

Coronavirus disease-2019 in a newborn: an autopsy and postmortem histology case report

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Article info


PATHOLOGY

Case report

Article history:
Accepted December 01,
2022

Published online
December 29, 2022

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Keywords:
SARS-CoV-2,
COVID-19,
Coronavirus disease 2019,
newborn death,
placenta

Abstract

The article presents the results of the pathological examination of the coronavirus disease in a child who lived 5 hours after the birth. The results. There was found at the autopsy examination focal meningoencephalitis (bacteriological examination - St. Aureus, St. Epidermidis), focal productive ependymitis, atelectasis of the left lung, bilateral polysegmental hemorrhagic-bacterial pneumonia (PCR of sectioned material of lung tissue for RNA virus SARS-CoV-2 positive, bacteriological examination of the tissue of the trachea, bronchi, lungs - St. Epidermidis, Enterobacter cloacae), necrotic erosive tracheitis, bronchitis, bronchiolitis, infectious-toxic shock, DIC-syndrome with hemorrhages in the lungs, kidneys, adrenal glands, serous membranes, total hemorrhage in the left adrenal gland with the formation of a cystic cavity, fetal hepatitis with multiple foci of extramedullary hematopoiesis, interstitial nephritis with necrosis of the epithelium of the renal tubules, erosive-necrotic esophagogastritis (bacteriological examination - Enterobacter cloacae), edema of the brain, lungs, dysplasia of the thymus with depletion of peripheral immune organs, parietal deciduitis. The detected changes in internal organs and tissues led to the development of multiple organ failure, which became the direct cause of the death of the newborn child. Conclusion. The data of multisystem morphological changes caused by SARS-CoV-2 in a newborn child presented in the article allows to enrich the small number of reports on neonatal loss in the case of coronavirus disease-2019 and to increase the awareness of neonatologists and pathologists about the clinical and morphological features of the disease. Further research will help improve the diagnosis and treatment of coronavirus disease in children.

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Introduction.

Pregnant women who are infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have

increased risk of severe complications from coronavirus disease-2019 (COVID-19) compared to non-pregnant

women of reproductive age [1]. There is a risk of developing some pregnancy complications (for example, premature birth) compared to uninfected or asymptomatic disease. But there is no conclusive evidence to suggest an increased risk of miscarriage or early pregnancy loss in women with COVID-19. Reports of short-term pregnancies with coronavirus infection do not show a relationship between infection and an increased risk of miscarriage or pregnancy loss [2].

There are isolated publications about intrauterine infection of the fetus with coronavirus from a sick mother [1], but most often newborns can become infected with COVID-19 during childbirth or during contact with sick people after childbirth. According to Chen et al., testing of amniotic fluid, umbilical cord blood, newborn throat swabs, and breast milk samples from mothers infected with COVID-19 were negative for viruses [3]. In another study, three placentas from infected mothers were tested and were virus-free [4]. There is currently no evidence for transmission of viruses through vaginal secretions, so mother-to-child transmission is most likely postnatal. Because there is no reliable data on in utero fetal damage from COVID-19, virus-induced congenital pathology of the fetus is currently considered unlikely.

Objectives.

To increase the awareness of neonatologists and pathologists regarding the clinical course and morphological changes of the internal organs of newborns with coronavirus disease, we offer a clinical case in practice.

Material and methods (Case presentation).

The article presents a clinical case of coronavirus disease in a child who lived 5 hours after birth and died of multiple organ failure. Postmortem diagnosis was carried out in compliance with biological safety requirements. All tissues were fixed in 10% buffered formalin for 28 hours followed by standard paraffin embedding. Histological sections were stained with hematoxylin and eosin.

Results.

A full-term newborn girl, K., was born at 13:35 on 18/09/2021 from the 1st pregnancy (complicated by SARS-CoV-2 at 38-39 weeks of gestation - positive PCR test in the mother), the first natural childbirth at 40 weeks gestation,

weighing 3200 grams, length 50 cm, with an Apgar score of 5-6 points. SARS-CoV-2 RNA was detected in the mother by polymerase chain reaction. After birth, the newborn child underwent sanitation of the upper respiratory tract under direct laryngoscopy, the intubation tube was clean, ventilation with an Ambu bag, after which independent breathing appeared. The child was transferred to the intensive care unit for observation, monitoring and treatment with the clinical diagnosis: Respiratory distress syndrome. The threat of intrauterine infection. Despite the started treatment, after 40 minutes, apnea occurred, in connection with which the child was transferred to mechanical ventilation with a BEAR device. In the future, the condition worsened, asystole was recorded in the child. The initiated resuscitation measures, carried out in full, had no effect and biological death was recorded at 6:10 p.m. on September 18, 2021. The final clinical diagnosis was established: Respiratory distress syndrome. Severe respiratory disorders. Intrauterine infection. Congenital pneumonia of a newborn child. Cerebral edema syndrome. Suspicion of intraventricular hemorrhage.

