COVID-19 and Pregnancy: A Case Study

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The 2019 novel coronavirus disease is spreading all over the world. Pregnant women and infants require particular concern, owing to the special immune conditions. A case of a pregnant woman who was exposed to SARS-CoV-2 at 34+1 weeks gestation and chose to continue pregnancy is reported. Without obvious symptoms or signs, the woman did not receive any treatment before delivery, and gave birth at 37+5 weeks to a neonate with positive immunoglobulin G for SARS-CoV-2 and negative nucleic acid tests. The mother was given anti-infection, oxytocin, and fluid rehydration treatment after delivery. Both mother and infant recovered well after a three-month follow-up. Continued expectation to deliver at term instead of preterm can decrease the potential risk of severe perinatal and infant complications and is beneficial to the development of the neonate. More studies are required to confirm the presence of vertical transmission.

In this study, we report a confirmed case of pregnant woman who was exposed to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) at 34+1 weeks and gave birth at 37+5 weeks to a neonate with positive immunoglobulin G (IgG) for SARS-CoV-2.

A 30-year-old woman (gravida 2, para 1) at 34+1 weeks' gestation developed fever on February 2, 2020. The highest point reached 38.5 °C. Before the onset of the symptom, nuchal translucency (NT), maternal serum markers for Down's Syndrome screening, non-invasive prenatal genetic testing (NIPT), oral glucose tolerance test (OGTT), and fetal ultrasound were performed on the patient, and no abnormality was found.

She lived with her husband, her son, and parents-in-law and had no other close contact expect her family members. On the same day, her mother-in-law, who always went to market with nonsurgical mask and eventually diagnosed with COVID-19, developed the same symptom. After developing fever, the patient started to take Ibuprofen suspension (20 mL PO Q8hrs) by herself and relieved after 8 d.

All family members received nucleic acid tests (NATs) for SARS-CoV-2 on throat swab samples on February 8, 2020, and positive result was found only in her mother-in-law. However, abnormal chest computed tomography (CT) was noticed in all members except her son. Ground-glass opacities were found in the patient’s right-side lung. Then the patient was transferred to isolation ward as a close contact with the confirmed case. The nucleic acid test was repeated twice but both were negative. Without obvious symptoms or signs, she did not receive any treatment in the isolation ward and chose to continue expectant till 37+5 weeks without fully maturation treatment. Fetal ultrasound on February 22, 2020, found no abnormality.

Before delivery, her vital signs were normal (body temperature 36.5 °C, blood pressure 130/80 mmHg, respiratory rate 20 breaths min⁻¹, and pulse rate 80 beats min⁻¹), and the pertinent laboratory findings are listed in Table 1. The fetal heart rate (FHR) was 135 bpm and fetal heart monitoring was normal. Due to the history of the scarred uterus, the patient underwent a cesarean section at 37+5 weeks' gestation on February 27, 2020. A 3860 g male infant was delivered without complication. Apgar scores at 1 and 5 min were 8 and 9, respectively. Lung auscultation on neonate revealed no rhonchi over the lung. The mother was given anti-infection, oxytocin, fluid rehydration treatment after surgery. Laboratory examinations revealed elevated leukocyte count, neutrophils, and C-reactive...
Table 1. Laboratory results for the mother and neonate.

