Screening of Chronic Kidney Diseases in Patients Hospitalized for Surgery at the National Hospital of Zinder in Niger

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Abstract

Background: Chronic kidney diseases (CKD) represent a significant public health issue worldwide, particularly in developing countries. Often with a silent onset, kidney diseases are frequently diagnosed late, necessitating hemodialysis treatment. Hence, prevention through screening remains the primary approach to addressing this issue.

Objective: To screen for CKD patients hospitalized at the National Hospital of Zinder, Niger (HNZ) and scheduled for surgery.

Methods: This cross-sectional study was conducted within 8 surgical departments of the National Hospital of Zinder (HNZ) in Niger over six months. The study included patients scheduled for surgery across various departments of HNZ.

Results: During this period, 497 patients were screened leading to the identification of 91 cases of CKD (stage 3 and below), representing a prevalence of 18.3%. Among the children tested, 33 out of 47 (70.2%) had CKD stage 3 and above, without proteinuria. The mean age of all patients was 31± 8 years, with a gender ratio of 2.6. Medical histories revealed high blood pressure (n=24;4.8%), diabetes (1 patient), urinary tract infections (n=13;2.6%), and obstructive syndrome of the lower urinary tract (n=30;7.8%). Overweight was observed in 4.8% of cases. De novo high blood pressure was identified in 98 patients (24.7%). Dipstick screening yielded positive results in 17 patients (3.4% of cases). Renal ultrasound examination was performed in 75(15.1%) patients, with hydronephrosis being the most frequent finding (n=22, *i.e.*, 29.3% of tested patients). Regarding the absolute number of patients, among the different departments of surgery, CKD prevalence was higher in general surgery, urology, and pediatric surgery.

Conclusion: Our findings demonstrate that childhood, hypertension, and urological pathologies are risk factors for CKD. Subclinical renal abnormalities can be detected through screening *via* urine dipstick urinalysis, biological examinations, and renal ultrasound.

Keywords: *Chronic kidney disease, Niger; surgery, dipstick urinalysis, hypertension, childhood, diabetes.*

INTRODUCTION

Chronic kidney diseases represent a significant global public health challenge [1]. In 2019, more than 750 million individuals worldwide were affected by chronic kidney diseases [2]. This prevalence is influenced by socioeconomic, cultural, and health policies. For example, in many African countries, the lack of health coverage leads people to avoid screening for chronic diseases. Managing chronic kidney disease demands substantial human, material, and financial resources, underscoring the importance of prevention as a primary management strategy. Global screening initiatives are crucial in this prevention effort [3]. Chronic kidney diseases often manifest silently, leading to late detection and eventual progression to end-stage renal disease requiring urgent dialysis treatment. However, early detection enables timely intervention and can significantly delay disease progression, thereby limiting the substantial financial burden of CKD, particularly in developing countries [1]. While the overall prevalence of chronic kidney diseases in Africa remains largely undocumented, some countries on the continent have reported significant prevalence rates [4]. Notably, in Niger, a staggering 90% of patients referred to Nephrology departments already present with end-stage renal failure [5]. Screening for chronic kidney diseases typically involves simple dipstick urinalysis tests, blood tests, and blood pressure measurements conducted during World Kidney Days (https://www.worldkidneyday.org) among specific target populations.

At Zinder National Hospital, to mitigate operative risks and postoperative complications among surgical patients, the surgical team routinely consults with an anesthesiologist for preoperative assessments. These assessments invariably include renal function measurements, often leading to the incidental discovery of chronic kidney diseases. Furthermore, we advocated

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for the implementation of comprehensive urine analysis tests, including dipstick urinalysis tests, to detect urinary abnormalities.

This study, the first of its kind conducted in Zinder (Niger), aims to provide an overview of chronic kidney diseases among surgical patients at HNZ in Niger. The objectives are to screen for chronic kidney diseases, describe their clinical and paraclinical characteristics, and identify associated risk factors.