Pathological examination revealed: focal meningoencephalitis (bacteriological examination - St. Aureus, St. Epidermidis), focal productive ependymitis (Fig. 1), atelectasis of the left lung, bilateral polysegmental hemorrhagic bacterial pneumonia (PCR of lung tissue section material for SARS virus RNA CoV-2 positive, bacteriological examination of the tissue of the trachea, bronchi, lungs - St. Epidermidis, Enterobacter cloacae) (Fig. 2), necrotic erosive tracheitis, bronchitis, bronchiolitis, infectious-toxic shock, DIC syndrome with hemorrhages in the lungs, kidneys, adrenal glands, serous sheets, total hemorrhage in the left adrenal gland with the formation of a cystic cavity, fetal hepatitis with multiple foci of extramedullary hematopoiesis, interstitial nephritis with necrosis of the epithelium of kidney tubules, erosive necrotic esophagogastroenteritis (bacteriological examination - Enterobacter cloacae), edema of the brain, lungs, dysplasia of the thymus with depletion of peripheral organs of immunity, parietal deciduit (Fig. 3). The detected changes in internal organs and tissues led to the development of multiple organ failure, which became the direct cause of the death of the newborn child. Detailed results of the pathological examination are presented in Table 1.

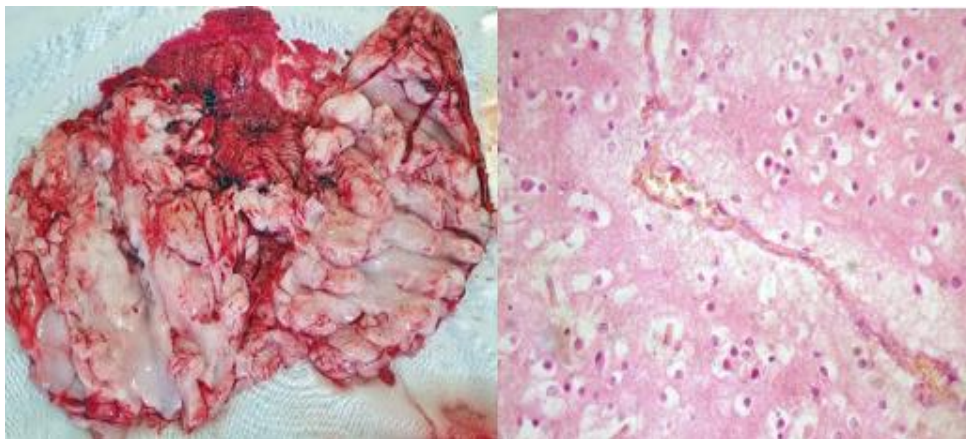


Figure 1. Macroscopic and microscopic appearance of the brain: A - hyperemia, subependymal small foci of softening of the brain. B –peri- and intracellular edema, perivascular leukomalacia of the brain substance. Staining: hematoxylin and eosin-stained section; original magnification x 200.

