

Early vs. Late Initiation of Hemodialysis: Early Initiation as a Life-Saving Option in Stage III Leptospirosis Induced Acute Kidney Injury

Arifin¹⁾, Prasasti Probowirasmi²⁾, Nadiya Aliyah Roselyn²⁾, Helmi Fakhruddin²⁾

¹⁾Departement of Tropical Infection, Interna Medication,

Regional General Hospital of Dr. Moewardi, Central Java, Indonesia

²⁾Faculty of Medicine, Sebelas Maret University, Surakarta, Central Java, Indonesia

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ABSTRACT

Background: Leptospirosis is a zoonotic disease endemic in tropical regions with a high burden among low-income populations. Its clinical spectrum ranges from mild illness to severe Weil's disease, which may involve multiple organs with common and severe complication is acute kidney injury (AKI) with no specific therapy exists. In this report, we describe how early hemodialysis may improve outcomes.

Case Presentation: A 60-year-old man presented with a 10-day history of fever. He also reported calf pain and jaundice that had appeared one week prior to admission. Over the past week, the patient experienced decreased urinary frequency, with urine becoming more concentrated in color. Laboratory tests revealed thrombocytopenia, leukocytosis, elevated SGOT and SGPT levels, hyperbilirubinemia, and azotemia. *Leptospira* IgM was positive. Urinalysis demonstrated proteinuria and bilirubinuria. The patient's Modified Faine's Criteria score was 34, and his SOFA score was 11.

Results: Patient was diagnosed with Weil's disease with AKI III complicated by sepsis. The furosemide stress test was administered to the patient but the results was not favorable therefore hemodialysis was initiated leading to an improvement in the patient's condition.

Conclusion: Early initiation of hemodialysis in patients with leptospirosis induced AKI provides favorable immediate outcome and prevents them from falling into uremic syndrome leading to mortality.

Keywords: Weil's disease, leptospirosis, early hemodialysis, outcome, uremic syndrome

Correspondence:

Prasasti Probowirasmi. Faculty of Medicine, Universitas Sebelas Maret. Jl. Ir. Sutami No. 36A, Kentingan, Jebres, Surakarta, Central Java, Indonesia. Email: probowirasmi@student.uns.ac.id

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BACKGROUND

Leptospirosis is a zoonotic infection caused by pathogenic bacteria of the genus *Leptospirae*. The primary reservoirs are the renal tubules of wild and domestic animals. Transmission occurs through direct contact with infected animal urine or indirectly via contaminated soil and water (Rajapakse,

2022; Hutajulu et al., 2023). This makes leptospirosis a common public health problem in areas with poor sanitation and frequent flooding, as stagnant water often serves as a medium for transmission. The highest prevalence of leptospirosis is reported in tropical regions particularly in

Southeast Asia, Sub-Saharan Africa, Caribbean, and Oceania.

Several provinces in Indonesia are endemic for leptospirosis, with the highest incidence areas being Central Java and East Java (Hutajulu et al., 2023). Leptospirosis mostly affects low-income populations, contributing to significant increase in morbidity and mortality (Rajapakse, 2022). The burden is especially high in South and Southeast Asian countries, such as India and Indonesia reflecting both the environmental conditions that favor the survival of *Leptospira* and the limited resources available for prevention and treatment. The disease therefore poses not only a medical challenge but also a socioeconomic burden, as it primarily affects populations with high occupational and environmental exposure, such as farmers, miners, and sanitation workers (Costa et al., 2015).

Clinical manifestations of leptospirosis are wide ranging, from mild, self-limiting illness, to severe, life-threatening stages. Weil's disease as the severe manifestation can affect various organs, including the central nervous system, liver, lungs, and kidneys (Rajapakse, 2022). Renal involvement often present as acute kidney injury (AKI) which occurs in up to 66% in critical ill patients which is associated with increased mortality and morbidity (Małeckki et al., 2019).

Patients with AKI experience a significant decrease in renal function, leading to fluid overload, electrolyte disturbances, metabolic acidosis, and toxic increases in serum urea (Li et al., 2023). Patients with leptospirosis-induced AKI require close monitoring and timely intervention to prevent further deterioration. Conservative management strategies, such as fluid and electrolyte balance, may suffice in mild cases. However, in moderate to severe cases, especially when there is persistent

oliguria or worsening metabolic abnormalities more intensive and aggressive treatment are needed.