PATIENTS AND METHODS

This study employed a descriptive cross-sectional design conducted within eight surgical departments of the National Hospital of Zinder in Niger over six months. The study included patients scheduled for surgery across various departments of HNZ, namely General Surgery, Urology, Traumatology, Stomatology, Neurosurgery, Pediatric Surgery, Ophthalmology, and Ear Nose Throat (ENT). Patients of all age groups hospitalized at Zinder National Hospital scheduled for surgery and who underwent a pre-anesthetic consultation were eligible for inclusion. Patients who underwent emergency surgery were excluded because they might have acute kidney injury, such as those with polytrauma, or intestinal occlusion. Additionally, patients already under nephrology follow-up and scheduled for elective surgery were excluded because they already had CKD.

Data were collected from patients' hospitalization records, pre-anesthetic consultation sheets, and preoperatively urinary examinations conducted using urine dipstick at the patient's bedside. Additionally, data were supplemented through interviews with patients or their caregivers. The study was approved by the Technical Consultative Committee (TCC) of the National Hospital of Zinder. Furthermore, all the patients had given their informed consent to participate in the study.

DEFINITIONS OF CONCEPTS

Kidney Disease: Renal involvement, with or without a decrease in glomerular filtration rate (GFR), characterized by biological abnormalities (proteinuria, hematuria, leukocyturia), and/or histological or radiological findings.

Estimated glomerular filtration rate (eGFR): to estimate eGFR, we used the CKD-EPI formula [6, 7].

Chronic Kidney Disease (CKD): Characterized by a reduction in renal functional mass, resulting in a sustained decrease (for at least three months) in the GFR to less than 60 mL/min/1.73m^2. This condition reflects an irreversible reduction in the number of functional nephrons due to chronic kidney disease. In this study, as none of the patients had undergone serum creatinine assessments before hospitalization, we assumed that any increase in serum creatinine, in the absence of obvious dehydration, was deemed chronic.

High Creatinine: serum creatinine level exceeding 120 µmol/L.

Proteinuria: Abnormal presence of proteins in urine.

Hematuria: Abnormal presence of blood in urine.

Leukocyturia: Abnormal presence of white blood cells in urine, with a sensitivity threshold of 10,000 leukocytes/ml.

Renal Lithiasis: Presence of kidney crystals in the urines or stones in the kidneys.

Hydronephrosis: Distension of the kidney's excretory cavities due to urine accumulation caused by ureteral obstruction.

Arterial Hypertension: Defined as prolonged elevation of blood pressure at rest, with systolic (≥ 140 mm Hg) and/or diastolic (≥ 90 mm Hg) readings (**Table S1**).

Anemia: Anemia is characterized by an abnormal decrease in hemoglobin levels in the blood. According to the World Health Organization (WHO), anemia is classified as mild if the hemoglobin (Hb) level ranges between 11.0 and 11.9 g/dl, moderate if the Hb level ranges between 8.0 and 10.9 g/dl, and severe if the Hb level is less than 8.0 g/dL. (https://www.hug.ch/sites/interhug/files/2022-09/strategie_anemie_final.pdf).

Body Mass Index (BMI): BMI is a measure used to evaluate a person's body fat and determine their body size. It is calculated using the formula: BMI = Weight / (Height)^2.

- Normal BMI: 18.5-25 kg/m².
- BMI < 18.5 kg/m²: Undernutrition.
- BMI 25-30 kg/m²: Overweight.
- BMI 30-35 kg/m²: Level 1 or moderate obesity.
- BMI 35-40 kg/m²: Level 2 or severe obesity.
- BMI > 40 kg/m²: Level 3 or morbid obesity.

Estimation of the required sample size to address the primary aim of our study: we have estimated that the prevalence of CKD (chronic kidney disease) would be 30% with an estimated precision of 5%. The estimation was based on the study of Kaze AD *et al.* [8].

This required a sample size of 103 subjects for 80% confidence (α = 20%), 145 subjects for 90% confidence (α=10%), and 179 subjects for 95% confidence (α= 5%).

