

# Value of chest imaging in the newborn with suspected COVID-19

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**Abstract. – OBJECTIVE:** This paper presents a newborn (G2P2, gestational age of 39+6 weeks, birth weight of 3,200 g, with normal fetal amniotic fluid) with suspected coronavirus disease 2019 (COVID-19) admitted to our hospital on February 10, 2020, at the birth age of 16 hours and 34 minutes. The Apgar scores at 1 and 5 min were 9 and 10 points, respectively.

**PATIENTS AND METHODS:** The mother of the newborn was exposed to a patient with COVID-19 five days before delivery. The newborn had nausea and vomiting after birth, with feeding intolerance, and full enteral feeding was given on the 6th day after birth. The newborn was in good general condition during the period of hospitalization.

**RESULTS:** The two 2019-nCoV nucleic acid tests of the newborn were negative on the 5th and 7th days after birth. On the 1st and 8th days after birth, typical pulmonary lesions were detected in the newborn by chest CT. Our study supports that chest imaging examination should be actively performed in the newborn even with a negative 2019-nCoV nucleic acid test in cases where a pregnant woman is exposed to a patient with COVID-19 or is confirmed with 2019-nCoV infection.

**CONCLUSIONS:** For newborns with typical pulmonary lesions, strict quarantine measures are suggested if the possibility of COVID-19 cannot be excluded.

## Key Words:

2019-nCoV infection, Newborn, Coronavirus disease 2019 (COVID-19), Pulmonary lesion.

## Introduction

Coronavirus disease 2019 (COVID-19) is highly infectious, and the population is generally susceptible to 2019-nCoV according to epidemiological investigations<sup>1-3</sup>. Children, especially newborns, are a special group. Accurate diagnostic criteria, as well as active and effective treatment and quarantine measures, are of great significance to

reduce the further spread of 2019-nCoV and to improve the outcome of the disease. Our hospital is the only hospital in Baoding City designated for the quarantine of patients suspected of having COVID-19. One newborn less than 1 day after birth with suspected COVID-19 was admitted to our hospital on February 10, 2020. The pediatric patient received active symptomatic treatment during the period of hospitalization with a good therapeutic effect, was cured, and was discharged after 10 days of quarantine.

## Patients and Methods

### Case Presentation

#### Condition on admission

A male pediatric patient of Han ethnicity, the son of Qu, aged 16 hours and 34 minutes, was admitted to the hospital at 00:59 on February 10, 2020, due to “nausea and vomiting for 6 hours”. The patient was born at 39<sup>+6</sup> weeks to a G2P2 mother by normal spontaneous delivery with signs of labor. The cord had been wrapped around the newborn’s neck for one week before birth, with no abnormalities in the fetal amniotic fluid or placenta. The Apgar score was 9 and 10 points at 5 min and 10 min after respiratory tract clearance and subsequent warming. The newborn weighed 3.2 kg and was given the opportunity to breastfeed approximately 3 hours after birth. The newborn had nausea and vomiting for 6 hours before admission, with brown vomitus once and poor suckling. The newborn was provided with gastric lavage at the local hospital, with an intragastric injection of 200 units thrombin and an intramuscular injection of 1 mg vitamin K<sub>1</sub>. After that, the newborn was sent to the Outpatient Department of our hospital for treatment. Routine blood test+CRP+SAA: White blood cell count of 21.21×10<sup>9</sup>/L, lymphocyte ratio of 7.40%, lympho-