Currently, there are no specific therapies for leptospirosis-induced AKI. Supportive care remains the key of management. In this case, renal replacement therapy, such as hemodialysis, becomes essentials. Hemodialysis playing a central role in patients with severe renal impairment. Hemodialysis is a therapeutic choice for patient with renal insufficiency. It uses a device to replace the kidney to excreting the metabolic waste product and fluids (Pratiwi, Tamtomo and Suryono, 2019).

Early initiation of hemodialysis has been associated with improved clinical outcomes and reduced mortality, as it helps correct metabolic derangements and prevents complications of fluid overload. The early initiation of hemodialysis can be considered to improve the patient's clinical condition and prevent mortality (Małeckki et al., 2019; Hutajulu et al., 2023).

However, limited studies exist regarding the optimal modality, target outcome, and timing of hemodialysis initiation in Weil's disease. Some studies suggest that earlier initiation of dialysis could provide survival benefits, while others emphasize the need to individualize treatment based on clinical severity and laboratory parameters. Further research is required to establish standardized protocols for the management of leptospirosis-induced AKI, particularly in resource-limited settings where the disease burden is highest.

CASE PRESENTATION

A 60-year-old man was admitted with a chief complaint of fever persisting for 10 days prior to admission. The fever was continuous and accompanied by headache, without convulsions, chills, diaphoresis, nausea, or vomiting. The fever subsided

temporarily with acetaminophen but recurred a few hours after administration. One week before admission, the patient developed calf pain and jaundice.

He also reported decreased urinary frequency and dark-colored urine during the same period. There were no bowel disturbances. The patient worked as a farmer and often worked barefoot in rice fields where rats were commonly found, both in the fields and around his home environment. No other family members experienced similar symptoms.

On physical examination, the patient appeared weak with a Glasgow Coma Scale

(GCS) score of E4V5M6. Vital signs revealed a blood pressure of 100/71 mmHg, pulse rate of 130 beats per minute, respiratory rate of 30 breaths per minute, axillary temperature of 38.9°C, and SpO₂ of 99% on room air. Anthropometric assessment showed a body weight of 60 kg and a height of 160 cm, yielding a BMI of 19.5 kg/m² (within the normal range). The skin was icteric without petechiae or purpura. The palpebral conjunctiva appeared pale, and the sclera was icteric.



Figure 1. Clinical photo of patient's icteric sclera

There were no signs of epistaxis, gum bleeding, or lymphadenopathy. Cardio-pulmonary and abdominal examinations were unremarkable. On musculoskeletal examination, the patient reported tenderness in the gastrocnemius muscle.

Several laboratory studies and imaging were performed. On admission, laboratory findings revealed anemia with hemoglobin 9.9 g/dL, hematocrit 28%, erythrocytes $3.31 \times 10^6/\mu\text{L}$, mean corpuscular hemoglobin (MCH) 29.9 pg, and

mean corpuscular volume (MCV) $35.3 \mu\text{m}^3$. Thrombocytopenia was noted at $56 \times 10^3/\mu\text{L}$, along with leukocytosis ($13.8 \times 10^3/\mu\text{L}$) consisting of neutrophils 80.9%, lymphocytes 9.4%, monocytes 9.1%, eosinophils 0%, and basophils 0.6%. Liver enzymes were elevated (SGOT 38 U/L, SGPT 54 U/L), and the patient was markedly hyperbilirubinemic (total bilirubin 18.62 mg/dL). Renal parameters were deranged with elevated creatinine (4.9 mg/dL) and urea (360 mg/dL).

Chemical blood examination showed prolonged PT (PT 15.1 seconds), APTT 31.9 seconds, INR 1.160. Hypoalbuminemia was presented (albumin 30g/dL). Urinalysis revealed proteinuria (1+), bilirubinuria (2+), and hematuria (1+). The patient

tested positive for anti-*Leptospira* IgM and the gold-standard MAT identified *Serogroup Ballum, Serovar Ballum, Strain Mus127* with a titer of 1:640 (Gasem *et al.*, 2020).

