

Original Research

Epidemiological characteristics of neonates born to mothers infected with COVID-19: A single-centre observational study

T. Verulava^{a,b,*} and N. Galogre^a

^a*School of Medicine and Healthcare Management, Caucasus University, Tbilisi, Georgia*

^b*Faculty of Health Care Economics and Management, Teaching University Geomedi, Tbilisi, Georgia*

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Abstract.

BACKGROUND: COVID-19 disease can affect women at any stage of pregnancy, and newborns could become infected with SARS-CoV-2 through vertical or horizontal transmission. Little is known about SARS-CoV-2 infection in neonates born to mothers with COVID-19. Experts emphasize the importance of ensuring the safety of newborns without compromising the benefits of early contact with the mother. The aim of the study was to investigate the epidemiological characteristics of newborns born to mothers infected with SARS-CoV-2.

METHODS: Observational, prospective cohort study was conducted in the intensive care unit of the perinatal center (Georgia). Information was collected by reviewing and personal observations of medical histories of newborns born to mothers infected with SARS-CoV-2.

RESULTS: The study included 38 newborns with suspected ($n = 16$; 42.1%) and confirmed ($n = 22$; 57.9%) COVID-19 infection cases, treated in the neonatal intensive care unit. The study did not reveal the risk of vertical transmission of SARS-CoV-2 infection and confirmed a fairly large rate of horizontal transmission of infection ($n = 25$; 66%). Skin-to-skin mother care was performed in 68.7% of newborns, 26.3% received exclusive maternal or donated breast milk during hospital stay.

CONCLUSION: Prevention of horizontal transmission of infection in newborns should be a priority. It is recommended skin-to-skin mother care and maternal or donated breast milk during hospital stay, taking into account the health of the mother and the newborn, following the rules of hygiene and use of the mask by the infected mother.

Keywords: COVID-19, horizontal transmission, infection SARS-CoV-2, newborn, newborn feeding

1. Introduction

The new coronavirus (SARS-CoV-2) disease (COVID-19), first detected in China in December 2019, has recently become one of the most important public health challenges [1]. The global pandemic is

particularly troubling in terms of infecting such vulnerable groups of the population as pregnant women and newborns. Although coronavirus infection is relatively rare in children and is mostly mild [2], neonates may develop more severe forms of the disease [3]. Although most diagnostic tests performed on infants born to infected mothers were negative [4, 5], various studies have identified SARS CoV-2 infection in biological materials, including amniotic fluid,

*Address for correspondence: Tengiz Verulava, MD, PhD, Caucasus University, Tbilisi, Georgia. E-mail: tverulava@cu.edu.ge.

placenta, and breast milk, indicating no clear evidence of vertical transmission of the infection [6–8]. In a study by Raschetti et al., 70% of the 176 neonatal infections described revealed a horizontal and 30% a vertical route of transmission [9].

There are three potential mechanisms for the transmission of SARS-CoV-2 infection from mother to infant: Intrauterine transmission by transplacental hematogenous spread or the presence of virus particles in the amniotic fluid that the fetus inhales or swallows; transmission of the infection during childbirth after contact with the mother's discharge or feces; postpartum transmission from an infected mother, family member, or medical staff [10–12].

Due to insufficient evidence, a cautious approach should be taken to high-risk infants, although the negative impact of mother-child separation should be considered [13]. Experts unequivocally support skin-to-skin contact and the immunological and psychosomatic benefits of breastfeeding in both the short and long term [14–16]. Exceptions are the state of health of the mother and her inability to care for the newborn, during which the newborn is supplied with freshly expressed unpasteurized breast milk [17, 18]. Skin-to-skin contact is recommended and mother-infant cohabitation is permitted, following basic hygiene measures [19, 20]. In some cases, when the SARS-CoV-2 virus was detected in breast milk, breast-feeding was discontinued and resumed after the isolation period and a negative test confirmed by the mother [21, 22].

Little is known about COVID-19 in the perinatal period. The aim of the research was to study the epidemiological characteristics of newborns born to mothers infected with SARS-CoV-2.

2. Materials and methods

An observational, prospective cohort study method was performed. The study was conducted in the Department of Neonatal Intensive Care of the Perinatal Center of one of the clinics in Tbilisi, where about 2500 births are performed per year. Information was collected by reviewing and personal observations of medical histories of newborns born to mothers infected with SARS-CoV-2 in the neonatal intensive care unit of the clinic from March 2020 to May 2021. Prospective collection of neonatal epidemiological, clinical and laboratory data was performed.

All pregnant women admitted to the clinic with or without symptoms underwent polymerase chain

reaction (PCR) test. The diagnosis of SARS-CoV-2 infection was made through viral PCR testing of nasal swab samples. Pregnant women with a positive PCR test that did not give birth within a week from the test and pregnant women with previous evidence of infection during pregnancy underwent a second PCR at the time of delivery. Every neonate underwent collection of a nasal swab sample at birth for performance of the SARS-CoV-2 PCR test.

