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Delayed Umbilical Cord Clamping at <32 Weeks' Gestation: Implementation and Outcomes

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Abstract

Objectives—This study aims to evaluate the implementation of a delayed umbilical cord clamping (DCC) protocol for neonates <32 weeks. Secondly, to evaluate the impact of DCC on maternal outcomes and on the ability to obtain umbilical cord blood gases.

Study Design—Retrospective cohort study from November 2014 to March 2016 of patients delivered by 31^{6/7} weeks. In 2014, an institutional protocol for DCC at <32 weeks was implemented. We assessed adherence to the protocol and compared adverse maternal outcomes (utilizing a hemorrhage composite). We evaluated the impact of DCC on the ability to obtain adequate umbilical cord blood gas specimens.

Results—Of the 185 patients included in the study, 90 underwent DCC, and 72% of potentially eligible patients appropriately received DCC. There was no significant difference in the maternal hemorrhage composite outcome between DCC and immediate cord clamping (23.3 vs. 36.8%, adjusted odds ratio = 0.64, 95% confidence interval = 0.33, 1.26). There was also no significant difference in the ability to obtain a single or paired umbilical cord blood gas result.

Conclusion—Implementation of a DCC protocol for preterm neonates is feasible and was successful. We did not find an increase in maternal risk or a decrease in the ability to obtain umbilical cord blood gases following DCC.

Keywords

delayed cord clamping; delayed umbilical cord clamping; timing of cord clamping; umbilical cord blood gas; umbilical cord clamping

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Note

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Conflict of Interest

None.

Introduction

Delayed umbilical cord clamping (DCC) allows for placental transfusion at birth. This is of particular importance in preterm neonates in whom up to two-thirds of the total fetoplacental blood volume can be in the placenta at the time of delivery.¹ Several randomized controlled trials have been performed in early preterm or very low-birth-weight neonates who are at the highest risk of adverse outcomes related to prematurity and who have the greatest potential for benefit from DCC. These studies have consistently demonstrated that DCC in preterm neonates results in less need for blood transfusions, less intraventricular hemorrhage of all grades, and lower risk of necrotizing enterocolitis.²⁻⁵ In response to these data, the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics issued a joint statement in 2012 supporting a 30 to 60-second delay in cord clamping of preterm neonates.⁶

While there are robust data on the benefits of DCC for preterm neonates, little attention has been paid to the implementation of DCC in clinical practice. Few studies have addressed potential adverse maternal effects as a result of DCC or the impact of DCC on other usual clinical practices such as collection of umbilical cord blood gases at the time of delivery.

The primary objective of this study was to evaluate the success of the implementation of a DCC protocol for preterm neonates <32 weeks' gestation by assessing compliance with the protocol in eligible patients. Our secondary objectives were to evaluate the impact of DCC on adverse maternal outcomes and on the ability to obtain umbilical cord blood gas specimens.

Materials and Methods

This was a retrospective cohort study from November 2014 to March 2016 of patients delivered at a single academic tertiary care hospital. Patients were included in this study if they delivered between 23^{0/7} weeks and 31^{6/7} weeks gestation based on best obstetrical dating. Exclusion criteria from the study were fetal demise, multiple gestations, and major fetal anomalies that required neonatal intensive care unit admission. This study was approved by the Washington University Human Research Protection Office.

In 2014, an institutional protocol was implemented for routine DCC for all deliveries between 23^{0/7} weeks and 31^{6/7} weeks gestation unless contraindicated. The protocol was developed and agreed upon in a multidisciplinary meeting with maternal-fetal medicine and neonatology. Subsequently, educational sessions were held with all of the pediatric and obstetric providers, including house staff, as well as the nursing staff on labor and delivery. Signage with the DCC protocol algorithm was displayed on the labor and delivery floor.

The specified contraindications in the protocol were intrauterine growth restriction with absent or reversed end-diastolic flow on umbilical artery Doppler studies, multiple gestations, maternal hemoglobin <7 g/dL, placental abnormalities (suspected placental abruption, placenta previa, placenta accreta, or vasa previa), and a neonatal heart rate <60 beats per minute. The protocol also explicitly stated that the following scenarios are not contraindications to DCC: meconium-stained fluid, intra-amniotic infection, fetal anomaly,

maternal infectious disease (including human immunodeficiency virus, hepatitis B and C), and mode of delivery.