Table 3. MAT result

No	SeroGroup	SeroVar	Strain	Normal	Result
1	Andamana	Andamana	CH 11	<1/20	1:20
2	Australis	Australis	Ballico	<1/20	1:320
3	Australis	Bratislava	Jez Bratislava	<1/20	1:320
4	Autumnalis	Autumnalis	Akiyami A	<1/20	<1:20
5	Autumnalis	Rachmati	Rachmat	<1/20	1:320
6	Ballum	Ballum	Mus 127	<1/20	1:640
7	Ballum	Castellonis	Castellon 3	<1/20	1:20
8	Bataviae	Bataviae	Swart	<1/20	1:160
9	Canicola	Benjamini	Benjamin	<1/20	1:160
10	Celledoni	Whittcombi	Whittcomb	<1/20	1:20
11	Cynopteri	Cynopteri	3522 C	<1/20	1:80
12	Grippotyphosa	Grippotyphosa	Moksva V	<1/20	<1:20
13	Hebdomadis	Hebdomadis	Hebdomadis	<1/20	1:320
14	Icterohaemorrhagiae	Copenhageni	M 20	<1/20	1:320
15	Icterohaemorrhagiae	Icterohaemorrhagiae	RGA	<1/20	1:160
16	Icterohaemorrhagiae	Icterohaemorrhagiae	Lai	<1/20	1:160
17	Icterohaemorrhagiae	Naam	Naam	<1/20	1:20
18	Javanica	Coxi	Cox	<1/20	1:20
19	Javanica	Javanica	Veldart	<1/20	<1:20
20	Panama	Panama	CZ214	<1/20	<1:20
21	Pomona	Pomona	Pomona	<1/20	1:40
22	Pomona	Proechyms	Il6I U	<1/20	1:20
23	Pyrogenes	Pyrogenes	Sallmen	<1/20	1:20
24	Sarmin	Sarmin	Sarmin	<1/20	<1:20
25	Sejroe	Sejroe	M84	<1/20	<1:20
26	Sejroe	Hardjo	Hardjoprajitno	<1/20	1:20
27	Sejroe	Saxkoebing	Mus 24	<1/20	1:80
28	Semaranga	Patoc	Patoc 1	<1/20	1:20
29	Semaranga	Semaranga	V Semarang 173	<1/20	<1:20
30	Shermani	Shermani	1342 k	<1/20	<1:20
31	Tarassovi	Tarassovi	Perpeltisin	<1/20	1:320

Both anti-HIV and anti-HCV were nonreactive. Electrocardiographic examination (ECG) showed normal findings (Figure 2). Chest X-ray examination showed no

abnormalities in the heart and lungs (Figure 3). Ultrasound examination showed no organs abnormalities (Figure 4).

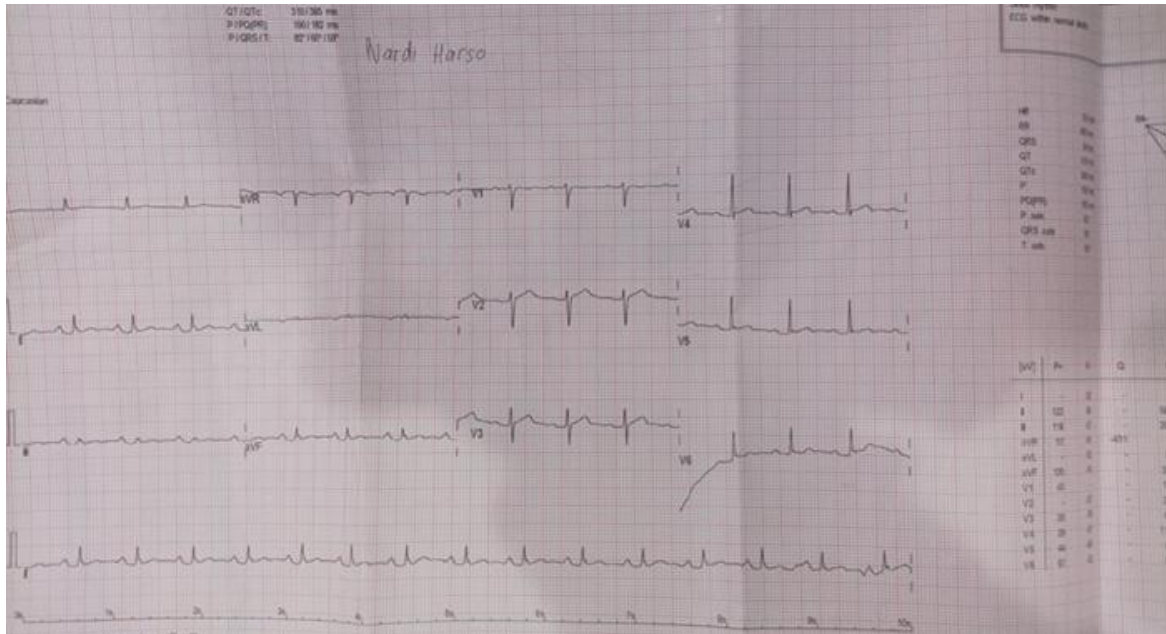


Figure 2. ECG showed no abnormality



Figure 3. Chest x-ray examination showed no abnormalities.



