Analysis of clinical course in term patients with early and delayed umbilical cord clamping after birth

A Gutierrez, R Velasquez, M Iriarte

Citation

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Abstract

Background – The optimal time of cord clamping has been a subject of heated discussion. It has been reported that placental transfusion occurs primarily at 10 seconds after delivery, therefore immediate cord clamping may deprive the newborn of blood. Material and methods – Two hundred term newborns born over a two-month period were divided into two groups: group A with immediate cord clamping and group B with clamping at 10 seconds after birth.Results – At least one morbidity event was recorded in 35% of patients in group A and in 8% of patients in group B.Discussion – The time of delay was based on reports that 5% of circulating volume can be transfused at 10 seconds after birth without risk. Morbidity was higher in the group with immediate cord clamping than in the delayed clamping group.Conclusions – Delayed cord clamping is a safe procedure with beneficial effects for the newborn.

INTRODUCTION

The optimal time of cord clamping has been the subject of discussion for many years. In 1968, Walsh and Yao began a scientific analysis of the physiologic effects of delayed cord clamping, showing that the time of cord clamping has hemodynamic effects in the newborn and that immediate cord clamping deprives the newborn of a significant blood volume. [1,2,3].

Figure 1

Figure 1 – Rate of placental transfusion

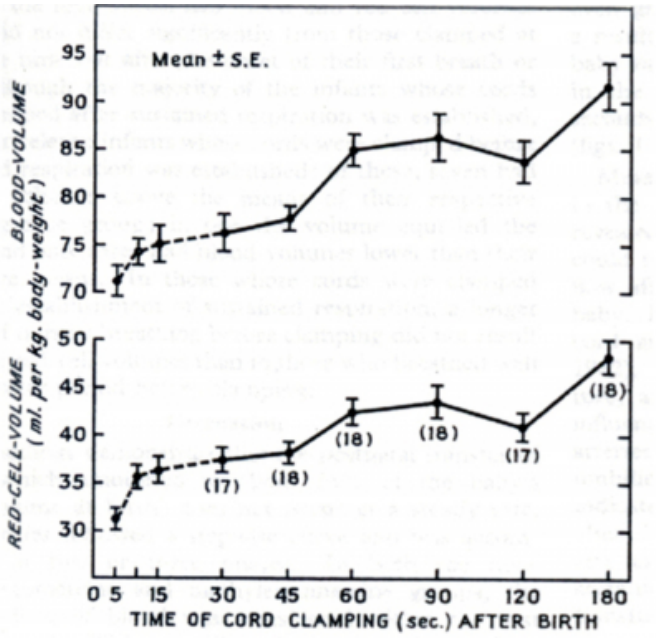
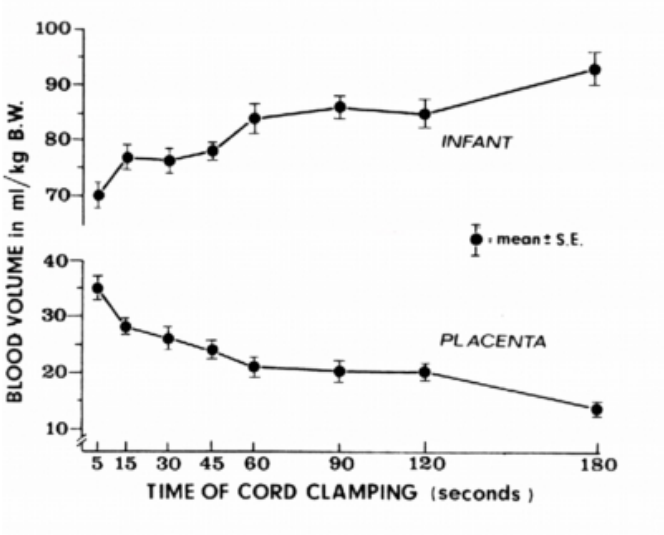


Figure 2

Figure 2 – Relationship between infant's blood volume and placental residual blood-volume at various time of cord clamping



Recent studies have confirmed the results of these early reports. Lainez et al. reported that placental circulation and exchange of blood and gas do not stop immediately after birth. The fetus has an approximate blood volume of 70 ml/kg and the placenta a further 45 ml for each kg of fetal weight. If the umbilical cord is not clamped immediately after birth, a volume of 20-35 ml/kg can be transfused to the fetus, potentially representing a 50% increase in fetal blood volume. [4]

When the fetus is in the uterus, the pulmonary circulation is diminished since blood flow goes through the foramen ovale and the ductus arteriosus. Immediately after birth, cardiac output to the lungs increases from 8% to 45%, requiring transfer of an adequate blood volume.

