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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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/1471-0528.16597

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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 March 1st and May 31st, 2020. Data were collected from 70 centers that participate in the Spanish Registry of COVID-19.

Methods: Patient’s 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%), whereas the DCC group consisted of 172 infants (42.7%). A total of 5 positive newborns (1.7% of total tests performed) were identified with the nasopharyngeal PCR tests performed in the first 12 hours postpartum, 2 from the ECC group (1.7%) and 3 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 have found no differences in perinatal outcomes when performing ECC or DCC, and skin-to-skin contact, and breastfeeding.

Funding: This study was fully funded with public funds from the Institute of Health Carlos III and co-financed with FEDER funds.

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

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

On January 12th, 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 11th March due to the prevalence, spread, and severity of the disease.\(^2\) To date, a higher predisposition to infection of pregnant women compared to the general population has not been proven; however, evidence suggests they have a greater susceptibility to develop pneumonia.\(^3,4\) Moreover, the clinical course seems more severe among them. Higher rates of preterm births and cesarean 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 cesarean deliveries have been modified during the pandemic. Some centers have suppressed or substantially minimized 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;\(^6\) or 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 March 1st and May 31st, 2020. Pregnant women were considered as having SARS-CoV-2 infection if tested positive using a nasopharyngeal PCR at the time of hospital admission, regardless their symptoms. Data were collected from the Spanish Registry of COVID-19.\(^20\) A total of 100 Spanish centers 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 centers included SARS-CoV-2 infected mothers in the present study. The study was firstly approved by the Puerta de Hierro University Hospital Ethics

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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 with 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.

**Analyzed 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 about 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 showing symptoms of COVID-19, it was repeated. If this second PCR was negative, the first PCR was then considered as contaminated or a false positive; however, 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 as having SARS-CoV-2 infection if tested positive in the first PCR test and confirmed (positive) in the second one. All infants (regardless PCR results or symptoms) were followed-up at 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 at 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 U Mann-Whitney test for quantitative ones, when appropriate. Statistical significance was established with \( P < .05 \). All statistical analyses were performed with SAS 9.4.
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 out because of a lack of information about the timing of the cord clamping. Therefore, 403 positive mothers were finally analyzed. ECC was performed on 231 neonates (57.3%), whereas 172 (42.7%) received DCC. No significant differences were found between ECC and DCC groups in maternal age and 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, whereas 142 (82.6%) were asymptomatic. The gestational age at delivery with ECC was significantly lower than DCC (37+9 versus 38+8 weeks, \( P = .001 \)). The number of instrumental and cesarean deliveries were higher with ECC than DCC (13.0% versus 8.1% for instrumental ones, and 45.9% versus 17.4% for cesarean); whereas the number of normal labors was higher for DCC (74.4% versus 41.1%). The weight at birth was significantly higher with DCC than ECC (3,210.4 versus 3,065.7 grams, \( P = .037 \)). Although statistically significant, this difference was not clinically relevant.

A total of 5 positive newborns (1.7% of total tests performed) were identified with the nasopharyngeal PCR tests performed within 12 hours after delivery, specifically 2 from the ECC (1.7%) and 3 from the DCC group (3.6%; Table 2). No significant differences between groups were found regarding neonatal tests for SARS-CoV-2 (\( P = .390 \)). All positive newborns reported within 12 hours after delivery resulted 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 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%, \( P = .001 \)). Breastfeeding in the immediate postpartum period was also significantly higher with DCC than ECC (77.3% versus 50.2%, \( P = .001 \)).

No significant differences between groups were found regarding arterial pH and Apgar score at 5 minutes in neonates. A higher percentage of admissions to the ICU were reported in the ECC (16.5% versus 8.1%, \( P = .015 \)).
Considering the temporal distribution, ECC was more prevalent than DCC during the first few days of the pandemic (5.2% versus 2.3% between 1st and 15th March, 25.5% versus 15.1% between 16th and 31st March, and 31.6% versus 20.9% between 1st and 15th April. Time evolution is shown in Table 3.) The main reason for an ECC was due to maternal COVID-19 disease (37.2%)

Discussion

Main findings

Our study supports the recommendations from WHO, CDC, and the Spanish Government 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 centers across Spain), being one of the largest cohorts described. Furthermore, it represents a novel topic because, to our knowledge, there are no studies that have analyzed perinatal outcomes in neonates born to SARS-CoV-2 infected mothers regarding the timing of cord clamping, or that 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 is necessary to indicate that false negative results could occur with PCR tests, especially if these are performed shortly after SARS-CoV-2 exposure. Routine serology tests (for determining 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 centers. 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 after 14 of the delivery had also intrinsic limitations like that parents were 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 that the neonates came back to a hospital (secondarily) were the reasons for performing a phone follow-up. Furthermore, the clinical questionnaire (for evaluating the neonatal symptoms) was not normalized and homogeneous in all the centers. 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 if the healthcare professionals

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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 like this, we do 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 symptomatic patients were significantly higher in the ECC group, 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 participant center provided exhaustive information of the type and severity of the symptoms of these patients and we are aware of this limitation.

