Acute kidney injury in a patient with COVID-19: Questions

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Case summary

A 16-year-old girl was admitted to our hospital with chest pain, diarrhea, and swelling in the eyelids and legs. She was followed up in another hospital for behavioral problems and did not benefit from treatment. She was the third child of first-degree cousin parents; otherwise, the family history was unremarkable. On physical examination, crepitant rales, periorbital edema, and pretibial 2+ pitting edema were found. Her blood pressure was 135/85 mmHg.

Laboratory findings on admission were hemoglobin 10.1 g/dL, white blood cells 6500/mm³ (absolute lymphocyte count 650/mm³), thrombocytes 212,000/mm³, blood urea nitrogen 33.5 mg/dL, serum creatinine 2.1 mg/dL, uric acid 6.9 mg/dL, sodium 133 mmol/L, potassium 4.6 mmol/L, calcium 8.9 mg/dL, phosphorus 5.8 mg/dL, total protein 4.4 g/dL, and albumin 1.9 g/dL. Arterial blood gas analysis showed pH 7.36 and HCO₃ 18.9 mmol/L. Erythrocyte sedimentation rate was 52 mm/h (normal range 0–20 mm/h) and C-reactive protein 2.1 mg/dL (normal range 0–0.8 mg/dL). Urinalysis revealed an increased specific gravity (1030), proteinuria (3+), and hematuria (3+). Spot urine protein/creatinine ratio was 9 mg/mg and 24-h urine

protein 35 g. Ultrasonography showed increased echogenicity in both kidneys. Nasopharyngeal swab polymerase chain reaction (PCR) assay was found to be positive for Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). Thorax computed tomography (CT) showed infiltration in the lower lobe of the left lung and peripherally located nodular areas with irregular contours, and Coronavirus disease 2019 (COVID-19) pneumonia diagnosis was made (Fig. 1).

The patient was started on favipiravir and antibiotics for possible secondary bacterial infections. On the next day of hospitalization, she got more edematous and hypertensive, and her urine output decreased. Bolus methylprednisolone treatment was introduced due to the rapidly progressive course of kidney injury, and hemodialysis was started. Hypertension was controlled with volume withdrawal, amlodipine, and doxazosin treatments. Pneumonia findings gradually improved during this period; the patient's urine volume increased after 5 days of bolus methylprednisolone treatment and after four sessions of hemodialysis. On the 10th day of admission, while her nasopharyngeal swab PCR assay was still positive for SARS-CoV-2, a kidney biopsy was performed.

Kidney biopsy showed 32 glomeruli located in the cortex and corticomedullary region. There were partial or circumferential epithelial crescents in 14 glomeruli. Endocapillary proliferation, mesangial matrix increase, “wire-loop” formation, karyorrhexis, necrosis, double contour formation, and neutrophil leukocyte infiltration were observed in 90% of the glomeruli. In some crescentic glomeruli, fragmented erythrocytes and fibrin were noted (Fig. 2a, b). Tubules showed hydropic changes with erythrocytes and shed epithelial cells, lymphocytes, and neutrophil leukocytes in their lumens. Edema and patchy mononuclear inflammatory cell infiltration in the interstitium were noted (Fig. 2c). No significant microscopic pathological features were seen in the vessels. Immunofluorescence microscopy showed granular staining with C3, C4, C1q, IgM, and IgG in the mesangium and the basement membrane and + 3 kappa and lambda in the mesangium (Fig. 2d).

The answers to these questions can be found at <http://dx.doi.org/10.1007/s00467-021-05237-y>.

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Fig. 1 Chest computed tomography images of the patient. Ground-glass opacity nodules in the right lung (**a**, **b**) and infiltration in the lower lobe of the left lung (**b**) are seen

Fig. 2 Pathological findings from kidney biopsy. **a** Prominent endocapillary proliferation in two glomeruli and almost circular crescent formation in the right one (HE stain $\times 100$). **b** The glomerular tuft is compressed by circumferential extracapillary proliferation (PAS stain $\times 200$). **c** There is a marked endocapillary proliferation with cellular crescents in two glomeruli. The glomerulus marked with arrow

shows shed crescent cells, inflammatory cells, and necrotic material in the tubule lumen at the opening point of the Bowman capsule to the proximal tubule (Trichrome stain $\times 100$). **d** Immunofluorescence microscopy shows deposits of C3 in the mesangium and in the peripheral glomerular capillary walls in a global distribution

Questions

1. What are the possible causes of acute kidney injury in this patient?
2. What additional tests would you perform?
3. What is the most likely diagnosis in this patient in view of the histopathological findings?
4. How should this patient be managed?

Data availability Not applicable.

Code availability Not applicable.

Declarations

Ethics approval Not applicable.

Consent to participate Informed consent was obtained from the parents.

Consent for publication Not applicable.

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