Figure 4. The result of the renal ultrasound examination showed no abnormalities in the patient kidney organs.

During hospitalization patient treated with a 1700kcal diet containing 60 gram/day protein and low sodium (<2 grams/day). Fluid resuscitation therapy including intravenous NaCl (0.9%) 90cc/hour, amino acid keto infusion once daily, acetaminophen injection 1 gram/ 8 hours, ceftriaxone injection 2 grams/days, curcuma 1 tablet/ 8 hours, CaCO₃ 1 tablet/8 hours, VIP albumin 1capsule/8 hours, and oxygenation 3L/minute with nasal cannula. The patient had received *furosemide stress test* 20mg, but urine output remain <200cc over 2 hours (McMahon and Chawla, 2021). On day two, hemodialysis was initiated along

with transfusion of 4 units of thrombocyte concentrates (TC).

RESULTS

Based on these history taking and examination results, the patient's Modified Faine's Criteria score was 34 (Bandara et al., 2016) (see table 1 for patient Modified Faine's Criteria score), classifying the case as presumptive leptospirosis. Given the presence of jaundice and renal failure, the diagnosis was confirmed as severe leptospirosis (Weil's disease) with AKI stage III complicated by sepsis with a SOFA score of 11 (Cheranakhorn and Teeratpatcharakun, 2021) (see table 2 for patient SOFA score).

Table 1. Modified Faine’s Criteria Score

Criteria		Score
Part A		
Headache	+	2
Fever	+	2
Fever >39°C	-	0
Conjunctival suffusion	+	4
Meningism	-	0
Muscle pain/myalgia	+	4
Congjunctival suffusion + meningism + muscle pain	-	0
Jaundice	+	1
Albuminuria/nitrogen retention	-	0
Hemoptysis/dyspnea	-	0
Part B		
Rainy season	+	5
Contact with contaminated environment	+	4
Contact with animal	+	1
Part C		
Isolation of leptospira in culture, ELISA IgM (+), SAT (+), MAT (+)	+	15
Titer MAT increased	-	0
Total		34

Table 2. SOFA Score

Criteria	Score
Respiration (PaO ₂ /FiO ₂)	2
<300	
Coagulation (Platelet count x 10 ³)	2
<100	
Liver (bilirubin)	4
>12	
Cardiovaskular (MAP)	0
>70mmHg	
Neurology (GCS)	0
15	
Renal (creatinine)	3
3.5–4.9	
Total	11

During hospitalization patient treated with a 1700kcal diet containing 60gram/day protein and low sodium (<2 grams/day). Fluid rescucitaion therapy including intravenous NaCl (0.9%) 90cc/hour, amino acid keto infusion once daily, acetaminophen injection 1 gram/ 8 hours, ceftriaxone injection 2 grams/days, curcuma 1 tablet/ 8 hours, CaCO₃ 1 tablet/8 hours, VIP albumin 1capsule/8

hours, and oxygenation 3L/minute with nasal cannula.

The patient had received *furosemide stress test* 20mg, but urine output remain <200cc ober 2 hours (McMahon and Chawla, 2021). On day two, hemodialysis was initiated along with transfusion of 4 units of thrombocyte concentrates (TC).

By day five, the patient showed significant clinical improvement with urine output increased to 1000cc/day. Post

hemodialysis laboratory result demonstrated hemoglobin 7.3g/dL, hematocrit 22%, erythrocytes $2.29 \times 10^6/\mu\text{L}$, leukocytes $34.7 \times 10^3/\mu\text{L}$, platelets $418 \times 10^3/\mu\text{L}$. Renal function improves with ureum level decreasing to 186mg/dL and creatinine to 2.1mg/dL. Total bilirubin decreased to 9.1mg/dL (direct bilirubin 9mg/dL and indirect bilirubin 0.1mg/dL). Patient's follow up resume is describe in table 4.

