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## COVID-19 nephropathology; an emerging condition caused by novel coronavirus infection

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COVID-19, a pandemic caused by a novel coronavirus, has become a major public health problem worldwide. It principally affects the upper and lower respiratory tract in the majority of cases. In severe cases, it may involve multiple organs including the kidneys. Kidney involvement has been reported to be around 3-9% and the most common presentation is with acute kidney injury (AKI); however, the data is still preliminary. Data regarding COVID-19 virus affecting patients with prior kidney diseases are still rudimentary. Further research is needed to understand the full spectrum of COVID-19 infection on kidney health.

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COVID-19 is an abbreviated name for coronavirus disease 2019, suggested by the World Health Organization (WHO) (1,2). This pathogen was first detected in December 2019 in China, which mostly affected the respiratory tract, producing novel coronavirus pneumonia and critical complications. Coronaviruses are a big family of viruses that are commonly found in humans and various species of animals, including cats and bats (1-3). Infrequently, animal coronaviruses may infect humans and therefore spread among populaces. The disease caused by COVID-19 does not seem to be clinically much different from common influenza or to be life-threatening, even in the case of development of pneumonia, except in elderly people and in those with serious co-morbidities. The symptoms of coronavirus disease are fever, fatigue, lymphopenia, dry cough and shortness of breath. Coronavirus (COVID-19) principally presents as an acute respiratory disease with alveolar and interstitial pneumonia; however, it may affect various organs such as nervous system, digestive tract, blood, kidney and heart (2-4). The disease can vary from very mild (in individuals with no reported complaints) to a severe disease resulting in death (severe acute respiratory syndrome). Many of the older individuals who develop a significantly more morbid disease have signs of underlying diseases like, liver, renal and heart diseases or malignant

neoplasms (3-5). Renal disorders appear to be common in individuals who have been tested positive for COVID-19 and who have developed disease, since there is evidence that COVID-19 also invades the kidneys. Recent investigations have shown that proteinuria and hematuria may ensue following COVID-19 infection, while some infected individuals may present with signs and symptoms of acute kidney injury (AKI). The incidence of acute renal failure following COVID-19 infection is somewhat low and may be detected in 3%-9% of cases; however, these individuals may have a poor prognosis, since renal impairment has been shown to be an independent risk factor for the mortality of hospitalized patients (5-9).

More recent studies have shown the presence of viral RNA in urine and renal tissue of this infection, indicating that renal system is also a target of COVID-19 infection, and a direct viral invasion into tubules and interstitium is possible. This condition may be labelled as COVID-19 nephropathology. Additionally, cytokine storm syndrome related to sepsis secondary to COVID-19 infection could lead to indirect cellular damage in the kidneys resulting in acute renal dysfunction. Preliminary findings have shown that acute renal failure may represent an independent risk factor for morbidity and mortality in hospitalized individuals with established COVID-19 infection (4-9). More recent studies support the evidence that coronavirus

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gains entry into the human body through involving the epithelial cells by binding to angiotensin I converting enzyme 2 (ACE2) receptors located on the cell surface of a variety of host cells including the renal tubular epithelial cells. However, the major cellular targets for COVID-19 agent are type II pneumocytes and enterocytes. Thus, AKI related to COVID-19 infection, most probably is multifactorial, including a major role of immune activation, though a rise in the level of inflammatory chemokines and mediators, pro-inflammatory cytokines, inducible nitric oxide synthetase by M1 subtype of macrophages to form cytotoxic peroxynitrite, all of which mediate kidney damage. Hence, cytokine storm syndrome has a main role in various infection-mediated multiple organ failure syndromes, including kidneys (5-9).

COVID-19 infection in elderly and those with various chronic diseases, like hypertension, diabetes or heart disease, is more likely to lead to acute renal impairment. Additionally, coronavirus disease in association with acute renal failure is a clinical challenge that not only enhances the mortality rate but may also trigger chronic renal failure. Thus, AKI is a strong risk factor for chronic renal failure later on, and all patients with AKI or proteinuria must be evaluated for chronic kidney disease (CKD) after recovery. Conversely, individuals with chronic renal disease are at greater risk of morbidity and mortality when they get coronavirus disease. Therefore, all patients with CKD stages 3 to 5, who are at augmented risk of critical illness from COVID-19 infection, are required to take extra care in preventing this infection (7-12).

In summary, renal involvement in COVID-19, although rare, can lead to potentially significant morbidity and mortality. However, the data is still preliminary and there is a need for continued research into different aspects of viral injury to kidney.

#### Authors' contribution

HN prepared the primary draft. MM edited the manuscript. Both authors read and signed the final manuscript.

#### Conflicts of interest

The authors report no conflict of interest.

#### Ethical considerations

Ethical issues including plagiarism, double publication, and redundancy have been completely observed by the authors.

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