The use of DCC at delivery required agreement about the eligibility of the neonate between the obstetric and pediatric teams before delivery. The pediatric team started a timer at delivery and verbally reported the time at each 15-second interval. The obstetric team held the neonate below the level of the placenta or between the maternal legs in a cesarean delivery with the head higher than the body. No milking or stripping of the cord was performed. The obstetric team palpated the neonate's pulse in the umbilical cord throughout the delay and dried and stimulated the infant. The cord was clamped at 30 to 45 seconds, and the infant was handed to the pediatric team for routine resuscitation. The protocol specified exit criteria for which DCC should be abandoned, including neonatal heart rate below 60 beats per minute or at the discretion of the pediatrician or obstetrician. A segment of the umbilical cord was doubly clamped and used for collection of arterial and venous umbilical cord blood gas specimens as per our institutional policy for universal umbilical cord blood gas collection. Immediately after cord clamping, routine postpartum oxytocin was administered, and the placenta was delivered with uterine massage. The duration of delay in cord clamping was recorded in the medical record.

Details regarding maternal demographics, antepartum and intrapartum history, delivery outcomes, and umbilical cord blood gas results were abstracted from the electronic medical record system by trained research nurses. If two umbilical cord blood gas results were identified, the samples were validated to be arterial and venous by ensuring that the pH was at least 0.02 lower in the artery than the vein.⁷

Our initial analyses evaluated the success of implementation of the DCC protocol. We compared maternal demographic and intrapartum characteristics between patients who received DCC and those who had immediate cord clamping (ICC). To evaluate the success of protocol implementation, we calculated the rate of DCC overall and in those patients who were potentially eligible. We also assessed adherence to the protocol by reviewing the documented contraindications to DCC in the ICC group. In addition, we assessed compliance with the recommended duration of delay and the indications for early cessation of DCC.

We secondarily evaluated the difference in maternal outcomes between patients who had DCC and those who had ICC. We compared the rate of a prolonged third stage of labor greater than 30 minutes and the rate of a hemorrhage composite outcome. The hemorrhage composite consisted of postpartum hemorrhage (defined as estimated blood loss >500 mL in a vaginal delivery or >1,000 mL in a cesarean delivery), the use of additional uterotonics beyond routine postpartum oxytocin, or the need for a blood transfusion at any point in the delivery hospitalization.

Finally, we evaluated the impact of DCC on the ability to obtain sufficient paired arterial and venous umbilical cord blood gas specimens. Of the patients with validated paired cord blood gas results, we additionally explored the difference in abnormal cord blood gas outcomes of arterial pH <7.1, arterial base deficit ≥ 12 mmol/L, and arterial lactate >4 mmol/L.

Data analysis was performed using descriptive, univariable, and multivariable statistics. Normality of distribution of continuous variables was assessed using histograms and the Kolmogorov–Smirnov test. A Student's *t*-test or Wilcoxon rank sum test was then used as appropriate. The C^2 or Fisher's exact test was used as appropriate for categorical variables. A *p* value <0.05 was considered significant. Multivariable logistic regression models were developed to adjust for potential confounders. Covariates that were significant in univariate analysis were included in the initial model and were removed sequentially with the use of backward stepwise elimination. The final model adjusted for parity, mode of anesthesia, and mode of delivery. All eligible patients during the study period were included; no a priori sample size estimation was performed. Analyses were performed using Stata Special Edition 12.1 (StataCorp, College Station, TX).

Results

There were 232 deliveries between 23^{0/7} weeks and 31^{6/7} weeks in the study period. Of those, 185 met inclusion criteria for this study, and 90 (48.6%) patients underwent DCC (Fig. 1). Women who received DCC were more likely to be nulliparous, white, have neuraxial anesthesia, and achieve a vaginal delivery compared with those who underwent ICC (Table 1).

The documented contraindications for the 95 patients who had ICC at < 32 weeks are presented in Table 2. Of those patients, 35 were potentially eligible for DCC based on the protocol. Thus, 90 of 125 (72%) potentially eligible patients appropriately received DCC. Of the patients who received DCC, 75 (83.3%) received at least 30 seconds of delay as recommended in the protocol. The median duration of the delay was 40 seconds (interquartile range: 30–45 seconds). The most common indication for early cessation of DCC was a neonatal heart rate <60 beats per minute (66.7%). The reason was not documented in the remaining 33.3% of cases. Overall, we found no significant difference in the rate of adverse maternal outcomes between DCC and ICC after adjusting for relevant confounders (Table 3). These results were unchanged after a sensitivity analysis which limited the analysis to cesarean deliveries only (data not shown). The overall rate of obtainment of paired cord blood gases was low (58.9%). There was no significant difference in the ability to obtain a single umbilical cord blood gas or paired arterial and venous cord blood gases between those who underwent DCC and ICC (Table 4). Similarly, there was no difference in the mean arterial umbilical cord blood pH between patients with DCC and ICC (7.30 ± 0.08 vs. 7.26 ± 0.12 , respectively, *p* = 0.98). There was also no difference in the rate of abnormal arterial cord blood gas outcomes between the two groups.