The patient was discharged on day five with prescriptions for acetaminophen

500 mg three times daily, albumin capsules three times daily, calcium carbonate three times daily, curcuma three times daily, and N-acetylcysteine three times daily. Follow-up was scheduled one week post-discharge. At first outpatient visit, patient reported no complaints. Vital signs were stable, and laboratory tests showed further improvement with normalized renal function (ureum at 30mg/dL and creatinine at 0.8mg/dL).

Table 4. Follow Up Resume

Examination	Date of Follow Up					
	30/12	31/12	2/1 (Post HD)	3/1	4/1	9/1
Hemoglobin	9.9 g/dL	N/A	9.3 g/dL	N/A	N/A	$8.9 \times 10^3/\text{U/L}$
Hematocrit	28%	N/A	22%	N/A	N/A	27%
Leucocyte	$13.8 \times 10^3/\text{U/L}$	N/A	$34.7 \times 10^3/\text{U/L}$	N/A	N/A	$12.1 \times 10^3/\text{U/L}$
Trombocyte	$56 \times 10^3/\text{U/L}$	N/A	$418 \times 10^3/\text{U/L}$	N/A	N/A	$507 \times 10^3/\text{U/L}$
Eritrocyte	$3.3 \times 10^6/\text{U/L}$	N/A	$2.29 \times 10^6/\text{U/L}$	N/A	N/A	$2.77 \times 10^3/\text{U/L}$
SGOT	38 u/L	N/A	N/A	N/A	N/A	N/A
SGPT	54 u/L	N/A	N/A	N/A	N/A	N/A
Creatinin	4.9 mg/dL	N/A	2.1 mg/dL	N/A	N/A	0.8 mg/dL
Ureum	360 mg/dL	N/A	186 mg/dL	N/A	N/A	30 mg/dL
Na	149 mmol/L	N/A	144 mg/dL	N/A	N/A	139 mmol/L
K	4.1 mmol/L	N/A	4.4 mg/dL	N/A	N/A	3.8 mmol/L
Ca	0.95 mmol/L	N/A	0.98 mg/dL	N/A	N/A	1.1 mmol/L
Total bilirubin	18.62 mg/dL	N/A	N/A	9.1 mg/dL	N/A	1.89 mg/dL
Direct bilirubin	17.50 mg/dL	N/A	N/A	9.00 mgdL	N/A	N/A
Indirect bilirubin	1.12 mg/dL	N/A	N/A	0.1 mg/dL	N/A	N/A
PT	N/A	15.1 sec	N/A	N/A	N/A	N/A
APTT	N/A	31.9 sec	N/A	N/A	N/A	N/A
INR	N/A	1.16	N/A	N/A	N/A	N/A
Albumin	N/A	3.0 g/dL	N/A	N/A	N/A	3.8 g/dL
Urine output	N/A	<200 cc/ 2 hours	1200cc/24 hours	1000 cc/ 24 hours	1000 cc/ 24 hours	N/A
Protein urine	N/A	N/A	+1	N/A	N/A	N/A
Bilirubin urine	N/A	N/A	+2	N/A	N/A	N/A
Eritrocyte urine	N/A	N/A	+1	N/A	N/A	N/A

The patient was discharged on day five with prescriptions for acetaminophen 500 mg three times daily, albumin capsules three times daily, calcium carbonate three

times daily, curcuma three times daily, and N-acetylcysteine three times daily. Follow-up was scheduled one week post-discharge. At first outpatient visit, patient reported no

complaints. Vital signs were stable, and laboratory tests showed further improvement with normalized renal function (ureum at 30mg/dL and creatinine at 0.8mg/dL)

DISCUSSION

Symptoms experienced by patients with leptospirosis are very diverse ranging from fever, myalgia, to organ failure such as acute kidney injury (AKI), jaundice, pulmonary haemorrhage, to meningitis. The kidneys are the most commonly affected organs in leptospirosis, with potential progression to chronic kidney disease (CKD) (Rajapakse, 2022). Renal involvement in Weil's disease is characterized by symptoms of oliguria, albuminuria, and hematuria (Malecki *et al.*, 2019). Based on the KDIGO classification, the patient in this case had AKI grade III (Goyal *et al.*, 2024).

