

# Early acute kidney injury in a patient infected with Sars-CoV-2

Injúria renal aguda precoce em paciente infectado com SARS-CoV-2



Stefany Dantas da Silva<sup>1\*</sup>

Sergio Aparecido Cleto<sup>1</sup>

<sup>1</sup>Instituto de Infectologia Emílio Ribas, Especialização Multiprofissional - São Paulo - São Paulo - Brazil.



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**\*Corresponding Author:**

Stefany Dantas da Silva

E-mail: fany-dantas@live.com /  
enfermeirastefany@outlook.com

## ABSTRACT

The SARS-Cov-2 virus mainly affects the respiratory system, sometimes necessitating intensive care for the patient; however, it can directly or indirectly affect other essential organs such as the kidneys. Our objective is to report and discuss the case of a patient with severe coronavirus disease (COVID-19) who developed acute kidney injury on the fourth day of hospitalization and was successfully treated with renal replacement therapy.

**Keywords:** Acute kidney injury; Critical care; SARS-CoV-2; Severe acute respiratory syndrome; Case Report.

## RESUMO

O vírus SARS-CoV-2 acomete principalmente o sistema respiratório, podendo cursar com SRAG (síndrome respiratória aguda grave) e levar o paciente a necessitar de cuidados intensivos; mas outros órgãos nobres também podem ser direta ou indiretamente acometidos, como por exemplo os rins. O objetivo deste Relato de Caso é descrever e analisar o caso de um paciente crítico com COVID-19 grave, o qual desenvolveu injúria renal aguda já no quarto dia de internação, tratado com sucesso por terapia de substituição renal.

**Descritores:** Injúria renal aguda; Resultados de cuidados críticos; SARS-CoV-2; Síndrome respiratória aguda grave; Relato de Caso.

## INTRODUCTION

Most patients with coronavirus disease (COVID-19) suffer from the mild form, presenting symptoms such as fever, cough, sore throat, myalgia, headache and coryza<sup>1</sup>. According to the World Health Organization, approximately 80% of the detected cases are asymptomatic or oligosymptomatic and require home care, whereas approximately 20% require hospital care due to breathing difficulty, of which approximately 5% may require ventilatory support and admission to the intensive care unit (ICU)<sup>2</sup>.

One of the most common indications for ICU is the severe acute respiratory syndrome (SARS); however, significant renal function impairment has also been reported, leading to acute kidney injury (AKI) necessitating renal replacement therapy (RRT), sometimes on an emergency basis<sup>3,4</sup>.

This case report aims to identify the factors that led to early acute kidney injury in a patient infected with the SARS-CoV-2 virus.

## CASE REPORT

A 44-year-old male patient with a basal metabolic index of 30.86 and without comorbidities presented with dry cough, headache, and myalgia;

6 days later he reported a positive nasal swab RT-PCR result for SARS-CoV-2. He was admitted (Day 1) to the ICU of a referral hospital in São Paulo, SP, Brazil with acute respiratory failure (ARF). Chest tomography images showed 50–75% compromised lung parenchyma. The patient had an initial tachypnea of 41 bpm, saturation of 86% on a non-rebreathing oxygen mask at 15 l/min, was pale, and had bilateral crackles on physical examination. The main laboratory results at the time of admission are shown in Table 1.

**Table 1** - Laboratory test results on admission

Tests	Results
Pro-calcitonin	1,33ng/mL
Alanine aminotransferase (ALT/TGP)	60 U/L
Aspartate aminotransferase (AST/TGO)	68 U/L
Gamma glutamyl transferase (GGT)	277 U/L
C-reactive protein (CRP)	418,80 mg/L
Glucose (GLU)	149 mg/dL
Lactic dehydrogenase (LDH)	700 U/L
Creatine (Cr)	0,66 mg/dL
Urea (Ur)	30 mg/dL
Potassium (K)	5,3 mmol/L
Sodium (Na)	129 mmol/L
Fibrinogen (FIBC)	778 mg/dL
Hemoglobin (Hb)	13,2 g/dL
Hematocrit (Ht)	41,5%
Leukocytes	10,60 mil/mm <sup>3</sup>
Neutrophils	9,600/mm <sup>3</sup>
Segs	9,200/mm <sup>3</sup>
Bands	400/mm <sup>3</sup>

On Day 2, he underwent orotracheal intubation after unsuccessful periods of non-invasive ventilation (NIV). The initial mechanical ventilation parameters were set at 80% of inspired oxygen fraction and PEEP of +12 cm/H<sub>2</sub>O, with a PaO<sub>2</sub>/Fio<sub>2</sub> ratio of 100. The patient underwent antibiotic therapy since Day 1 with piperacillin/tazobactam besides methylprednisolone, prophylactic enoxaparin, and sedation with fentanyl, propofol, midazolam and pancuronium in a continuous infusion pump, without any vasoactive drugs.

