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Original Article
Intrapartum care

Umbilical cord clamping and skin-to-skin contact in deliveries from women positive for SARS-CoV-2: a prospective observational study

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Objective To demonstrate that delayed cord clamping (DCC) is safe in mothers with confirmed SARS-CoV-2 infection.

Design, setting and participants Prospective observational study involving epidemiological information from 403 pregnant women with SARS-CoV-2 between 1 March and 31 May 2020. Data were collected from 70 centres that participate in the Spanish Registry of COVID-19.

Methods Patients' information was collected from their medical chart.

Main outcomes and measures The rate of perinatal transmission of SARS-CoV-2 and development of the infection in neonates within 14 days postpartum.

Results The early cord clamping (ECC) group consisted of 231 infants (57.3%) and the DCC group consisted of 172 infants (42.7%). Five positive newborns (1.7% of total tests performed) were identified with the nasopharyngeal PCR tests performed in the first 12 hours postpartum, two from the ECC group (1.7%) and three from the DCC group (3.6%). No significant differences between groups were found regarding neonatal tests for SARS-CoV-2. No confirmed cases of vertical transmission were detected. The percentage of mothers who made skin-to-skin contact within the first 24 hours after delivery was significantly higher in the DCC group (84.3% versus 45.9%). Breastfeeding in the immediate postpartum period was also significantly higher in the DCC group (77.3% versus 50.2%).

Conclusions The results of our study show no differences in perinatal outcomes when performing ECC or DCC, and skin-to-skin contact, or breastfeeding.

Keywords Breastfeeding, COVID-19, safety, SARS-CoV-2, skin-to-skin, umbilical cord clamping, vertical transmission.

Tweetable abstract This study demonstrates that delayed cord clamping is safe in mothers with confirmed SARS-CoV-2 infection.

Linked article This article is commented on by AC Katheria and J Koo, p. 916 in this issue. To view this mini commentary visit https://doi.org/10.1111/1471-0528.16607.

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Introduction

On 12 January 2020, Chinese authorities shared the genetic sequence of a novel type of virus belonging to the Coronaviridae family, given the name severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] By international consensus, its related disease has been called coronavirus disease 2019 (COVID-19). The World Health Organization (WHO) declared COVID-19 a pandemic on 11 March due to the prevalence, spread and severity of the disease.[2] To date, a higher predisposition to infection of

*A list of the Spanish Obstetric Emergency Group collaborators appears in the Acknowledgements section.

pregnant women compared with the general population has not been proven; however, evidence suggests they are more susceptible to pneumonia.[3,4] Moreover, the clinical course seems more severe among them. Higher rates of preterm births and caesarean deliveries have also been detected, the latter being associated with an elevated risk of clinical impairment.[5] Protocols for isolation and social distancing in pregnant women are the same as those for the general population.[6,7] There is no strong evidence supporting the existence of vertical transmission.[8–13] Some case reports suggest the possible transplacental transmission of SARS-CoV-2.[14] Nevertheless, although vertical transmission has been described, it is very uncommon. Certain practices during vaginal and caesarean deliveries have been modified during the pandemic. Some centres have suppressed or substantially minimised delayed cord clamping (DCC), mother/infant skin-to-skin contact and breastfeeding.[11,15] However, WHO[16] and diverse scientific societies (Centers for Disease Control and Prevention [CDC],[17] The American College of Obstetricians and Gynecologists, [ACOG],[18] National Institute for Health and Care Excellence [NICE],[19] Spanish Society of Obstetrics and Gynecology [SEGO],[6] The Spanish Neonatology Society [SENEO],[6] among others) recommend these practices in SARS-CoV-2-positive mothers because the benefits in the newborn and in the mother-child relationship outweigh the risks, and the likelihood of neonatal infection is actually very low. The objective of the present study was to demonstrate that DCC is safe in mothers with confirmed SARS-CoV-2 infection.

Methods

Study design and population

This prospective observational study involved epidemiological information from pregnant women with SARS-CoV-2 between 1 March and 31 May 2020. Pregnant women were considered to have SARS-CoV-2 infection if they tested positive using a nasopharyngeal PCR at the time of hospital admission, regardless of their symptoms. Data were collected from the Spanish Registry of COVID-19.[20] A total of 100 Spanish centres participate in the Registry, representing 49.95% (n = 172 000) of total deliveries (n = 359 770) carried out in 2019 in Spain.[21] Finally a total of 70 centres included SARS-CoV-2-infected mothers in the present study. The study was initially approved by the Puerta de Hierro University Hospital Ethics Committee and subsequently by the Ethics Committee of each participating hospital. Procedures were in concordance with the Declaration of Helsinki. Oral informed consent was obtained from each participant. The study was fully funded by public funds from the Institute of Health Carlos III and co-financed with FEDER funds. This research was carried out without the involvement of patients. The complete list of the study collaborators is shown in the Acknowledgements section.

