Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Vertical Transmission in Neonates Born to Mothers With Coronavirus Disease 2019 (COVID-19) Pneumonia

Xiaolin Hu, MD, Jinzhi Gao, MD, PhD, Xiaoping Luo, MD, PhD, Ling Feng, MD, PhD, Weiyong Liu, MD, Juan Chen, MD, PhD, Alexandra Benachi, MD, PhD, Daniele De Luca, MD, PhD, and Ling Chen, MD, PhD

INTRODUCTION

The novel β-coronavirus (severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) is mainly transmitted through respiratory droplets, but other routes are possible.1 Previous studies have reported mainly nonpregnant patients.2 Few data exist about perinatal infection with SARS-CoV-2, and vertical transmission has been hypothesized.3–5 We report seven cases of coronavirus disease 2019 (COVID-19) during late pregnancy and neonatal outcomes observed from January 20, 2020, to February 20, 2020.

METHODS

The diagnosis was given following the Coronavirus Pneumonia Prevention and Control Chinese Program.6 Report was approved by the local institutional review board, and informed consent was obtained. Maternal and neonatal samples were tested with a dedicated kit following the manufacturer’s instructions; details of reverse transcription polymerase chain reaction were as previously reported.7 Laboratory testing followed current World Health Organization guidance.8 Patients’ data were recorded in a customized spreadsheet and shared with two international experts (an obstetrician and a neonatologist) who critically reviewed the cases and confirmed the clinical interpretation.

RESULTS

Characteristics of the seven pregnant women are reported in Table 1 and summarized below. None had other diseases; before the COVID-19 diagnosis, six of the pregnancies had been uneventful, and one of the pregnant women had presented with liver dysfunction. The presentations included low-grade fever (37.8–38.8°C), cough, and diarrhea; one patient was asymptomatic and was evaluated because of known exposures. Clinical symptoms, if present, began 8 hours to 12 days before admission. Chest computed tomography scans showed diffuse and patchy lung consolidation. Laboratory abnormalities, if present, included lymphopenia and mild transaminitis. No mother experienced clinical deterioration, and there were no delivery-related complications. All mothers recovered from COVID-19 infection. Amniotic fluid samples obtained at delivery (seven patients) were negative by PCR testing. Cesarean delivery was performed according to local guidelines to reduce the risk of vertical transmission and for logistic reasons.8 One woman delivered vaginally before the planned cesarean. All neonates were immediately isolated.
Neonatal characteristics are described in Table 2. Neonates were tested within the first 24–36 hours of life, and one of the seven (14.3%) was positive for SARS-CoV-2 infection. For all of the other neonates, reverse transcription polymerase chain reaction testing in throat swab, blood, feces, and urine samples had negative results. Neonates were isolated for 14 days, and none developed clinical symptoms or evidence of illness. They were exclusively formula-fed. Routine biochemical tests and blood cell counts were normal on the first and third days of life (Table 3). Chest X-rays and cerebral ultrasound scans performed on the first day of life were also normal.

**Table 1. Clinical Characteristics of the Pregnant Women**

| Characteristic                          | Case No. |
|----------------------------------------|----------|
| Age (y)                                | 1 2 3 4 5 6 7 |
| Important epidemiologic features       |          |
| Lives 1 mile from Huanan market        | 34       |
| Husband affected                       | 31       |
| Lives 3 mi from Huanan market          | 34       |
| Family member affected                 | 30       |
| Fever                                  | No       |
| Cough                                  | No       |
| Fatigue                                | No       |
| Dyspnea                                | No       |
| Diarrhea                               | No       |
| Complications during pregnancy         | No       |
| Time between symptom onset and delivery| 8 h      |
| Type of delivery                       | Cesarean |
| Prelabor rupture of membranes          | No       |
| Placenta                               | Normal   |
| Throat swab for SARS-CoV-2             | Positive |
| Antiviral treatment before delivery    | No       |
| SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