The importance of opening pulmonary capillaries while expanding the lungs at birth has been described. Maintenance of the fetus-placental circulation while the baby begins to breathe allows the pulmonary capillaries to fill, which improves pulmonary perfusion. Efficient pulmonary perfusion and expansion contributes to a better arterial-alveolar oxygen ratio. [5,6]

If the cord is clamped immediately after birth, 25-50% of the fetus-placental blood volume is excluded from the newborn circulation, especially if the newborn has not begun spontaneous breathing. [7,8]

When the cord is clamped before an adequate placental transfusion to the infant has occurred, blood volume may be taken from other capillary beds resulting in relative hypoperfusion. Such hemodynamic instability in the newborn may cause ischemic lesions in the brain, gastrointestinal tract, and lungs. [6]

At birth, the red cell volume by kg of weight is similar in term and preterm newborns. The great variability in blood volume, red cell volume, and hematocrit observed during the neonatal period is due to variation in the placental transfusion volume following birth. [9] The increase in blood volume after birth may be predicted in relation to the time of cord clamping (Figure 1).

The placental transfusion volume is influenced by:

- Vaginal or cesarean birth
- Presence or not of uterine contractions
- Position of newborn relative to the placenta
- Time between birth and cord clamping
- Use of oxytocin
- Umbilical cord manipulation

Coexisting conditions such as maternal anemia, pre-eclampsia, diabetes, hemorrhage, asphyxia, intrauterine growth retardation, isoimmunization, or hydrops fetalis. [8]

Klebe et al. studied the residual placental blood volume after birth by measuring the remaining blood in the fetal side of the placenta. They found that this volume was greater in vaginal births due to the deposition of blood in the placenta during the second stage of labor. Thus, in these cases early cord clamping deprives the newborn of approximately 30 ml of fetal blood, whereas delayed cord clamping favors placental transfusion of fetal blood that was previously deposited in the placenta in addition to placental blood. [10]

Some reports comparing delayed and early cord clamping concluded that early clamping is associated with increased neonatal morbidity such as respiratory distress syndrome, anemia, and hypovolemia. Other studies have reported hemodynamic and respiratory changes with delayed cord clamping, but these are not typically associated with increased neonatal morbidity, since the increase in blood volume is compensated for and tolerated by the newborn. [4]

Deficiency of red cells and hypovolemia at birth are associated with severe respiratory distress syndrome, thus it

has been suggested that a delay in cord clamping protects against this disease. Lainez and Kimmond reported a similar incidence of respiratory distress syndrome in late and early cord clamping; however, there were differences between the groups in the severity of the disease. Fewer patients in the delayed cord clamping group required high concentrations of inspired oxygen, their median supplemental oxygen dependence time was shorter, their first day arterial-alveolar oxygen ratios were more favorable, and they required a lower rescue dose of surfactant. [4,5,7]

Delayed cord clamping has been used to correct hypovolemia and anemia. [8] The increase in blood volume, red cells, and hemoglobin leads to increased iron deposits in the newborn, reducing the likelihood of iron deficiency anemia in the first year of life [4] and diminishing the need for blood transfusion, especially in preterm newborns. [7,8] Kinmond et al found that patients with early cord clamping require more blood transfusions than those with delayed cord clamping. [5] In addition, it has been suggested that delayed cord clamping allows the increased blood volume to perfuse not only the lungs of the preterm infant, but also the bowel, kidneys, and skin, replacing the respiratory, nutrition, and thermal regulation functions that had previously been provided by the placenta. [7,8]

Despite these reports, the umbilical cord is generally clamped immediately after birth, especially in preterm deliveries, to avoid delays in resuscitation or the onset of hypothermia. [7]

There are also concerns that an excessive volume of placental transfusion might cause polycythemia, hypervolemia, or hyperbilirrubinemia, although many randomized studies of preterm deliveries at less than 33 weeks have reported that delayed cord clamping is a safe procedure. [7] Furthermore, cord blood between 25 and 31 weeks of gestation is rich in hemopoietic stem cells, therefore placental transfusion might be important in determining the constitution of the bone marrow of preterm infants and may provide protection against infection. [5,6]

Data on preterm babies show greater stability in physiological variables when cord clamping is delayed. The arterial pressure in the initial hours is higher and more stable, and there is a lower incidence of hypoglycemia and complications such as vomiting, necrotizing enterocolitis, retinopathy of prematurity, late onset sepsis, and intracranial hemorrhage. [5-8] Additional benefits of delaying cord clamping in patients with low weight include reduced hypotension, higher hematocrit levels, better oxygen transport, fewer days under mechanical ventilation, reduced oxygen dependency, fewer transfusions, and a lower rate of intraventricular hemorrhage. These authors also reported reduced incidence of sepsis during the stay in the neonatal intensive care unit in patients in the delayed cord clamping group. [6]

The time of delayed cord clamping is a matter of controversy: Yao et al. showed that the first, and most significant, placental transfusion occurs 10 to 15 seconds after delivery (Figure 1), followed by a period of insignificant gain of blood at 30 and 45 seconds. Of the total placental volume, 23 to 30% transfuses in the first 10 to 15 seconds, and the remainder at the first and third minutes. [1,3]

