key words: Delayed umbilical cord clamping; Early umbilical cord clamping; Hyperbilirubinemia of newborn; Neonatal anemia; Neonatal asphyxia.

Introduction

At the time of birth, the infant is still attached to the mother via the umbilical cord. The infant is usually separated from the placenta by clamping the cord. The timing of clamping the cord is divided in two ways: early cord clamping (ECC) and delayed cord clamping (DCC). ECC is generally advised to be carried out in the first 60 seconds after birth, regardless of whether the cord pulsation has ceased. It will decrease 20-30 ml/kg blood infusion and lead to deficiency of iron reserve in newborns [1-2]. DCC is carried out 60 seconds after birth or when cord pulsation has ceased [3]. It has some advantages: improving iron deficiency, decreasing the rate of iron deficiency anemia, and improving the resuscitation of birth asphyxia [4, 5], however it can increase the incidence rate of pathological jaundice of newborn [6]. In this study, the authors conducted a randomized controlled trial of pregnant women under cesarean section, observed the effect of the DCC on outcomes of mothers and newborns and explored the best timing for clamping the cord for the health of mothers and newborns.

Materials and Methods

The inclusion criteria of the participants were the following: women in cesarean section, single fetus, women in normal physiological condition, and women willing to participate in the study. The exclusive criteria included women and family refusing to participate, women that had severe pregnant complications such as: previa of placenta, postpartum bleeding, heart disease, diabetes with need of insulin therapy, rupture of uterus, and twin pregnancy.

The study included 338 women with term pregnancies (equal to or greater than 37 completed weeks' gestation) that were collected from Rizhao People's Hospitals. They were randomly divided into two groups: ECC (n=169) and DCC (n=169). There was no obvious difference in general information ($p > 0.05$) (Table 1).

ECC occurred after cesarean section and the cord was clamped as soon as the infant was born (less than 60 seconds), whereas DCC occurred after cesarean section and the cord was clamped when cord pulsation had ceased.

Observation indexes included the following: 1) remaining blood volume of placenta: blood was collected when the placenta was separated spontaneously from the uterus; 2) postpartum blood was collected by weighing the gauzes to estimate the volume of postpartum haemorrhage and more than 1,000 ml was defined as the same [6]; 3) hemoglobin and hematocrit of umbilical cord blood were assessed; 4) hemoglobin and hematocrit of heel blood after 72 hours of childbirth were also assessed; 5) neonatal bilirubin was measured using transcutaneous bilirubin measurements every day. The peak of bilirubin was recorded as neonatal bilirubin. The standard of diagnosing hyperbilirubinemia of newborn followed established reference ranges [7]. It was recorded whether blue light treatment was prescribed; 6) Apgar scores at one and five minutes were taken. If the newborn required resuscitation due to asphyxia, Apgar score was taken again at ten minutes. The time required for resuscitation and used medicines were also recorded.

Statistical analysis

The data were evaluated for statistical differences using SPSS9. The *t*-test was used for statistical comparisons of measurement data between two groups. Chi-squared test was used for statistical analysis of counting data. A statistical significance was con-

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Table 1. — *General information of women and newborns ($\bar{x} \pm s$).*

	DCC (n=169)	ECC (n=169)	*t*	*p*
Age	27.71±3.83	28.47±4.23	1.75	0.08
Gestational week	39.63±0.89	39.62±0.88	0.05	0.96
Hemoglobin at one week before childbirth (g/L)	117.70±14.31	111.35±13.53	4.19	0.00
Hematocrit at one week before childbirth (%)	39.31±5.85	39.80±5.83	0.76	0.44
Neonatal weight (g)	3190.14±441.68	3139.52±491.84	0.99	0.32

Table 2. — *Maternal and neonatal outcomes ($\bar{x} \pm s$).*

	DCC (n=169)	ECC (n=169)	*t*	*p*
Residue blood (ml)	46.278±30.205	95.301±66.954	8.676	0.000
Postpartum haemorrhage (ml)	156.775±87.415	221.627±197.234	3.908	0.000
Hemoglobin of cord blood (g/L)	150.633±11.037	149.964±10.766	0.564	0.564
Hematocrit of cord blood (%)	45.199±3.509	45.534±4.226	0.794	0.482
Hemoglobin of heel blood (g/L)	188.520±14.292	171.733±10.809	12.179	0.000
Hematocrit of hell blood (%)	51.614±6.174	45.139±4.306	11.181	0.000
Highest bilirubin (mmol/L)	10.599±1.885	10.374±1.776	1.128	0.260
Apgar score at 1 min.	9.52±1.05	9.56±1.08	0.122	0.904
Apgar score at 5 min.	9.84±3.74	9.80±0.50	0.296	0.770

firmed when the *p*-value was less than 0.05.

