Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Editorial

The kidney and COVID-19 patients – Important considerations

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The ongoing coronavirus disease 2019 (COVID-19) pandemic, has caused substantial damage to the health system globally. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) primarily affects the lungs, however, this virus can also affect other organs such as intestine, kidney, heart, and brain [1–3]. Kidney dysfunctions are also observed in a large proportion of COVID-19 patients [4]. Initially, the involvement of kidneys was considered negligible, and little attention was paid to the incidence of acute kidney injury (AKI) [5]. Subsequently, AKI incidence in COVID-19 patient was found to be up to 15% in comparison to an earlier suggested range of 3%–9% potentiating the evidence that AKI is common and that the virus can specifically damage the kidneys [6,7]. The incidence of AKI could be up to 25% among critically-ill COVID-19 patients with underlying comorbidities [7]. An autopsy study also showed the virus tropism to the kidney [8]. Other coronaviruses such as the avian infectious bronchitis virus, are also known to cause severe kidney damage in chicken [9,10].

The exact mechanism of SARS-CoV-2 associated renal damage is not fully known. Studies showed that the cellular components required for virus entry such as angiotensin-converting enzyme 2 (ACE2), cellular transmembrane serine protease 2 (TMPRSS2), and cathepsin L (CTSL) are highly expressed in kidneys [8]. Expressions of ACE2 RNA in the small intestine, duodenum and kidneys were found much higher (around 100-fold) than the lung [4]. Furthermore, the co-expression of ACE2 and TMPRSS is reported to be relatively high in the proximal straight tubule cells and podocytes, suggesting favourable condition for localization of the SARS-CoV-2 in kidneys [11]. Studies reporting albuminuria and hematuria in the COVID-19 patients along with the detection of viral RNA from the urine samples further support the potential tropism of the SARS-CoV-2 for the renal tissues [4,12]. The cytokine storm associated along with the direct cytopathic effect of SARS-CoV-2 is suggested as the probable cause of kidney dysfunction [13].

Moreover, the AKI in response to cytokine storm might occur due to renal inflammation, increased vascular permeability, cardiomyopathy and volume depletion leading to cardiorenal syndrome-1 (Fig. 1) [14]. Additionally, injuries of the renal tubules related to the hypoperfusion in response to cytokine storm may also be partly responsible for the kidney injury [13]. The computed tomography of the kidneys revealed a reduction in the density suggesting the renal inflammation and oedema [4].

Kidney dysfunction is characterized by elevated levels of blood urea nitrogen (BUN), creatinine, uric acid and D-dimer, along with proteinuria and hematuria [4]. A study reported that 60% out of 147 COVID-19 patients developed proteinuria, and 48% exhibited hematuria on hospitalization [4]. Elevated levels of BUN was reported in 31% of the total patients and found common in severely ill and deceased cases [4]. A study conducted on 701 consecutive hospitalized COVID-19 patients revealed proteinuria and hematuria in 43.9% and 26.7%, respectively on admission. Moreover, the prevalence of elevated BUN and serum creatinine was reported 13.1% and 14.4% respectively, in the COVID-19 patients [15]. AKI was associated with higher mortality rates, especially when renal replacement therapy is required [7]. In this context, AKI was reported as an independent risk factor for hospitalized COVID-19 patients [4]. Therefore, along with clinical management for pneumonia, potential intervention to protect the kidneys from the virus tropism and cytokine storm must be considered to minimize the mortalities associated with acute renal failure (Fig. 1).

Those COVID-19 patients suffering from the chronic kidney disease and other comorbidities are reported to be at higher risk of a severe form of the disease and they are advised to take extra preventive measures to avoid the exposure of SARS-CoV-2 [16]. A higher number of comorbidities was also found to be associated with this virus tropism for kidney [8]. The COVID-19 posed a new challenge in the form of renal damage directly through virus tropism and indirectly through cytokine storm and increased mortality associated with kidney damage. In this context, clinical care by monitoring and protecting the kidney functions regardless of the patient's comorbidity is utmost necessary to save the patients from unnoticed renal damage during the course of the disease.

