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ORIGINAL ARTICLE

Variations in umbilical cord clamping practices in the United States: a national survey of neonatologists

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ABSTRACT

Objective: Since the first publication of the American College of Obstetricians and Gynecologists committee opinion in 2012, and following the update in 2017, multiple institutions in the United States (US) adopted the practice of delayed cord clamping (DCC) and/or umbilical cord milking (UCM) in preterm and term infants. However, there have been variations reported in practices with regard to method of placental transfusion, timing of cord clamping and gestational age thresholds. Furthermore, the optimal cord clamping practice in situations of depressed infants needing resuscitation or in higher-risk delivery situations, such as placental abruption, intrauterine growth restriction, multiple gestation, chorioamnionitis, maternal human immunodeficiency virus syndrome/hepatitis or maternal general anesthesia is often debated. An evaluation of these variations and exploration of associated factors was needed to optimally target opportunities for improvement and streamline research activities. The objective of this survey, specifically aimed at neonatologists working in the US was to identify and describe current cord clamping practices and evaluate factors associated with variations.

Study design: The survey was distributed electronically to the US neonatologists in August 2019 with a reminder email sent in October 2019. Clinicians were primarily identified from Perinatal Section of AAP, with reminders also sent through various organizations including California Association of Neonatologists, Pediatrix and Envision national groups. Descriptive variables of interest included years of experience practicing neonatology, affiliation with a teaching institution, level of the neonatal intensive care unit (NICU) and practicing region of the US. Questions on variations in cord management practices included information about center specific guideline/protocol, cord clamping practices, gestational age threshold of placental transfusion, performance of UCM and practice in higher-risk delivery situations.

Results: The response rate was 14.8%. Among 517 neonatologists whom responded, majority (85.5%) of the practices had a guideline and performed (81.7%) DCC in all gestational ages. The cord clamping practice was predominantly DCC and it was categorized as reporting clamping times <60 s in 46.6% and ≥ 60 s in 48.7% of responses. A significant association was detected between time of delay in cord clamping and region of practice. The Northeast region was more likely to clamp the cord in <60 s than other regions in the US. More than half of the providers responded not performing any UCM (57.3%) in their practice. Significant associations were detected between performance of UCM and all queried demographic variables independently. Clinicians with >20 years of experience were more likely from institutions performing UCM compared to the providers with fewer years of experience. However, teaching hospitals were less likely to perform UCM compared to non-teaching hospitals. Similarly, practices with level IV NICUs were less likely to perform UCM compared to practices with level III units. Hospitals in the Midwest region of US were less likely to perform UCM compared to hospitals in the Western region. Significant variations were also noticed for not providing placental transfusion in higher-risk deliveries. Demographic and professional factors were noted to be associated with these differences.

Conclusion: Although the majority of practices have a guideline/protocol and are performing DCC in all gestational ages, there are variations noted with regard to timing, method, and performance in higher-risk deliveries. Demographic and professional factors play an important role in these variations. Future research needs to focus on the modifiable factors to optimize the procedure and impact of DCC.

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Introduction

Evidence exists that delayed cord clamping (DCC) may reduce mortality and adverse neonatal outcomes in preterm infants [1,2]. In term infants DCC may improve iron stores in the first several months of life leading to a favorable effect on neurodevelopmental outcomes [3,4]. DCC is currently endorsed by various scientific societies, including the World Health Organization (WHO), American College of Obstetrics and Gynecologists (ACOG), American Academy of Pediatrics (AAP) and Neonatal Resuscitation Program (NRP) [5–7]. Since the first publication of ACOG committee opinion in 2012, and following the update in 2017, multiple institutions in the United States (US) adopted the practice of DCC and/or umbilical cord milking (UCM) in preterm and term infants [8,9]. However, there have been variations reported in practices with regard to method of placental transfusion, timing of cord clamping and gestational age thresholds [10,11]. Furthermore, the optimal cord clamping practice in situations of depressed infants needing resuscitation or in higher-risk delivery situations, such as placental abruption, intrauterine growth restriction (IUGR), multiple gestation, chorioamnionitis, maternal human immunodeficiency virus (HIV) syndrome/hepatitis or maternal general anesthesia is often debated [12,13]. An evaluation of these variations and exploration of associated factors was needed to optimally target opportunities for improvement and streamline research activities.