**Table 2. Clinical Characteristics of the Neonates**

| Characteristic                          | Case No. |
|----------------------------------------|----------|
| Sex                                    | Male     |
| Male                                   | Male     |
| Female                                 | Female   |
| Gestational age (wk)                   | 40       |
| 41 2/7                                 | 38 4/7   |
| 39 5/7                                 | 38 2/7   |
| Birth weight (g)                       | 3,250    |
| 3,470                                  | 3,250    |
| 3,670                                  | 3,180    |
| 3,200                                  | 3,300    |
| 1-min Apgar score                      | 8        |
| 8                                      | 8        |
| 8                                      | 7        |
| 9                                      | 8        |
| 9                                      | 9        |
| 5-min Apgar score                      | 9        |
| 9                                      | 9        |
| 9                                      | 8        |
| 9                                      | 9        |
| fever                                  | No       |
| Yes                                    | No       |
| Transfusion of blood product           | No       |
| No                                     | No       |
| Weight loss (%)                        | 0        |
| 2.9                                    | 2.5      |
| 5.4                                    | 1.9      |
| 2.5                                    | 2.5      |
| 3                                      | 3        |
| Complications                          | No       |
| No                                     | No       |
| No                                     | No       |
| Chest radiograph                       | Normal   |
| Normal                                 | Normal   |
| Normal                                 | Normal   |
| Normal                                 | Normal   |
| RT-PCR for SARS-CoV-2                  | Positive*| Negative |
| Positive*                              | Negative |
| Normal                                 | Negative |
| Normal                                 | Negative |
| Normal                                 | Negative |

RT-PCR, reverse transcription polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

* This neonate had throat swabs positive for SARS-CoV-2 at 36 hours of life. Subsequently, throat swabs as well as blood, urine, and feces were negative.
DISCUSSION

Our findings suggest that the vertical transmission of SARS-CoV-2 infection from mothers affected by COVID-19 during the last days of pregnancy is possible but relatively infrequent. This must be considered with caution, because these results are reported during a rapidly evolving epidemiologic emergency and based on a limited number of cases, but they are partially consistent with other series. The neonate who tested positive was delivered by prelabor cesarean, so the route of infection was likely transplacental, although the transcervical route cannot be ruled out.

Based on the institution’s Wuhan-government based protocols, we report a neonatal transmission rate of one of seven (14.3%), with none symptomatic. It is unclear whether the management plan of prelabor cesarean delivery, neonatal isolation, and formula feeding prevented further transmission or if this represents the biological characteristics of third-trimester infection. As further data regarding vertical transmission accumulate, knowledge of the role of management strategies, maternal viral load and clinical status, and biologic characteristics will be enhanced.

REFERENCES

1. Society of Pediatrics, Chinese Medical Association, Editorial Board, Chinese Journal of Pediatrics. Recommendations for the diagnosis, prevention and control of the 2019 novel coronavirus infection in children (first interim edition) [in Chinese]. Zhonghua Er Ke Za Zhi 2020 Feb 9. [Epub ahead of print].

2. Wang L, Shi Y, Xiao T, Fu J, Feng X, Mu D, et al. Chinese expert consensus on the perinatal and neonatal management for the prevention and control of the 2019 novel coronavirus infection (first edition). Ann Transl Med 2020;8:47.

3. Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 2020;395:809–13.

4. Zhu H, Wang L, Fang C, Peng S, Zhang L, Chang G, et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. Transl Pediatr 2020;9:51–60.

5. Zeng L, Xia S, Yuan W, Yan K, Xiao F, Shao J, et al. Neonatal early-onset infection with SARS-CoV-2 in 33 neonates born to mothers with COVID-19 in Wuhan, China. JAMA Pediatr 2020 Mar 26. [Epub ahead of print].

6. National Health Commission of China. New coronavirus pneumonia prevention and control program [in Chinese]. 4th ed. Available at: http://www.gov.cn/zhengce/zhengceku/2020-01/28/5472673/files/0f96c10cc09d4d36a6f9a9f0b4d972b.pdf. Retrieved March 1, 2020.

7. Ming W, Qing W, Wanzhou X, Bin Q, Jingtai W, Hongyun Z, et al. Clinical diagnosis of 8274 samples with 2019-novel coronavirus in Wuhan. Available at: https://www.medrxiv.org/content/10.1101/2020.02.12.20022327v2.full.pdf. Retrieved March 1, 2020.

8. World Health Organization. Coronavirus disease (COVID-19) technical guidance: laboratory testing for 2019-nCoV in humans. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-testing. Retrieved March 1, 2020.

PEER REVIEW HISTORY

Received March 10, 2020. Received in revised form April 15, 2020. Accepted April 17, 2020. Peer reviews are available at http://links.lww.com/AOG/B882.