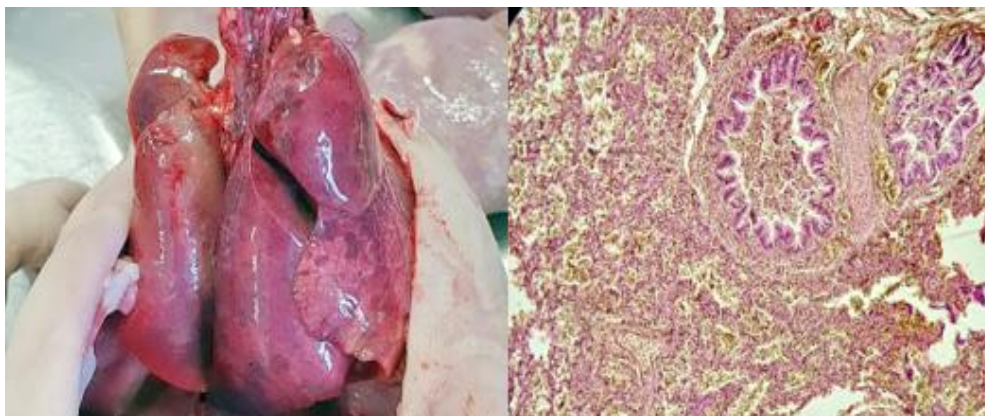


Figure 2. Macroscopic and microscopic appearance of the lungs: A - pulmonary edema, multiple subpleural hemorrhages. B – swelling, hyperemia, stasis, thrombosis of pulmonary vessels, lympho-leukocyte infiltration of lung parenchyma and bronchi. Staining: hematoxylin and eosin-stained section; original magnification x 200.

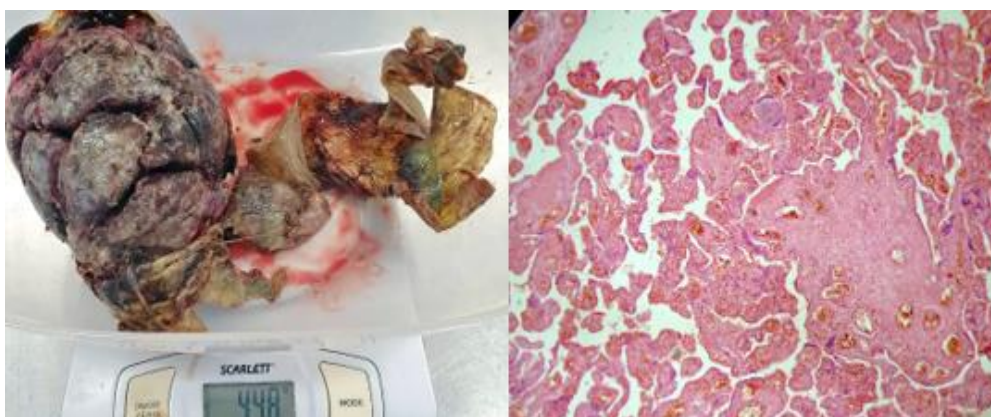


Figure 3. Macroscopic and microscopic appearance of the placenta: A - placenta of red-bluish color, dirty-greenish shade, unevenly full-blooded, with peripheral areas of infarctions, areas of sclerosis and bloody layers. B - moderate growth of syncytial nodules, diffuse areas of fibrinoid necrosis and foci of pseudoinfarcts. Staining: hematoxylin and eosin-stained section; original magnification x 200.