His serum creatinine levels (1.45 mg/dL) increased on Day 3 without clinical intervention and worsened on Day 4 with a rise of three times the baseline (5.1 mg/dL). A positive fluid balance of 1.134 ml and urinary output of 1300 ml in the previous 24 h, hyperkalemia (6.3 mg/dL) without electrocardiographic changes, and stable vital

signs were still observed. On Day 4, blood cultures drawn during admission showed no bacterial growth.

Additionally, on Day 4, the patient was evaluated by the nephrology team while diagnosed with AKI (Kdigo III), thereby RRT was initiated through daily hemodialysis, the antibiotic dosage was reduced and enoxaparin was replaced by unfractionated heparin. He successfully underwent the first three-hour hemodialysis session on the same day (Day 4), without losses. On Day 5, he underwent another such session with a total of 1500 ml filtered, followed by daily sessions without hemodynamic changes (Table 2).

**Table 2.** Hemodialysis sessions and renal function test results

Number of sessions	Creatinine	Urea	Session duration (hours)	Filtered volume (ml)
1	5,1 mg/dL	176 mg/dL	3	0
2	5,9 mg/dL	173 mg/dL	3	1500
3	7,3 mg/dL	237mg/dL	3	1500
4	8,2 mg/dL	301 mg/dL	4	1800
5	8,2 mg/dL	296 mg/dL	4	2000
6	8,2 mg/dL	275 mg/dL	4	2000
8	7,3 mg/dL	220 mg/dL	4	1500
9	7,4 mg/dL	238 mg/dL	4	1500
10	6,2 mg/dL	222 mg/dL	4	1000
11	8,1 mg/dL	238 mg/dL	3	1200
12	7,6 mg/dL	257 mg/dL	4	1000
13	5,8 mg/dL	183 mg/dL	3	1000
14	5,1 mg/dL	184 mg/dL	3	0
Average	6,9 mg/dl	230,7 mg/dl	3,5	1269

On Day 9, sedation was discontinued for neurological evaluation and extubation protocol, but the patient maintained a low level of consciousness due to uremia (238 mg/dl), although being hemodynamically stable. He presented neurological improvement only on Day 14 (Glasgow 14), when he was successfully extubated and kept up eupneic under O<sub>2</sub> nebulization.

The patient underwent a total of 14 daily hemodialysis sessions and exhibited progressive improvement in renal function, fluid balance and urinary output. He was discharged after 30 days from admission and his serum creatinine and urea levels were 0.89 mg/dL and 49 mg/dL, respectively. No urinalysis was found in the medical record.

## DISCUSSION

Among the several factors that lead to AKI in a COVID-19 patient, the most cited in the

literature are hypoxemia, angiotensin II activation, glomerulopathies, inflammatory dysregulation, thrombotic microangiopathy, secondary sepsis, and drug toxicity<sup>5,6</sup>. Although the absence of comorbidities does not ascertain that the patient has not used potentially nephrotoxic drugs around the time he became ill, we consider this hypothesis unlikely even for antibiotics, either due to its short term use or the well-known pharmacological safety of the piperacillin/tazobactam combination.

Hernandez-Arroyo *et al.* attributed acute tubular damage to hemodynamic instability caused by shock and hypovolemia, aggravated by longer hospital stay and mechanical ventilation<sup>5,7</sup>. This case report shows no evidence of bacterial sepsis and/or hypovolemia, rather an important systemic inflammatory process supported by the signs, symptoms, and laboratory test results.

It is likely that the AKI in this patient was a consequence of a direct viral aggression facilitated by an increased expression of the angiotensin converting enzyme 2 receptor in the renal tubular epithelium, causing severe tubular necrosis by direct cytotoxic action<sup>5,6</sup>.

As well as AKI happened early in this case, the clinical response to the early initiation of daily RRT may also be highlighted, allowing renal function recovery in two weeks. This reinforces the hypothesis of acute tubular necrosis by direct SARS-CoV-2 action and its cytopathic effects on renal cells.

## CONCLUSION

AKI in COVID-19 patients is still a public health challenge, thus describing and paying attention to progression-related factors may help identify the criteria for developing better care practices. The reported case highlights direct viral infection of the kidney as the likely cause and the importance of timely RRT.

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