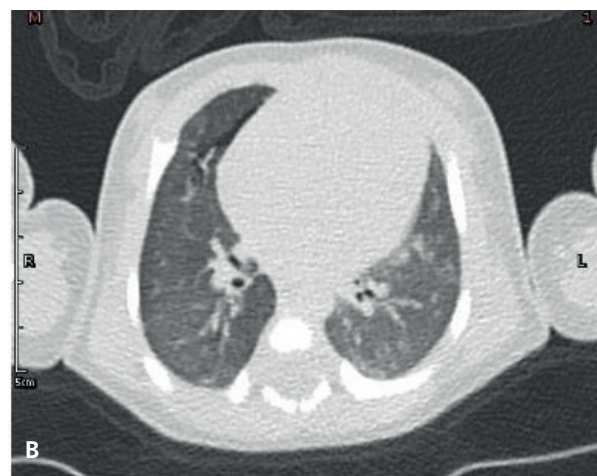
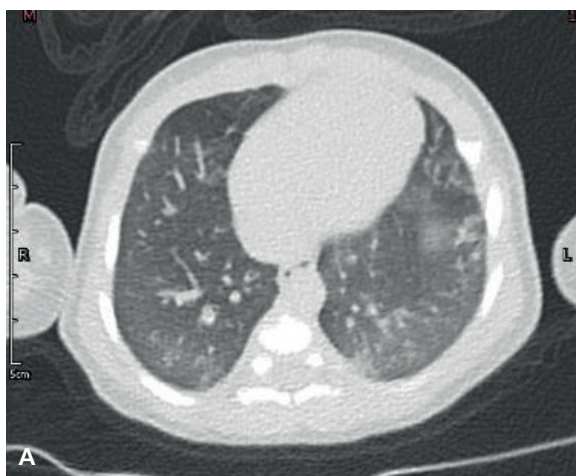
cyte count of  $1.58 \times 10^9/L$ , hemoglobin of 159.00 g/L, platelet of  $141.00 \times 10^9/L$ , neutrophil ratio of 84.80%, neutrophil count of  $17.97 \times 10^9/L$ , SAA of 19.93 mg/l, and C-reactive protein (CRP) of  $<1.00$  mg/L. Chest CT: Inflammation of both lungs, multiple localized bright areas on the right lung margin, and a small amount of pneumothorax". The mother of the newborn was healthy during pregnancy, and his parents both had the blood type of Rh positive, type O. Epidemiological history: the mother had contact with a confirmed COVID-19 patient on February 5 (4 days before delivery) during her prenatal examination at a county hospital. After expert consultation, the newborn was considered to have "suspected COVID-19", transferred to our department by ambulance under the escort of medical staff, and admitted to our hospital due to "suspected COVID-19". Physical examination on admission: T of  $36.7^\circ C$ , P of 130 times/min, R of 42 times/min, BP of 70/39 mmHg, Wt of 3.2 kg, with a clear mind, typical appearance of a full-term infant, normal responses, relatively stable breathing, visible red rash scattered all over the body with no abscesses or ulcerations, low tension of the anterior fontanelle, no stiff neck, coarse breathing sounds in both lungs, no monitoring of rhonchus and moist rales, strong heart sounds, soft abdomen, no umbilical cord separation with oozing, no palpable swelling in the liver and spleen, slightly weakened bowel sounds, normal muscular tension of the four limbs, and presence of neonatal reflexes. Initial diagnosis: 1. Suspected COVID-19; 2. neonatal gastrointestinal dysfunction; and 3. erythema neonatorum.