Table 1. Autopsy macroscopic and microscopic findings

Organ	Macroscopic changes	Histological changes
Lungs	They are not symmetrical, the right one is swollen, fills the right pleural cavity, the left one is collapsed. The surface is smooth, dull with subpleural focal hemorrhages on the back surface, brown-bluish in color. On the section, the tissue is not uniform, brown-red in color with focal hemorrhages. The viscous mucous-hemorrhagic a little content is released when lung is squeezed. The walls of small bronchi are open.	Atelectasis of the left lung, right lung with areas of disteectases. Pronounced edema, acute hemoptysis, stasis, thrombosis of pulmonary vessels with perifocal inflammatory infiltration. The pleura is thickened, in places with hemorrhagic infiltration. Alveolar septa, alveoli - swelling, hyperemia, lympho-leukocyte infiltration.
Trachea and large bronchi	The mucous membrane is brownish-gray, with local hyperemia. There are significant, viscous, mucous-hemorrhagic masses of brown-gray color in the lumen.	Trachea and large bronchi with complete desquamation, destruction and necrosis of the mucous epithelium. Peribronchial tissue with lymphocytic infiltration, stasis, vascular thrombosis and perivascular hemorrhages.
Heart	Dimensions 4.5x3.8x3.0 cm, weight 18 g. The trunk vessels are formed correctly. The cavities do not contain blood or clots. The oval window is open, up to 0.8 cm in diameter. The parietal endocardium is slightly thickened. Valves are present, some are slightly elastic, slightly thickened. The myocardium is heterogeneous, red-brown, flaccid in some places, elastic at the apex.	Edema, partial defibrillation of muscle fibers and partial loss of transverse striation, anemia, hyperplasia of cardiomyocytes with slight focal lymphocytic infiltration. Irregular hyperemia of blood vessels, stasis, thrombosis of epicardial vessels.
Kidneys	The left kidney measures 4.0x2.5x1.8 cm, weighs 8.0 grams, the right kidney measures 3.5x2.5x1.5 cm, weighs 9.0 grams. The surface is smooth, dark red with small points of hemorrhages. The cortical layer is gray, the cerebral layer is dark red, the layers are weakly differentiated on the section.	Multiple glomeruli with partial destruction. The layers are hyperemic with multiple focal hemorrhages. Edema and focal necrosis of the tubule epithelium, small focal lymphocytic infiltration.
Liver	Weight 147.0 g, dimensions - 11.5x7.0x6.0x4.0 cm, with rounded edges. The surface is smooth, dark red with small subcapsular hemorrhages, the consistency is loose. On the section - flaccid, fine-grained, dark brown, hyperemic.	Partial discomplexation of girders, with hyperemic dilated sinusoids, brown pigment deposition is seen. There is stasis, vascular thrombosis, tissue swelling. Multiple small foci of extramedullary hematopoiesis are present. The dilation and small lymphocytic infiltration of portal tracts, cholestasis, small hemorrhages are observed. There is a vacuolization and necrosis of some hepatocytes.
Stomach	Stomach has a normal shape, is slightly inflated. The contents has dark gray mucous masses in moderate amounts with a greenish tint. The mucous membrane is folded with small hemorrhages and spot erosions.	There is swelling, acute hemoptysis, partial desquamation and necrosis of the epithelium with focal lymphocytic infiltration.
Adrenal glands	The right adrenal gland of a triangular shape is significantly hyperemic, swollen, weighing up to 4.0 g. The left adrenal gland of an oval shape with a massive hemorrhage into the capsule and tissue,	The right adrenal gland with swelling, depletion and hypoplasia of the cortical layer, hemoptysis of the layers with small hemorrhages in the medulla with focal autolysis of the medulla. Left adrenal gland is with hemorrhages in

	with the formation of a cavity, weighing up to 5.0 g.	all layers with the formation of a cavity filled with bloody masses with hemolysis, with focal tissue necrosis and accumulation of brown pigment at the edges of the cortical layer. There is edema, the areas of autolysis of the medullary layer.
Brain	The weight of the brain is 390 gr. The tissue is grayish-red with a bluish tint, swollen, hyperemic, dough-like consistency. The sulci are shallow, the convolutions are smoothed. On the section of high humidity, white and gray matter is not differentiated, hyperemic, with scattered subependymal small foci of softening.	Sharply expressed perivascular, pericellular edema. Acute hemoptysis, stasis, thrombosis of vessels with small perivascular hemorrhages. Diffuse and focal perivascular subependymal lymphocytic infiltration of brain tissue with multiple foci of leukomalacia.
Thymus	Reduced in size, weight 11.0 g, gray-yellow color.	Cellular structure, focal venous hemoptysis, stasis, vascular thrombosis, edema and hemorrhages. Hassal bodies are placed singly (mostly in the center), small in size, some of them with signs of destruction, cellular detritus. Moderately apparent delymphatization of the lobes.
Placenta	Irregular rounded shape, dimensions - 19.0x16.0x3.0 cm, weight 448 g, red-bluish color, dirty-greenish shade, hyperemic with marginal areas of infarctions, areas of sclerosis and bloody layers. Lateral attachment of the umbilical cord is seen. The umbilical cord is thickened, gray-red with a greenish tint, swollen, with focal hemorrhages in the thickness, 48 cm long, 1.5-2.0 cm in diameter, with a false node near the free end. The membranes are swollen, thickened, hyperemic, gray-bluish in color with a dirty greenish tint and focal bloody layers.	The structure of the placenta corresponds to the gestation period, mature, with moderate growth of syncytial nodules, with diffuse areas of fibrinoid necrosis and foci of pseudoinfarcts. Focal petrifications, evident perivascular fibrosis, anemia of the intervillous spaces on the background of blood stasis in the arteries of the villous tree. Fetal membranes with focal parietal deciduits. Umbilical cord - severe swelling and perivascular hemorrhages with focal thrombosis of vessels. The lumen of the vein is significantly widened in some places, the arteries are spasmed, in some places are thickened.