Analysed variables

Women were differentiated according to the timing of cord clamping (early or delayed). Early cord clamping (ECC) and DCC were established when performed <30 or >30 seconds after the delivery, respectively. Primary variables included the rate of perinatal transmission of SARS-CoV-2 and development of the infection in neonates within 14 days postpartum. Perinatal transmission was defined by a positive PCR in a nasopharyngeal sample from the neonate. Given the lack of a uniform criterion for neonatal infection, the diagnosis was made by PCR from a nasopharyngeal sample, following specific considerations. If the PCR was positive within 12 hours after delivery (or when the first PCR test was performed, in some cases during the 12–48 hours postpartum) or the woman was showing symptoms of COVID-19, PCR was repeated. If this second PCR was negative, the first PCR was then considered contaminated or a false-positive; if positive, the infection was corroborated. Unless infants showed symptoms of COVID-19, they were not re-tested when negative within 12 hours of delivery (or when the first PCR test was performed). An infant was considered to have SARS-CoV-2 infection if they tested positive in both the first PCR test and the second one. All infants (regardless of PCR results or symptoms) were followed up 14 days after delivery, by phone. The state of health of each neonate was confirmed during the writing of this manuscript (June 2020). Secondary variables included: the need for neonatal resuscitation, admission to the intensive care unit (ICU), neonatal symptomatology suggestive of COVID-19, and rates of skin-to-skin contact and early breastfeeding. Neonatal symptoms were evaluated at day 14 after delivery, by completing a clinical questionnaire during a phone interview.

Statistical analysis

For the descriptive analysis, categorical variables were expressed as absolute and relative frequencies, and quantitative values as mean and range (minimum–maximum values). Comparisons between ECC and DCC groups were carried out with the Chi-square or Fisher Exact tests for categorical variables, and t test or Mann–Whitney U test for quantitative variables, when appropriate. Statistical significance was established as $P < 0.05$. All statistical analyses were performed with SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Data from 475 pregnant women with confirmed SARS-CoV-2 infection and their deliveries were initially included

in the study; however, 72 were discarded because of a lack of information about the timing of the cord clamping. Thus, 403 positive mothers were finally analysed. ECC was performed on 231 neonates (57.3%) and 172 (42.7%) received DCC. No significant differences were found between ECC and DCC groups in maternal age or time between the SARS-CoV-2 positive test (diagnosis) and delivery (Table 1). Regarding maternal symptomatology at the time of delivery, 82 (35.5%) and 149 (64.5%) women showed COVID-19 symptoms or were asymptomatic in the ECC group, respectively. In the case of DCC, 30 women (17.4%) showed symptoms and 142 (82.6%) were asymptomatic. The gestational age at delivery with ECC was significantly lower than DCC (37+9 versus 38 + 8 weeks, $P = 0.001$). The numbers of instrumental and caesarean deliveries were higher with ECC than with DCC (13.0% versus 8.1% for instrumental deliveries and 45.9% versus 17.4% for caesareans), whereas the number of normal labours was higher for DCC (74.4% versus 41.1%). The weight at birth was significantly higher with DCC than with ECC (3210.4 versus 3065.7 g, $P = 0.037$). Although statistically significant, this difference was not clinically relevant.

Five positive newborns (1.7% of total tests performed) were identified with the nasopharyngeal PCR tests performed within 12 hours after delivery, specifically two from the ECC (1.7%) and three from the DCC group (3.6%; Table 2). No significant differences between groups were found regarding neonatal tests for SARS-CoV-2 ($P = 0.390$). All positive newborns reported within 12 hours after delivery, tested negative in the confirmation test performed between 12 and 48 hours post-delivery. Therefore, no confirmed cases of vertical transmission were detected. A new positive infant was found in the DCC group within 12–48 hours of delivery, which was possibly related with horizontal transmission through contact with a relative without the use of protection measures (and unknown infection). This infant was re-tested between 12 and 48 hours of delivery because it was in direct contact with a positive relative (grandmother). None of the neonates experienced COVID-19 at day 14 after delivery.

The percentage of mothers who made skin-to-skin contact within the first 24 hours after delivery was significantly higher with DCC (84.3% versus 45.9%, $P = 0.001$). Breastfeeding in the immediate postpartum period was also significantly higher with DCC than ECC (77.3% versus 50.2%, $P = 0.001$).

