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Letter to the Editor

LETTER TO THE EDITOR

# Severe COVID-19-induced AKI: a 3-month follow-up

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Since November 2019 and the emergence in China of a novel coronavirus named severe acute respiratory syndrome coronavirus 2, the whole world has been facing a global pandemic [1]. Coronavirus disease 2019 (COVID-19) is mainly responsible for pneumonia, with severe respiratory damage like acute respiratory distress syndrome (ARDS), and can require prolonged invasive mechanical ventilation in the intensive care unit (ICU) [2]. Other organ injuries, probably underestimated, have been reported, including acute kidney injury (AKI) [3]. We reported an incidence of AKI of 80% in severe COVID-19 patients in a study that included the ICU at the University Hospital of Bordeaux [4]. Most of the AKI patients suffered from persistent AKI (93%), with likely tubular involvement [urine protein:creatinine ratio 82 mg/mmol (range 54–140)]. To date, no data have been reported concerning renal outcome after COVID-19-induced AKI.

We carried out a 3-month follow-up study of patients admitted to the medical ICU of the University Hospital of Bordeaux. Basal serum creatinine (SCr) was systematically recorded using previous laboratory analyses for each patient. Standardized blood and urine laboratory tests were provided to the patient 3 months after discharge from the ICU.

From 5 March to 2 May 2020, 57 patients were admitted in our ICU for severe COVID-19. Among them, eight died during hospitalization, seven were lost to follow-up and 2 with previous chronic kidney disease (CKD) before admission were excluded. CKD was defined as an estimated glomerular filtration rate (eGFR) $<60$ mL/min/1.73 m$^2$. Among the 40 patients analysed, 27 (68%) suffered from AKI during their stay in the ICU. The mean age was $61 \pm 11$ years, the mean simplified acute physiology score II (SAPS II) was $37 \pm 17$. Nineteen of 27 (70%) and 20 of 27 (74%) patients required vasopressor and mechanical ventilation, respectively. Basal SCr was $66 \pm 14$ $\mu$mol/L and basal eGFR was $98 \pm 12$ mL/min/1.73 m$^2$ (Table 1).

Using the Kidney Disease: Improving Global Outcomes classification, 9 of 27 patients (33%) had AKI stage I; 9 of 27 (33%) had AKI stage II and 9 of 27 (33%) had AKI stage 3. Among these, 4 of 9 (44%) required renal replacement therapy (RRT).

At 3 months of follow-up, SCr was $80 \pm 28$ $\mu$mol/L and eGFR was $84 \pm 21$ mL/min/1.73 m$^2$. The median urine protein:creatinine ratio was 9 mg/mmol (interquartile range 5–34) without haematuria or glycosuria.

## RENAL RECOVERY

Renal recovery was defined as a return of SCr to within 125% of baseline without dialysis [5]. Twenty of 27 AKI patients (74%) had an early recovery (in the first 7 days) and 7 of 27 (26%) had acute kidney disease (AKD). Three of AKD patients (43%) recovered within the 3 months of follow-up (Figure 1). Renal recovery at Day 90 was seen in 23 of 27 (85%) patients.

## CKD AT 3 MONTHS

Four of 27 patients (15%) suffered from new-onset CKD. Among these four patients, three required RRT during their stay in the ICU. All these new CKD patients suffered from AKD after AKI and prior to CKD. No patient needed RRT at 90 days of follow-up.

