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Coronavirus-nephropathy; renal involvement in COVID-19

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Implication for health policy/practice/research/medical education:
Renal disturbances by coronavirus disease 2019 (COVID-19), consisted of acute kidney injury, due to acute tubular necrosis induced by sepsis, hydration, cytokine storm syndrome, rhabdomyolysis and hypoxia. As the direct cytopathic effect of virus on various renal cells has been detected in previous studies, direct virus invasion to the renal tubular cells and interstitium or glomeruli is possible. Previous studies showed that coronavirus enters into the cells by angiotensin-converting enzyme II receptors that are extensively presented in the renal cells. Further, acute kidney injury in COVID-19 is strongly associated with higher mortality and morbidity and is an indicator for survival with Coronavirus infection. In the overall approach to patients with COVID-19 infection, special attention should be paid to control of classical risk factors of kidney injury.

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Epidemiology and Prevention

Coronavirus disease 2019 (COVID-19) is a recently detected transmissible disease caused by the novel coronavirus. COVID-19 is principally presenting as a severe acute respiratory syndrome demonstrated by alveolar and interstitial pneumonia. Although pulmonary system is the main organ system involved in the manifestation of disease, it also involves other organs like gastrointestinal tract, renal and nervous systems with mild clinical manifestations in coronavirus infected patients. The overlapping clinical presentations in patients infected by COVID-19 makes it difficult for physicians to distinguish the causative agents without a solid laboratory analysis. Laboratory analysis includes a wide spectrum of diagnosis ranging from conventional such as viral culture and direct/indirect immunofluorescence assay (IFA) to the next generation and new diagnostic strategies including multiplex nucleic acid amplification and microarray-based assays such as Real-time RT-LAMP as well as reverse rRT-PCR method of detection (1). Since in patients confronted by multi-organ injuries, attention should also be paid to comorbidities in the treatment of coronavirus infection. Therefore, detecting and excluding issues that have a negative impact on the recovery, is a main factor to improve survival from coronavirus infection.

Recent reports show that renal disorder is common in confirmed coronavirus patients (2, 3). Li et al (3) conducted a study on kidney function in 59 COVID-19 infected patients consisting of twenty-eight diagnosed as severe cases and three deaths. This study reported proteinuria in 63% of patients. In addition to this raised values of serum creatinine and urea nitrogen were found in 19% and 27% of their patients, respectively. Besides this computerized tomography (CT) scan of kidneys from 27 patients showed inflammation and edema of the renal parenchyma in all patients (100%) (4). Likewise, a sequential investigation of 710 coronavirus positive subjects admitted in an educational hospital in Wuhan (2020), showed the presence of proteinuria in 44% and hematuria in 26.9% of patients. Further, raised plasma creatinine and blood urea nitrogen was respectively observed in 15.5% and 14.1% of their patients. Furthermore, acute renal injury was found in 3.2% of infected individuals. Subsequently,

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survival curves visualized through Kaplan-Meier analysis demonstrated that the renal failure had a greater risk for in-hospital mortality. The Cox regression model confirmed that the acute kidney injury, proteinuria, hematuria, raised plasma creatinine and urea nitrogen were independent risk factors for predicting in-hospital patients' mortality (5).

The possible mechanisms interacted in renal disturbances by COVID-19, consisted of dehydration, which this condition may be due to fever or decreased intake of fluids in old persons. Dehydration has various consequences on the kidney, directing to reduction of glomerular filtration rate and acute kidney injury. If volume depletion is not severe, it is reversible with hydration, however if ischemia persists like shock, acute tubular necrosis may happen. Other proposed mechanisms comprise sepsis by COVID-19, which directs to cytokine storm syndrome. Furthermore, rhabdomyolysis and hypoxia are other possibilities. Additionally, direct virus invasion to the renal tubular cells and interstitium or glomeruli is possible, since the direct cytopathic effect of virus on various renal cells have been detected in previous studies (6,7). These studies showed that coronavirus enters into the cells via ACE2 (angiotensin converting enzyme II) receptors, which are extensively presented in the renal cells, while ACE2 is a cell entry receptor for this virus. ACE2 presentation in kidney and various parts of gastrointestinal tract like duodenum and small intestine is nearly 100-fold more than that in pulmonary tract. This finding explains that the renal cells are *targeted* and *infected* by the COVID-19. According to previous investigations, the virus-induced glomerulopathy in the family viruses of corona was reported to be low, however immune complexes deposition of viral particles or virus-induced specific immunological abnormalities is possible (3-8). Other mechanisms of renal failure consisted of inappropriate use of non-steroidal anti-inflammatory drugs (NSAIDS) and presence of uncontrolled diabetes or hypertension (7,8).

In summary, renal involvement in COVID-19 (Coronavirus-nephropathy) has a complex etiology; however acute kidney injury in COVID-19 is strongly associated with higher mortality and morbidity and is an indicator for survival with coronavirus infection.

Authors' contribution

Primary draft was prepared by AB, AM, and RV. LVKSB and AM edited the paper. All authors read and signed the final paper.

Conflicts of interest

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Ethical considerations

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