No significant differences between groups were found regarding arterial pH and Apgar score at 5 minutes in

Table 1. Characteristics of mothers and deliveries

	Early cord clamping ($n = 231$)	Delayed cord clamping ($n = 172$)	*P*-value
Maternal characteristics			
Age, mean years (range)	33.2 (18.0–48.0)	32.1 (18.0–46.0)	0.076
Age groups, *n* (%)			
<20	6 (2.6)	7 (4.1)	
20–34	117 (50.9)	97 (57.1)	
≥35	107 (46.5)	66 (38.8)	
Time between COVID-19 diagnosis and delivery, mean days (range)	6.0 (0.0–61.8)	9.1 (0.0–78.8)	0.386
Symptomatology, *n* (%)			
Showing COVID-19 symptoms	82 (35.5)	30 (17.4)	0.001
Asymptomatic	149 (64.5)	142 (82.6)	
Delivery characteristics			
Gestational age, mean weeks (range)	37.9 (23.0–42.0)	38.8 (27.0–42.0)	0.001
Preterm deliveries (<37 weeks), *n* (%)	43 (18.6)	16 (9.3)	0.001
Start of delivery, *n* (%)			
Spontaneous	102 (44.2)	96 (55.8)	0.003
Induced	85 (36.8)	63 (36.6)	
Scheduled caesarean	44 (19.0)	13 (7.6)	
Type of delivery, *n* (%)			
Normal labour	95 (41.1)	128 (74.4)	0.001
Instrumental	30 (13.0)	14 (8.1)	
Caesarean	106 (45.9)	30 (17.4)	
Weight at birth, (g), mean (range)	3065.7 (680.0–5190.0)	3210.4 (940.0–4640.0)	0.037

Table 2. Outcomes in neonates born to mothers with COVID-19

	Early cord clamping (*n* = 231)	Delayed cord clamping (*n* = 172)	*P*-value
Neonatal tests for COVID-19, *n* (%)			
<12 hours from delivery	118 (51.1)	83 (48.3)	0.058
Positive ones	2 (1.7)	3 (3.6)	0.390
Type of delivery of positive ones			
Normal labour	–	2/3	
Instrumental	1/2	–	
Caesarean	1/2	1/3	
12–48 hours from delivery	100 (43.3)	54 (31.4)	0.015
Positive ones	0 (0.0)	1 (1.9)*	0.390
Skin-to-skin within first 24 hours, *n* (%)	106 (45.9)	145 (84.3)	0.001
Breastfeeding immediately postpartum, *n* (%)	116 (50.2)	133 (77.3)	0.001
Arterial pH, mean value (range)	7.27 (6.20–7.49)	7.26 (7.04–7.42)	0.183
Apgar score at 5 min, *n* (%)			
<5	5 (2.2)	1 (0.6)	0.193
≥5	225 (97.8)	171 (99.4)	
Admission to the ICU, *n* (%)	38 (16.5)	14 (8.1)	0.015
Evaluation day 14 after delivery			
n available	186	123	
Symptomatology, *n* (%)			
Showing COVID-19 symptoms	1 (0.5)	0 (0.0)	1.000
Asymptomatic	185 (99.5)	123 (100.0)	

ICU, intensive care unit.
*Positive case related to horizontal transmission by the contact with another positive person (grandmother), using no protection measures.

neonates. A higher percentage of admissions to the ICU were reported in ECC (16.5% versus 8.1%, $P = 0.015$).

Considering the temporal distribution, ECC was more prevalent than DCC during the first few days of the pandemic (5.2% versus 2.3% between 1 and 15 March, 25.5% versus 15.1% between 16 and 31 March, and 31.6% versus 20.9% between 1 and 15 April; the evolution over time is shown in Table 3). The main reason for ECC was due to maternal COVID-19 disease (37.2%).

Discussion

Main findings

Our study supports the recommendations from WHO,[16] CDC[17] and the Spanish Government[6] on the management of deliveries and neonate care during the COVID-19 pandemic in terms of cord clamping, skin-to-skin contact and breastfeeding.

Strengths and limitations

The main strength of the study is the number of registered SARS-CoV-2-infected mothers (403 deliveries from 70 centres across Spain), being one of the largest cohorts described. In addition, the topic of the study is novel because, to our knowledge, no studies have analysed perinatal outcomes in neonates born to SARS-CoV-2-infected mothers in terms of the timing of cord clamping, or have evaluated the safety of DCC, skin-to-skin contact and breastfeeding practices in these neonates.

