



## RADIOLOGICAL SIGNS OF URINARY TRACT INVOLVEMENT IN COVID-19: A CASE REPORT AND A LITERATURE REVIEW

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*The extrapulmonary manifestations of Coronavirus Disease 2019 (COVID-19) are common. However, radiological reports presenting urinary tract abnormalities related to COVID-19 were not widely published. We present a case of a female patient with a mild course of the COVID-19 disease, which affected the entire urinary tract. CT scanning showed inflammatory kidney changes with multiple ureter and bladder blood clots accompanied by a decrease in renal function. A literature review found only several publications that included imaging of urinary tract manifestations of COVID-19, generally presenting as renal infarctions due to a COVID-19 related hypercoagulability state. Also, there is evidence of some discrete changes in renal parenchymal CT attenuation values due to kidney inflammation in COVID-19 patients. However, imaging of other parts of the urinary system, with the exception of the kidneys, are rarely described to be affected by COVID-19. More clinical attention is needed to diagnose the unknown aspects of the disease.*

Keywords: COVID-19, CT, ACUTE KIDNEY INJURY, BLADDER, BLOOD CLOT

### INTRODUCTION

Although the respiratory tract is the most commonly affected system by a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the extrapulmonary manifestations are also frequent. Urinary tract involvement is very important to recognize as it requires more clinical attention and could increase mortality for patients with underlying kidney disorders (1). The Incidence of renal involvement is generally higher in patients with severe forms of the disease (2). It mainly manifests as acute renal infarction and/or acute kidney injury (AKI). However, the current studies showed that the incidence of AKI with Corona-

virus Disease 2019 (COVID-19) is not frequent (2). The proposed pathogenetic mechanisms of the renal involvement are kidney tubular damage or collapsing glomerulopathy, prerenal azotemia, hypercoagulability, or complications from the COVID-19 treatment (1, 3).

Radiologists play important role in the COVID-19 diagnosis and management (4, 5). Although the radiological findings of COVID-19 respiratory system involvement were well-described, the radiological reports presenting complications within the urinary tract due to a COVID-19 are infrequent. We present a case of a female patient with COVID-19 involvement of the entire urinary tract, including kidney, ureter and bladder. The case presentation was followed by the literature review.

### CASE REPORT

A 63-year-old female presented to the Emergency department with mild respiratory symptoms (SpO<sub>2</sub> 94%) and high fever (38.3°C), having lasted for five days. Laboratory findings showed CRP 34.9 mg/L, other findings were within

normal range. Renal parameters at the admission day were: urea 2.9 mmol/L, creatinine 41 µmol/L and eGFR 106 mL/min/1.73m<sup>2</sup>. Patient had no comorbidity.

At the seventh hospital day (and 12th day of COVID-19), patient complained of the pain in the left hemiabdomen and macrohematuria. Blood analysis detected a rapid decrease in renal function (urea 7.1, creatinine 67, eGFR 84.1, proteinuria), D-dimers were 0.62 mg/L and CRP 27.4 mg/L. Urine analysis showed elevated erythrocytes (3+), proteins (3+), positive nitrites and leukocyte esterase. Vital parameters were as follows: heart rate 60/min, blood pressure 130/70 mmHg, SpO<sub>2</sub> 95%, temperature 36.5 °C, and patient was not on oxygen therapy. An urgent postcontrast CT scans demonstrated enlarged left kidney with delayed and striate opacification and without excretion of the contrast urine into the pelvicalyceal system and left ureter (Figure 1). Instead, the pelvicalyceal system of the left kidney and left ureter were filled with fresh blood clots. Bladder also showed multiple filling defects due to blood clots (Figure 2). The right kidney showed a normal CT appearance

