

Original Research Article


Renal involvement and early prognosis in patients with Covid-19 pneumonia in tertiary health care centre

Dharmapuri Vaishnavcharankumar^{1*}, Yeruva Veda Parimala²,
Uday Sankar Akash Vankayala³, Ankit Sunil Kulkarni⁴,
Akkalashetty Uday Shree⁵

^{1,2}Post Graduate, ^{3,4,5}House Surgeon

Department of General Medicine, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana, India

*Corresponding author email: vaishnavcharankumar1234@gmail.com

	International Archives of Integrated Medicine, Vol. 10, Issue 7, July, 2023. Available online at http://iaimjournal.com/ ISSN: 2394-0026 (P) ISSN: 2394-0034 (O)
	Received on: 25-6-2023 Accepted on: 2-7-2023 Source of support: Nil Conflict of interest: None declared. Article is under creative common license CC-BY
How to cite this article: Dharmapuri Vaishnavcharankumar, Yeruva Veda Parimala, Uday Sankar Akash Vankayala, Ankit Sunil Kulkarni, Akkalashetty Uday Shree. Renal involvement and early prognosis in patients with Covid-19 pneumonia in tertiary health care centre. IAIM, 2023; 10(7): 11-16.	

Abstract

Background: The corona virus disease (Covid-19) is a pandemic which is rapidly evolving and expanding, has infected a population of more than 77 million across the globe and around 10 million in India as of 25th December 2020. This virus was first recognized in December 2019 in Wuhan of China when pneumonia of unknown origin came into limelight. It was identified as Covid -19, a neo virus causing severe pneumonia that rapidly led to a major health crisis with devastating consequences not only in India but also in major developed countries of the world. Initially data from China and Italy, which was identified as caused by Covid-19, shows that death rate worsens in persons with increasing age more than 50 years and also leads to higher risk due to co-morbidities like hypertension (HTN), cardiac disease, diabetes mellitus, chronic renal disease, cancer, etc. Severe acute respiratory viral infections are frequently accompanied by multiple organ dysfunction, including acute kidney injury (AKI). While diffuse alveolar damage and acute respiratory failure are the main features of Covid-19, and the incidence of AKI is not well described. The present study was conducted to assess the Renal Involvement and its association with Prognosis among Patients admitted with Covid-19 Pneumonia.

Aim: To assess the renal involvement and its association with prognosis among patients admitted with Covid-19 pneumonia.

Materials and methods: A single centered cross-sectional study was conducted at Malla Reddy Institute of Medical Sciences during 15th March to 1st May 2021 where 151 Patients admitted with Covid-19 Positive on RT-PCR were included. Renal function tests include Creatinine and Urea. The most commonly used endogenous marker for the assessment of glomerular function is creatinine. The calculated clearance of creatinine is used to provide an indicator of GFR. Urea is a nitrogen-containing compound formed in the liver as the end product of protein metabolism and the urea cycle. Serum urea levels increase in conditions where renal clearance decreases (in acute and chronic renal failure/ impairment). Urea may also increase in other conditions not related to renal diseases such as upper GI bleeding, dehydration, catabolic states, and high protein diets. Data entry was done using Excel 2013 and analysis using SPSS v16. Student t test and chi-square test were used to find the significant association without come.

Results: A total of 151 patients who had tested positive for COVID-19 were included in the study. The mean age in years of the study participants was 47.76 ± 12.85 . 72.8% were male and 27.2% were female. The mean serum creatinine was 1.44 ± 0.94 and mean Blood urea was 41.35 ± 24.06 . Mortality observed in the study was 44.4%. Significantly high levels of serum creatinine (2.06 ± 1.10) were reported among those who died due to COVID-19 compared to those who recovered (0.93 ± 0.28) ($p < 0.0001$) in the study. Our study poses a conclusion of increase in serum creatinine in COVID 19 affected patients that shows a temporal association of SARsCOV-2 with AKI.

