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Emergency Hemodialysis at the National Hospital Center of Nouakchott

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Abstract

Introduction: Emergency hemodialysis is frequently required in resource-limited countries because kidney failure is diagnosed late. Its epidemiological and clinical characteristics remain poorly documented in our country. Objective: To describe the epidemiological profile, the indications, and the outcomes of patients admitted for emergency dialysis to the Nephrology-Hemodialysis Department of the National Hospital Center (CHN) of Nouakchott. Methods: Prospective single-center study including all patients who required emergency hemodialysis between 21 November 2023 and 21 January 2024 at the CHN of Nouakchott. Results: Fifty patients were included. Mean age was 44.4 ± 16.4 years; there were 33 men and 17 women (sex ratio 1.94). Kidney failure was chronic in 41 patients and acute in 9 patients. The main indications were uremic syndrome (44%), diuretic-resistant acute pulmonary edema (36%), severe metabolic acidosis (14%), and threatening hyperkalemia (12%). A femoral catheter was used in 86% of patients. Four patients died (8.2%). Conclusion: At the National Hospital Center of Nouakchott, emergency hemodialysis mainly concerns young patients with chronic kidney disease discovered at a late stage. Clinical and biological uremic syndrome was the leading indication.

Keywords

Emergency Hemodialysis, Acute Kidney Injury, Chronic Kidney Disease, Uremic Syndrome, Femoral Catheter, Mauritania

1. Introduction

Hemodialysis, an extracorporeal renal replacement technique, plays a central role in the management of patients with rapidly deteriorating kidney function, whether due to acute kidney injury (AKI) or to acute-on-chronic kidney disease (CKD) [1]. Its main purpose is the removal of uremic toxins and the control of volume status across a semipermeable membrane through diffusion and convection [2].

In resource-limited countries, kidney disease is frequently diagnosed late, so that hemodialysis is most often started as an emergency in the face of a life-threatening clinical and biological picture: acute pulmonary edema (APE) resistant to medical treatment, severe hyperkalemia, severe metabolic acidosis, or poorly tolerated uremic syndrome [3]. This situation exposes patients to substantial peridialytic morbidity and mortality, particularly when the vascular access available in an emergency remains precarious, most often a femoral catheter [4] [5].

Few data are available on the circumstances of dialysis initiation, the indications, and the outcomes of patients undergoing emergency hemodialysis in Mauritania. This study was conducted in the Nephrology-Hemodialysis Department of the CHN of Nouakchott. Its objective was to describe the epidemiological and clinical profile of patients admitted for emergency dialysis and to determine the indications for emergency hemodialysis in this department.

2. Patients and Methods

2.1. Study Design and Population

This was a single-center, descriptive study with an analytical component and prospective data collection, conducted over two months, from 21 November 2023 to 21 January 2024, in the Nephrology-Hemodialysis Department of the National Hospital Center of Nouakchott (Mauritania).

All patients admitted with a condition requiring emergency hemodialysis during the study period were included, regardless of age. Patients with end-stage kidney disease presenting for their usual maintenance hemodialysis session were not included. Informed consent was obtained from each patient, or from a parent for the three patients under 18 years of age. Data were collected using a standardized form, through patient interview and review of medical records, and then entered into an anonymized database before analysis. The parameters collected included sociodemographic characteristics, medical history, admission ward, indication for emergency hemodialysis, type of kidney failure, laboratory, electrocardiographic (ECG), and radiological data, technical characteristics of the extracorporeal renal replacement session (vascular access, duration, ultrafiltration, number of sessions, transfusion), intradialytic incidents, and outcome.

2.2. Classification of Kidney Failure

The type of kidney failure was defined according to the Kidney Disease: Improving Global Outcomes (KDIGO) definitions.

AKI was defined by an increase in serum creatinine ≥ 0.3 mg/dL (≥26.5 μmol/L) within 48 hours, or ≥1.5 times baseline within the preceding 7 days, or urine output < 0.5 mL/kg/h for 6 hours [6].

Chronic kidney failure was defined as impaired kidney function present for more than 3 months [7], associated with normochromic normocytic non-regenerative anemia, hypocalcemia, hyperphosphatemia, and elevated intact PTH, with small kidneys and poor corticomedullary differentiation on ultrasound.