Descriptive analyses presented quantitative data as means with standard deviations or medians with interquartile ranges, while categorical parameters were expressed as absolute numbers and relative percentages. Comparisons of categorical data were performed using the Chi-square test. Statistical tests adhered to a two-sided 0.05 level of significance, with a p-value considered significant below 0.05.

Statistical analyses were conducted using the Epi Info version 7.2.4 software.

RESULTS

During the data collection period, a total of 497 patients underwent screening, of whom 331 (66.6%) were adults. The average age was 31 ± 8 years, with the youngest patient being a newborn and the oldest being 89 years old. The age group under 15 years of age accounted for 31.9% of the cases. Male patients constituted the majority, comprising 73% of the sample (n=361), resulting in a sex ratio of 2.6.

A history of hypertension was present in 4.8% (n=24) of patients screened, whereas a history of type 2 diabetes was observed in a single patient. Medical histories of urinary tract infections (n=13), and obstructive nephropathy (n=30) were present in 2.6%, and 7.8% respectively. Additionally, 4.8% of screened patients (n=24) were classified as overweight.

Renal function results revealed:

- 290 had normal renal function eGFR > 90 mL/min (58.3%).
- 116 (23.3%) had eGFR between 60 and 90 mL/min (78.22 ± 7.05); none of them had proteinuria.
- CKD was present in 91 patients (18,3%), including:
  - 85 patients (17.1%) with stage 3 CKD (mean eGFR: 43.80 ± 7.35 mL/min)
  - 6 patients (1.2%) with stage 4 CKD (mean eGFR: 25.33 ± 1.87 mL/min).

Table **1** presents the prevalence of chronic kidney diseases (CKD) according to surgery departments. To minimize biases, we considered departments only with at least 25 patients screened. The three departments with the highest prevalence of CKD were General Surgery, Urology, and Pediatric surgery, with prevalence rates of 11.3%, 16.8%, and 70.2%, respectively. Pediatric patients represented 36.2% (33 out of 91) of our CKD patients.

Additional findings included:

- Anemia (hemoglobin < 11 g/dL) was present in 3.4% of cases (n=17), with 3% classified as mild and 0.4% as moderate.

Table 1: Prevalence of chronic kidney diseases (CKD) according to surgery departments.

Departments	No CKD n	Stage 3 n	Stage 4 n	Percentage of CKD Patients
Neurosurgery	3	3	0	50
Paediatric surgery	14	30	3	70.2
General surgery	165	20	1	11.3
Ophtalmology	10	4	0	28.5
ENT	22	0	0	0
Stomatology	9	3	0	41.6
Traumatology	94	9	0	8.7
Urology	89	16	2	16.8

Abbreviations: CKD, chronic kidney diseases; ENT, Ear, nose throat.

Table 2: Dipstick urinalysis results according to serum creatinine values.

Dipstick Urinalysis	Serum Creatinine (µmol/L)		Total
	Increased (> 120) n(%)	Not Increased (< 120) n(%)	
Hematuria	6(35.3)	8(47.1)	17
Leucocyturia	0(0)	8(100)	8
Proteinuria/Hematuria	8(100)	0(0)	8
Proteinuria	8(88.9)	1(11.1)	9

Table 3: Urinary tract echography findings.

Kidney and Urinary Tract Echography Findings		Frequency	Percentage
Lithiasis	Kidney	7	6.23
	Ureteral	2	
	Bladder	22	
Bilateral hydronephrosis		11	2.22
Bilateral hydronephrosis + prostate hypertrophy		11	2.22
Renal cyst with compression of urinary tract		1	0.20
No urinary tract abnormality		7	1.40
Hypertrophie prostatique		14	2.82
Not done		422	84.91

- Dehydration, *i.e.* acute kidney injury, was observed in 1.6% of cases (n=8), all of whom had elevated urea levels.
- Proteinuria was detected in 3.4% of cases (n=17) (**Table 2**). Of these, 50% also had hematuria. All patients with proteinuria had elevated serum creatinine, *i.e.* no patient with eGFR > 60 mL/min exhibited proteinuria.

Upon hospitalization, 98 of 497 (24.7%) were found to have hypertension, classified as grade I in 69 cases (13.9%); and grade II in 29 cases (10.8%).

