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Acute Renal Failure in the Elderly in the Nephrology Department of Aristide Le Dantec Hospital in Senegal: About 45 Cases

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Abstract

Introduction: The incidence of acute renal failure (ARF) increases with age. In Senegal, few studies have described the epidemiology of ARF in the elderly. The aim of our study is to establish the epidemiological profile of elderly patients with ARF, identify the causes of ARF in the elderly and assess treatment and prognosis. **Methods:** We conducted a descriptive and retrospective study over a five-year period from 2011 to 2015 involving patients aged 60 and over, treated for ARI during the study period. Data entry and analysis were done on Epi info 7.3. **Results:** We included a total of 45 patients. The prevalence of ARF was 3.34%. The mean age was 70.31 years (60 - 83) and the sex ratio was 3.5. Phytotherapy was found in 68.9%, hypertension was found in 68.9%, and diabetes was found in 31.1%. Prostate hypertrophy was found in 53.4% of patients. Pre-renal ARF was the most common (46.6%). Most of the cases, 66.67%, were at Stage 3 of KDIGO. The most common etiologies were respectively tumor (35.5%) and infection (20%). The most common complications were respectively hyperkalemia (33.3%) and hyponatremia (33.3%). Recovery was complete in 62.6% of cases, partial in 37.8% of patients and 13.3% of patients ended up on chronic hemodialysis. Mortality was 4.4%. **Conclusion:** Herbal medicine, hypertension and diabetes are frequently associated with ARF in the elderly. This justifies increased monitoring of the elderly subject with these

conditions in order to subject him to early and appropriate care.

Keywords

Acute Renal Failure, Elderly, Epidemiology

1. Introduction

Acute renal failure (ARF) is the rapid loss of kidney function, occurring over hours or days and resulting in the accumulation of metabolic waste products and the dysregulation of extracellular volume and electrolyte homeostasis [1] [2] [3].

The aging of the population is a public health reality that will become increasingly worrying in the years to come. Currently, the World Health Organization (WHO) defines an elderly person as anyone over the age of 60, and their number is expected to double by 2050 [4].

Acute renal failure is a common reason for hospitalization in the general population and its incidence increases with age. This is explained by the anatomical and structural changes of the kidney related to aging, underlying chronic pathologies and polypharmacy [5]. Multiple studies have demonstrated that the elderly are more susceptible to developing AKF [6] [7] [8]. ARF has consistently been associated with increased morbidity and mortality and multiple studies as well as a recent meta-analysis have demonstrated worse outcomes in the elderly [6] [9] [10]. In a multicenter study carried out in Australia and New Zealand, 51% of patients admitted to the intensive care unit were aged ≥65 years. Patients over the age of 80 with ARF had a poor survival rate [11]. In France, one-third of patients with ARI are over 70 years old. The incidence is estimated at 950 cases per million inhabitants [12]. In Algeria, 25% of patients over the age of 75 have ARF [13]. In Senegal, this prevalence is estimated at 27.5% according to a study carried out in Saint Louis [14].

ARF is a risk factor for progression to chronic renal failure [15] [16]. On the other hand, although few studies provide specific information on the vital prognosis of elderly people suffering from ARF, this failure does not seem to be associated with excess age-related mortality [8].

In Senegal, few studies report epidemiological data on ARF in elderly patients. In view of the increase in the incidence of ARF with age and the risk of progressing to chronic kidney disease, we set out to establish the epidemiological profile of elderly subjects with ARF and identify the causes of ARI in the elderly in Senegal.

2. Materials and Methods

This was a descriptive and retrospective study over a period of five years from January 1, 2011, to December 31, 2015. The study was carried out in the Nephrology-Hemodialysis-Transplantation Department of the Aristide Le Dantec Uni-

versity Hospital in Dakar. We included all records of patients aged at least 60 years. These patients were either treated in hospitalization or followed on an outpatient basis for acute renal failure (ARF) during the study period. Acute renal failure was confirmed on the basis of clinical, biological and imaging data. Not included were all patients meeting the age criteria, but having pre-existing nephropathy diagnosed before the study period, as well as incomplete or unusable medical records of patients. The selection of patients was made from the register and the medical records of patients.