2.3. Definitions of the Criteria for Emergency Dialysis

- Threatening hyperkalemia was defined as serum potassium > 6.5 mmol/L, or ≥6.0 mmol/L when associated with another emergency indication. Electrocardiographic signs were sought whenever an ECG could be performed but were not required for the diagnosis, as an ECG was not available for most patients.
- Poorly tolerated uremic syndrome was defined by neurological and/or digestive signs attributed to uremia in a patient with markedly elevated blood urea.
- Severe metabolic acidosis was defined clinically by Kussmaul breathing and a serum bicarbonate level < 15 mmol/L, arterial blood gas analysis not being available.
- Acute pulmonary edema (APE) was diagnosed clinically (acute dyspnea, oxygen saturation < 90%, and bilateral crackles in both lung fields).

2.4. Outcome Measures

- The primary outcome was in-hospital mortality, defined as death from any cause between the first emergency session and discharge from the department.
- The immediate clinical response to the emergency hemodialysis session: resolution of the clinical signs of APE, normalization of serum potassium, and correction of metabolic acidosis.

2.5. Statistical Analysis

Data were entered using Excel and analyzed using SPSS version 22. Quantitative variables are expressed as mean ± standard deviation or as median [interquartile range], and qualitative variables as counts and percentages. Survivors and deceased patients were compared using the Mann-Whitney U test for quantitative variables and Fisher's exact test for qualitative variables, with a significance level of $p < 0.05$.

Claude Opus 5.5 (Anthropic) was used to clean the data entry (harmonization of labels, conversion of text values into numbers). The authors verified all results and take full responsibility for them.

3. Results

Fifty patients were included during the study period; their mean age was 44.4 ± 16.4 years. Sociodemographic characteristics and medical history are presented in **Table 1**.

Table 1. Sociodemographic characteristics of the patients (n = 50).

Characteristic	Number (n)	Percentage (%)
Mean age ± SD (years); median; range	44.4 ± 16.4; 46; 3 - 77	-
Male	33	66.0
Female	17	34.0
Sex ratio M/F	1.94	-
Low socioeconomic level	43	86.0
Middle socioeconomic level	5	10.0
Good socioeconomic level	2	4.0

Chronic kidney failure was found in 41 patients (82%) and acute kidney injury (AKI) in 9 patients (18%).

The indications for emergency hemodialysis, sometimes combined in the same patient, were clinical and biological uremic syndrome in 22 patients (44%), pulmonary edema unresponsive to medical treatment in 18 patients (36%), severe metabolic acidosis in 7 patients (14%), threatening hyperkalemia in 6 patients (12%), and severe hypercalcemia in 1 patient (2%). Three patients had multiple indications. Table 2 summarizes the indications for emergency dialysis.

Table 2. Distribution according to medical history (n = 50).

History	Number (n)	Percentage (%)
Hypertension	21	42.0
Known chronic kidney disease (CKD)	10	20.0
Diabetes	6	12.0
Heart disease	1	2.0
No notable history	17	34.0

Among the 6 patients with threatening hyperkalemia, serum potassium ranged from 6.4 to 7.9 mmol/L and exceeded 6.5 mmol/L in 5 of them; the patient with a potassium level of 6.4 mmol/L also had severe metabolic acidosis. An ECG was performed in 5 patients, and only 1 showed electrocardiographic signs of hyperkalemia. Among the 22 patients with uremic syndrome, urea ranged from 1.02 to 4.00 g/L and exceeded 2 g/L in 14 of them. The diagnosis of APE was clinical in all 18 patients.

Laboratory parameters at admission are summarized in Table 3. Anemia (hemoglobin < 11.5 g/dL) was present in 42 of the 47 patients tested (89.4%), hyperkalemia (potassium > 5.5 mmol/L) in 20 of 46 (43.5%), and hyponatremia (sodium < 135 mmol/L) in 19 of 46 (41.3%).

Renal-vesico-pelvic ultrasound, performed in 40 patients (80.0%), showed reduced kidney size in 12 patients and poor corticomedullary differentiation in 15 patients, in favor of chronic nephropathy. Chest radiography was performed in 12

patients (24%), but only 5 patients had alveolar opacities compatible with APE.

Table 3. Indications for emergency hemodialysis (indications sometimes associated; n = 50).

