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Impact of COVID-19 infection on pregnancy outcomes and the risk of maternal-to-neonatal intrapartum transmission of COVID-19 during natural birth

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Abstract: Little is known about the maternal-to-neonatal intrapartum transmission of COVID-19 *via* vaginal route. In this study, we report the adverse pregnancy outcomes in pregnant women infected with COVID-19 pneumonia and the risk of intrapartum transmission of COVID-19 *via* vaginal route. None of the three neonates were infected with COVID-19 delivered *via* natural birth. Only one neonate was delivered prematurely. No neonatal death and stillbirth were observed in pregnant women infected with COVID-19. Moreover, all of the neonates had normal birth weight, birth length, and normal Apgar score.

Introduction: Atypical pneumonia known as coronavirus disease (COVID-19) caused by SARS-CoV-2 is highly infectious and is currently spreading rapidly around the globe. Since the emergence of SARS-CoV-2 in Wuhan, Hubei Province, China during December 2019, it has caused the global thousands of morbidities and mortalities around the globe [1]. Many studies focusing on infected patients from the general population have been reported, however, very limited details are available related to pregnancy outcomes of COVID-19 infected women. Until now Chen et al [2] reported the maternal-neonatal outcomes and vertical transmission potential of COVID-19 pneumonia in pregnant women. Their report focused on the pregnant women who delivered babies through C-section only, however, no case for normal vaginal delivery was reported. Moreover, no healthcare worker was included, although, healthcare workers are at higher risk of contracting the infection and psychological consequences[3]. We conducted a case report study in pregnant women with laboratory-confirmed COVID-19 infection who delivered babies through the vaginal route at Renmin Hospital, Wuhan, China. Both healthcare workers and general women were included in this study.

Method: We conducted a case report study on pregnant women (n =3) infected with COVID-19 admitted to Renmin hospital from Jan 28 to March 1, 2020. COVID-19 pneumonia was diagnosed according to the new Coronavirus Pneumonia Prevention and Control Program

(4th edition) published by the National Health Commission of China [7]. All the three pregnant women were found positive for COVID-19 using quantitative RT-PCR (qRT-PCR) on specimens from the respiratory tract (nasal and pharyngeal swabs) and blood specimens [8]. In order to know neonatal infection with COVID-19, cord blood and neonatal throat swab samples were collected after delivery (within 12 hours) in the operating room and was tested by using quantitative RT-PCR (qRT-PCR) [8]. All the available information was collected and presented in tables regarding maternal-neonatal outcomes. The study protocol was approved by the Ethical Review Board of the Renmin hospital.

Case presentation

Case 1: Patient 1 was a 28 years old woman, (gravida 1, para 1) at 34^{+6dyas} weeks' gestation. On admission (28^{th} January 2020), she was found with the onset of fever and cough. She had a history of contact with a COVID-19 infected patient. Her body temperature was 37.3°C. The laboratory test of the nasopharyngeal swab was found positive for COVID-19. On 28^{th} January, at 34^{+6days} weeks of pregnancy, a preterm live baby was delivered *via* vaginal route. The newborn responded well, with an Apgar score of 8-9 at 1 min and 5 min respectively. The neonatal birth weight was 2890 g and the birth length was 48 cm. The newborn was found negative with COVID-19 infection and was under observation in the neonatal department. To prevent and control postpartum infection, the patient was given an intravenous injection of azithromycin, oral Lianhua Qingwen capsules (Chinese medicine) and oseltamivir antiviral drugs.

Case 2: Patient 3 was a 33 years old woman, (gravida 1, para 1) at 39^{+1day} weeks gestation. She was admitted to the hospital on 22^{nd} February 2020, with the onset of fever and cough. Her body temperature was 37.6° C. She had a history of contact with a COVID-19 infected family member. The laboratory test of the nasopharyngeal swab was found positive for

COVID-19. On 22nd February, at 39^{+1days} weeks of pregnancy, she delivered a baby *via* a vaginal route with an Apgar score of 9-10, birth weight of 3500 g and birth length of 50 cm. The newborn was found negative with COVID-19 infection. The patient was given antibiotics, antiviral drugs, and intermittent oxygen inhalation.

Case 3: Patient 2 was a 27 years old woman, (gravida 1, para 1) at 38^{+2days} weeks gestation. She was admitted to the hospital on 1st March 2020, with the onset of cough and chest tightness. She had a history of contact with a COVID-19 infected patient. The laboratory test of the nasopharyngeal swab was found positive for COVID-19. The fetal heart was good and the ultrasound examination was normal. On 1st March, at 38^{+2days} weeks of pregnancy, she delivered a term live baby *via* a vaginal route with an Apgar score of 9-10, birth weight of 3730 g, and birth length of 51 cm. The baby laboratory test of the nasopharyngeal swab was found negative for COVID-19. The baby was transferred to the pediatric ward and kept under observation. The patient was given antibiotics, antiviral drugs, Chinese medicine, and intermittent oxygen inhalation.