| Date              | Days after birth | Laboratory test                  | Value  | Reference rangea) |
|-------------------|------------------|----------------------------------|--------|-------------------|
| **Mother**        |                  |                                   |        |                   |
| February 8, 2020  | –                | NAT of throat swab               | –      | –                 |
| February 26, 2020 | –                | Leucocyte count [\(\times 10^9 \text{ L}^{-1}\)] | 8.11   | 3.5–9.5           |
|                   |                  | Lymphocyte count [\(\times 10^9 \text{ L}^{-1}\)] | 1.56   | 1.1–3.2           |
|                   |                  | Neutrophil ratio [%]             | 75.7   | 40–75             |
|                   |                  | Hb [g L\(^{-1}\)]               | 124    | >110              |
|                   |                  | PLT [\(\times 10^9 \text{ L}^{-1}\)] | 181    | 150–400           |
|                   |                  | Fibrinogen [mg L\(^{-1}\)]      | 4.24   | 2–4               |
|                   |                  | D-dimer [\(\mu \text{g mL}^{-1}\)] | 1.7    | <0.4              |
|                   |                  | CRP [mg L\(^{-1}\)]             | 0.7    | <1                |
| February 27, 2020 | –                | Leucocyte count [\(\times 10^9 \text{ L}^{-1}\)] | 11.37  | 3.5–9.5           |
|                   |                  | Lymphocyte count [\(\times 10^9 \text{ L}^{-1}\)] | 1.46   | 1.1–3.2           |
|                   |                  | Neutrophil ratio [%]             | 83     | 40–75             |
|                   |                  | Hb [g L\(^{-1}\)]               | 112    | >110              |
|                   |                  | PLT [\(\times 10^9 \text{ L}^{-1}\)] | 147    | 150–400           |
|                   |                  | Fibrinogen [mg L\(^{-1}\)]      | 5.99   | 2–4               |
|                   |                  | D-dimer [\(\mu \text{g mL}^{-1}\)] | 4.14   | <0.4              |
|                   |                  | CRP [mg L\(^{-1}\)]             | 13     | <1                |
| **Neonate**       | 0                | NAT of amniotic fluid            | –      | –                 |
| February 27, 2020 |                  | NAT of throat swab               | –      | –                 |
|                   | 0                | SARS-CoV-2 IgG [AU mL\(^{-1}\)] | 134.13 | ≤10               |
|                   | 0                | SARS-CoV-2 IgM [AU mL\(^{-1}\)] | 3.52   | ≤10               |
|                   | 0                | Urine leucocyte                  | +      | –                 |
|                   | 0                | Specific gravity                 | 1.009  | 1.001–1.020       |
|                   | 0                | Leucocyte count [µL\(^{-1}\)]   | 20.7   | 0–4 per low-power field |
|                   | 0                | Leucocyte count [\(\times 10^9 \text{ L}^{-1}\)] | 16.48  | 9–30              |
|                   | 0                | Neutrophil count [\(\times 10^9 \text{ L}^{-1}\)] | 11.15  | 2.5–8             |
|                   | 0                | Neutrophil ratio [%]             | 67.7   | 55–70             |
|                   | 0                | Lymphocyte ratio [%]             | 20.8   | 20–40             |
|                   | 0                | RBC [\(\times 10^12 \text{ L}^{-1}\)] | 3.74   | 4.8–7.1           |
|                   | 0                | Hb [g L\(^{-1}\)]               | 140    | 140–240           |
|                   | 0                | PLT [\(\times 10^9 \text{ L}^{-1}\)] | 369    | 150–300           |
|                   | 0                | β\(_2\) microglobulin [mg L\(^{-1}\)] | 1.55   | 1–2               |
|                   | 0                | Urine creatinine [µmol L\(^{-1}\)] | 2677   | 88–176 µmol kg\(^{-1}\) d\(^{-1}\) |
|                   | 0                | Cystatin C [mg L\(^{-1}\)]      | 1.87   | 0.6–2.5           |
|                   | 0                | hs-CRP [mg L\(^{-1}\)]          | 0.5    | <10               |
|                   | 0                | cTnI [pg mL\(^{-1}\)]           | 8.1    | <20               |
|                   | 0                | NT-proBNP [pg mL\(^{-1}\)]      | 1342   | <125 (adult)      |
|                   | 0                | TBil [µmol L\(^{-1}\)]          | 76.4   | 17.1–205          |
|                   | 0                | DBil [µmol L\(^{-1}\)]          | 7.5    | 1.7–5.1           |
|                   | 0                | ALT [U L\(^{-1}\)]             | 6      | 4–36              |
|                   | 0                | AST [U L\(^{-1}\)]             | 26     | 35–140            |
|                   | 0                | TP [g L\(^{-1}\)]              | 51.4   | 46–74             |
|                   | 0                | ALB [g L\(^{-1}\)]             | 35.3   | 35–54             |
protein level (listed in Table 1). She was afebrile without any discomfort. Her pharyngeal swab sampled for COVID-19 was still negative on two successive examinations and the result of CT was normal on March 2, 2020. The mother was discharged on March 5, 2020, and a high level of IgG and immunoglobulin M (IgM) to SARS-CoV-2 was first found from the peripheral blood on March 10, 2020. Therefore, according to the Chinese Clinical Guidance for COVID-19 Pneumonia Diagnosis and Treatment (7th ed.),[4] this patient was finally diagnosed as a COVID-19 confirmed case on March 10, 2020.