Because patients had to pay for renal ultrasound examinations, only 75 patients (15.1% of the cohort) underwent the procedure.

Bilateral hydronephrosis was the most common abnormality detected (n=22) (**Table 3**), with half of these cases (n=11) associated with prostate hypertrophy. The second most common abnormality (n=31) was the presence of lithiasis, *i.e.* 7 renal stones, 2 ureteral stones, and 22 bladder stones.

DISCUSSION

In our study cohort, adult patients surpassed children (below the age of 15), constituting 68.1% of the total population. The mean age was 31±8 years. These findings align closely with those reported by Kalyesubula *et al.* who screened for chronic kidney diseases in Uganda [9]; the mean age of their patients was 31 years, ranging from 18 to 87 years. Several studies on chronic kidney disease screening have been conducted without stratification by age, such as

the investigation by Soyannwo *et al.* on self-urinalysis as an early detection method for kidney diseases in Saudi Arabia [10]. Most studies have focused either on children, as exemplified by Cho *et al.* screening through urinalysis in Korean schools [11], or on adults, such as Garcia *et al.* study on chronic kidney disease screening during World Kidney Day in Jalisco, Mexico [12].

The diverse age representation in our study can be attributed to its broad scope, encompassing all surgical services. Within our sample, males predominated, constituting 72.8% of the cohort compared to 27.2% of females, resulting in a sex ratio of 2.6. This male preponderance is consistent with findings reported by Diakité in a chronic kidney disease screening study in Mali [13] and by Kaba *et al.* in an assessment of renal function in adult hypertension patients in Conakry, Guinea [14]. Conversely, some studies have reported a female predominance, as seen in Okafor *et al.* mass screening in Niger and Nigeria [15] and Kalyesubula *et al.* study in Uganda [9].

The predominance of males in our study may be attributed to factors such as the absence of a maternity center at HNZ and the greater financial autonomy of men, facilitating access to medical care compared to women. Among the 497 patients screened, 85.2% had no personal medical history, a single patient had type 2 diabetes, and 4.8% were known hypertensive individuals (of whom 3% were under treatment with adequate monitoring, while 1.8% were not under follow-up). Additionally, 2.6% had a history of urinary tract infection (n=13), and 7.8% (n=30) had a history of lower urinary tract obstructive syndrome.

In all chronic kidney disease screening studies, a higher prevalence of arterial hypertension than diabetes has been observed among hypertensive patients, as evidenced by Harward *et al.* community screening study [16]. Similarly, Akpan *et al.* study on the comparability of glomerular filtration rate equations based on serum creatinine in adult West African communities [17] and Dada *et al.* study on risk factors for chronic kidney diseases among civil servants in Saudi Arabia [18] demonstrated a higher prevalence of hypertension compared to diabetes.

Given that obesity is a known risk factor for chronic kidney diseases, we assessed the body mass index (BMI) of our patients. Among the 497 patients screened, the majority (92%) had a normal BMI, 2% were malnourished, and only 4.8% (n=24) were overweight. Obesity and overweight have been associated with an increased prevalence of chronic kidney diseases, with higher frequencies observed in women compared to men, as reported by Cueto-Manzano *et al.* [19] and Ou *et al.* [20].

High blood pressure, or arterial hypertension, is also a significant risk factor for chronic kidney disease. Among our patients, in addition to 4.8% of patients being hypertensive, we found that 98, *i.e.* 24.7% had overt undiagnosed hypertension. Grade 1 hypertension was observed in 69 out of the 98 newly diagnosed patients, *i.e.* a prevalence of 70.4%. These findings are consistent with Touré *et al.* study on blood pressure screening in Niamey [21], suggesting a lack of awareness of health status in the absence of symptoms.