Conclusion: The Covid pandemic has posed major challenge around the globe. Renal clinical presentation ranging from mild proteinuria, hematuria to progressive AKI necessitating renal replacement therapy (RRT), thrombotic microangiopathy and rhabdomyolysis. More research is needed to obtain adequate evidence to support current clinical approaches and to develop new approaches to management. Kidney failure occurs in most patients with COVID-19 pneumonia. Although proteinuria, hematuria and AKI are usually resolved in such patients within 3 weeks after the onset of symptoms, kidney problems in COVID-19 have been associated with higher mortality. AKI is independent predictor of mortality in Covid-19.

Key words

Renal, Prognosis, Covid-19, Pneumonia.

Introduction

The coronavirus disease (Covid-19) is a pandemic which is rapidly evolving and expanding has infected a population of more than 77 million across the globe and around 10 million in India as of 25th December, 2020.

This virus was first recognized in December 2019 in Wuhan of China when pneumonia of unknown origin came into limelight [1, 2]. It was identified as Covid-19, a neo virus causing severe pneumonia that rapidly led to a major health crisis with devastating consequences not only in India but also in major developed

countries of the world [3, 4]. Initially data from China and Italy, which was identified as caused by Covid-19, shows that death rate worsens in persons with increasing age more than 50 years and also leads to higher risk due to co-morbidities like hypertension (HTN), cardiac disease, diabetes mellitus, chronic renal disease, cancer, etc. Severe acute respiratory viral infections are frequently accompanied by multiple organ dysfunction, including acute kidney injury (AKI). While diffuse alveolar damage and acute respiratory failure are the main features of Covid-19, and the incidence of AKI is not well described. The present study was conducted to assess the Renal Involvement and its association

with Prognosis among Patients admitted with Covid-19 Pneumonia.

like anemia, low specific gravity, changes in serum electrolytes, etc.

Materials and methods

Source of data: 151 patients with Covid-19 who presented to In-patient Department of Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad.

Study design: Cross-sectional study

Study period: 45 days

Sample size: Present study was conducted on 151 Covid-19 patients admitted in Malla Reddy Institute of Medical Sciences.

Procedure

All eligible cases were studied during this period, which fit in for inclusion criteria. All patients who were admitted for Covid-19 infection related complaints with age group >18 years were taken in the study. Detailed history, physical examination and investigations were recorded in the pretested proforma. These samples were selected by using simple random sampling method.

Statistical parameters correlation was used for analysis. Informed consent was obtained from all patients.

Inclusion criteria

Adult Patients diagnosed to have covid-19 infection and age more than 18 years.

Exclusion criteria

Criteria for diagnosing chronic kidney disease

- Symptoms of uremia for more than 3 months
- Elevated blood urea, serum creatinine and decreased creatinine clearance
- Ultrasound evidence of CKD
- Bilateral contracted kidney – Size less than 8 cm in male and size less than 7 cm in female
- Poor cortico-medullary differentiation
- Type 2 or 3 renal parenchymal changes
- Supportive laboratory evidence of CKD

Detailed clinical history and clinical examination was under taken with preference to renal diseases. Investigations include Hemoglobin, total count, ESR, RBS, Blood urea, serum creatinine, Serum electrolytes, Urine analysis, ECG.

Results

A total of 151 patients who had tested positive for COVID-19 were included in the study.

The mean age in years of the study participants was 47.76 ± 12.85 (**Graph – 1**). The mean serum creatinine was 1.44 ± 0.94 and mean Blood urea was 41.35 ± 24.06 (**Graph – 3**). Significantly high levels of serum creatinine (2.06 ± 1.10) were reported among those who died due to Covid-19 compared to those who recovered (0.93 ± 0.28) ($p < 0.0001$) in the study.

Our study poses a conclusion of increase in serum creatinine in Covid-19 affected patients that shows a temporal association of SARS-CoV-2 with AKI (**Graph – 5**).