### Supplementary Examination

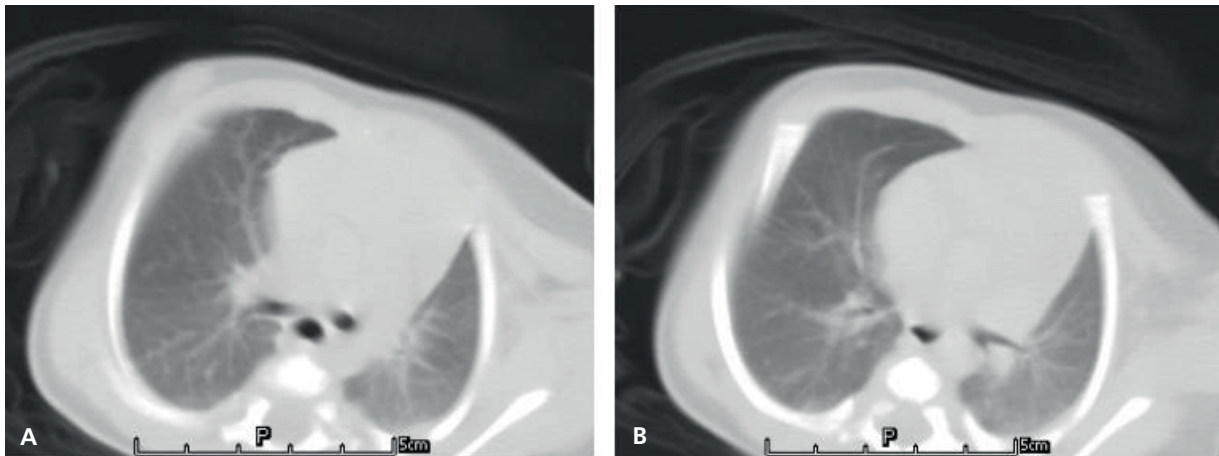
Outpatient chest CT on February 9, 2020: multiple ground glass opacities and small patchy high-density shadows in both lungs, especially in the outer zone of the lower lung, with an unclear boundary. Strip-like and localized bright areas in the right lung margin were also present. Examination and diagnosis: bilateral lung inflammation, multiple localized bright areas on the right lung margin, and a small amount of pneumothorax (Figures 1 A, B).

### Results of Laboratory Tests on February 10, 2020

Routine blood test+CRP+SAA: white blood cell count of  $20.21 \times 10^9/L$ , red blood cell count of  $6.04 \times 10^{12}/L$ , lymphocyte ratio of 15.20 %, lymphocyte count of  $3.07 \times 10^9/L$ , hemoglobin of 220.00 g/L, platelet of  $334.00 \times 10^9/L$ , neutrophil ratio of 79.10 %, neutrophil count of  $15.98 \times 10^9/L$ , SAA of 24.22 mg/l, and CRP of 16.36 mg/L. The increase in CRP indicated the presence of a bacterial infection. Myocardial enzymes: aspartate aminotransferase of 88.00 U/L $\uparrow$ , creatine kinase isoenzyme of 57.00 U/L $\uparrow$ , creatine phosphokinase of 649.00 U/L $\uparrow$ , and lactic dehydrogenase of 979.00 U/L $\uparrow$ , suggesting the presence of myocardial damage. Liver function: albumin of 38.50 g/L $\downarrow$ , ratio of alanine aminotransferase and aspartate aminotransferase 0.26 $\downarrow$ , alanine aminotransferase of 23.00 U/L, unconjugated bilirubin of 118.39  $\mu\text{mol}/L\uparrow$ , total bilirubin of 120.90  $\mu\text{mol}/L\uparrow$ , and total protein of 70.50 g/L, which were roughly normal. Renal function: carbon dioxide



**Figures 1. A-B,** Chest CT on February 9, 2020: multiple patchy ground glass opacities and small patchy high-density shadows in both lungs, especially in the extrapulmonary zone of the lower lung, with an unclear boundary. Strip-like and localized bright areas in the right lung margin.



**Figures 2. A, B.** Chest CT on February 17, 2020: reduced permeability of the lung field, multiple spot-like and patchy high-density shadows in the subpleural area of both lungs, with an unclear boundary.

of 14.47 mmol/L↓ and uric acid of 541.96 μmol/L↑, which were considered to be associated with the crying and low food intake of the newborn. The results of the four measures of coagulation were roughly normal.

Five infection tests on February 11, 2020 (HB-SAg, HBsAb, HBeAg, HBeAb, and HBcAb) were all negative. There was no abnormality in the routine stool test.

Pharyngeal swab culture on February 13, 2020: There was no bacterial growth in normal culture for 2 days. Routine urine test: Vitamin C of +3, which was speculated to be related to the infusion of vitamin C.

The first 2019-nCoV nucleic acid test on February 14, 2020: Negative.

The second 2019-nCoV nucleic acid test on February 16, 2020: Negative.