For each patient, we collected the following data from medical records using a standardized questionnaire:

- Epidemiological: Age, sex.
- Comorbidities: Hypertension, diabetes, uro-nephrological diseases, infections, heart disease, neoplastic surgery, vascular surgery, uro-genital surgery.
- Alcohol, tobacco, phytotherapy.
- Physical signs.
- Biological: Urea test, serum creatinine, potassium, sodium, calcium, phosphorus, albumin, protein, leukocyte count, hemoglobin, platelets, LDH/CPK, CRP, cytobacteriological examination of urine (CBEU), thick blood smear, proteinuria.
- Radiological: Ultrasound data of the urinary tract which assessed the size, the structure, the cortico-medullary differentiation of the kidneys, the presence of pyelo-calyceal dilatation and assessment of other abdominal structures. The ultrasound was supplemented, if necessary, by the uroscan data.
- Therapeutics: Hygiene-dietary measures (water and sodium restriction, diet low in potassium, cessation of all nephrotoxic medication), IV fluids for vascular filling, antibiotics, diuretics, blood transfusion, antihypertensives, antibiotics, hemodialysis (number of sessions).

The elements of monitoring sought during treatment were:

- Clinical: Hemodynamic parameters (blood pressure, temperature, heart rate, respiratory rate), diuresis, clinical examination.
- Biological: Urea, serum creatinine, blood ionogram.
- Radiological: Elements of the ultrasound of the urinary tract.

Outcomes after treatment were either:

- A favorable outcome (defined by a cure of the ARF based on the resumption of the diuresis and the normalization of the urea and creatinine), or
- An unfavorable outcome. The unfavorable treatment outcome was one of the following situations:
  - Partial recovery (defined by the resumption of diuresis and the improvement of renal function without normalization of serum creatinine).
  - Complications related to ARF.
  - Chronicity (defined by the absence of normalization of renal function and dependence on dialysis).
  - Death.

The data collected were entered and analyzed with the Epi info version 7.3 software. The descriptive study was carried out by calculating the percentages for the qualitative variables and by calculating the averages for the quantitative variables.

3. Results

During the study period, 4546 patients were received in the department (hospitalization or consultations), of which 1346 were at least 60 years old. ARF was found in 55 patients aged at least 60 years, *i.e.* a prevalence of acute renal failure of 4.08%. Ten medical records were excluded because they were incomplete or unusable. The study therefore involved 45 patients. The prevalence of ARF adjusted was 3.34%.

The average age was 70.31 ± 6.52 years with a median of 69 years and extremes of 60 and 83 years. There were 35 men (78%) and 10 women (22%). The sex ratio was 3.5. Twenty-one patients (46.7%) came from the emergency department and 13.3% came from a urology department. Hypertension (68%) and phytotherapy (68%) were the most frequent risk factors for the occurrence of ARF (Table 1).

Thirty patients, or 66.67%, had Class 3 (KDIGO) acute renal failure. Class 2 and Class 1 accounted for 17.8% and 15.5% of cases respectively.

Regarding the mechanism of ARF, functional ARF or pre-renal ARF was the most common (46.6% n = 21). The etiologies found in the 21 patients were dominated by sepsis in 6 patients (28.6%) and cardiac decompensation (cardiorenal syndrome) in 6 patients (28.6%). The other etiologies were extracellular dehydration in 5 patients (23.8%) and hemorrhage in 4 patients, *i.e.* 19%.

Table 1. Different comorbidities found in elderly patients with ARF.

Comorbidities	Number (n = 45)	Percentage (%)
Hypertension	31	68.9
Phytotherapy	31	68.9
Diabetes	14	31.1
Heart failure	12	26.7
Infection	1	2.2
Rheumatic disease	7	15.5
Urological disease	19	42.1
Recent gastroenteritis	4	8.9
Cancer surgery	1	2.2
Gynecological surgery	2	4.4
Urological Surgery	3	6.7
NSAIDs	3	6.7

Obstructive or post-renal ARF was found in 16 patients (35.6%) including 15 cases secondary to extrinsic compression (93.8%) and 1 case of tumor invasion (6.2%). Organic ARF concerned 8 patients, *i.e.* 17.7% of cases. It was more frequently acute tubular necrosis (75%) (Table 2).

Hyperkalemia and hyponatremia were the most common complications. They represented 33.3% each. They were followed by poorly tolerated uremia with 15.55%. Table 3 presents the distribution of patients according to the complications found.