The data collection was prospective for mothers and infants. We collected data for epidemiological and clinical variables. We considered the presentation mild if it was limited to upper respiratory symptoms, fever or anosmia.

The included population consisted of all mothers with positive serology for SARS-CoV-2 and their respective newborns at the facility between March 2020 to May 2021. All neonates born to mothers with COVID-19 who delivered at the facility were retrospectively identified. The study included all those who had the necessary medical records and the neonate's RT-PCR result. Patients with incomplete neonatal or maternal medical records were excluded from the study.

The statistical analysis was performed with the software SPSS version 23. A *p*-value of 0.05 was considered statistically significant.

The study was approved by the Research Ethics Committee of Caucasus University (23-2020). We adhered to the principles of the Declaration of Helsinki at all times.

3. Results

We included a total of 93 mothers with evidence of infection by SARS-CoV-2 between March 2020 and May, 2021 giving birth to 95 newborns (including two twins). There were 18 caesarean Sect. (47%) and 20 vaginal deliveries (53%). Out of 95 newborns, 16 (16.8%) newborns were transferred to the neonatal intensive care unit. In the neonatal intensive care unit, 22 newborns confirmed by COVID-19 were admitted by referral from other clinics. Thus, the study included 38 newborns with suspected ($n = 16$; 42.1%) and confirmed ($n = 22$; 57.9%) COVID-19 infection cases, treated in the neonatal intensive care unit. Table 1 shows the epidemiological and clinical characteristics of the neonates.

The median birth weight of newborns was 3005 g and the median gestational age 36 weeks, and 62%

Table 1
Epidemiological characteristics of suspected and confirmed neonates at COVID-19 in the neonatal intensive care unit

	Newborns with suspected COVID-19 <i>n</i> = 16; 42%	Newborns with confirmed COVID-19 <i>N</i> = 22; 58%	All <i>n</i> = 38	<i>p</i> -value
Sex of newborns				
Male	7 (44%)	12 (54,5%)	19 (50 %)	0.1
Female	9 (56%)	10 (45,5%)	19 (50 %)	
Type of delivery				
Vaginal delivery	6 (37%)	14 (63,6%)	24 (63%)	
Cesarean section	10 (63%)	8 (36,4%)	14 (37%)	0.71
Gestational age of the newborn				
Preterm birth 28–36 + 6/7 week	11 (69%)	13 (59%)	24 (62%)	0.27
Full-term delivery 37–42 week	5 (31%)	9 (41%)	14 (38)	0.16
The nose swab PCR test for COVID-19				
Positive	3 (25%)	14 ()	17 (41%)	
Negative	13 (75%)	8 ()	21 (59%)	
Respiratory failure				
Has no pronounced respiratory failure	3 (18.7%)	10 (45,5%)	13 (34%)	0.02
Mild to moderate respiratory distress syndrome	8 (36.4%)	11 (50%)	19 (50%)	0.1
Severe respiratory distress syndrome	5 (31.2%)	1 (4,5%)	6 (16%)	0.1
Oxygen therapy				
Supplemental oxygenation	3 (18.7%)	3 (13,6%)	6 (16%)	≤0.001
Non-invasive ventilation	5 (31.2%)	8 (36,5%)	13 (34%)	≤0.001
Invasive ventilation	5 (31.2%)	1 (4,5%)	6 (16%)	≤0.001
None	3 (18.7%)	10 (45,5%)	13 (34%)	
Treatment				
Treatment with exogenous surfactant	1 (6%)	4 (4,5%)	5 (13%)	≤0.01
Infusion therapy	9 (56%)	18 (81,8%)	27 (71%)	≤0.001
Symptom				
Hyperbilirubinemia	6 (38%)	7 (31,8%)	13 (34%)	0.1
Feeding type				
Breastfeeding	12 (75%)	14 (63,6%)	26 (69%)	0.27
Food intolerance	5 (31.2%)	4 (18,2%)	9 (24%)	
Adapted mixture	3 (18.7%)	7 (31,8%)	10 (26%)	
Complete parenteral	0	1 (4,5%)	1 (3%)	
Outcome				
Discharged	15 (94%)	21 (95,5%)	36 (92%)	≤0.001
Death	1 (6%)	1 (4,5%)	2 (5%)	0.1

of infants were born preterm (24/38). The age of COVID-19 confirmed female neonates was 7–18 days, while that of male-7-23 days. The confirmed incidence of males infected with COVID-19 was 9–23 days, while that of females was 3–18 days. Suspicious cases of COVID-19 infected males ranged from 14 to 56 days, while those of females ranged from 12 to 92 days. treatment required 5 (13%) neonates, while infusion therapy required 27 (71%) neonates. Hyperbilirubinemia was detected in 13 (34%) neonates.