Indication	Number (n)	Percentage (%)
Clinical and biological uremic syndrome	22	44.0
Acute pulmonary edema (APE)	18	36.0
Threatening hyperkalemia	6	12.0
Hypercalcemia	1	2.0
Severe metabolic acidosis	7	14.0

The vascular access was a femoral catheter in 43 cases (86%), an already functioning arteriovenous fistula in 5 patients (10%), and a jugular catheter in 2 patients (4%). The characteristics of the sessions are presented in **Table 4**.

Table 4. Biological parameters on admission.

Indication	Mean ± SD	Number (n)	Percentage (%)
Urea (g/L)	2.35 ± 0.96	0.59 - 4.00	47
Serum creatinine (mg/L)	131.6 ± 57.9	17.0 - 230.0	47
Serum sodium (mmol/L)	133.3 ± 7.4	113.0 - 144.0	46
Serum potassium (mmol/L)	5.22 ± 1.25	3.00 - 7.90	46
White blood cells (G/L)	13.3 ± 8.7	2.6 - 39.0	47
Hemoglobin (g/dL)	8.04 ± 2.73	3.4 - 17.0	47
Platelets (G/L)	293.5 ± 143.9	3.7 - 638.0	47
CRP (mg/L)	37.1 ± 25.1	12.0 - 96.0	14

The incidents observed during the session were arterial hypotension (3 cases), seizure (2 cases), hypoglycemia (1 case), and cardiorespiratory arrest (1 case).

Outcome was known in 49 patients: 45 patients (91%) were discharged alive and 4 patients (8%) died in hospital.

Survivors and deceased patients did not differ significantly in age or in the laboratory parameters measured at admission (**Table 5**). Likewise, no significant association was found between death and sex ($p = 1.000$), type of kidney failure ($p = 1.000$), history of chronic kidney disease ($p = 1.000$), history of hypertension ($p = 0.125$), the indication of APE ($p = 1.000$), or blood transfusion ($p = 0.617$) (Fisher's exact test). Two of the 6 patients who experienced an intradialytic incident died, versus 2 of the 40 patients without an incident ($p = 0.077$).

4. Discussion

The mean age of our patients, 44.4 ± 16.4 years, is close to that reported by Koroma *et al.* in Dakar (43.46 ± 16.41 years) [8] and by Squalli *et al.* in Morocco

(43 ± 12 years) [9], but markedly lower than that observed in France by Vinsonneau *et al.* (65 years) [10] or by Bensalem *et al.* (62 years) [11]. This gap may reflect differences in the age structure of the populations, in the causes of kidney disease, and in access to early screening and nephrological follow-up; the latter is not the case in our setting, where patients present at advanced stages of chronic kidney disease.

Table 5. Characteristics of the emergency hemodialysis session.

Session characteristic	Value
Mean session duration (min)	117.4 ± 30.4 (range 60 - 180)
Mean number of sessions to resolve the emergency	2.43 ± 1.12 (range 1 - 6)
Mean hourly ultrafiltration	0.96 ± 0.73 L/h (range 0.20 - 3.00 L/h)
Peri-dialytic blood transfusion	23/50 (46.0%)
Peri-dialytic incident (all causes)	7/50 (14.0%)

The male predominance (sex ratio 1.94) found in our series is consistent with the data of Ben Hamida *et al.* in Tunisia (sex ratio 1.65) [12].

The low socioeconomic level, found in 86% of our patients, is in line with the findings of Diallo *et al.* in Mali [13]. Precarious living conditions may be an obstacle to access to nephrological care and to early diagnosis of kidney disease [13], but our study did not measure this link. Hypertension remains the main cardiovascular risk factor found in our series (42%), which is consistent with its high prevalence in sub-Saharan Africa [14].

Clinical and biological uremic syndrome was the leading indication for emergency hemodialysis in our series (44%), ahead of acute pulmonary edema (36%). This predominance of uremia has also been reported by Koroma *et al.* (43.2%) [8], Sané *et al.* (56.7%) [15], and Kane *et al.* in Thiès, Senegal (50.5%), where hyperkalemia ranked second (40.2%) [16]. Conversely, hyperkalemia was the leading indication at Donka, Guinea (46.5%), ahead of uremia (42.3%) [17]. The high proportion of chronic kidney failure discovered at the time of the emergency in our series is compatible with a diagnostic delay, as described in other African settings [18], but our study design does not allow a causal link to be established. Unplanned dialysis starts are not specific to resource-limited countries: in a Canadian multicenter study, only 19.8% of incident hemodialysis patients had started dialysis optimally, as outpatients with a permanent vascular access [19]. However, these series differ markedly from ours in age, comorbidities, and access to care, which limits direct comparison of the indications.