Discussion

The findings regarding these COVID-19-related renal manifestations indicate that SARS-CoV-2 may also inflict disease beyond the respiratory tract, including organ systems like the kidneys, liver, heart, and brain. This, in turn, may have direct influence on the course of the disease, with the possibility of exacerbating any pre-existing conditions. Emerging data from case reports and autopsy series of patients who've succumbed to COVID-19 suggests that it causes acute kidney injury (AKI), which can also result from extrinsic factors such as fluid depletion, multi-organ failure, and rhabdomyolysis. Intrinsic renal pathology including viral mediated tubular cell injury, thrombotic vascular processes, and glomerulonephritis have also been reported.

Clinical reports show proximal tubular injury in association with Fanconi syndrome that manifest as electrolyte imbalances like hypokalemia and hypophosphatemia. It also has features of normal anion gap metabolic acidosis and hypovolemia due to salt wasting manifestation.

The United States of America, France and China have reported an incidence of AKI varying from 3% to 37% in these patients in a retrospective, observational study. The pathogenesis and incidence of these renal manifestations, as well as the impact and outcome of COVID-19 on the kidney, however, is not completely known.

There are studies that describe the clinical manifestations, associated risk factors, and course of acute renal injury in hospitalized patients with COVID-19.

The largest available published material includes data from 13 New York metropolitan city hospitals. Out of 5,449 patients who were admitted to these centers due to COVID-19, AKI was diagnosed in 36.6% cases. Amongst them, 14.3% needed kidney replacement therapy. Acute renal injury was mostly observed in conditions with respiratory failure. It was more common (89.7%) in patients on mechanical ventilation as compared to those not on mechanical ventilation (21.7%). Surprisingly 96.8% of patients requiring renal replacement therapy were on ventilators.

The onset of AKI was observed to be within 24 hours of intubation in 52.2% of those who needed mechanical ventilation.

Major risk factors for AKI included older aged patients, black race, and co-morbidities like diabetes mellitus, cardiac disease, hypertension and the requirement for mechanical ventilation and inotropic agents. This study clearly shows that AKI occurs early in the course and is in temporal association with respiratory failure, having a poor prognosis.

There are predominantly three pathways of renal injury: Renal impairment due to hemodynamic changes, direct cytotoxic effect, and cytokine storm syndrome. Expression of viral receptor ACE2 on tubular epithelial cells was identified as the binding site for SARS-CoV-2 virus, suggesting direct cytopathic effect in renal injury.

Immunologic and prothrombotic factors may play a role in this disease process, which may be triggered by the infection. Viral RNA has been identified in kidney tissue in infected patients.

Even though this is a small and single centered prospective study, the findings of kidney failure in patients with COVID-19 which were associated with higher mortality was similar to the findings of Hirsch JS, Ng JH, Ross DW, et al, D Yang et al. COVID-19 patients with CKD who presented with a high incidence of neutrophilia, poor prognosis and in-hospital death [5].

Another study by Hui-Xian Xiang, et al. [7], where 154 patients with COVID-19 were recruited from the Second People's Hospital of Fuyang City in Anhui, China out of which 125 were mild and 29 were severe cases, showed that renal dysfunction (Serum creatinine and cystatin C were increased and estimated glomerular filtration rate (eGFR) was decreased) had occurred in the majority of patients with COVID-19 pneumonia, more pronounced in the severe cases compared to the milder ones. The study was concluded using a multivariate logistic regression. Male gender, older age and hypertension were found to be three important independent risk factors for renal dysfunction in COVID-19 patients [7].

The 28-day mortality among such patients was approximately 50%; risk factors for death included older age, oliguria and admission to a hospital with relatively limited ICU resources. Angiotensin converting enzyme 2 (ACE2) receptors for SARS CoV-2 are highly expressed in the proximal tubule cells [6, 9].

Another study, conducted in a large academic hospital in Brussels, examined a cohort of 49 patients. There was evidence of proximal tubule dysfunction in a subset of patients with COVID-19, as attested by low-molecular-weight proteinuria, neutral aminoaciduria, and defective handling of uric acid or phosphate [8].

At the structural level, kidneys from patients with COVID-19 showed prominent tubular injury, including the initial part of the proximal tubule with brush border loss and a marked decreased expression of megalin, acute tubular necrosis and intraluminal debris.