Previous published surveys on placental transfusion practices were performed before or soon after the publication of updated 2017 ACOG committee opinion. Majority of these were addressed to the obstetric providers [10,14–17]. Neonatologists work with obstetricians and provide guidance on performance of DCC in complex delivery situations. Moreover, newborn providers play a major role in preparation of institutional placental transfusion guidelines, caring for infants and reporting outcomes. The objective of this survey, specifically aimed at neonatologists working in the US was to identify and describe current cord clamping practices. We hypothesized that variations in practice exist and there may be certain demographic and professional factors associated with these differences.

Methods

Survey questionnaire

A cross-sectional survey consisting of nine multiple-choice questions was administered using an online survey tool. Descriptive variables of interest included years of experience practicing neonatology, affiliation with a teaching institution, level of the neonatal intensive care unit (NICU) and practicing region of the US. Questions on variations in cord management practices included information about center specific guideline/protocol, cord clamping practices, gestational age threshold of placental transfusion, performance of UCM and practice in higher-risk delivery situations.

The survey was distributed electronically to the US neonatologists in August 2019 with a reminder email sent in October 2019. Clinicians were primarily identified from Perinatal Section of AAP, with reminders also sent through various organizations including California Association of Neonatologists, Pediatrix and Envision national groups. The respondents' identity was anonymous. Participation was voluntary and no incentive was provided. The study was approved by Baylor Scott & White Health Institutional Review Board.

Statistical analysis

Descriptive analyses including frequencies and percentages were used to describe the data. Unanswered questions were coded as missing and not included in the denominator while calculating the percentages. There was no pattern noticed in missing data. The responses for major practice variations such as delaying cord clamping <60 s versus ≥ 60 s; not performing versus performing UCM; not performing DCC/UCM in higher-risk delivery situations were analyzed in relation to neonatologist's years of experience, affiliation with a teaching institution, level of the NICU and region of the United States independently. A chi-square or Wilcoxon rank-sum test was performed to assess associations in bivariate comparisons. Data were analyzed using SAS 9.4 and the level of significance was set at $p < 0.05$.

Results

The survey was completed and submitted by 517 neonatal providers. With approximately 3500 members in Perinatal section of AAP, the response rate was 14.8%. About 85.5% (437/511) responded to having a guideline/protocol in place for cord management. The majority reported performing delaying cord clamping in all gestations [81.7% (419/513)]. The practice was predominantly DCC and it was categorized as reporting clamping times <60 s in 46.6% (241/517) and ≥ 60 s in 48.7% (252/517) of responses. A significant association was detected between time of delay in cord clamping and region of practice (Table 1). The Northeast region was more likely to clamp the cord in

Table 1. Distribution of neonatologists delaying cord clamping (DCC) <60 s versus ≥60 s.

Variable (*n*)	<60 s DCC *n* (%)	≥60 s DCC *n* (%)	*p*-Value
Years in practice (493)			0.42
0–5 years (118)	60 (50.8)	58 (49.2)	
6–10 years (70)	28 (40)	42 (60)	
11–20 years (109)	50 (45.9)	59 (54.1)	
>20 years (196)	103 (52.5)	93 (47.5)	
Teaching hospital (492)			0.32
Yes (320)	162 (50.6)	158 (49.4)	
No (172)	79 (45.9)	93 (54.1)	
NICU level (490)			0.54
Level I (5)	4 (80)	1 (20)	
Level II (32)	15 (46.9)	17 (53.1)	
Level III (311)	155 (49.8)	156 (50.2)	
Level IV (142)	67 (47.2)	75 (52.8)	
Region of practice (485)			0.01
Northeast (123)	75 (61)	48 (39)	
West (118)	49 (41.5)	69 (58.5)	
South (139)	62 (44.6)	77 (55.4)	
Midwest (105)	52 (49.5)	53 (50.5)	

Table 2. Distribution of neonatologists not performing versus performing umbilical cord milking (UCM).

