Umbilical cord clamping timing: Results of a quality improvement program

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ABSTRACT

Introduction. Most publications recommend clamping the umbilical cord (UCC) after the first minute after birth; more recently, others have proposed clamping after the third minute or delaying it until the umbilical cord pulses cease.

Objective. To evaluate the results of implementing a quality improvement program (QIP) focused on ensuring that UCC was performed on a deferred basis as much as possible.

Population and methods. A prospective, observational, analytical, quasi-experimental, before-and-after study conducted at a private institution in the Autonomous City of Buenos Aires. The study population included healthy, full-term newborns who did not require cardiopulmonary resuscitation. We compared umbilical cord clamping timing across both study periods (2010-2019) by mode of delivery, and we recorded other variables influencing this decision.

Results. The study enrolled 151 patients. The mean UCC duration was 81.4 ± 27.4 s, significantly higher than the 48 ± 19 s reported in the previous study (p <0.01). Early UCC decreased markedly to 16.6% (25/151), while delayed UCC increased to 83.4% (126/151). The significant difference in UCC times between vaginal and cesarean deliveries persisted in both study periods.

Conclusion. After implementing the QIP, UCC timing increased significantly. The strongest influences were joint decisions by healthcare professionals on UCC timing and the vaginal delivery.

Keywords: *newborn; umbilical cord clamping; quality of health care; quality improvement.*

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INTRODUCTION

Current evidence recommends delayed umbilical cord clamping (UCC) whenever possible. All recommendations suggest performing it after the first minute of life, and some recommend waiting until the third minute or until the umbilical cord pulses have ceased.[1,2] The reasons supported by the strongest evidence are improved adaptation of the newborn (NB) to extrauterine life and the prevention of iron-deficiency anemia in infancy due to increased iron stores resulting from the so-called placental transfusion that occurs before UCC.[3-6] In a study conducted at our center in 2010, which included 427 newborns, the average time to umbilical cord clamping was 48 ± 19.26 s;[7] it occurred significantly earlier in cesarean deliveries, when stem cell collection was performed, or when there was no prior agreement between obstetricians and neonatologists regarding the appropriate timing for umbilical cord clamping.[7] These concerning findings led to the implementation of a quality improvement program (QIP) in the newborn reception area to delay UCC collection in healthy NB beyond 60 seconds or for as long as possible.

This study aimed to evaluate changes in UCC timing between two periods (2010-2019) after implementing a QIP. The secondary objective was to identify perinatal variables that might influence UCC timing.

POPULATION AND METHODS

Design, setting and population

A prospective, observational, analytical, quasi-experimental, before-and-after study. It took place at a private clinic in the Autonomous City of Buenos Aires, where more than 4000 babies are born each year and where the institution's neonatologists care for all newborns.Healthy full-term newborns ($37^{0/7}$-$41^{6/7}$ weeks),[8] born between July 1, 2019, and March 30, 2020 were included.

Inclusion criteria were gestational age $37^{0/7}$-$41^{6/7}$ weeks in singleton pregnancies, with no need for resuscitation. One of the researchers must be present in the delivery area.

Exclusion criteria were newborns with major congenital malformations, newborns who received resuscitation and twin pregnancies.

Quality improvement program

The QIP's educational activities focused on promoting the benefits of delayed umbilical cord clamping (UCC), emphasizing its safety given evidence that it is not associated with increased maternal complications. These efforts targeted neonatologists, obstetricians, nurses, and circulating staff in the obstetric unit. The program promoted recording UCC time in the medical record for each birth, professional consensus on optimal UCC timing, and implementation of skin-to-skin contact (SSC) for both vaginal and cesarean deliveries. Staff postponed procedures such as newborn identification, recording birth weight, and the initial physical examination. Staff replaced analog wall clocks in the delivery room and operating rooms with digital clocks to make the time easier to read.

Other educational activities included perinatal seminars, clinical case discussions, and *ad hoc* educational materials distributed to all healthcare personnel. These materials emphasized the importance of agreement between the neonatologist and the obstetrician on the timing of UCC before each birth.

Procedure for recording the time of umbilical cord clamping

The timing of the UCC was recorded by one of the researchers (GP and JZB) Monday through Friday between 8:00 a.m. and 8:00 p.m.