Results

There was no obvious difference between two groups with regards to hemoglobin and hematocrit of umbilical cord blood, the highest bilirubin, Apgar scores, and hyperbilirubinemia ($p > 0.05$) (Table 2). There was an obvious difference between two groups with regards to remaining blood volume of placenta, postpartum haemorrhage, hemoglobin and hematocrit of heel blood after 72 hours of childbirth, and the resuscitation of birth asphyxia ($p < 0.05$) (Tables 3, 4). For early cord clamping group, nine newborns were transferred to neonatal ward. Seven of them were cured and two of them died. There was no significant difference in death rate between two groups.

Discussion

Neonatal anemia is one of the common diseases of newborns and greatly influences their growth, development, and intelligence [8]. It is still necessary to find ways to prevent neonatal anemia. Placental transfusion is greatly related to gravity and contraction. Under the reflex of infant, cord

Table 3. — *Percentage of hyperbilirubinemia of newborn and blue light treatment (%).*

	Hyperbilirubinemia (%)	Blue light treatment (%)
DCC (n=169)	25 (14.8)	20 (11.8)
ECC (n=169)	24 (14.2)	21 (12.4)
χ^2	0.024	0.028
p	0.877	0.868

Table 4. — *Percentage of birth asphyxia and successful resuscitation (%).*

	Birth asphyxia resuscitation	Successful neonatal	Transfer to ward	Died
DCC (n=169)	12 (7.5)	12 (100%)	0	0
ECC (n=169)	20 (11.8)	11 (55%)	9 (45)	2 (5)
χ^2	1.710	7.513	7.513	1.280
p	0.191	0.016	0.012	0.516

blood will close when the newborn get the optical blood volume. Timing of cord clamping is divided in two ways: ECC and DCC. ECC will decrease 20-30 ml/kg blood infusion and lead to deficiency of iron reserve of newborns. DCC is carried out when cord pulsation has ceased. It can transfuse 80 ml blood to newborn from cord and increase 50 grams iron reserve [9]. Xia *et al.* reported that DCC can prevent neonatal anemia to some extent [10]. McDonald *et al.* also found that DCC can increase hemoglobin concentration and iron reserve of newborns [11]. In this study, the authors found that the remaining blood volume of placenta greatly decreased, indicating that the newborns received more blood transfusion. Compared to ECC group, hemoglobin and hematocrit of newborns were higher in DCC group, which is consistent with other reports [12].

Studies have also shown that newborns received more blood and red blood cells from mother with DCC. The damage of red blood cells will cause neonatal bilirubin to increase and lead to jaundice [13]. Other studies showed that DCC increased neonatal bilirubin [14]. In this study, the authors found that the rate of hyperbilirubinemia was not increased after DCC. There was no increase of newborns who required blue light treatment. The present authors infer that self-regulation of infant-umbilical cord-placenta play important role during this process.

Asphyxia neonatorum suggests a lack of oxygen, retention of carbon dioxide, and acidosis in newborn infants due to various causes of pre-delivery, delivery, and post-delivery. In China, the incidence of asphyxia neonatorum is about 5%-10% [15]. It can lead to death of newborns and influence the development of children. After delivery, the blood transfuses from placenta to newborns through uterine contraction at varying pressure. After three minutes of DCC or in a fetus higher than 20 cm than placenta, the transfusion will cease [16]. In this study, the authors found that the remaining blood volume of placenta greatly decreased, sug-

gesting that the transfusion occurred. DCC will increase the blood volume of newborn, change hemodynamic, and prevent neonatal shock. It will ensure sufficient blood supply for tissues and increase successful resuscitation.

Studies showed that DCC in natural childbirth decrease the hemorrhage risk in third stage of labor, therefore Federation of Gynecology and Obstetrics and International Union of Midwives suggested that DCC until the pulsation of cord ceases, should be a routine protocol during the third stage of labor. [17]. In this study, the authors found that postpartum haemorrhage was lesser in DCC than in ECC group under cesarean section, suggesting that DCC can be recognized as one important step of cesarean section.

Conclusion

In conclusion, the authors found that the DCC did not influence the hemoglobin and hematocrit levels of umbilical cord blood, the highest bilirubin, Apgar score, and hyperbilirubinemia. The remaining blood volume of placenta and postpartum haemorrhage was decreased. Hemoglobin of heel blood 72 hours of birth and the rate of successful neonatal resuscitation increased. There was no obvious adverse effect on health of mothers and newborns and therefore, DCC is safe. The long term effect on newborns needs to be further explored.

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