Variable (*n*)	No UCM *n* (%)	Yes UCM *n* (%)	*p*-Value
Years in practice (515)			<0.01
0–5 years (123)	83 (67.5)	40 (32.5)	
6–10 years (73)	48 (65.7)	25 (34.3)	
11–20 years (112)	66 (58.9)	46 (41.1)	
>20 years (207)	98 (47.3)	109 (52.7)	
Teaching hospital (514)			<0.01
Yes (333)	209 (62.8)	124 (37.2)	
No (181)	85 (47)	96 (53)	
NICU level (512)			0.01
Level I (6)	3 (50)	3 (50)	
Level II (33)	17 (51.5)	16 (48.5)	
Level III (326)	175 (53.4)	151 (46.3)	
Level IV (147)	97 (66)	50 (34)	
Region of practice (507)			<0.01
Northeast (124)	81 (65.3)	43 (34.7)	
West (122)	53 (43.4)	69 (56.6)	
South (155)	83 (53.5)	72 (46.5)	
Midwest (106)	74 (69.8)	32 (30.2)	

<60 s than other regions in the US. More than half of the providers responded not performing any UCM [57.3% (295/515)] in their practice. Significant associations were detected between performance of UCM and all queried demographic variables (years of practice, teaching hospital affiliation, NICU level, and region of practice) independently (Table 2). Clinicians with >20 years of experience were more likely from institutions performing UCM compared to the providers with fewer years of experience. However, teaching hospitals were less likely to perform UCM compared to non-teaching hospitals. Similarly, practices with level IV NICUs were less likely to perform UCM compared to practices with level III units. Hospitals in the Midwest region of US were less likely to perform UCM compared to hospitals in the Western region.

Table 3 depicts the distribution of providers not performing DCC/UCM in higher-risk delivery situations. Clinicians with least experience (0–5 years) were more likely from practices not performing placental transfusion compared to >20 years of experience in higher-risk deliveries such as severe placental abruption, multiple gestation (dichorionic or monochorionic), maternal general anesthesia, or in case of depressed newborn. Teaching hospitals were more likely to not perform DCC/UCM compared to non-teaching hospitals in situations of severe placental abruption or IUGR. In contrary, non-teaching hospitals were less likely to perform placental transfusion compared to teaching hospitals in cases of chorioamnionitis or maternal HIV/hepatitis. Hospitals with level IV units were more likely to not perform DCC/UCM compared to level III units in severe placental abruption and monochorionic multiple gestation. The Northeast region was more likely to not perform placental transfusion in a depressed infant compared to the Western region.

Discussion

In a previous survey, performed prior to the publication of 2012 ACOG committee opinion, only a minority (3.5%) of the US obstetricians reported having an umbilical cord clamping policy at their hospital [14]. This number increased to 28.1% following a cross-sectional survey that was conducted few years later, but prior to the publication of 2017 ACOG committee update [10]. This study highlighted that the existence of an institutional policy for cord clamping was indicative of perceived importance of DCC and this belief was predictive of provider practicing it. In our current survey of the US neonatologists conducted few years after the publication of 2017 ACOG committee opinion, the majority (85.5%) responded that their practice has a protocol/guideline for cord clamping. This observation correlates with reported increase in the practice of DCC over the past few years and supports the finding that establishing policies on cord clamping within institutions and practices may help to increase the uptake of evidence-based practice [18]. Surveys from Europe found that interdisciplinary discussion in guidelines development, knowledge of related techniques and their benefits, good communication between obstetricians and neonatologists and engagement across disciplines within the delivery team were key determinants for the implementation of DCC [19–21].

