

# Letters

## RESEARCH LETTER

### Possible Vertical Transmission of SARS-CoV-2 From an Infected Mother to Her Newborn

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is highly infectious, with multiple possible routes of transmission.<sup>1-3</sup> Controversy exists regarding whether SARS-CoV-2 can be transmitted in utero from an infected mother to her infant before birth. A series of 9 pregnant women found no mother-child transmission.<sup>4</sup> We report a newborn with elevated IgM antibodies to SARS-CoV-2 born to a mother with coronavirus disease 2019 (COVID-19).

**Methods** | A mother with COVID-19 and her infant delivered February 22, 2020, at Renmin Hospital, Wuhan, China, were evaluated. The institutional review board of Wuhan University approved the study, and written informed consent was obtained.

Clinical information was obtained from interview of the mother and clinical records. Both mother and infant underwent chest computed tomography (CT); real-time reverse transcriptase-polymerase chain reaction (RT-PCR) for SARS-CoV-2 nucleic acid of nasopharyngeal swabs; and IgM and IgG antibody, cytokine, and other biochemistry tests in blood. The mother also underwent RT-PCR testing of vaginal secretions at delivery. The sensitivity of IgM for SARS-CoV-2 reached 70.2% and specificity was 96.2%. The sensitivity of IgG for SARS-CoV-2 reached 96.1% and specificity was 92.4%.<sup>3</sup>

**Results** | On January 28, 2020, a 29-year-old primiparous woman (34 weeks 2 days of gestation) suspected of being exposed to SARS-CoV-2 developed a temperature of 37.9° C and nasal congestion, which progressed to respiratory difficulties. On January 31, a chest CT showed patchy ground-glass opacities in the periphery of both lungs. The RT-PCR on a nasopharyngeal swab was positive. On February 2, the patient was admitted to Renmin Hospital and received antiviral, antibiotic, corticosteroid, and oxygen therapies. Results from 4 repeat RT-PCR tests were positive (**Table 1**). On February 21, IgG and IgM antibody levels to SARS-CoV-2 were 107.89 AU/mL and 279.72 AU/mL, respectively (normal IgM and IgG <10 AU/mL). The results of an RT-PCR test of the patient's vaginal secretions were negative.

On February 22, an infant girl was delivered by cesarean in a negative-pressure isolation room. The mother wore an N95 mask and did not hold the infant. Her birth weight was 3120 g and Apgar scores were 9 at 1 minute and 10 at 5 minutes. The neonate had no symptoms and was immediately quarantined in the neonatal intensive care unit. At 2 hours of age, the SARS-CoV-2 IgG level was 140.32 AU/mL and the IgM level was 45.83 AU/mL. Cytokines were elevated (IL-6, 28.26 pg/mL; IL-10, 153.60 pg/mL), as well as a white blood cell count of  $18.08 \times 10^9/L$ . Chest CT was normal. The neonate was transferred to a children's hospital as per protocol. Results from 5 RT-PCR tests on nasopharyngeal swabs taken from 2 hours to 16 days of age were negative. Her IgM (11.75 AU/mL) and IgG (69.94 AU/mL) levels were still elevated on March 7 (**Table 2**), and she was discharged on March 18.

Table 1. Laboratory Results for the Mother

Time	Laboratory test	Value	Reference range
Feb 2	White blood cell count, $\times 10^9/L$	8.03	3.5-9.5
	Neutrophil count, $\times 10^9/L$	6.57	1.8-6.3
	Neutrophil ratio, %	81.9	40-75
	Lymphocyte count, $\times 10^9/L$	1.08	1.1-3.2
	Lymphocyte ratio, %	13.4	20-50
	C-reactive protein, mg/L	57	0-10
Feb 10	PCT, ng/mL	0.086	0.1
	ALT, U/L	40	7-40
	AST, U/L	38	13-35
Feb 10	PCR of nasopharyngeal swab	+	-
Feb 19	PCT of nasopharyngeal swab	+	-
	PCR of vaginal secretion	-	-
Feb 21	SARS-CoV-2 IgG, AU/mL	107.89	<10
	SARS-CoV-2 IgM, AU/mL	279.72	<10
Feb 26	PCR of nasopharyngeal swab	+	-
Feb 28	Breast milk	-	-
Feb 29	SARS-CoV-2 IgG, AU/mL	116.30	<10
	SARS-CoV-2 IgM, AU/mL	112.66	<10
Mar 1	PCR of nasopharyngeal swab	+	-

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; PCR, polymerase chain reaction; PCT, procalcitonin; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; -, negative; +, positive.

Table 2. Laboratory Results for the Neonate

Time	Laboratory test	Value	Reference range
Feb 22	White blood cell count, $\times 10^9/L$	18.08	3.5-9.5
	Neutrophil count, $\times 10^9/L$	13.46	1.8-6.3
	Neutrophil ratio, %	74.5	40-75
	Lymphocyte count, $\times 10^9/L$	2.89	1.1-3.2
	Lymphocyte ratio, %	16.00	20-50
	C-reactive protein, mg/L	<5.0	0-10
	PCT, ng/mL	0.137	<0.1
	ALT, U/L	11	7-40
	AST, U/L	65	13-35
	Total bilirubin, $\mu\text{mol/L}$	44.2	0-23
	Direct bilirubin, $\mu\text{mol/L}$	7.5	0-8.0
	Creatine kinase, U/L	937	40-200
	Lactate dehydrogenase, U/L	629	120-250
	Glucose, mmol/L	2.91	3.9-6.1
	Potassium, mmol/L	4.88	3.5-5.3
	IL-6, pg/mL	28.26	$\leq 20.0$
	IL-10, pg/mL	153.60	$\leq 5.9$
	SARS-CoV-2 IgG, AU/mL	140.32	<10
	SARS-CoV-2 IgM, AU/mL	45.83	<10
Feb 24	PCR of nasopharyngeal swab	-	-
Feb 27	PCR of nasopharyngeal swab	-	-
Mar 1	PCR of nasopharyngeal swab	-	-
Mar 6	PCR of nasopharyngeal swab	-	-
Mar 7	SARS-CoV-2 IgG, AU/mL	69.94	<10
	SARS-CoV-2 IgM, AU/mL	11.75	<10
Mar 9	PCR of nasopharyngeal swab	-	-

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; PCR, polymerase chain reaction; PCT, procalcitonin; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; -, negative.