#### **Results of Supplementary Examination on February 17, 2020**

Routine blood test+CRP+SAA: white blood cell count of  $11.63 \times 10^9/L$ , red blood cell count of  $5.44 \times 10^{12}/L$ , lymphocyte ratio of 44.70 %, lymphocyte count of  $5.20 \times 10^9/L$ , hemoglobin of 190.00 g/L, platelet of  $386.00 \times 10^9/L$ , neutrophil ratio of 38.80 %, neutrophil count of  $4.52 \times 10^9/L$ , CRP of 3.60 mg/L, and SAA of <5.00 mg/l. Myocardial enzymes: aspartate aminotransferase of 88.00 U/L↑, creatine kinase isoenzyme of 25.00 U/L↑, creatine phosphokinase of 92.00 U/L, and lactic dehydrogenase of 272.00 U/L↑, all of which had clearly decreased since the last test, suggesting an improved condition. There was no abnormality in the liver function tests.

Pulmonary CT: reduced permeability of the lung field, multiple spot-like and patchy high-density shadows in the subpleural area of both lungs, showing a slight improvement from the last CT (Figures 2 A, B).

#### **Treatment**

The newborn was admitted to the isolation ward, given intravenous nutrition supportive therapy due to poor suckling, with blood glucose monitoring and gradual recovery of breastfeeding capacity. The newborn showed a positive reaction on skin test to both ceftazidime and cefuroxime. Therefore, the patient was provided with anti-infection therapy using erythromycin, ambroxol for resolving phlegm, and symptomatic therapy with vitamin C for myocardial nutrition. In addition, the patient received external applications of calamine to his buttock.

#### **Outcome**

On the 3<sup>rd</sup> day after birth (February 11, 2020), the newborn began to vomit without fever or cough. The child showed slight yellow staining of the skin during the hospitalization, with bilirubin levels fluctuating from 3.1 to 6.0 mg/dl. His milk intake improved gradually, and he had full enteral feeding on the 6<sup>th</sup> day after birth (February 16, 2020). The newborn had a good milk intake when discharged, and approximately 60-70 ml of milk was consumed each time. On February 17, 2020, the child showed improved clinical symptoms, stable breathing and no fever. There was no abnormality in a review of routine blood tests, C-reactive protein and SAA, and his chest



CT displayed improvements. His nucleic acid test was negative twice at a time interval of 24 hours. His mother underwent 14 days of quarantine, with a negative 2019-nCoV nucleic acid test result. Hence, the newborn was released from quarantine after 10 days of hospitalization, and he was discharged from the hospital after improvement. The child was followed up and found to be in good condition three months after birth.

## Discussion

According to previous reports, there is a relatively lower incidence of COVID-19 in children and an even lower incidence in newborns<sup>4</sup>. Close contact between family members is the main mode of 2019-nCoV infection in children<sup>5,6</sup>. In this regard, the number of children infected may increase as the number of adults infected increases<sup>7</sup>.

The data show that compared with adults, children infected with 2019-nCoV experience mostly mild illness, with atypical symptoms, such as vomiting, diarrhea and other gastrointestinal symptoms or only mental weakness and shortness of breath. However, children have low immunity<sup>8</sup>. The newborn period is a transitional stage in which newborns adapt from the intrauterine to the extrauterine environment. Newborn characteristics are thus different from those of infants and older children. Newborns are a special group with low immunity, they are not a mini version of adults.

It has been reported that 43.8% of adult patients with COVID-19 have no fever in the early stage<sup>9</sup>. With respect to the above, there may be a high rate of missed diagnoses of 2019-nCoV infection in children by adult symptom criteria, especially in those with mild illness<sup>5</sup>. Therefore, it is an important research issue to improve the rate of accurate diagnosis of children with mild illness and to achieve early quarantine.