Transmission electron microscopy identified particles resembling corona viruses in vacuoles or cisternae of the endoplasmic reticulum in proximal tubule cells. Among features of proximal tubule dysfunction, hypouricemia within appropriate uricosuria was independently associated with disease severity and with a significant increase in the risk of respiratory failure requiring invasive mechanical ventilation using Cox (adjusted hazard ratio 6.2, 95% CI 1.9-20.1) or competing risks (adjusted subdistribution hazard ratio 12.1, 95% CI 2.7-55.4) survival models. Thus, our data establishes that SARS-CoV-2 causes specific manifestations of proximal tubule dysfunction and provides novel insights into the severity of COVID-19 and its outcomes.

Conclusion

The Covid pandemic has posed major challenge around the globe. Renal clinical presentation ranging from mild proteinuria, hematuria to progressive AKI necessitating renal replacement therapy (RRT), thrombotic microangiopathy and rhabdomyolysis. More research is needed to obtain adequate evidence to support current clinical approaches and to develop new approaches to management. Kidney failure occurs in most patients with COVID-19 pneumonia. Although proteinuria, hematuria and AKI are usually resolved in such patients within 3 weeks after the onset of symptoms, kidney problems in COVID-19

have been associated with higher mortality. AKI is independent predictor of mortality in Covid-19.

References

1. Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *Int J Surg.*, 2020 Apr; 76: 71-76. Doi: 10.1016/j.ijisu.2020.02.034. Epub 2020 Feb 26.
2. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel corona virus in Wuhan, China. *Lancet*, 2020; 395: 497-506.
3. Phan LT, Nguyen TV, Luong QC, et al. Importation and human-to human transmission of a novel corona virus in Vietnam. *N Engl J Med.*, 2020; 382: 872-4.
4. Agrawal R. The aftermath of corona virus disease 2019: devastation or a new dawn for nephrology? *Nephrol Dial Transplant.*, 2020; 35.
5. Hirsch JS, Ng JH, Ross DW, et al. Acute kidney injury in patients hospitalized with COVID-19. *Kidney Int.*, 2020; 98(1): 209-18.
6. Wang M., XiongH, Chen H, Li Q, Ruan XZ. Renal Injury by SARS-CoV-2 Infection: A Systematic Review. *Kidney Dis.*, 2021; 7 (2): 100-110. doi.org/10.1159/000512683
7. Hui-Xian Xiang, Jun Fei, Ying Xiang, Zheng Xu, Ling Zheng, Xiu-Yong Li, Lin Fu, Hui Zhao. Renal dysfunction and prognosis of COVID-19 patients: a hospital-based retrospective cohort study. *BMC Infectious Diseases*, 2021; volume 21, Article number: 158.
8. Werion A, Belkhir L, Perrot M, Schmit G, Aydin S, Chen Z, Penaloza A, De Greef J, Yildiz H, Pothen L, Yombi JC, Dewulf J, Scohy A, Gérard L, Wittebole X, Laterre PF, Miller SE, Devuyt O,

Dharmapuri Vaishnavcharankumar, Yeruva Veda Parimala, Uday Sankar Akash Vankayala, Ankit Sunil Kulkarni, Akkalashetty Uday Shree. Renal involvement and early prognosis in patients with Covid-19 pneumonia in tertiary health care centre. IAIM, 2023; 10(7): 11-16.

Jadoul M, Morelle J; Cliniques universitaires Saint-Luc (CUSL) COVID-19 Research Group. SARS-CoV-2 causes a specific dysfunction of the kidney proximal tubule. *Kidney Int.*, 2020 Nov; 98(5): 1296-1307. doi: 10.1016/j.kint.2020.07.019. Epub 2020 Aug 10.

9. COVID-19: Issues related to acute kidney injury, glomerular disease, and

hypertension. Available from: <https://www.uptodate.com/contents/covid-19-issues-related-to-acute-kidney-injury-glomerular-disease-and-hypertension>.