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**Table 1. Baseline characteristics and renal outcomes at day 90**

| Baseline characteristics | |
|---|---|
| Males, No. (%) | 21 (78) |
| Age (years), mean (SD) | 61 ± 11 |
| BMI, mean (SD) | 33 ± 5 |
| Hypertension, No. (%) | 21 (78) |
| Diabetes, No. (%) | 8 (30) |
| Cardiovascular history, No. (%) | 6 (22) |
| Catecholamine use, No. (%) | 19 (70) |
| Mechanical ventilation, No. (%) | 20 (74) |
| Length of mechanical ventilation (days), median [IQR] ($n = 20$) | 23 [14–38] |
| SAPS II, mean (SD) | 37 ± 17 |
| SOFA, mean (SD) | 5 ± 3 |
| Minimum $PaO_2/FiO_2$, mean (SD) | 102 ± 43 |
| Basal SCr ($\mu$mol/L), mean (SD) | 66 ± 14 |
| eGFR (mL/min/1.73 $m^2$), mean (SD) | 98 ± 12 |
| SCr at admission ($\mu$mol/L), mean (SD) | 108 ± 107 |
| SCr max ($\mu$mol/L), mean (SD) | 234 ± 204 |
| AKI, No. (%) | 27 (100) |
| KDIGO 1, No. (%) | 9 (33) |
| KDIGO 2, No. (%) | 9 (33) |
| KDIGO 3, No. (%) | 9 (33) |
| RRT, No. (%) | 4 (15) |
| AKD, No. (%) | 7 (26) |
| ICU length of stay (days), median [IQR] | 19 [12–37] |
| Hospital length of stay (days), median [IQR] | 31 [22–54] |
| **Renal outcomes at day 90** | |
| SCr ($\mu$mol/L), mean (SD) | 80 ± 28 |
| eGFR (mL/min/1.73 $m^2$), mean (SD) | 84 ± 21 |
| Urine protein/creatinine ratio (mg/mmol), median [IQR] | 9 [5–34] |
| Renal recovery, No. (%) | 23 (85) |
| CKD, No. (%) | 4 (15) |
| RRT, No. (%) | 0 (0) |
| MAKE criteria incidence, No. (%) | 4 (15) |
| Need of RRT, No. (%) | 4 (15) |
| Mortality, No. (%) | 0 (0) |
| Persistent renal dysfunction, No. (%) | 0 (0) |

Cardiovascular history includes strokes, ischemic heart diseases, peripheral arterial disease and a history of hospitalization for heart failure. BMI, body mass index; IQR, interquartile range; SD, standard deviation; SOFA, sequential organ failure assessment.

## MAJOR ADVERSE KIDNEY EVENTS

Major adverse kidney events criteria, defined as the need of RRT, mortality or persistent renal dysfunction (defined as an SCr >200% of baseline) [6] at 90 days was seen in 4 of 27 (15%) patients, due exclusively to the need for RRT during ICU hospitalization.

To our knowledge, this report is the first to estimate the short-term outcome of kidney injury in severe COVID-19. Because of the specificity of COVID-19-induced AKI associated with a highly inflammatory state [4], a higher incidence of CKD at 3 months could be expected. However, this report seems to be reassuring and the low proteinuria supported this hypothesis. Nevertheless, prolonged and careful follow-up is necessary with larger multicentre studies.

## CONFLICT OF INTEREST STATEMENT

The authors report that they have no relevant financial interests. The results presented in this article have not been published previously in whole or part.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, AO, upon reasonable request.

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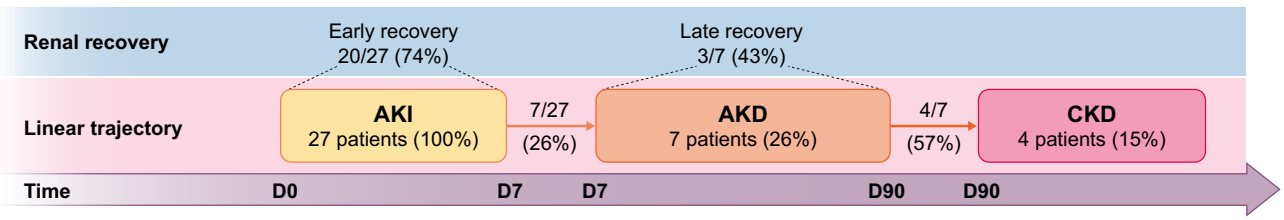


**FIGURE 1:** Renal trajectories after AKI.