The throat swabs, peripheral blood samples, and amniotic fluid of the neonate were collected and tested for nucleic acid and antibodies of SARS-CoV-2 immediately at birth. The only positive result was high IgG level in peripheral blood (134.13 AU mL⁻¹). Most of the laboratory findings were normal except an elevated leukocyte count and an alleviated lymphocyte (listed in Table 1). The antibodies in neonate peripheral blood were tested twice on March 4 and March 8, 2020, and the IgG was still at a high level (215.04 and 119 AU mL⁻¹).

| Date       | Days after birth | Laboratory test | Value       | Reference range |
|------------|------------------|-----------------|-------------|-----------------|
| March 4, 2020 | 6                | SARS-CoV-2 IgG [AU mL⁻¹] | 215.04      | ≤10             |
|            |                  | SARS-CoV-2 IgM [AU mL⁻¹] | 2.38        | ≤10             |
|            |                  | NAT of throat swab | –           | –               |
|            |                  | Stool routine    | –           | –               |
|            |                  | Urinalysis       | –           | –               |
| March 8, 2020 | 10               | SARS-CoV-2 IgG [AU mL⁻¹] | 119         | ≤10             |
|            |                  | SARS-CoV-2 IgM [AU mL⁻¹] | 2.79        | ≤10             |
|            |                  | NAT of throat swab | –           | –               |
|            |                  | NAT of anal swab  | –           | –               |
|            |                  | NAT of urine     | –           | –               |
|            |                  | NAT of excrement  | –           | –               |
|            |                  | TBil [µmol L⁻¹]  | 128.4       | 17.1–205        |
|            |                  | DBil [µmol L⁻¹]  | 14          | 1.7–5.1         |
|            |                  | ALT [U L⁻¹]      | 6           | 4–36            |
|            |                  | AST [U L⁻¹]      | 18          | 15–60           |
|            |                  | TP [g L⁻¹]       | 49          | 46–74           |
|            |                  | ALB [g L⁻¹]      | 32.8        | 35–34           |
|            |                  | LDH [U L⁻¹]      | 295         | 160–450         |
|            |                  | hsCRP [mg L⁻¹]   | 0.3         | <10             |
|            |                  | Leucocyte count [× 10⁹ L⁻¹] | 9.87 | 9–30             |
|            |                  | Neutrophil count [× 10⁹ L⁻¹] | 4.44 | 2.5–8           |
|            |                  | Neutrophil ratio [%] | 45 | 55–70           |
|            |                  | Lymphocyte count [× 10⁹ L⁻¹] | 3.94 | 1–4             |
|            |                  | Lymphocyte ratio [%] | 39.9 | 20–40           |
|            |                  | RBC [× 10¹² L⁻¹] | 3.15        | 4.8–7.1         |
|            |                  | Hb [g L⁻¹]       | 112         | 140–240         |
|            |                  | PLT [× 10⁹ L⁻¹]  | 546         | 150–300         |
|            |                  | IL-6 [pg mL⁻¹]   | <5          | <5              |
|            |                  | IL-10 [pg mL⁻¹]  | <5          | <7              |
| Notes: NAT, nucleic acid test; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2; RBC, red blood cell; Hb, hemoglobin; PLT, platelet; CRP, C reaction protein; hsCRP, hypersensitivity C reaction protein; cTnI, cardiac troponin I; NT-proBNP, N-terminal pronatriuretic peptide; TBil, total bilirubin; DBil, direct bilirubin; ALT, alanine aminotransferase; AST, aspartate aminotransferase; TP, total protein; ALB, albumin; IL, interleukin; TNF, tumor necrosis factor; –, negative; +, positive.

Table 1. Continued.
excrement, and urine at the same time were all negative. On March 8, 2020, the neonate developed symptoms of jaundice and the laboratory findings showed an elevated serum total bilirubin, interleukin 2 receptor, and tumor necrosis factor α (listed in Table 1). The neonate was diagnosed as physiological jaundice not neonatal hyperbilirubinemia by his medical history and the clinical standard. In this case, the neonate jaundice appeared on the 10th day after birth, and lasted for 4 d. The direct bilirubin was 14 µmol L⁻¹, which was less than the minimum threshold of neonatal hyperbilirubinemia, i.e., 34 µmol L⁻¹. An intermittent phototherapy was provided. The neonate recovered and was discharged on March 11, 2020. A seven-month follow-up showed that the development of neonate, including the intelligence, weight (11 kg), and height (80 cm), were all in the normal range. Reexaminations of the mother’s SARS-CoV-2 NATs and antibodies also came negative on May 7, 2020.