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

**Interpretation**

Humanized assistance during childbirth includes delayed cord clamping, skin-to-skin 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. 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, and provide benefits in those born at term. Thus, there is no evidence for not continuing to perform it. DCC and breastfeeding are carried out only when the mother is hemodynamically stable and nor requiring an urgent intervention. The routine separation of the neonate from the mother interferes in the mother/infant relationship. A woman with a probable or confirmed suspicion of SARS-CoV-2 infection can give skin-to-skin contact in the delivery room, and 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. 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. ECC, little skin-to-skin contact, and negativity to breastfeeding practices,
were the decisions made in many cases. Other organizations like the International Federation of Gynecology and Obstetrics (FIGO) do not recommend the use of DCC.\textsuperscript{24} According to our study, ECC was more prevalent over DCC during the early period. Both ECC and DCC were equally used between 16\textsuperscript{th} and 30\textsuperscript{th} April. Once Healthcare Authorities proclaimed the safety of these interventions,\textsuperscript{25} the clinical practice took a new stance and 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.

The characterization of our present study is the provision of perinatal outcomes of neonates born to SARS-CoV-2-positive mothers with DCC, practicing skin-to-skin contact and early breastfeeding under appropriate safety measures. Moreover, we included perinatal outcomes of neonates with ECC due to diverse reasons. 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 both groups. This fact corroborates the safety of DCC and skin-to-skin contact and breastfeeding practices in SARS-CoV-2 infected women, in agreement with main scientific societies.\textsuperscript{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.\textsuperscript{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.\textsuperscript{26} In our study, we reported 5 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 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 and did not require admission into the ICU. None of the neonates from our cohort showed COVID-19 symptoms when the phone evaluation took place at day 14 after delivery, and while writing this manuscript (June 2020). Moreover, none of the neonates required admission into the ICU due to severe symptomatology of SARS-CoV-2 infection.

\textbf{Conclusions}
We have not demonstrated that DCC, skin-to-skin contact, and early breastfeeding in SARS-CoV-2 infected mothers leads 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.

Acknowledgements

Authors would express gratitude to Meisys for assisting in the preparation of the manuscript.