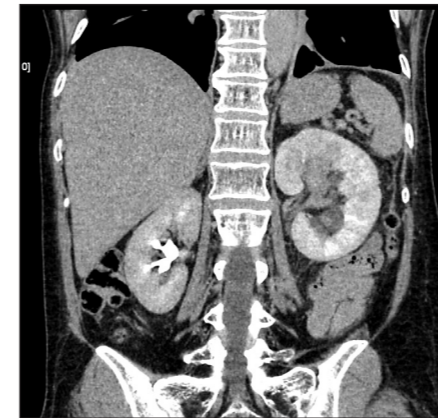


Figure 1. Postcontrast CT scans of both kidneys during a delayed phase demonstrated the enlarged left kidney with striate nephrographic opacification. There is no excretion of contrast urine into the pelvicalyceal system, which is filled with multiple blood clots. Right kidney showed normal appearance and excretion.

and excreted contrast urine normally. No other abnormalities were detected on the CT scans. Such CT appearance corresponded to an acute ureteral obstruction and nephritis due to a COVID-19, which corresponded to the clinical findings. An urgent cystoscopy with clots evacuation was performed. Patient was given appropriate antibiotic and other treatment.

During the whole hospital stay, patient had mild respiratory symptoms, and was not hospitalized at the Intensive care unit. No follow up abdominal CT examinations were requested. Renal function was gradually returning to normal, and patient was discharged two weeks later. On the discharge day the renal function was fully recovered (urea 4.7 mmol/L, creatinine 41 µmol/L and eGFR 106.0 mL/min/1.73m<sup>2</sup>).

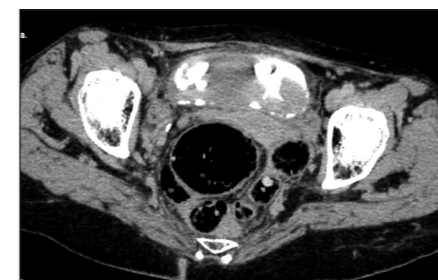


Figure 2. Postcontrast CT scans of a bladder during a delayed phase showed multiple filling defects due to the abundance of blood clots in the bladder.

### DISCUSSION

The case showed imaging of urinary tract involvement in a COVID-19 female patient. Contrary to most of the literature evidence that showed the kidney was usually affected during a severe COVID-19 course, our patient had mild COVID-19 respiratory symptoms and was otherwise healthy. To our knowledge, there are only three case studies to describe renal complications within a mild COVID-19 course (4-6). However, the COVID-19 related hypercoagulability state in first two case studies presented as renal infarctions (4, 5). We found no radiological signs of renal infarction in our patient; instead, the kidney inflammation and multiple blood clots in ureter and bladder were detected. This finding is quite unusual and not described so far. Third case study had very similar CT presentation to our case study, including signs of pyelonephritis and ureteral blood clot in an otherwise healthy young woman, closely relating the possibility it could be due to COVID-19 (6). We hypothesize that a hemorrhagic infection of the urothelium might cause multiple blood clot formation within the ureter, which could lead to urinary stasis and bacterial infiltration of the kidney.

Occurrence of the acute kidney injury (AKI) in the COVID-19 patients was found to be a very rare complication. It is caused mostly by the acute tubular necrosis and papillary necrosis which are results of the combination of hypoperfusion, cytokines invasion and direct renal invasion by a SARS-CoV-2 (7). The papillary necrosis might induce hematuria with ureteral blood clots formation without other viral manifestations. However, there is growing evidence that kidney is often affected with SARS-CoV-2, even in patients with less severe COVID-19 disease, which was confirmed by the histopathologic changes of kidneys (8).

The literature search considering the imaging findings of the COVID-19 renal complications is scarce. The major reason is that the abdominal ultrasound or CT imaging is usually not performed regularly in the COVID-19 patients. The imaging techniques are requested when

a patient presents with abdominal pain, hematuria, or some other symptom. Present literature search included search of PubMed/Medline with a combination of search terms: radiology, CT, ultrasound, COVID-19, urinary tract, and kidney, as well as the references of included papers.