Table 3. Distribution of neonatologists not performing DCC/UCM in higher-risk deliveries.

Variable (*n*)	No DCC/UCM *n* (%)	*p*-Value
Placental abruption (severe)		
Years in practice (503)		<0.01
0–5 years (121)	105 (86.8)	
6–10 years (73)	61 (83.6)	
11–20 years (110)	88 (80)	
>20 years (199)	149 (74.9)	
Teaching hospital (503)		<0.01
Yes (327)	274 (83.8)	
No (176)	129 (73.3)	
NICU level (502)		0.02
Level I (6)	6 (100)	
Level II (33)	28 (84.8)	
Level III (316)	237 (75)	
Level IV (147)	131 (89.1)	
Region of practice (497)		0.09
Northeast (122)	102 (83.6)	
West (117)	86 (73.5)	
South (153)	120 (78.4)	
Midwest (105)	90 (85.7)	
Intrauterine growth restriction		
Years in practice (517)		0.18
0–5 years (123)	20 (16.3)	
6–10 years (74)	12 (16.2)	
11–20 years (112)	13 (11.6)	
>20 years (208)	24 (11.5)	
Teaching hospital (503)		0.03
Yes (327)	53 (15.8)	
No (176)	16 (8.8)	
NICU level (502)		0.08
Level I (6)	1 (16.7)	
Level II (33)	3 (9.1)	
Level III (316)	39 (11.9)	
Level IV (147)	26 (17.6)	
Region of practice (497)		0.28
Northeast (122)	20 (15.9)	
West (117)	10 (8.2)	
South (153)	23 (14.8)	
Midwest (105)	14 (13.2)	
Multiple gestation (dichorionic)		
Years in practice (517)		<0.01
0–5 years (123)	35 (28.5)	
6–10 years (74)	17 (23)	
11–20 years (112)	15 (13.4)	
>20 years (208)	30 (14.4)	
Teaching hospital (516)		0.1
Yes (419)	70 (20.9)	
No (97)	27 (14.9)	
NICU level (514)		0.55
Level I (6)	1 (16.7)	
Level II (33)	8 (24.2)	
Level III (327)	56 (17.1)	
Level IV (148)	32 (21.6)	
Region of practice (509)		0.71
Northeast (126)	22 (17.5)	
West (122)	21 (17.2)	
South (155)	34 (21.9)	
Midwest (106)	19 (17.9)	
Multiple gestation (monochorionic)		
Years in practice (517)		<0.01
0–5 years (123)	69 (56.1)	
6–10 years (74)	41 (55.4)	
11–20 years (112)	45 (40.2)	
>20 years (208)	77 (37)	
Teaching hospital (516)		0.08
Yes (335)	160 (47.8)	
No (181)	72 (39.8)	
NICU level (514)		<0.01
Level I (6)	2 (33.3)	
Level II (33)	10 (30.3)	
Level III (327)	141 (43.1)	
Level IV (148)	79 (53.4)	
Region of practice (509)		0.39
Northeast (126)	65 (51.6)	
West (122)	51 (41.8)	
South (155)	69 (44.5)	
Midwest (106)	45 (42.4)	
Chorioamnionitis		
Years in practice (517)		0.75
0–5 years (123)	23 (18.7)	
6–10 years (74)	12 (16.2)	
11–20 years (112)	12 (10.7)	
>20 years (208)	35 (16.8)	
Teaching hospital (516)		0.04
Yes (335)	45 (13.4)	
No (181)	37 (20.4)	
NICU level (514)		0.05
Level I (6)	2 (33.3)	
Level II (33)	12 (36.4)	
Level III (327)	47 (14.4)	
Level IV (148)	21 (14.2)	
Region of practice (509)		0.16
Northeast (126)	21 (16.7)	
West (122)	13 (10.7)	
South (155)	31 (20)	
Midwest (106)	14 (13.2)	
Human immunodeficiency virus/hepatitis		
Years in practice (517)		0.46
0–5 years (123)	63 (51.2)	
6–10 years (74)	35 (47.3)	
11–20 years (112)	59 (52.7)	
>20 years (208)	97 (46.6)	
Teaching hospital (516)		0.04
Yes (335)	154 (46)	
No (181)	100 (55.2)	
NICU level (514)		0.33
Level I (6)	4 (66.7)	
Level II (33)	23 (69.7)	
Level III (327)	153 (46.8)	
Level IV (148)	73 (49.3)	
Region of practice (509)		0.67
Northeast (126)	58 (46)	
West (122)	57 (46.7)	
South (155)	79 (51)	
Midwest (106)	56 (52.8)	
General anesthesia		
Years in practice (517)	62 (50.4)	<0.01
0–5 years (123)	34 (45.9)	
6–10 years (74)	46 (41.1)	
11–20 years (112)	60 (28.8)	
>20 years (208)		
Teaching hospital (516)		0.69
Yes (335)	129 (38.5)	
No (181)	73 (40.3)	
NICU level (514)		0.75
Level I (6)	4 (66.7)	
Level II (33)	16 (48.5)	
Level III (327)	122 (37.3)	
Level IV (148)	60 (40.5)	
Region of practice (509)		0.36
Northeast (126)	57 (45.2)	
West (122)	42 (34.4)	
South (155)	60 (38.7)	
Midwest (106)	40 (37.7)	
Depressed newborn		
Years in practice (517)		<0.01
0–5 years (123)	106 (86.2)	
6–10 years (74)	55 (74.3)	
11–20 years (112)	74 (66.1)	
>20 years (208)	133 (63.9)	