Dipstick urinalysis, a simple yet informative test, was performed on all patients to screen for chronic kidney diseases. Among the dipstick urinalysis tests conducted, 92.1% yielded negative results. Isolated proteinuria, proteinuria coupled with hematuria, hematuria alone, and leukocyturia accounted for 1.8%, 1.8%, 2.8%, and 1.6%, respectively. Hematuria and leukocyturia were exclusively observed in urology patients. Finally, none of the children with CKD had proteinuria. The utility of dipstick urinalysis in detecting chronic kidney diseases has been demonstrated by Li *et al.* [22] and Zamanzad [23].

In a study published in 2018, Xie *et al.* evaluated the burden of CKD worldwide between 1990 and 2016. When comparing CKD prevalences according to age and sociodemographic index (SDI) they found that in low SDI countries such as Niger prevalence of CKD was 16.01% below the age of 5, and 27.12% between the age of 5 to 14, *i.e.* 43.13%, whereas the respective figures in high SDI countries are 5.24 and 10.88%, *i.e.* 16.12%. Therefore, the prevalence of CKD in children worldwide is almost three times higher in poorer countries as compared to richer countries [24]. In our series, we found similar results because 36.2% of our CKD patients were children. McGregor *et al.* had indeed reported that acute kidney injury (AKI) occurred in at least 5% of all noncritically ill hospitalized children [25]. However, in our study, because we did not assess follow-up serum creatinine/eGFR we cannot assess the proportion of patients having AKI *vs.* CKD.

Given the prevalence of chronic kidney diseases and their often asymptomatic nature, renal function assessment, including serum creatinine and urea measurements, is essential for all patients scheduled for surgery. Elevated urea levels were observed exclusively among adults in our study.

Routine blood count examinations, conducted before each intervention, revealed anemia in 3.4% of patients, with 3% classified as mild and 0.4% as moderate. Anemia is a recognized complication of chronic kidney diseases, as evidenced by Fernando *et al.* [26].

The study has many limitations. The first one is that we only included patients for whom elective surgery was planned. Indeed, we did not want patients with acute kidney injury to be included, *e.g.* those presenting with polytrauma (rhabdomyolysis) or those having intestinal occlusion resulting in electrolyte disorders and abdominal compartments. The second one is the unavailability of some additional examinations such as kidney ultrasound

examination. The unavailability of some additional examinations constituted a limitation to the scope of the study. Indeed, kidney ultrasound examination, an invaluable screening tool, was performed on only 15.1% of patients (n=75), constituting a limitation to our study. The importance of ultrasound in chronic kidney disease screening has been emphasized by Liu *et al.* [27]. The high prevalence of chronic kidney diseases in the urology department (40.1%) underscores the role of urological pathologies as risk factors, as demonstrated by Stevens [28].

CONCLUSION

Kidney pathologies pose a significant public health concern, particularly in emerging countries. They warrant proactive screening measures to prevent or mitigate their progression. Our study performed in Niger, one of the poorest countries in the world, aimed to detect chronic kidney diseases among patients undergoing hospitalization for various surgeries. We identified arterial hypertension and urinary tract pathologies as key risk factors. Dipstick urinalysis tests revealed cases of hematuria, proteinuria, and leukocyturia, underscoring the importance of comprehensive screening for chronic kidney diseases using dipstick urinalysis, alongside biological and radiological assessments. Finally, we found that 91 (18.3%) of patients may have CKD (stage 3 and above) This study contributes valuable insights into hospital-based screening practices at HNZ and aids in understanding the scope of the issue.

ETHICS APPROVAL

Ethics approval for this study was obtained from the Faculty of Health Sciences, André Salifou University, Zinder, Niger (Ref: FSS_UASZ_Niger_No 026/10/01/2021). All procedures performed in studies involving human participants were following the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT OF PUBLICATION

Informed consent was obtained from all the participants of this study.

AVAILABILITY FOR DATA

Source data are available upon reasonable demands.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHORS' CONTRIBUTION

Conceptualization, HMD, LC, LR; methodology, HMD, LR; software, SBW; validation, HMD, ZMMT and LR; formal analysis, HMD and SBW; investigation, MA, HML, AG, and LC; resources, HMD; data curation, LC, and SBW; writing—original draft preparation, HMD; writing—review and editing, ZMMT, and LR; supervision, LR.

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