Spanish Obstetric Emergency Group collaborators: Águeda Rodríguez-Vicente (Hospital Universitario de Girona Doctor Josep Trueta), Albert Tubau-Navarra (Hospital Universitario Son Llàtzer), Alberto Puertas-Prieto (Hospital Universitario Virgen de las Nieves), Alejandra Abascal-Saiz (Hospital Universitario La Paz), Alejandra María Cano-García (Hospital del Tajo), Ana María Fernández-Alonso (Hospital Universitario Torrecárdenas), Ana Villalba-Yarza (Hospital Universitario de Salamanca), Ángeles Sánchez-Vegazo (Complejo Hospitalario San Millán y San Pedro), Antonio Sánchez-Muñoz (Hospital General Universitario de Ciudad Real), Beatriz Marcos-Puig (Hospital La Fe), Begoña Encinas-Pardilla (Hospital Puerta de Hierro), Begoña Muñoz-Abellana (Hospital Sant Joan de Reus), Camino Fernández-Fernández (Complejo Asistencial de León), Carmen Baena-Luque (Hospital Infanta Margarita), Carmen María Orizales-Lago (Hospital Universitario Severo Ochoa), Carmen Parada-Millán (Hospital do Barbanza), Cristina Álvarez-Colomo (Hospital Clínico Universitario de Valladolid), Cristina Lesmes-Heredia (Hospital Parc Taulí), Elena Ferriols-Pérez (Hospital del Mar), Encarnación Carmona-Sánchez (Hospital Santa Ana), Esther Álvarez-Silvares (Complejo Hospitalario Universitario de Ourense), Esther María Canedo-Carballeira (Complejo Hospitalario A Coruña), Eva Morán-Antolín (Hospital Universitario Son Espases), Irene Gastaca-Abásolo (Hospital Universitario Araba-Txagorritxu), Jose Adánez-Garcia (Hospital Universitario Central de Asturias), José Antonio Sainz-Bueno (Hospital Viamed Santa Ángela de la Cruz), José Navarrina-Martínez (Hospital Donostia), José Ruiz-Aragón (Hospital Universitario de Ceuta), Juan Carlos Wizner-de Alva (Hospital San Pedro Alcántara), Laia Pratcorona Alicart (Hospital Universitari Germans Trias i Pujol), Laura Forcén-Acebal (Hospital Doce de Octubre), Laura Fuentes-Ricoy (Hospital Universitario de Ferrol), Laura González-Rodríguez (Hospital Álvaro Cunqueiro), Lucas Cerrillos-González (Hospital Universitario Virgen del Rocío), Lucía Díaz-Meca (Hospital Clínico Universitario Virgen de la Arrixaca), Mar Muñoz-Chapuli (Hospital General Universitario Gregorio Marañón), María Caridad Ortiz-Herrera (Hospital Costa del Sol), María del Carmen Barbancho-López (Hospital Universitario Infanta Sofía), María del Carmen Medina-Mallén (Hospital de la Santa Creu i Sant Pau), María del Pilar Guadix-Martín (Hospital Universitario Virgen Macarena), María Isabel Pardo-Pumar (Complejo Hospitalario Universitario de Pontevedra), María Joaquina Gimeno-Gimeno (Hospital Reina...
Sofía), María José Núñez-Valera (Hospital Virgen de la Luz), Maria Reyes Granell-Escobar (Hospital Universitario Juan Ramón Jiménez), María Suárez-Arana (Hospital Regional Universitario de Málaga), María Teulón-González (Hospital Universitario de Fuenlabrada), María-Rosa Vila-Hernández (Hospital de Santa Caterina), Marta García-Sánchez (Hospital Quirónsalud Málaga), Marta Ruth Meca-Casbas (Hospital de Poniente), Mercedes Fraca-Padilla (Hospital Universitario de Basurto), Mercedes Ramírez-Gómez (Hospital General La Mancha Centro), Mónica Catalina-Coello (Hospital Virgen de la Concha), Mónica López Rodríguez (Hospital Universitario de Tarragona Juan XXIII), Montse Macià-Badía (Hospital Arnaud de Vilanova), Noelia Pérez-Pérez (Hospital Clínico San Carlos), Olga Nieto-Velasco (Hospital Universitario Quirónsalud Madrid), Onofre Alomar-Mateu (Hospital d'Inca), Óscar Vaquerizo-Ruiz (Hospital Universitario de Cabueñes), Otilia González-Vanegas (Hospital Universitario San Cecilio), Pablo Guillermo Del Barrio-Fernández (Hospital Universitario de Getafe), Paloma Hernando-López-de-la-Manzanera (Fundación Investigación Puerta de Hierro), Pilar Monteliu-González (HM Hospitales), Pilar Prats-Rodriguez (Hospital Universitari Dexeus - Grupo Quirónsalud), Rocío López-Pérez (Hospital General Universitario Santa Lucía), Rosa Ostos-Serna (Hospital Universitario Virgen de Valme), Rubén Alonso-Saiz (Hospital Universitario de Burgos), Rut Bernardo-Vega (Hospital Universitario Rio Hortega), Silvia Mateos-López (Hospital de Torrejón), Susana Soldevilla-Pérez (Hospital Jerez de la Frontera), Víctor Muñoz-Carmona (Hospital Alto Guadalquivir).

Disclosure Statement

The authors report no conflict of interest. Completed disclosure of interest forms are available to view online as supporting information.

Contribution to Authorship

OMP conceived the original idea and coordinated the study. OMP, RSL, EGR, IRdIT and IMJ contributed with 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 in the acquisition and organization during the review process. All the authors critically reviewed and contributed to the final version of the manuscript.

Details of Ethics Approval

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The study was firstly approved by the Puerta de Hierro University Hospital Medical Ethics Committee on March 23rd, 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.