(*continued*)

Table 3. Continued.

(*continued*)

Table 3. Continued.

Variable (*n*)	No DCC/UCM *n* (%)	*p*-Value
Teaching hospital (516)		0.1
Yes (335)	247 (73.7)	
No (181)	121 (66.9)	
NICU level (514)		0.26
Level I (6)	6 (100)	
Level II (33)	27 (81.8)	
Level III (327)	219 (67)	
Level IV (148)	116 (78.4)	
Region of practice (509)		<0.01
Northeast (126)	103 (81.7)	
West (122)	73 (59.8)	
South (155)	113 (72.9)	
Midwest (106)	77 (72.6)	

ACOG recommends a delay in cord clamping of at least 30–60 s whereas WHO defines DCC as at least 60 s [5,9]. A survey from Italy performed in 2016 reported that 15% of the centers performing DCC declared clamping the cord before 1 min in term infants and before 30 s in preterm infants [21]. In a report of data from 52 units in California, 21% of the infants receiving DCC had the delay for less than 30 s [11]. Variability in timing exists perhaps due to either lack of evidence-based knowledge or time pressure on obstetric providers to hand over the newborn to the neonatal team [17]. Clinical studies reported that DCC of less than 30 s is not optimal and in contrary delay of at least 60 s in preterm infants results in significant benefits [22–24]. It has been shown in a large randomized control trial that DCC for ≥60 s is feasible even in extremely preterm infants [25]. In the current survey 46.6% of neonatal providers practicing in the US reported clamping the cord in <60 s in their institution. The Northeast region was more likely to clamp the cord in <60 s than the other regions. To our knowledge, this regional difference was not measured or reported in previous US surveys. Type of clamping (early versus delayed) and its relationship with sociodemographic, professional and work environment characteristics was explored in a recent survey conducted in Spain [26].