On the other hand, our study has several limitations. It should be noted that false-negative results can occur with PCR tests, especially if these are performed shortly after SARS-CoV-2 exposure. Routine serology tests (to determine the immunological state after delivery) were not performed in neonates born to mothers with confirmed SARS-CoV-2 infection due to the lack of availability at the beginning of the pandemic in Spain, and later, once they were available, due to the diversity of tests and protocols in the distinct centres. In addition, to date, there are no studies showing that SARS-CoV-2 antibodies cross the placenta during pregnancy, and much remains to be studied about the immunity generated by the virus.

Phone follow up of neonates 14 days after delivery also had intrinsic limitations, such as parents being responsible for reporting the symptoms of the infants. Therefore, mild symptoms could have gone unnoticed. Nevertheless, the lack of tests at that time (primarily) and to avoid the neonates returning to hospital (secondarily) were the reasons for performing a phone follow up. Furthermore, the clinical questionnaire (for evaluating the neonatal symptoms)

Table 3. Temporal distribution and reasons for cord clamping timing

	Total (*n* = 403)	Early cord clamping (*n* = 231)	Delayed cord clamping (*n* = 172)	*P*-value
Per fortnight, *n* (%)				
1–15 March	16 (4.0)	12 (5.2)	4 (2.3)	0.001
16–31 March	85 (21.1)	59 (25.5)	26 (15.1)	
1–15 April	109 (27.1)	73 (31.6)	36 (20.9)	
16–30 April	92 (22.8)	52 (22.5)	40 (23.3)	
1–15 May	66 (16.4)	23 (10.0)	43 (25.0)	
16–31 May	35 (8.7)	12 (5.2)	23 (13.4)	
Reason for clamping choice, *n* (%)				
Standard Hospital protocol	179 (44.4)	42 (18.2)	137 (79.7)	
Maternal COVID-19 disease	86 (21.3)	86 (37.2)	0 (0.0)	
Neonatal resuscitation	47 (11.7)	47 (20.4)	0 (0.0)	
Cesarean delivery	29 (7.2)	29 (12.6)	0 (0.0)	
Preterm birth	13 (3.2)	1 (0.4)	12 (7.0)	
Unknown	33 (8.2)	14 (6.1)	19 (11.1)	
Others	16 (4.0)	12 (5.2)	4 (2.4)	
Instrumental	3 (0.7)	3 (1.3)	0 (0.0)	
Mother/Father choice	3 (0.7)	1 (0.4)	2 (1.2)	
Short umbilical cord	2 (0.5)	2 (0.9)	0 (0.0)	
General anaesthesia	2 (0.5)	2 (0.9)	0 (0.0)	
Shoulder dystocia	1 (0.3)	1 (0.4)	0 (0.0)	
Gastroschisis	1 (0.3)	1 (0.4)	0 (0.0)	
Antepartum fetal death	1 (0.3)	0 (0.0)	1 (0.6)	
Out-of-hospital delivery	1 (0.3)	0 (0.0)	1 (0.6)	
Immediate neonatal evaluation	1 (0.3)	1 (0.4)	0 (0.0)	
Velamentous insertion, umbilical cord rupture	1 (0.3)	1 (0.4)	0 (0.0)	

was not normalised or homogeneous in all the centres. The determination of parts of the virus in the neonate with ultrasensitive tests does not mean the existence of the complete virus with infective capacity. We did not know whether the healthcare professionals who assisted the deliveries or the relatives who visited the neonates were SARS-CoV-2-positive or not. We were able to trace this association in one of the positive PCR infants; nevertheless, in a pandemic such as this, we believe that the present results are unique and relevant because of the difficult circumstances in which they were obtained.

In addition, the studied outcome (positive neonates) had a low frequency (n = 5 at <12 hours from delivery), which could affect the power of the analysis of possible differences between ECC and DCC. Furthermore, the odds of having symptomatic patients were significantly higher in the ECC group, a fact that could be responsible for less skin-to-skin contact and breastfeeding in this group if symptoms were severe. Unfortunately, it was not possible to prove this hypothesis because not every participating centre provided exhaustive information of the type and severity of the symptoms of these patients and we are aware of this limitation.

Finally, we must emphasise that preterm neonates usually require an early stabilisation, thus conclusions about the association of preterm deliveries and ECC may be clinically sound.