The manifestation of AKI in Weil's disease is primarily attributed to acute tubulointerstitial nephritis (ATIN) which is associated with hypokalemia and excessive sodium excretion. Histopathological features of ATIN in leptospirosis include diffuse interstitial edema and mononuclear cell infiltration. Two main mechanisms underlie this process are direct nephrotoxicity from microbial endotoxins and hypoxia caused by impaired renal circulation (Chancharoentana *et al.*, 2022). Patients with AKI require renal replacement therapy (RRT)--in this case hemodialysis--to improve hemodynamic function. Hemodialysis modalities in patients with AKI include continuous RRT (CRRT), sustained low efficacy dialysis (SLED), and intermittent hemodialysis (IHD) (Connor, Neyra and Ostermann, 2022). The main indications for RRT in AKI are volume overload with diuretic resistance, hyperkalemia, severe metabolic acidosis, and manifestations of uremic syndrome

including encephalopathy, pericarditis, and convulsion (Negi *et al.*, 2016).

Early initiation of hemodialysis is defined as hemodialysis within 12 hours of oliguria (urine output <30ml/h in 6 hours or creatinine clearance <20ml/min) (Negi *et al.*, 2016; Mishra *et al.*, 2022). In this case, the patient experienced volume overload unresponsive to furosemide and a marked elevated ureum level above 140 mg/dL (creatinine 4.9mg/dL and ureum 360mg/dL) (Li *et al.*, 2023). Therefore, the decision of early initiation of RRT with IHD in this case was necessary to prevent uremic syndrome and prevent mortality (Kusumawardani and Jufan, 2025).

Early initiation of hemodialysis in patients with leptospirosis-induced AKI has both advantages and disadvantages that require cautions. Early initiation of hemodialysis in weill's disease patients with AKI can reduce the progressivity of AKI and reduce mortality (De Francesco Daher *et al.*, 2017). Systematic review and meta-analysis studies have shown that early initiation of RRT in critically ill patients with AKI provide clinical benefit compared to patients with late initiation (Negi *et al.*, 2016). Theoretically, early initiation of RRT offers advantages such as prevention of electrolyte and acid-base disturbances, improved hemodynamic stability, and avoidance of uremic complications. However, long-term outcomes do not significantly differ between early and late initiation, as early RRT is also associated with risks including RRT-induced kidney injury, hypotension, and infection (Mishra *et al.*, 2022; Wu and Huang, 2025).

Besides RRT, an antibiotic therapy is also crucial in the management of severe leptospirosis (Chancharoentana *et al.*, 2022). This patient received intravenous ceftriaxone 2 grams/ day on the first day of admission. The recommended antibiotic

options in such cases include penicillin, ceftriaxone, or doxyxyxline for seven days. Previous studies shows that ceftriaxon significantly reduce hospital stay, the need of intensive care admission (De Francesco Daher *et al.*, 2016), and reduce the risk of both AKI and RRT (Osorio-Rodríguez *et al.*, 2024).

Close monitoring of diet and fluid intake is necessary after hemodialysis. Patients receive customized nutritional intakes, especially in protein intake. According to the ISCCM guideline, the recommended protein intake for AKI patients with IHD is 1-1.5g/kg/day (Mishra *et al.*, 2022), thus with a body weight of 60kg the patient received a diet of 1700kcal with 60gram/day protein.

Besides protein intake, the patient's fluid intake needs to be carried out with strict hemodynamic monitoring to prevent worsening of the lung and kidney organs (Hutajulu *et al.*, 2023; Osorio-Rodríguez *et al.*, 2024). This patient received 90 cc per hour of NaCl (0.9%) with close monitoring of the daily urine output of more than 0.5ml/kg per hour (approximately 720ml/day).

Monitoring urine output threshold is important to reduce the risk of worsening AKI and fluid overload (Osorio-Rodríguez *et al.*, 2024). In other than monitoring fluid through urine output, the levels of ureum, creatinine, electrolytes, and blood gases also need to be closely monitored to assess the success of therapy (Daher, de Abreu and da Silva Junior, 2010).

In summary, Early initiation of hemodialysis in patients with leptospirosis-induced AKI provides favorable immediate outcome and prevents them from falling into uremic syndrome leading to mortality. The patient's clinical condition and laboratory findings are important to consider in making decisions. Further

research on the optimal timing of hemodialysis in patients with leptospirosis induced AKI is essential.

AUTHOR CONTRIBUTION

Each author prepared the figure, authored the majority of the manuscript, and edited it.

CONSENT FOR PUBLICATION

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CONFLICT OF INTEREST

The author declare no conflict of interest.

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