Table 1: A summary of maternal and neonatal outcomes infected with COVID-19

Case No.	**1**	**2**	**3**	**n/N (%)**
Maternal and neonatal outcomes				
Age (Years)	28	33	27	------
Gravida (G) and Para (P)	G1,P1	G1,P1	G1,P1	------
Gestational age on admission (weeks^{+days})	34^{+6}	39^{+1}	38^{+2}	------
Mode of delivery				
Vaginal route	Yes	Yes	Yes	3/3 (100%)
Sign and symptoms				
Fever	Yes	Yes	No	2/3 (66.6%)
Cough	Yes	Yes	Yes	3/3 (100%)
Chest tightness	No	No	Yes	1/3 (33.3%)
Infected with COVID-19	Yes	Yes	Yes	3/3 (100%)
Laboratory results				
White blood cell count (× 10⁹ cells per L)	7.5	11.7	12.9	------
Lymphocyte count (× 10⁹ cells per L)	1.1	2.76	1.06	------
C-reactive protein(mg/L)	32	18.4	1.5	------
ALT (U/L)	10	16	6	------
AST (U/L)	30	27	13	------
Neonatal outcomes				
Apgar score(1 min, 5 min)	8-9	9-10	9-10	------
Birth weight (g)	2890	3500	3730	------
Birth length (cm)	48	50	51	------
Preterm delivery	Yes	No	No	1/3 (33.3%)
Neonatal death/still birth	No	No	No	0/3 (0.00%)
Infected with COVID-19	No	No	No	0/3 (0.00%)

Discussion: We report a case report study of three pregnant women with laboratory-confirmed COVID-19 pneumonia. All of the three pregnant women delivered babies *via* vaginal route. Almost similar signs and symptoms manifested by these patients with COVID-19 infection, as reported in a very recent study [2]. We found that one of three patients (case 1) delivered a preterm baby. However, preterm baby (case 1) was found negative with COVID-19 and suggest that the preterm was not caused by vertical transmission of COVID-19. Moreover, preterm delivery may be caused by psychological stress during pregnancy associated with COVID-19 pneumonia. Chen et al [2] found four of nine patients had a preterm delivery, but preterm delivery was not associated with COVID-19 pneumonia. However, they believed that preterm delivery was associated with severe preeclampsia and other complications that were not observed in our study.

We did not observe neonatal death or stillbirth in four patients. However, during 2002–03 pandemic, twelve pregnant women were infected with SARS-CoV. Four of seven (57%) pregnant women had a miscarriage in the first trimester of pregnancy. Four of five (80%) pregnant women had preterm delivery [4]. In this study, two of three patients (66.6%) were found with elevated C-reactive protein (>10 mg/L). Like Chen et al [2], we also found elevated C-reactive protein (>10 mg/L) in pregnant women with COVID-19 pneumonia. The neonatal birth weight ranged from 2890 g to 3730 g. The neonatal birth length ranged from 48 cm to 51 cm. All of the three neonates were found with normal Apgar scores ranged from 8-10 at 1 min and at 5 min. All neonates were found negative with COVID-19 infection. This case report study was limited to the small sample size. However, a study with a large sample size should be encouraged to investigate the possibility of COVID-19 vertical transmission in the second and third trimester of pregnancy and possible adverse pregnancy outcomes. In summary, none of the four patients died of COVID-19 infection, as of March 1, 2020. No vertical transmission of COVID-19 was found in the third trimester of pregnancy delivered

via vaginal route. Moreover, we did not find evidence of maternal-to-neonatal intrapartum transmission of COVID-19 *via* vaginal route.

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Ethical statement: The work described has been carried out in accordance with The Code of Ethics of the World Medical Association and informed consent was obtained from the patients and parents of the babies.

Conflict of interest: The authors declare that there is no conflict of interest.

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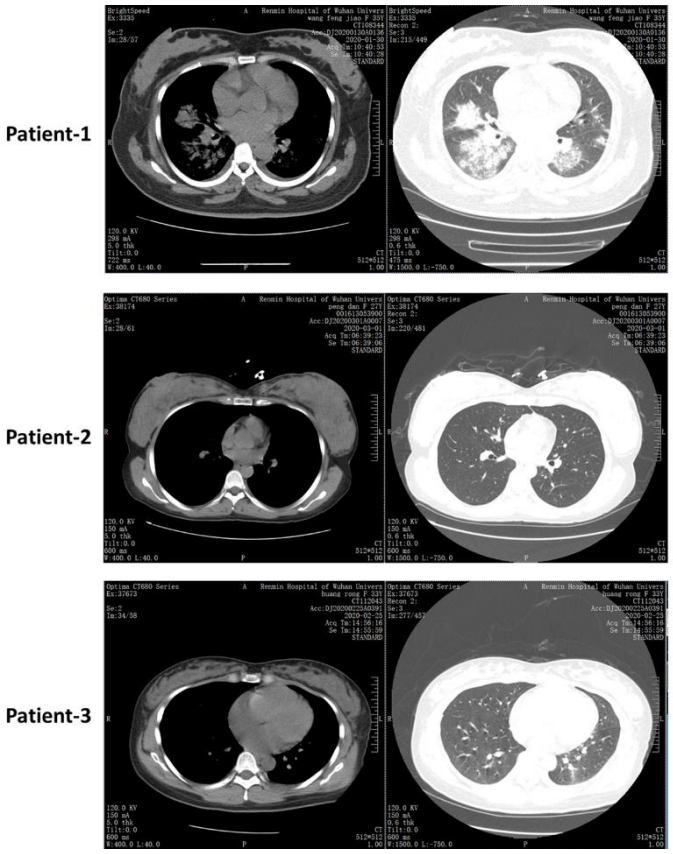

Figure 1. Chest CT scans of three patients. This figure shows patchy consolidation and opacities