The obstetricians and neonatologists involved in the deliveries were unaware that the study was being conducted, and the researchers' presence was justified by their role as supervisors of the obstetric center. Data collection began at birth—defined as the complete delivery of the newborn's shoulders and body—and continued until the UCC.[9] The methodology for recording the time to UCC was the same as that used by the same researchers in the previous 2010 study. In all cases, a cell phone stopwatch (App Store app: Best Stopwatch®) was used, with an accuracy of hundredths of a second.

Study variables

- Time of cord clamping: expressed in seconds.
- Gestational age (GA): expressed in weeks, based on a reliable last menstrual period (LMP) and/or early ultrasound.
- Birth weight (BW): expressed in grams.
- Mode of delivery: vaginal or cesarean section.
- Apgar score at 1 minute.
- Apgar score at 5 minutes.
- Blood collection for stem cells (SC): record of cases in which this was performed.
- Joint decision by healthcare professionals regarding the timing of UCC: recording of births in which there was a verbal agreement

among healthcare professionals to perform deferred UCC.
- Complications requiring immediate UCC: within 15 seconds.

Ethical considerations

The institution's Research Ethics Committee approved the study on July 5, 2019.

Upon admission to the institution, patients sign an informed consent form authorizing the anonymous and confidential use of data obtained from their medical records. Since this was not an interventional study, the Institutional Review Board determined that special informed consent was not required. Data confidentiality was ensured in compliance with Law 25326 on the Protection of Personal Data.

Statistical analysis

Based on our previous study,[7] a sample size of 150 newborns was calculated, with a two-tailed alpha value of 0.05 and 95% power.

We conducted a descriptive analysis of the study population characteristics. Categorical variables were summarized using absolute frequencies and percentages, while continuous variables were expressed as mean and standard deviation or median and interquartile range, depending on their distribution. To compare the results between the period before and after the intervention was implemented, comparison tests were used for categorical variables (chi-square or Fisher's exact test) and for continuous variables (using Student's t-test or the Wilcoxon [Mann-Whitney] rank-sum test, as appropriate). We considered p <0.05 statistically significant.

The primary variable of the study, time of cord clamping, was categorized according to the literature as immediate clamping (<15 seconds),[10] early clamping (<60 seconds), and delayed clamping (≥60 seconds).[11]

Depending on the distribution of continuous variables, we used parametric tests (t-test) or nonparametric tests (Mann-Whitney) for comparison. Categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate.

Statistical analysis was performed using the Stata 14® statistical software package.

RESULTS

Patients were enrolled between July 22, 2019, and March 25, 2020. A total of 4028 infants were born in that period, of whom 412 were preterm infants (gestational age <37 weeks) and 3616 were full-term infants. A total of 153 observations were made; 2 were excluded due to incomplete data (gestational age and birth weight, length of stay in the neonatal intensive care unit [NICU]); 151 newborns had complete records of their UCC timing and were included in the study (*Figure 1*).

Table 1 shows the population's baseline characteristics.

The mean gestational age was 38.4 weeks (± 1), and the mean birth weight was 3346 g (± 421); 23 (15.3%) were born by vaginal delivery and 128 (84.7%) by cesarean section. A joint decision among healthcare professionals to perform the UCC was documented in 146 (96.7%) of the records.

Only 3 patients (1.99%) were born with complications that led to immediate UCC. Of the 151 births evaluated, 29 (19.2%) had blood collected for SC. The mean UCC time was 81.4 ± 27.4 s, significantly higher than the 48 ± 19 s reported in the 2010 study (mean difference of 33.3 s; p < 0.01).

Compared with the 2010 study, we observed a 19.7% increase in deferred UCC, from 84/427 in 2010 to 83.4% (126/151) in 2020.

Comparing the mean durations of early and delayed UCC also showed a statistically significant increase from 2010 to 2020 (*Table 2*).

Among the perinatal variables of interest, time to UCC increased significantly by mode of delivery. Among those born vaginally, the time until UCC was longer (117.3 ± 39.1 s) than in those born by cesarean section (74.9 ± 18.5 s); the average difference was 42.3 s (p <0.01).

For cesarean deliveries, the time increased from 46.1 ± 16.2 s in 2010 to 74.9 ± 18.5 s in 2020 (mean difference of 28 s, p <0.01) and, for vaginal births, from 55.1 ± 26.1 s in 2010 to 117.2 ± 39.1 s in 2020 (mean difference of 62 s, p <0.01).