Interpretation

Humanised assistance during childbirth includes DCC, skin-to-skin contact and breastfeeding. These actions have amply demonstrated their benefits in the newborn and in the mother–child relationship worldwide. Our aim with this study was to provide evidence on the safety of these beneficial practices for mother and baby in the context of a SARS-CoV-2 infection. Current evidence does not conclusively support intrauterine transmission of SARS-CoV-2.[8–13] Our study shows that DCC appears safe in women infected with SARS-CoV-2 and therefore provides further evidence for the absence of vertical transmission of the virus. In addition, it is known that DCC, and not ECC, can reduce the risk of death before hospital discharge in

preterm neonates,[22] and provide benefits in those born at term. Thus, there is no evidence against continuing to perform it. DCC and breastfeeding are carried out only when the mother is haemodynamically stable and does not require an urgent intervention. The routine separation of the neonate from the mother interferes with the mother/infant relationship.[23] A woman with a probable or confirmed suspicion of SARS-CoV-2 infection can be in skin-to-skin contact with her child in the delivery room and can exclusively breastfeed her baby. Breastfeeding improves the health of both mother and infant, results in benefits for the families, and has a positive social and economic impact.[23] On the whole, this current pandemic has led to combining the promotion of breastfeeding with adequate measures of infection control (wearing a mask, frequent hand washing, and social distancing). In Spain and other countries worldwide, the lack of solid evidence on the vertical transmission of the coronavirus during the initial days of the pandemic led to very conservative recommendations from the Spanish Ministry of Health for the management of deliveries in SARS-CoV-2-infected women.[6] ECC, little skin-to-skin contact, and negative attitudes towards breastfeeding practices were the decisions made in many cases. Other organisations such as the International Federation of Gynecology and Obstetrics (FIGO) do not recommend the use of DCC.[24] According to our study, ECC was more prevalent than DCC during the early period. Both ECC and DCC were equally used between 16 and 30 April. Once Healthcare Authorities proclaimed the safety of these interventions,[25] the clinical practice progressively returned to DCC and early skin-to-skin contact. Moreover, hygienic measures (wearing a mask and frequent hand washing) were introduced to avoid mother/infant transmission during breastfeeding.

Our present study characterises the provision of perinatal outcomes of neonates born to SARS-CoV-2-positive mothers with DCC, practising skin-to-skin contact and early breastfeeding under appropriate safety measures. Moreover, we included perinatal outcomes of neonates with ECC due to diverse causes. No significant differences in SARS-CoV-2-positives were detected between the ECC and the DCC groups. Likewise, no COVID-19 symptomatology was found in neonates at day 14 of follow up in either group. This fact corroborates the safety of DCC and skin-to-skin contact and breastfeeding practices in SARS-CoV-2-infected women, in agreement with the main scientific societies.[6,16,17] It is interesting to highlight in our study the large percentage of preterm neonates with ECC. The fear of vertical transmission of SARS-CoV-2 (principle reason for choosing ECC) probably caused the decrease in the number of DCC in these neonates, who in turn are those who may benefit most from this intervention.

The possible intrapartum infection of neonates has been described.[25] The suspicion could originate from a positive nasopharyngeal PRC test within 12 hours after delivery and confirmed within 24–48 hours. Horizontal transmission is suspected in the case of a positive nasopharyngeal PRC test within 24–48 hours, but a prior negative one.[26] In our study, we reported five positive nasopharyngeal PCR results within 12 hours of delivery, and all these infants were negative in the confirmation test within 24–48 hours post-delivery. This result points to the probable contamination during sample collection or to a false-positive. On the other hand, we reported one positive case in DCC group within 12–48 hours after delivery, possibly related to contact with a relative unaware of being infected. This neonate showed COVID-19 symptoms for some days but did not require admission to the ICU. None of the neonates from our cohort showed COVID-19 symptoms when the phone evaluation took place on day 14 after delivery, and during the writing of this article (June 2020). Moreover, none of the neonates required admission to the ICU due to severe symptomatology of SARS-CoV-2 infection.

Conclusions

In this study, DCC, skin-to-skin contact and early breastfeeding in SARS-CoV-2-infected mothers was not demonstrated to lead to an increase in neonatal transmission. Therefore, continued high quality evidence-based practice at time of birth should be a must even in times of COVID-19.

Disclosure of interests

None declared. Completed disclosure of interests forms are available to view online as supporting information.

Contribution to authorship

OMP conceived the original idea and coordinated the study. OMP, RSL, EGR, IRdlT and IMJ contributed to the data collection. JMG performed the statistical analysis. All the authors contributed to the interpretation of the results. IMJ took the lead in writing the manuscript with the support of OMP and JMG. MLdlCC contributed to the acquisition and organisation during the review process. All the authors critically reviewed and contributed to the final version of the manuscript.

Details of ethics approval

The study was initially approved by the Puerta de Hierro University Hospital Medical Ethics Committee on 23 March 2020 (reference number: PI 55/20) and subsequently by the Ethics Committee of each participating hospital. Procedures were in concordance with the Declaration of

Helsinki. Oral informed consent was obtained from each participant.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article. ■

References

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