COVID-19 is an emerging disease which is highly contagious and spreading rapidly all over the world. Pregnant women and infants are potential vulnerable groups owing to the physiological changes and low immune, respectively. Several studies revealed that pregnant women may have a high risk of obstetric complications and perinatal adverse outcomes after virus infection.

In this case, we reported a pregnant woman exposed to SARS-CoV-2 in her late trimester. She was finally diagnosed as a COVID-19 confirmed case by serum antibodies on March 10, 2020. According to the previous studies which demonstrated that the antibodies levels increased rapidly during the first two weeks, we retrospect her course of the disease and speculate that she was infected before delivery. Her nucleotide assays were all negative, considering the possibility of sample collection and/or detection methods and the positive antibodies. Given that she developed fever symptom on February 2, 2020, and the abnormality in her CT on February 8, there is a high possibility that she was infected at that time. Therefore, the infant may be exposed to SARS-CoV-2 for 26 d.

The mother and the newborn recovered well till the censorship of follow-up. Disease was mild in this patient and the symptom improved rapidly only by taking Ibuprofen suspension, which demonstrated that pregnant women with COVID-19 might not have adverse outcomes. Our multicenter retrospective study reviewed 92 pregnant women with COVID-19 and their 78 newborns, and all the pregnant women had recovered and discharged from hospital (unpublished data). Large series are required to confirm the outcome of this cohort and the effect of the virus on the fetus.

This patient was exposed to virus at 34+1 weeks’ gestation and gave birth at 37+5 weeks. Positive IgG and negative IgM were found in three times’ tests of antibodies for SARS-CoV-2 in the neonate. Due to the nucleic acid of infant’s throat swabs, excrement, anal swab and amniotic fluid were all negative, the possibility of perinatal transmission of COVID-19 was low. Therefore, it is possible that mother produced antibodies against the virus, and the IgG was transferred to the fetus via placenta, which may protect the fetus/neonate. There is no evidence to demonstrate that COVID-19 causes neonatal jaundice. In our case, the neonate was diagnosed with physiological jaundice according to his medical history and laboratory findings. In fact, neonatal jaundice is one of the most common phenomena in neonatal period, and mainly associated with the metabolic characteristics of bilirubin. The newborn had no pathological jaundice without cause of hyperbilirubinemia, for example, perinatal asphyxia, sepsis, hepatitis, biliary atresia, choledochal cyst, metabolic acidosis, immune hemolysis, glucose-6-phosphate dehydrogenase (G6PD) deficiency, and drugs. However, during the COVID-19 outbreak period, some rapid and progressive newborn diseases like bilirubin encephalopathy should not be ignored. Obstetricians and pediatricians should review the maternal medical history and birth history in detail, and examine comprehensively.

Clinicians should always weight the balance between possible risk of vertical transmission and the benefit of expectant management in pregnancy. As there was no direct evidence of COVID-19 vertical transmission, the patient with stable vital signs and normal fetal ultrasound chose expectant management for 26 d. The neonate’s birth weight was in a normal range and no complications and abnormal symptoms were noticed except a high IgG titer. Currently, no definitive conclusion has been reached on when to induce birth with mild COVID-19. In this case, the development of the neonate was satisfactory and the mother recovered well, which indicated that immediate termination of pregnancy might not be necessary for all cases. Continued expectation to deliver at term instead of preterm can decrease the potential risk of severe perinatal and infant complications and is beneficial to the development of the neonate.

Acknowledgements

This study was supported by the National Clinical Research Center for Obstetrics and Gynecology (2015BAI13B05); the National Natural Science Foundation of China (81672083, 81372804, 81873843); the Chinese Medical Association of Clinical Medicine special funds for scientific research projects (170204000709); and the Hubei Provincial Natural Science Foundation of China (2019CF0062). The patient’s permission for the publication of this case study was obtained. The opinions expressed by authors contributing to this journal do not necessarily reflect the opinions of the Centers for Disease Control and Prevention or the institutions with which the authors are affiliated.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

R.L. and D.W. contributed equally to this work. D.R.D. and S.J.L. contributed to study design. R.L., D.W., X.G.L., D.L., R.J.W., and L.J. contributed to the data collection. R.L. and D.W. analyzed the data. R.L. and W.L.L. interpreted the results. R.L., D.R.D., W.L.L., and S.J.L. wrote the manuscript. All authors contributed to the revision of the manuscript and the final approval of the version to be published.
Keywords

birth induction, COVID-19, IgG, vertical transmission

Received: August 18, 2020
Revised: October 18, 2020
Published online:

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