On February 28, the mother's breast milk had a negative RT-PCR test result. On February 29, her IgG level was 116.30 AU/mL and her IgM level was 112.66 AU/mL. A CT examination showed moderate resolution of the ground-glass opacities.

**Discussion** | A neonate born to a mother with COVID-19 had elevated antibody levels and abnormal cytokine test results 2 hours after birth. The elevated IgM antibody level suggests that the neonate was infected in utero. IgM antibodies are not transferred to the fetus via the placenta.<sup>2</sup> The infant potentially could have been exposed for 23 days from the time of the mother's diagnosis of COVID-19 to delivery. The laboratory results displaying inflammation and liver injury indirectly support the possibility of vertical transmission. Although infection at delivery cannot be ruled out, IgM antibodies usually do not appear until 3 to 7 days after infection, and the elevated IgM in the neonate was evident in a blood sample drawn 2 hours after birth. Also, the mother's vaginal secretions were negative for SARS-CoV-2. The infant's repeatedly negative RT-PCR test results on nasopharyngeal swabs are difficult to explain, although these tests are not always positive with infection. IgG antibodies can be transmitted to the fetus through the placenta and appear later than IgM. Therefore, the elevated IgG level may reflect maternal or infant infection.

Limitations of this report include the single case and that no PCR testing of amniotic fluid or placenta was performed.

Additional examination of maternal and newborn samples should be done to confirm this preliminary observation.

**Lan Dong, MD**  
**Jinhua Tian, MD**  
**Songming He, MD**  
**Chuchao Zhu, MD**  
**Jian Wang, MD**  
**Chen Liu, MD**  
**Jing Yang, MD**

**Author Affiliations:** Department of Obstetrics & Gynecology, Renmin Hospital of Wuhan University, Wuhan, Hubei, China (Dong, Tian, He, Yang); Department of Obstetrics and Gynecology, General Hospital of Central Command Theater in PLA, Wuhan, Hubei, China (Zhu); Department of Radiology, First Affiliated Hospital to Army Medical University, Chongqing, China (Wang, Liu).

**Corresponding Authors:** Jing Yang, MD, Department of Obstetrics & Gynecology, Renmin Hospital of Wuhan University, 283 Jiefang Rd, Wuhan, Hubei 430060, China ([13507182023@163.com](mailto:13507182023@163.com)); Chen Liu, MD, Department of Radiology, First Affiliated Hospital to Army Medical University, 30 Gao Tan Yan St, Chongqing 400038, China ([liuchen@aifmri.com](mailto:liuchen@aifmri.com)).

**Published Online:** March 26, 2020. doi:[10.1001/jama.2020.4621](https://doi.org/10.1001/jama.2020.4621)

**Author Contributions:** Drs Liu and Yang had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Drs Dong and Tian contributed equally to the study. Drs Liu and Yang contributed equally as senior authors.

*Concept and design:* Wang, Liu, Yang.

*Acquisition, analysis, or interpretation of data:* Dong, Tian, He, Zhu.

*Drafting of the manuscript:* Dong, Tian, He, Zhu, Liu.

*Critical revision of the manuscript for important intellectual content:* Zhu, Wang, Liu, Yang.

*Statistical analysis:* Dong, Tian, He, Liu.

*Obtained funding:* Zhu, Wang, Liu, Yang.

*Supervision:* Zhu, Yang.

**Conflict of Interest Disclosures:** None reported.

**Funding/Support:** This work was supported by the Chongqing Key technology and application demonstration of medical imaging depth intelligent diagnostic platform (cstc2018jszx-cyztzxX0017), the National Key Research and Development Project (2018YFC1002804, 2016YFC1000600), and the National Natural Science Foundation of China (No. 81771618 and No. 81801524).

**Role of the Funder/Sponsor:** The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

**Additional Contributions:** We thank the family members who were involved in this study and we thank the patient for granting permission to publish this information.

1. Wang W, Xu Y, Gao R, et al. Detection of SARS-CoV-2 in different types of clinical specimens. *JAMA*. Published March 11, 2020. doi:10.1001/jama.2020.3786
2. Woo PC, Lau SK, Wong BH, et al. Detection of specific antibodies to severe acute respiratory syndrome (SARS) coronavirus nucleocapsid protein for serodiagnosis of SARS coronavirus pneumonia. *J Clin Microbiol*. 2004;42(5):2306-2309. doi:10.1128/JCM.42.5.2306-2309.2004
3. Xu W, Li J, He X, et al. The diagnostic value of joint detection of serum IgM and IgG antibodies to 2019-nCoV in 2019-nCoV infection. *Chinese J Lab Med*. 2020;43(00):E012-E012. doi:10.3760/cma.j.cn114452-20200223-00109
4. Chen H, Guo J, Wang C, 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(10226):809-815. doi:10.1016/S0140-6736(20)30360-3