At the beginning of the study, from March to October 2020, the newborn was in contact with the parent via video call because, according to the regulations, he could not visit the newborn until the end of the isolation period and received a negative response to COVID-19. However, then the regulation was changed and 12 days after the confirmation, the parents were given the opportunity to visit the

newborn and have personal contact with him using personal protective equipment.

Food intolerance was confirmed in 9 (24%) cases. There were 26 (69%) newborns on natural feeding (breast milk), 10 (26%) newborns on adapted feeding, and 1 (3%) newborn on full parenteral nutrition.

Based on satisfactory clinical-laboratory indicators as a result of adequate treatment, 36 (92%) recovered newborns were discharged home and 2 (5%) newborns died (Table 1).

4. Discussion

The risk of vertical transmission during vaginal delivery in pregnant patients with COVID-19 is still a matter of debate. There are reports in the literature of identification of SARS-CoV-2 in biological specimens (including samples of placenta and amniotic fluid), which suggest that vertical transmission is

possible, although the evidence to date shows that it is infrequent [23–26], although it is likely that some of these infections resulted from horizontal transmission [27]. Taking this evidence into account, the prevention of horizontal transmission should be prioritised in these neonates.

Our study did not reveal the risk of vertical transmission of SARS-CoV-2 infection and confirmed a fairly large rate of horizontal transmission of infection ($n=25$; 66%). Our findings demonstrate that adherence to the recommendations with an emphasis on hand hygiene and the use of masks during contact with the newborn makes rooming-in possible, promoting mother-child bonding and maintenance of breastfeeding without compromising the safety of the neonate.

International or national guidelines on the management of newborns of mothers suspected or positive for COVID-19, have recommended at least temporary separation of mother and newborn as a precaution [28]. In contrast, other guidelines do not recommend systematic separation and consistently support breastfeeding [29]. If for any reason this is not possible (health status of the mother or newborn), then the type of feeding (enteral, parenteral) and type (breast milk, adapted mixture) should be decided in consultation with the doctor. The benefits of breastfeeding outweigh the potential risk of viral transmission, especially in developing countries where artificial feedings have been associated with significant morbidity and mortality [30].

According to our study, of the 38 newborns, 26 (68.7%) were on natural-breastfeeding and 10 (26.3%) were on the adapted mixture. These results are in accordance with the very low incidence of infection in newborns of infected mothers in a national cohort of the Georgia, in which guidelines for the postnatal management of infants of infected mothers included keeping the mother and infant together and encouraging breastfeeding with strict infection control measures from birth. Our findings support similar guidelines of various countries and health care societies [31, 32].

The most common complications in newborns are respiratory distress syndrome and necrotic enterocolitis. According to the study, 38 newborns did not reveal severe diseases of the digestive system. With a few exceptions, an average of 19 (50%) newborns had dyspepsia (vomiting, diarrhea, bloating). With adequate treatment, the symptoms stopped for a short period of 4–5 days. Severe respiratory disorders were detected in 5 (13.2%) neonates who required invasive

ventilation, including 5 (13.2%) neonates treated with exogenous surfactant.

On the 2–3rd day after confirmation of COVID-19 infection with newborns some common symptoms were revealed: tachycardia 160–190 in 22 (57.9%) newborns, febrile temperature 38–40°C in 7 (31.8%) neonates, subfebrile temperature 37–37.9°C was observed in 12 (54.5%) neonates, tachypnoea 60–70 in 9 (40.9%) neonates. With adequate treatment, these symptoms resolved within 2 days of hospitalization.

There are several limitations to the study. It was conducted in a single centre, which may limit its external validity. The sample was small and the follow-up finished at 15 days post birth, so we could not draw conclusions regarding the safety of the recommended measures beyond that time point or about neonatal infections in the medium to long term. Given the scarcity of the data, our findings should be interpreted with caution as we await evidence from studies with larger samples and longer durations of follow-up.

5. Conclusion

The study did not reveal a risk of vertical transmission of SARS-CoV-2 infection, however the research confirmed high extent of horizontal transmission of infection ($n=25$; 66%). This suggests that horizontal transmission of SARS-CoV-2 infection is possible, especially in the areas with high transmission rates; therefore, proactive infection prevention and control guidelines are warranted in all NICUs. Modern recommendations suggest mothers skin to skin contact and kangaroo care, placing the newborn and mother together (taking into account the health of the mother and newborn), effective establishment of breastfeeding, following some hygienic rules, contact with the newborns should be provided with the use of mask. Anti-inflammatory, immune booster, antimicrobial properties of breast milk should be taken into consideration, as a result breastfeeding is recommended. Further research is required to increase our knowledge of the epidemiology and short- and long-term impact of maternal and neonatal infections by SARS-CoV-2.

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