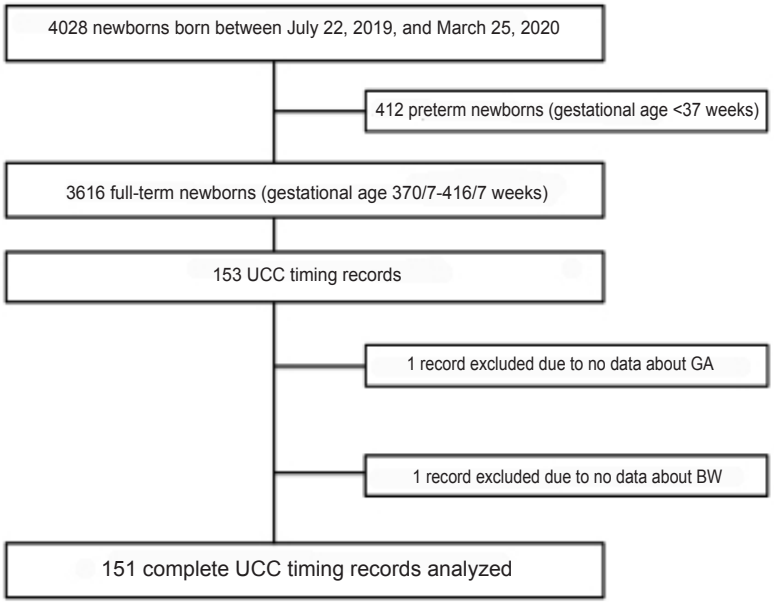
When healthcare professionals reached a joint decision before birth regarding the timing of UCC, the time increased from 50.6 ± 18.5 s in 2010 to 82.1 ± 25.3 s in 2020 (mean difference of 31.4 s, p <0.01) (*Table 3*).

The proportion of cases involving joint decisions by healthcare professionals increased significantly from 76.8% (328/427) in 2010 to 96.7% (146/151) in 2020 (p <0.01) (*Table 4*).

DISCUSSION

UCC times increased significantly from 48 ± 19 s in 2010 to 81.4 ± 27 s in 2020, an average difference of 33.3 s (p <0.01),

Figure 1. Newborns from the study period, according to gestational age and umbilical cord clamping record



NB: newborns; UCC: umbilical cord clamping; GA: gestational age; BW: birth weight.

Table 1. Demographic data

Variables	Results
Gestational age (weeks); mean (SD)	38.4 (1)
Birth weight (g); mean (SD)	3346 (421)
Cesarean delivery, n (%)	128 (84.7)
Complications at birth, n (%)	3 (1.9)
Stem cell collection, n (%)	29 (19.2)
Joint decision among healthcare professionals regarding the timing of UCC, n (%)	146 (96.7)

SD: standard deviation; UCC: umbilical cord clamping.

representing a 69.5% increase (greater than that reported in a previous study).[12]

A marked reduction in early UCC was observed, from 80.3% in 2010 to 16.6% in the current study, a figure lower than those reported in other publications, which cite 32.9%, 33%, 48.7%, and 56%.[13-16]

Deferred UCC increased from 19.7% in 2010 to 83.4% in 2020. These results suggest that improved adherence to current recommendations reflects increased awareness among healthcare providers of the benefits and safety of delayed UCC in full-term NB through our comprehensive QIP, with results comparable to other studies

Table 2. Early and delayed umbilical cord clamping 2010 vs. 2020 (N = 151)

UCC timing	2010	95% CI	2020	95% CI	Standard deviation	*p*-value
Early (<60 s)[1] (s); mean (SD)	41.2 (12)	40.1-42.7	49.2 (14)	43.4-53.8	7.7[¥]	<0.01*
Delayed (≥60 s)[1] (s); mean (SD)	75.2 (19)	71.2-79.3	87.7 (24)	83.1-42.9	12.5[¥]	<0.01*

UCC: umbilical cord clamping; SD: standard deviation.

[1] Definitions adopted from: McDonald SJ et al.[11]

[*] Significant difference: p <0.05.

[¥] Mann-Whitney U test.

with similar designs.[17] In 2021, Pauley[16] reported an increase in delayed UCC from 13% to 96%. Other authors show that combining educational interventions with guideline implementation effectively delays UCC.[13,14,18,19] It should also be noted that the timing of UCC increased significantly for both cesarean and vaginal deliveries, with compliance rates higher than those previously reported.[7]

As shown in the results, agreement between obstetricians and neonatologists reached 96% in the second study.