Comment

Implementation of a DCC protocol for preterm neonates <32 weeks is feasible and was overall successful at our institution. We did not find an increase in maternal risk associated with DCC. Additionally, DCC had no impact on the ability to obtain umbilical cord blood gases following delivery.

Since several well-done randomized controlled trials have demonstrated a clear benefit of DCC for preterm neonates, our primary objective was not to reexamine neonatal outcomes but to evaluate the implementation of a protocol that aims to provide these benefits to the highest risk neonates. Our results are consistent with other studies that have assessed implementation of a DCC protocol and found a similar compliance rate of ~70% following initiation of their DCC protocols.^{8–10} Our results on adherence to the protocol suggest that there remains an opportunity for further provider education and quality improvement initiatives regarding compliance with the indications and contraindications to DCC as outlined in the protocol.

Few prior studies on DCC have included maternal outcomes. Despite limited data, no difference has been found in the rate of postpartum hemorrhage, estimated blood loss, or a prolonged third stage of labor with DCC as compared with ICC.^{10,11} Our data on potential adverse maternal outcomes also did not demonstrate a signal for harm with DCC. As DCC becomes a more widely utilized intervention, future studies should be powered to assess maternal outcomes adequately.

There are also limited data on the effect of DCC on the ability to obtain umbilical cord blood gases, and no studies have assessed this at preterm deliveries. While we did not find a difference in the ability to obtain umbilical cord blood gas specimens, we did find an overall low rate of paired cord blood gas results. Prior work at our institution, where there is a universal cord gas policy, identified an approximately 90% rate of paired cord blood gases at term.¹² The lack of significant differences with DCC versus ICC suggests that the preterm gestational age, rather than timing of cord clamping, may limit the technical ability to obtain adequate arterial and venous specimens.

Prior studies at term have reported mixed results regarding the effect of DCC on umbilical cord blood gas results. Some reported no difference, and some reported worse umbilical cord blood gas outcomes with DCC.^{13–16} We found no difference in mean umbilical cord arterial pH or in rates of abnormal arterial cord gases between DCC and ICC in our preterm cohort. Future efforts should continue to be directed at determining the impact of DCC on umbilical cord blood gas outcomes at preterm and term gestational ages.

Our study illustrates the successful implementation of an institutional DCC protocol for neonates <32 weeks gestation and presents outcomes following “real world” initiation of DCC in this population. We further evaluated the impact of DCC on umbilical cord blood gases at preterm gestational ages. Our results also add to the limited available data on maternal outcomes. However, there are limitations to be considered. Based on the contraindications to DCC in our protocol, the DCC, and ICC groups are inherent of different risk for adverse maternal and umbilical cord blood gas outcomes. While we adjusted for significant confounders, there is the potential for residual confounding by unmeasured factors. In addition, our relatively small sample size and the rarity of these adverse outcomes may have limited our ability to demonstrate significant differences in some of our outcomes. Finally, our results may not be generalizable to all patient populations or gestational ages.

In January 2017, the American College of Obstetricians and Gynecologists revised their previous statement and now recommends DCC in vigorous term and preterm infants for at least 30 to 60 seconds after birth.¹⁷ This significant clinical practice change merits further research on maternal outcomes associated with DCC and the impact of DCC on umbilical cord blood gas results at term gestational ages.

In conclusion, we found that a DCC protocol for neonates <32 weeks gestation was implemented successfully at our institution. We did not find an increase in maternal risk associated with DCC or a decrease in the ability to obtain umbilical cord blood gases following DCC. These findings are important considerations for institutions initiating a routine DCC protocol and for further research as DCC becomes a more widespread obstetric practice.

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Fig. 1.
Flowchart of study cohort.