This timing can readily be explained because contractions of the uterus to express the placenta immediately after birth create a pressure gradient between the placenta and the baby and favor the first placental transfusion in the 10 to 15 seconds after birth. [1]

A study by Wallgren, analyzed by Yao et al., demonstrated that in the first 10 seconds after birth, the pressure in the umbilical vein increased from 15 to 50 mmHg, creating a pressure gradient favoring transfer to the inferior vena cava of the newborn, since this has a lower pressure. Although the umbilical arteries have a greater pressure, return of blood to the placenta is less likely since the uterus is contracted. Subsequent relaxation of the uterus reduces the gradient of pressure between the umbilical vein and the inferior vena cava, and the flow of blood from the placenta to the baby is balanced by the blood leaving the baby towards the placenta through the umbilical arteries, explaining why placental transfusion was not observed in babies whose cord was clamped 30 to 45 seconds after birth. [1]

Similarly, Aladangady et al. reported increased newborn blood volume when cord clamping was delayed up to 40 seconds, but found that a delay in cord clamping of 60 seconds produced minimum changes in newborn blood volume (Figure 2). [7]

HYPOTHESIS

A delay in cord clamping of 10 seconds allows the circulating blood volume of the newborn to increase by 5%, allowing good expansion of pulmonary capillaries and favoring a decrease in pulmonary resistances and pulmonary fluid absorption without adverse effects in the newborn.

MATERIAL AND METHODS

This study involved 200 term infants born at the Hospital Angeles del Pedregal over a period of two months.

The patients were divided into two groups, each with 100 patients: Group A, in which the umbilical cord was clamped immediately after birth, and Group B, in which the umbilical cord was clamped 10 seconds after birth.

Exclusion criteria were: perinatal problems, congenital malformations, preterm delivery, Apgar score < 7 at one minute, advanced neonatal resuscitation.

Weight, Apgar score, and hematocrit at 48 hours of life were registered.

The following variables were also registered, each of which was considered a morbidity event:

- Time in incubator during transition period > 3 hours
- Need for supplemental oxygen
- Tachypnea (respiratory rate > 60 breaths per minute)
- Cyanosis
- Trouble with temperature regulation

RESULTS

The gestational age range was 37 to 42 weeks. The

mean weight in group A was 2,909 g (range 2,060 to 3,700 g), and the mean weight in group B was 3,138 g (range 2,300 to 3,360 g).

The mean hematocrit at 48 hours was very similar in both groups: 46.4% in group A (range 37 to 61%) and 48.3% in group B (range 42 to 65%). The mean Apgar score at one minute was also similar in the two groups: 8.4 for group A (range 7 to 9) and 8.6 for group B (range 7 to 9).

None of the patients had symptoms of polycythemia.

In group A, 35 patients (35%) presented at least one morbidity event and there were 87 events in total, a mean of 2.4 events per patient.

In group B, 8 patients (8%) presented at least one morbidity event, and there were 13 events in total, a mean of 1.6 events per patient.

Figure 3

Table 1 – Patient characteristics

Variable	Group A	Group B
Mean weight	2,909 g	3,138 g
Mean hematocrit at 48 hrs	46.4%	48.3%
Symptoms of polycythemia	0	0
Mean Apgar at 1 minute	8.4	8.6
Morbidity*	35 patients	8 patients
Total number of morbidity events	87	13
Events/patient	2.4	1.6

Number of patients who had at least one event of morbidity

DISCUSSION

There was no significant difference between the groups in weight or Apgar score.

There were no patients with symptomatic polycythemia and the average hematocrit was similar in both groups. These findings are consistent with those of Aladangady et al., who did not observe polycythemia or hypervolemia in babies in which cord clamping was delayed and support the report by Lainez et al. showing that hemodynamic changes produced by a delay in cord clamping do not increase neonatal morbidity.

The incidence of morbidity was higher in the group with immediate cord clamping than in the group with delayed cord clamping (35% vs. 8%; 2.4 vs. 1.6 events per patient) .

In this study, we decided to delay cord clamping by 10 seconds since Yao et al showed that 5% of the circulating volume transfuses at 10 seconds, whereas a delay of 45 seconds is associated with a further increase of only 5%.

Moreover, with a delay of 10 seconds there is no risk of hypothermia, hypervolemia, delayed resuscitation, or interference with obtaining the blood cord sample for stem cells.

CONCLUSIONS

Our results show that a 10 second delay in clamping the umbilical cord decreases neonatal morbidity in term newborns.

Delayed cord clamping is a safe and inexpensive procedure

with beneficial effects for the term newborn.

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Author Information

Alberto Orozco Gutierrez
Neonatology Department, Hospital Angeles del Pedregal

Rosa María Estrada Velasquez
Neonatology Department, Hospital Angeles del Pedregal

Monica Tinajero Iriarte
Neonatology Department, Hospital Angeles del Pedregal