Case Discussion.

Coronavirus disease-2019 is a multisystem infectious disease with significant complications in many organs [5]. During the pathological examination of a newborn child, morphological changes of various degrees were found in most organs and systems. A sign of a severe course of COVID-19 is the excessive production of anti-inflammatory cytokines, which leads to the development of systemic inflammation and thrombosis [6, 7]. The dominant interdependent pathological processes in the severe course of COVID-19 are diffuse alveolar damage, thrombosis, hemophagocytosis, and exhaustion of immune cells. Additionally, published autopsy findings include pancreatitis, pericarditis, adrenal microinfarcts, secondary disseminated mucormycosis, and brain microglial activation, which require further investigation to understand their role in COVID-19 [8]. We observed signs of bacterial pneumonia, meningoencephalitis and esophagogastrocolitis typical for coronavirus disease, which was confirmed by

bacteriological examination of the sectional material. It is known that respiratory viral infections increase the susceptibility of patients to co-infections, with the subsequent increase in the severity of the course of the disease, and often in mortality [9]. The issue of the influence of accompanying microflora on the course of the disease and the risk of mortality of patients from complications of coronavirus infection requires further research. This clinical case does not allow us to reliably indicate the route of infection. The presence of a coronavirus disease in the mother, the life expectancy of the child, the detected pathomorphological features in the organs may indicate the probable vertical transmission of the infection. Regarding possible vertical transmission of infection (transmission from mother to child antenatally or intranatally), recent evidence suggests that vertical transmission is questionable, although the proportion of pregnancies in which infection occurs and the significance of this for the neonate remains to be determined [3, 4].

Conclusions.

The data of multisystem morphological changes caused by SARS-CoV-2 in a newborn child presented in the article allows to enrich the small number of reports on neonatal losses in the case of coronavirus disease and to increase the awareness of neonatologists and pathologists about the clinical and morphological features of the disease. Further research will help improve the diagnosis and treatment of coronavirus disease in children.

References.

- [1] Rasmussen S, Smulian J, Lednický J, et al. Coronavirus Disease 2019 (COVID-19) and Pregnancy: What obstetricians need to know. *Am J Obstet Gynecol* 2020; 222(5):415-426. doi: 10.1016/j.ajog.2020.02.017
- [2] Zhang J, Wang Y, Chen L, et al. Clinical analysis of pregnancy in second and third trimesters complicated severe acute respiratory syndrome. *Zhonghua Fu Chan Ke Za Zhi*;38:516-20. <https://pubmed.ncbi.nlm.nih.gov/14521763/>
- [3] 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
- [4] Chen S, Huang B, Luo DJ, et al. Pregnant women with new coronavirus infection: a clinical characteristics and placental pathological analysis of three cases. *Zhonghua Bing Li Xue Za Zhi* 2020; 49(5):418-423. doi: 10.3760/cma.j.cn112151-20200225-00138
- [5] Morris SB, Schwartz NG, Patel P, et al: Case series of multisystem inflammatory syndrome in adults associated with SARS-CoV-2 infection — United Kingdom and United States, March–August 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69:1450–1456. doi: 10.15585/mmwr.mm6940e1
- [6] Pedersen SF, Ho YC. SARS-CoV-2: A storm is raging. *J Clin Invest* 2020; 130(5):2202-2205. doi: 10.1172/JCI137647
- [7] Tufan A, Avanoğlu Güler A, Matucci-Cerinic M. Covid-19, immune system response, hyperinflammation and repurposing antirheumatic drugs. *Turk J Med Sci* 2020;50(SI-1):620–32. doi: 10.3906/sag-2004-168
- [8] Hanley B, Naresh KN, Roufousse C, et al. Histopathological findings and viral tropism in UK patients with severe fatal COVID-19: A post-mortem study. *Lancet Microbe* 2020;1:e245–53. doi: 10.1016/S2666-5247(20)30115-4
- [9] Cox MJ, Loman N, Bogaert D, O’Grady J. Co-infections: potentially lethal and unexplored in COVID-19. *Lancet Microbe*. 2020; 1:e11. [https://doi.org/10.1016/s2666-5247\(20\)30009-4](https://doi.org/10.1016/s2666-5247(20)30009-4)