Most frequently the case reports were presenting imaging of renal infarction, which occurred generally in the patients with severe COVID-19, as an isolated thromboembolic event or in combination with several embolic events (4, 5, 9-13). This indicates that the disease's hypercoagulability usually expresses as thromboembolism of the renal artery. Further, one study found CT detectable renal abnormalities more often than it was clinically suspected: all patients in the COVID-19 group had lower mean Hounsfield units of renal parenchyma than the control group that indicated kidney inflammation/edema (14). It suggested the radiologic examinations might be helpful even in patients with mild abdominal clinical symptomatology. Nevertheless, other urinary system parts than kidney, including ureter, bladder, and urethra, are almost no described to be affected with COVID-19. The mentioned single study showed ureteral blood clot formation accompanied by pyelonephritis, probably induced by the similar pathophysiological mechanism as was proposed in our patient (6). The last study we found suggested urinary frequency may be secondary to viral cystitis due to the underlying COVID-19 disease, suggesting that viral cystitis might have a role in pathogenesis of other urological manifestations (15).

Apart from CT, the ultrasound imaging, especially Doppler, is a very helpful diagnostic tool in detection of the renal abnormalities in COVID-19. It enables quick and non-invasive assessment of the renal cortical echogenicity, renal perfusion and allows for the obstructive uropathy to be quickly excluded. One study showed renal cortical hyperechogenicity, increased renal parenchymal resistive indices and decreased colour Doppler flow to be the notable manifestations of a collapsing focal segmental glomerulosclerosis secondary to the COVID-19 infection (16).

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## CONCLUSION

In conclusion, more investigation is needed to better understand and explain the effects of SARS-CoV-2 on the urinary tract. To reduce the patient mortality, the diagnosis and treatment of COVID-19 must involve paying close attention to the kidney and other urinary tract complications. This way the additional urinary tract findings may be detected, and the unknown aspects of COVID-19 could be diagnosed. CT and ultrasound are reliable diagnostic tools for detection of the renal COVID-19 complications.

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## Sažetak

## RADIOLOŠKI ZNAKOVI ZAHVAĆENOSTI MOKRAĆNOG SUSTAVA U COVID-19: PRIKAZ SLUČAJA I PREGLED LITERATURE

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*Ekstrapulmonalne manifestacije bolesti uzrokovane koronavirusom otkrivenim 2019 (COVID-19) su brojne. Ipak, radiološki prikazi manifestacija COVID-19 na mokraćnom sustavu nisu česti u postojećoj literaturi. Ovaj prikaz slučaja predstavlja pacijenticu s blagim simptomima COVID-19, koji se komplicirao promjenama na cijelom mokraćnom sustavu. CT presjeci su pokazali upalne promjene bubrega te brojne ugruške mokraćovoda i mokraćnog mjehura, što je bilo praćeno oslabljenom bubrežnom funkcijom. Pregled literature pronašao je nekoliko publikacija, koje su uključivale slikovnu dijagnostiku zahvaćenosti mokraćnog sustava tijekom COVID-19, a uglavnom je bila riječ o infarktu bubrega povezanog s hiperkoagulabilnim stanjem, koje se javlja u COVID-19 pacijenta. Također, postoje dokazi o diskretnim promjenama CT atenuacijskih vrijednosti bubrežnog parenhima u pacijentima s COVID-om, uzrokovanim prvenstveno upalnim promjenama bubrega. Izuzetno, manifestacije na drugim dijelovima mokraćnog sustava gotovo da nisu prepoznate i opisane. Potrebna je veća klinička pažnja kako bi se dijagnosticirali nepoznati aspekti bolesti mokraćnog sustava tijekom COVID-19 infekcije.*

Ključne riječi: COVID-19, CT, AKUTNO BUBREŽNO ZATAJENJE, MOKRAĆNI MJEHUR, KRVNI UGRUŠAK

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