**Funding**

This study was fully funded with public funds obtained in competitive calls: grant COV20/00020 from the Institute of Health Carlos III and co-financed with FEDER funds.
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| Table 1. Characteristics of mothers and deliveries |
|--------------------------------------------------|
| **Maternal characteristics**                     |
| Age, mean years (range)                           |
| Early cord clamping (N=231)                       |
| 33.2 (18.0–48.0)                                  |
| Delayed cord clamping (N=172)                     |
| 32.1 (18.0–46.0)                                  |
| P value                                           |
| .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) |
| Early cord clamping (N=231)                       |
| 6.0 (0.0–61.8)                                   |
| Delayed cord clamping (N=172)                     |
| 9.1 (0.0–78.8)                                   |
| P value                                           |
| .386                                             |
| Symptomatology, n (%)                            |
| Showing COVID-19 symptoms                        |
| 82 (35.5)                                        |
| 30 (17.4)                                        |
| Asymptomatic                                     |
| 149 (64.5)                                       |
| 142 (82.6)                                       |
| **Delivery characteristics**                     |
| Gestational age, mean weeks (range)              |
| Early cord clamping (N=231)                       |
| 37.9 (23.0–42.0)                                 |
| Delayed cord clamping (N=172)                     |
| 38.8 (27.0–42.0)                                 |
| P value                                           |
| .001                                             |
| Preterm deliveries (<37 weeks), n (%)             |
| Early cord clamping (N=231)                       |
| 43 (18.6)                                        |
| Delayed cord clamping (N=172)                     |
| 16 (9.3)                                         |
| P value                                           |
| .001                                             |
| Start of delivery, n (%)                         |
| Spontaneous                                      |
| 102 (44.2)                                       |
| 96 (55.8)                                        |
| Induced                                          |
| 85 (36.8)                                        |
| 63 (36.6)                                        |
| Scheduled cesarean                               |
| 44 (19.0)                                        |
| 13 (7.6)                                         |
| Type of delivery, n (%)                          |
| Normal labor                                     |
| 95 (41.1)                                        |
| 128 (74.4)                                       |
| Instrumental                                     |
| 30 (13.0)                                        |
| 14 (8.1)                                         |
| Cesarean                                         |
| 106 (45.9)                                       |
| 30 (17.4)                                        |
| Weight at birth, mean grams (range)              |
| Early cord clamping (N=231)                       |
| 3,065.7 (680.0–5,190.0)                          |
| Delayed cord clamping (N=172)                     |
| 3,210.4 (940.0–4,640.0)                          |
| P value                                           |
| .037                                             |
Table 2. Outcomes in neonates born to mothers with COVID-19

|                                      | Early cord clamping (N=231) | Delayed cord clamping (N=172) | P value |
|--------------------------------------|-------------------------------|--------------------------------|---------|
| Neopatal tests for COVID-19, n (%)   |                               |                                |         |
| <12 hours from delivery              | 118 (51.1)                    | 83 (48.3)                      | .058    |
| Positive ones                        | 2 (1.7)                       | 3 (1.7)                        | .390    |
| Type of delivery of positive ones    |                               |                                |         |
| Normal labor                         | --                            | 2/3                            |         |
| Instrumental                         | 1/2                           | --                             |         |
| Cesarean                             | 1/2                           | 1/3                            |         |
| 12–48 hours from delivery            | 100 (43.3)                    | 54 (31.4)                      | .015    |
| Positive ones                        | 0 (0.0)                       | 1 (1.9)                        | .390    |
| Skin-to-skin within first 24 hours, n (%) | 106 (45.9)                      | 145 (84.3)                      | .001    |
| Breastfeeding at the immediate postpartum, n (%) | 116 (50.2)                      | 133 (77.3)                      | .001    |
| Arterial pH, mean value (range)      | 7.27 (6.20–7.49)              | 7.26 (7.04–7.42)               | .183    |
| Apgar score at 5 minutes, n (%)      |                               |                                | .193    |
| <5                                   | 5 (2.2)                       | 1 (0.6)                        |         |
| ≥5                                   | 225 (97.8)                    | 171 (99.4)                     |         |
| Admission to the ICU, n (%)          | 38 (16.5)                     | 14 (8.1)                       | .015    |
| **Evaluation after day 14 of the delivery** |                               |                                |         |
| N available                          | 186                           | 123                            |         |
| Symptomatology, n (%)                |                               |                                | 1.000   |
| Showing COVID-19 symptoms            | 1 (0.5)                       | 0 (0.0)                        |         |
| Asymptomatic                         | 185 (99.5)                    | 123 (100.0)                    |         |

ICU, intensive care unit

* Positive case related with horizontal transmission by the contact with another positive person (grandmother), using no protection measures
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<sup>st</sup>-15<sup>th</sup> March| 16 (4.0)       | 12 (5.2)                    | 4 (2.3)                        | .001    |
| 16<sup>th</sup>-31<sup>st</sup> March| 85 (21.1)      | 59 (25.5)                   | 26 (15.1)                      |         |
| 1<sup>st</sup>-15<sup>th</sup> April | 109 (27.1)     | 73 (31.6)                   | 36 (20.9)                      |         |
| 16<sup>th</sup>-30<sup>th</sup> April| 92 (22.8)      | 52 (22.5)                   | 40 (23.3)                      |         |
| 1<sup>st</sup>-15<sup>th</sup> May  | 66 (16.4)      | 23 (10.0)                   | 43 (25.0)                      |         |
| 16<sup>th</sup>-31<sup>st</sup> 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 election              | 3 (0.7)        | 1 (0.4)                     | 2 (1.2)                        |         |
| Short umbilical cord                | 2 (0.5)        | 2 (0.9)                     | 0 (0.0)                        |         |
| General anesthesia                  | 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) |         |