The available data reveal that most of the reports related to newborns have emphasized whether there was vertical transmission from mother to child and the outcome of the mother and child<sup>10</sup>. For example, it has been reported that 10 pregnant women with COVID-19 have given birth to infants with a good clinical course, all with negative 2019-nCoV nucleic acid test results on pharyngeal swab<sup>11</sup>. However, serum 2019-nCoV IgM positivity was reported to be detected shortly after birth in a newborn whose mother had COVID-19<sup>12-13</sup>. However, considering the possibility of false-pos-

itive results<sup>14-15</sup>, IgM positivity alone cannot be regarded as the only diagnostic criterion for intrauterine transmission, and hence, a dynamic observation is required at the same time. At present, there are still no literature reports on pulmonary imaging of newborns born to pregnant mothers diagnosed with or exposed to COVID-19.

The newborn in our study was isolated from his mother at the hospital after birth and was transferred to our hospital for treatment due to feeding intolerance. The child was examined and showed negative results on 2019-nCoV nucleic acid tests on the 5<sup>th</sup> and 7<sup>th</sup> day after birth. The mother was generally in good condition before delivery, without pregnancy complications or infections. In addition, the mother had a history of contact with COVID-19 patients but had a negative 2019-nCoV nucleic acid test result in the local hospital, which did not support the diagnosis of 2019-nCoV infection.

Nevertheless, according to the results of routine blood tests and laboratory tests in the Outpatient Department and after admission to our hospital, the patient had a decreased neutrophil ratio and abnormally increased CRP and SAA. In combination with the history of pregnancy and childbirth, the mother had contact with a COVID-19 patient 4 days before delivery, and coarse breathing sounds were heard in the newborn's lungs during physical examination. Accordingly, the patient received chest CT after communication with the parents and informed consent had been obtained. On the 1<sup>st</sup> and 8<sup>th</sup> days after birth, his chest CT showed pulmonary inflammation. There were multiple small spot-like shadows, especially in the extrapulmonary zone, with decreased permeability of both lungs, multiple ground glass opacities and infiltrative shadows.

When considering the cause of his condition, there was a significant difference from common bacterial pneumonia but a high similarity to the chest CT of patients with 2019-nCoV infection. Based on the delivery history, the traced infection source, and the typical chest CT manifestations in particular, we suspected COVID-19. In addition, while there were no evident respiratory system signs in the child, there were significant gastrointestinal symptoms such as nausea and vomiting after birth, similar to the clinical manifestations of children with COVID-19. Therefore, the possibility of infection with 2019-nCoV could not be excluded at that time.

At present, there is no specific treatment for 2019-nCoV. The main protective measures are symptomatic supportive therapy, early control

of the source of infection and strict blocking of the transmission route in the clinical setting<sup>16</sup>. In this case, if there was an inexperienced doctor or an inaccurate understanding of the lung signs by the attending doctor, a chest imaging examination might not have been conducted or there might have been a delayed treatment using antibiotics and ambroxol or other symptomatic therapy. Therefore, it is necessary to carry out 2019-nCoV nucleic acid testing for newborns born to pregnant women exposed to COVID-19 and 2019-nCoV. Moreover, COVID-19 may be an inducing factor of illness deterioration in children. Moreover, even if the 2019-nCoV nucleic acid test is negative, it is recommended to carry out chest X-rays to understand the condition of the lungs, with chest CT if necessary.

### Conclusions

The newborn period is a special stage. In the clinical setting, great importance should be placed on detecting asymptomatic children with COVID-19<sup>17</sup> and on newborns with pulmonary lesions and negative 2019-nCoV nucleic acid test results. This paper analyzes the diagnosis and treatment process, as well as the chest CT manifestations of a newborn suspected of COVID-19 in our hospital, which is expected to provide assistance to the majority of medical workers so they can improve the quality of life of newborns.

### Authors' Contributions

Hong-ya Li and Cong-min Zhang conceived and designed the study; Yuan-yuan Lv and Wen-qiong Dai performed the study; and Bei Xu and Xiao-mi Qi provided analysis and interpretation of the study results. All the authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

### Ethical Approval

This study was approved by the Institutional Ethics Committee of Baoding First Central Hospital, and written informed consent was obtained from all participants.

### Conflict of Interest

The Authors declare that they have no conflict of interests.

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