A California report from 2016 concluded that preterm infants were two times more likely to receive DCC compared to term infants [11]. Similarly, a survey from year 2016 concluded that the US obstetricians were more likely to perform DCC in preterm infants compared to term infants [10]. This may be due to the 2012 ACOG committee opinion stressing that evidence existed to support DCC in preterm infants whereas evidence was insufficient to confirm the benefits in term infants [8]. Even though many other societies endorsed DCC for both preterm and term infants before 2017, the more widespread performance of DCC through all gestational ages may not have happened until after the publication of the updated 2017 ACOG committee opinion expanding recommendation to all infants [9]. In our survey the majority (81.7%) responded delaying cord clamping in all gestational ages reflecting the change after the update.

Currently ACOG, and other major societies neither support nor refute UCM due to insufficient evidence. There have been reports of UCM not providing the same physiological benefits of DCC in preterm subjects [27]. A recent randomized controlled study reported an increased incidence of severe intraventricular hemorrhage in extremely preterm infants receiving UCM compared with DCC [28]. These findings are of concern in preterm population making DCC the preferred method of cord management. The studies in term infants comparing UCM to immediate cord clamping conclude that UCM significantly improves blood pressure and hemoglobin levels within the first few days of life and iron stores up to 6 months of age [29]. UCM can be completed in <30 s and may be beneficial in situations where waiting longer for optimal DCC is not possible. In a published survey 37% of midwives reported performing UCM when resuscitation was needed [17]. Another survey reported 20% of obstetricians milking the cord when resuscitation was needed during vaginal birth [10]. In the current survey, the observation of clinicians with >20 years in practice more likely from institutions performing UCM compared to the providers with fewer years of experience supports the comments in a previous published survey that the providers with more clinical experience were more likely to adopt UCM into their practice [17]. Teaching hospitals were more likely to follow ACOG guidelines than non-teaching hospitals and hence may not have adopted UCM due to insufficient evidence [11]. Furthermore, level IV NICUs are usually synonymous with academic teaching hospitals, hence less likely the performance of UCM compared to the hospitals with level III units. The reasons for regional difference of UCM performance (the hospitals in the Midwest region of US less likely to perform UCM compared to the hospitals in the Western region) needs to be explored in future studies.

ACOG acknowledges that more evidence is needed for optimal cord clamping practice in situations of depressed infants needing resuscitation or deliveries with higher-risk, such as placental abruption, IUGR, multiple gestation, chorioamnionitis, maternal HIV syndrome/hepatitis or maternal general anesthesia. Other surveys also indicated provider uncertainty in

clinically challenging situations. This appeared to be affected by lack of clinical guidelines, insufficient research to guide the practice, or by culture of the practice setting [10,17]. In the current survey significant associations were detected between demographic and professional factors and performance of placental transfusion in various higher-risk delivery situations. These factors should be taken into consideration and evaluated in future DCC research.

This survey has several important limitations. The true response rate could not be computed. Even though the neonatologists were primarily recognized from Perinatal section of AAP, reminders were also sent through various organizations to optimize the number of responses and generalizability of the survey. There was a possibility of nonmembers of Perinatal section of AAP completing the survey. Moreover, we could not identify the number of neonatal providers who read the email, but did not complete the survey. However, obtaining more than 500 responses from neonatal providers was significant. As the response to the current survey was voluntary, there was potential for self-selection bias. It was possible that those neonatologists with a greater interest in the topic of DCC were more likely to respond. However, we observed equal representation from all the regions of the US. The survey responses could also be affected by recall bias. The answers may reflect personal opinions rather than true practice. Moreover, we did not address the attitudes and concerns of the providers as few of the other surveys did. We recognize that in majority of practices obstetric providers perform cord clamping and the responses of neonatal providers may not accurately reflect the practice especially during lower-risk delivery situations. Nevertheless, we feel this survey of neonatologists evaluating current variations in practice and associated factors will add valuable information to quality improvement activities and areas to focus for future DCC research.

In conclusion, although the majority of practices have a guideline/protocol and are performing DCC in all gestational ages, there are variations noted with regard to timing, method, and performance in higher-risk deliveries. Demographic and professional factors play an important role in these variations. Future research needs to focus on the modifiable factors to optimize the procedure and impact of DCC.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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