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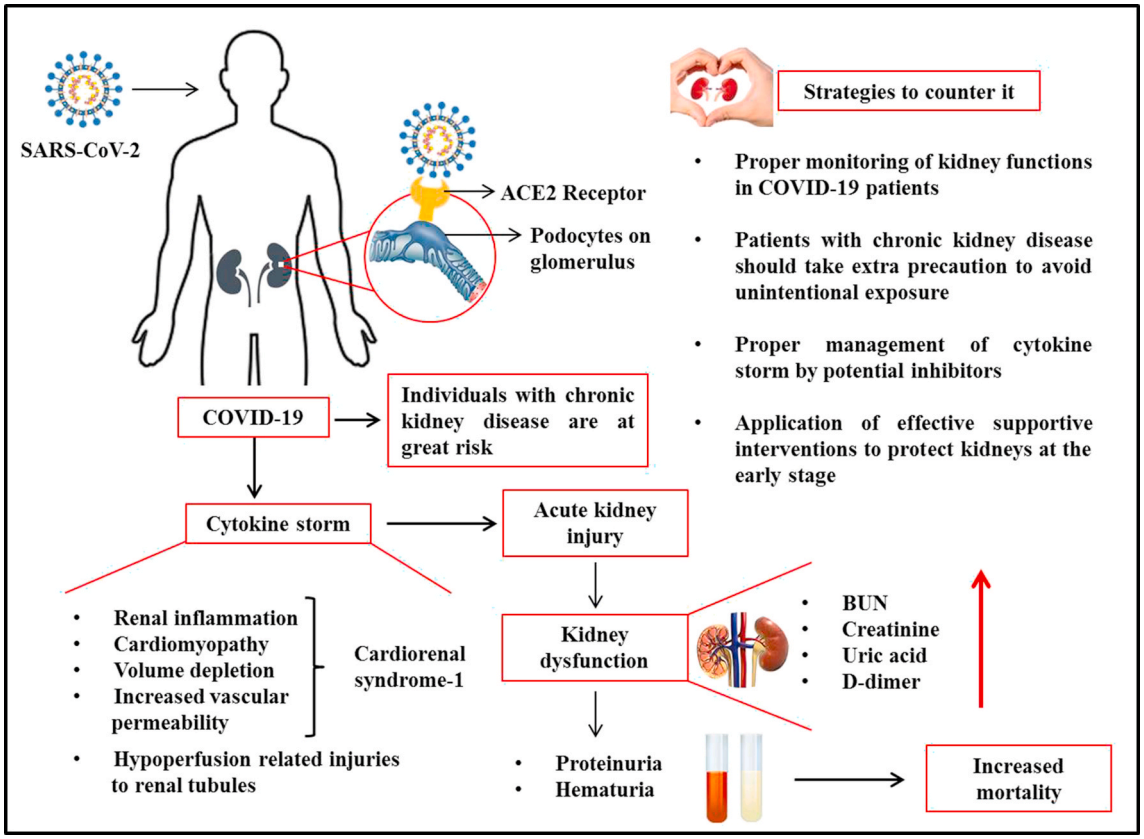

Fig. 1. Probable mechanism of COVID-19 associated kidney damage and strategies to counter it.

Moreover, the application of effective supportive and targeted interventions to protect kidneys at the early stage of SARS-CoV-2 infection is highly recommended [17,18].

CRediT authorship contribution statement

Shailesh Kumar Patel: Conceptualization, Writing - review & editing. **Rohit Singh:** Writing - original draft, Writing - review & editing. **Jigyasa Rana:** Writing - original draft, Writing - review & editing. **Ruchi Tiwari:** Writing - original draft, Writing - review & editing. **Senthilkumar Natesan:** Writing - original draft, Writing - review & editing. **Harapan Harapan:** Writing - original draft, Writing - review & editing. **Kovy Arteaga-Livias:** Writing - original draft, Writing - review & editing. **D. Katterine Bonilla-Aldana:** Writing - original draft, Writing - review & editing. **Alfonso J. Rodríguez-Morales:** Writing - original draft, Writing - review & editing. **Kuldeep Dhama:** Writing - original draft, Writing - review & editing.

Declaration of competing interest

None.

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