In principle, every patient with chronic kidney disease should benefit from planned renal replacement therapy before the onset of life-threatening complications [20]. The optimal timing for starting dialysis remains debated [21] [22]; the results of the IDEAL study argue for deferring dialysis until clinical indications

appear in patients under close nephrological follow-up [23]. The profile observed in our series suggests an absence of prior nephrological follow-up rather than a deliberate strategy of deferred initiation, although this could not be verified directly.

The most frequently used vascular access in our series was the femoral catheter (86%), a proportion close to those reported in Fès (84.4%) [9] and Thiès (81.3%) [16]. Compared with arteriovenous fistulas, central venous catheters are associated with an increased risk of infectious and thrombotic complications [24].

The mean session duration in our series (117.4 ± 30.4 minutes) is comparable to that reported by Kane *et al.* in Thiès (2.04 hours) [16], but shorter than that recommended for standard acute hemodialysis sessions (3.5 to 4 hours) [2].

In-hospital mortality in our series (8.2%) is close to that reported by Sané *et al.* (8.5%) [15], lower than those of Koroma *et al.* (25.8%) [8], Kane *et al.* (17.8%) [16], and Diakité *et al.* (16.9%) [17], and higher than that of Felah *et al.* in Tunisia (3%) [25]. These differences may reflect differences in recruitment, in the severity of the clinical picture at the start of hemodialysis, and in the period over which deaths were counted.

Our exploratory comparative analysis found no statistically significant association between death and age, hemoglobin, serum creatinine, serum sodium, or serum potassium. This result contrasts with the mortality risk factors classically reported in the literature [8] [15] [17], but must be interpreted with extreme caution: with only 4 observed deaths, the statistical power of our study is far too low to detect associations of moderate magnitude. These results should therefore be regarded as hypothesis-generating and should be confirmed in a larger multicenter cohort.

The renal outcome of the 7 patients with AKI was not collected systematically, so recovery of kidney function or progression to chronicity could not be reported. In a series of 84 patients with AKI requiring hemodialysis in Abidjan, complete recovery of kidney function was observed in 40.5% of them [26]; prospective follow-up of kidney function after AKI should be planned in future studies.

5. Study Limitations

- Single-center study with a modest sample size (n = 50), which limits the generalizability of the results.
- Short data collection period (two months), which may introduce uncontrolled seasonal variability.
- Small number of deaths (n = 4), making the analysis of mortality factors purely exploratory and underpowered.
- Incomplete documentation of some diagnostic tests in the emergency setting: an ECG was available in only 4 patients and chest radiography in 12, so the diagnosis of threatening hyperkalemia and APE relied mainly on laboratory and clinical criteria.
- Mortality assessed only during hospitalization, and renal outcome of patients with AKI not collected.

6. Conclusions

Acute hemodialysis is indicated in the management of patients with acute kidney injury, acute-on-chronic end-stage kidney disease, or severe fluid, electrolyte, or acid-base disorders. In this study, conducted in the Nephrology-Hemodialysis Department of the CHN of Nouakchott, the population undergoing emergency hemodialysis was predominantly young, male, and of low socioeconomic level. Clinical and biological uremic syndrome was the leading indication, and chronic kidney failure was most often discovered at the time of the emergency, which suggests late diagnosis of chronic kidney disease. Femoral access remained largely predominant, and in-hospital mortality was 8.2%.

These results argue for strengthened early screening for chronic kidney disease in the general population, better training of medical and paramedical staff in nephrology, and easier access to planned renal replacement therapy, which could help reduce the need for emergency hemodialysis and improve prognosis. Prospective multicenter studies with systematic follow-up are needed to confirm these findings.

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Author Contributions

Conceptualization, SM. MAH, B.E and M.L.; methodology, E.Y, J.A, A.A, and SM. MAH.; software, M.M, M.E; validation, SM.MAH., E.B., and A. Sidi ALY; formal analysis, SM. MAH, B.and M.L.; investigation, SM. MAH, B.and M.L.; resources, SM. MAH, B.and M.L.; data curation, SM. MAH, B.E.; SM. MAH; writing—SM. MAH, B.E.; visualization, M.L.; A. Sidi ALY; SM.MAH, X.X.; funding acquisition, N/A. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All authors declare that they received no financial support from any organization for the submitted work.

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