Table 1

Demographic and intrapartum characteristics of patients <32 weeks

Characteristics	Delayed cord clamping (<i>n</i> = 90)	Immediate cord clamping (<i>n</i> = 95)	<i>p</i> Value
Mean age, y (±SD)	27.2 (±5.6)	28.7 (±6.1)	0.05
Median gestational age, weeks (IQR)	28 (26, 30)	28 (26, 30)	0.73
Nulliparous	38 (42.2)	26 (27.4)	0.03
Race			0.02
Black	42 (46.7)	50 (52.6)	
White	45 (50.0)	40 (42.1)	
Other	3 (3.3)	5 (5.3)	
Obese ^a	41 (46.1)	55 (57.9)	0.11
Mode of delivery			<0.01
Vaginal	37 (41.1)	17 (17.9)	
Cesarean	53 (58.9)	78 (82.1)	
Operative vaginal	0	0	
Perineal laceration	6 (6.7)	5 (5.3)	0.69
Abnormal placentation	0	5 (5.3)	0.06
Type of anesthesia			0.03
Neuraxial	69 (76.7)	56 (59.0)	
General	8 (8.9)	35 (36.8)	
None	13 (14.4)	4 (4.2)	
Mean birth weight, g (±SD)	1,100 (±427)	1,159 (±488)	0.19

Abbreviations: SD, standard deviation.

Note: Data presented as *n* (%), except where specified median (interquartile range) or mean (±SD).^aBody mass index ≥ 30 kg/m².

Table 2

Documented contraindications to delayed cord clamping in patients <32 weeks

Contraindication	<i>n</i> (%)
Specified per protocol	
Placental abnormalities ^a	36 (37.9)
Neonatal heart rate <60 bpm	16 (16.8)
IUGR with AEDF or worse	7 (7.4)
Maternal anemia (hemoglobin <7 g/dL)	1 (1.1)
Not specified in protocol	
Maternal general anesthesia	12 (12.6)
Poor neonatal respiratory effort	12 (12.6)
None documented	11 (11.6)

Abbreviations: AEDF, absent end-diastolic flow; bpm, beats per minute; IUGR, intrauterine growth restriction.

^aPlacental abnormalities included placental abruption, placenta previa, placenta accreta, vasa previa.

Table 3

Maternal outcomes for patients <32 weeks

	Delayed cord clamping (<i>n</i> = 90)	Immediate cord Clamping (<i>n</i> = 95)	uOR (95% CI)	aOR ^a (95% CI)
Prolonged third stage of labor >30 min	1 (1.1)	0	N/A	N/A
Hemorrhage composite ^b	21 (23.3)	35 (36.8)	0.52 (0.26, 1.04)	0.64 (0.33, 1.26)
Postpartum hemorrhage ^c	14 (15.6)	30 (31.6)	0.40 (0.18, 0.86)	0.51 (0.24, 1.09)
Use of uterotonic therapy	4 (4.4)	4 (4.2)	1.06 (0.19, 5.87)	N/A
Need for blood transfusion	7 (7.8)	9 (9.5)	0.81 (0.24, 2.56)	N/A

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; N/A, not applicable; uOR, unadjusted odds ratio.

Note: Data presented as *n* (%).^a Adjusted for parity, mode of anesthesia, and mode of delivery.^b Composite of postpartum hemorrhage, use of uterotonic therapy, and the need for blood transfusion.^c Postpartum hemorrhage defined as estimated blood loss >500 mL for vaginal delivery or >1,000 mL for cesarean delivery.

Table 4

Umbilical cord blood gas outcomes for patients <32 weeks

	Delayed cord clamping (<i>n</i> = 90)	Immediate cord clamping (<i>n</i> = 95)	uOR (95% CI)	aOR ^a (95% CI)
Single cord blood gas resulted	83 (92.2)	82 (86.3)	1.88 (0.66, 5.84)	1.46 (0.51, 4.22)
Validated paired cord blood gases resulted	53 (58.9)	56 (58.9)	1.00 (0.53, 1.87)	0.86 (0.46, 1.62)
Arterial cord blood pH <7.1	3 (5.7)	1 (1.8)	3.30 (0.25, 176.3)	N/A
Arterial cord blood base deficit ≥ 12 mmol/L	3 (5.7)	1 (1.9)	3.18 (0.24, 170.0)	N/A
Arterial cord blood lactate >4 mmol/L	18 (34.0)	20 (35.7)	0.93 (0.39, 2.19)	0.97 (0.48, 1.97)

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; N/A, not applicable; uOR, unadjusted odds ratio.

Note: Data presented as *n* (%).^a Adjusted for parity, mode of delivery, and mode of anesthesia.