In vaginal deliveries, longer delayed UCC times may be related to the institutional practice of promoting immediate skin-to-skin contact by placing the newborn on the mother's abdomen or chest with the umbilical cord intact,[20] a practice that does not alter the volume of placental transfusion, as demonstrated in a previous study.[9] These findings are consistent with data from the literature showing greater adherence to delayed cord clamping in vaginal deliveries.[12,21] Umbilical cord clamping times in cesarean deliveries may be influenced by the difficulty in achieving immediate SSC with the umbilical cord intact. The study's strength lies in its prospective design and in the fact that neither the obstetricians nor the neonatologists involved in the deliveries were aware of the study's implementation. Furthermore, the researchers used the same methodology in both studies, both for recording the timing of UCC and for the analysis of the variables of interest.

One weakness is that it was conducted on weekdays during daytime hours, which may not represent the entire sample; however, in both the 2010 study and the current one, the methodology and data-collection days and times were similar. A future study will examine compliance with these practices on weekends and at night.

Given the long interval between our first and second studies, one might speculate that increased adherence to current recommendations

Table 3. Univariate analysis of the relationship between umbilical cord clamping time and variables of interest across studies from 2010 to 2020

Variable	2010		2020		Difference (s)	*p*- value
	Time (s); mean (SD)	95% CI	Time (s); mean (SD)	95% CI		
Type of delivery						
Cesarean	46.1 (16.2)	44.4-47.8	74.9 (18.5)	71.6-81.1	28	<0.01*§
Vaginal	55.1 (26.1)	49.6-60.4	117.2 (39.1)	100-134.2	62	<0.01*§
Stem cell collection						
Yes	41.4 (14.9)	37.4-45.3	76.5 (14.2)	71.1-81.9	35	<0.01*§
No	49.1 (19.6)	47.1-51.1	82.1 (29.5)	77.2-87.8	57	<0.01*§
Joint decision among healthcare professionals regarding the timing of UCC						
Yes	50.6 (18.5)	48.6-52.6	82.1 (25.3)	77.9-86.2	31.4	<0.01*¥
No	39.6 (19.1)	35.8-43.4	64.2 (59)	2.1-126.1	24	0.27
Complications at birth						
Yes	15.6 (13)	7.75-23.4	31 (35.4)	10-118	18.5	0.68
No	49.1 (18.5)	47.5-50.8	82.4 (26.3)	78.1-86.7	33.3	<0.01*¥

UCC: umbilical cord clamping; SD: standard deviation.
** Significant difference,* p *<0.05.*
¥ Mann-Whitney U test.
§ Two-sample t-test assuming equal variances.

Table 4. Comparison of the frequency of variables of interest between the 2010 and 2020 studies

Variables	2010 (n = 427) N (%)	2020 (n = 151) N (%)	*p*-value
Complications at birth	13 (3)	3 (1.9)	0.49
Stem cell collection	58 (13.6)	29 (19.2)	0.09
Joint decision among healthcare professionals regarding the timing of UCC	328 (76.8)	146 (96.7)	0.00*

¥ UCC: umbilical cord clamping.
** Significant difference,* p *<0.05.*
¥ Chi-square.

reflects greater awareness of the topic at scientific conferences, in specialized publications, and in the media. However, several studies indicate that implementing guidelines in isolation, without a tailored educational program, does not reliably translate into positive outcomes.[22]

Implementing programs that change deeply ingrained practices, such as UCC-based obstetric decision-making, requires commitment and leadership from everyone involved, since the primary goal is to drive cultural change that endures over time.

Training and commitment across all staff—particularly close collaboration between neonatologists and obstetricians, with prior agreement on the timing of clamping—may have been key factors in the program's success, a point we have not found referenced in the literature. We hypothesize that recording UCC timing could indicate perinatal care in delivery rooms, and we suggest recording it in medical records alongside the Apgar score and other variables, as in other countries, such as Uruguay, the closest example.[23]

This continuous monitoring provides up-to-date information and allows timely intervention when deviations from the proposed goals are observed.

CONCLUSION

After implementing the QIP, UCC times increased significantly. The perinatal factors that had the greatest influence were the prior agreement between obstetricians and neonatologists regarding the timing of UCC and vaginal deliveries. ■

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