Table 2. Mechanisms and etiologies of ARF.

Etiologies/mechanism of ARF		Number	Percentage
Functional ARF (46.6% N = 45)			
Sepsis		6	28.6 (n = 21)
Cardiac decompensation		6	28.6 (n = 21)
Dehydration		5	23.8 (n = 21)
Acute hemorrhage		4	19 (n = 21)
Organic ARF (17.7% N = 45)			
Acute tubular necrosis		6	75 (n = 8)
Acute vascular nephropathy		1	12.5 (n = 8)
Extracapillary glomerulonephritis		1	12.5 (n = 8)
Obstructive ARF (35.7% N = 45)			
Extrinsic compression	Benign prostatic hyperplasia	8	50 (n = 16)
	Malignant prostatic hyperplasia	6	37.5 (n = 16)
	Iatrogenic ureteral ligation	1	6.25 (n = 16)
Cancer invasion		1	6.25 (n = 16)

Table 3. Distribution of patients according to the complications.

Complications	Number (n = 45)	Percentage (%)
Hyperkalemia	15	33.33
Hyponatremia	15	33.33
Poorly tolerated uremia	7	15.55
Pulmonary edema	4	8.89
Sepsis	3	6.67
Multiple organ failure syndrome	1	2.22
Respiratory distress syndrome	1	2.22
Acidosis	1	2.22
Hypokalemia	1	2.22

The evolution after the management of ARF in patients was towards a partial recovery in nearly half of the cases (44.44%). Full recovery was recorded in 16 patients (35.5%). The evolution towards chronicity requiring extrarenal purification was recorded in 7 patients (15.56%). Two deaths (4.4%) related to complications of ARF (pulmonary edema and poorly tolerated uremia) were recorded.

4. Discussion

4.1. Epidemiology Data

4.1.1. Prevalence

The prevalence of ARF in the elderly remains highly variable depending on the region of the world. These differences are probably related to the demographic structure of the countries. In fact, in developing countries with large populations, the population is younger. This is the case in Senegal, where the average age is 19 [17], which contrasts with a much higher average age in developed countries such as France, where 16.2% of the population is over 65 [18]. Multiple studies have demonstrated that incidence of ARF increases with age. In an Italian hospital cohort, the elderly (≥65 years) had 10 times the incidence rate of ARF compared to those <65 years of age [7]. The same trend is found in a Spanish hospital cohort where the incidence of ARF was 3.5 times higher in patients older than 70 years than in younger counterparts [19]. the increased incidence of ARF in the elderly is multifactorial, attributable in part to anatomic and physiologic changes in the aging kidney, to an increased burden of comorbidities impacting kidney function, to more frequent exposure to medications and interventions that alter renal hemodynamics or are nephrotoxic, and to alterations in drug metabolism and clearance associated with aging (6, 17, 43). In our study, 45 patients aged 60 or over presented with ARF, *i.e.* a prevalence of 3.34%. Diallo *et al.* [14] in Saint Louis in Senegal had found a higher prevalence than ours (29.5%). However, the studies by Ishani *et al.* [9] in the United States and that of Turgutalp *et al.* [20] in Türkiye reported that prevalence was close to our series (3.1% and 5.8% respectively). The variability of prevalence in the literature is strongly influenced by the variability of the threshold for defining the "elderly" subject. In our study, we chose the threshold of 60 years, corresponding to the WHO [4] references. **Table 4** presents the prevalence in different studies.

4.1.2. Age

Age is an important factor in the occurrence of ARF. This is because the kidneys undergo a number of important age-dependent changes. Among these changes, we have the renal mass which decreases with aging, reaching approximately 75% - 80% of young adulthood weight by the age of 80 to 90 years [21] [22] [23]. The kidneys have lost between 30% to 50% of their cortical glomeruli by the age of 70 years due to ischemic changes and a significant number of the remaining glomeruli manifest some degree of sclerosis [24] [25]. In addition, there has been a reduction in the number and size of tubules, increasing tubulointerstitial

Table 4. Prevalence of ARF in elderlyin different studies.

Authors	Country	Years	Age range	Prevalence
Diallo *et al.* [14]	Senegal	2015	≥60	27.5%
Ishani *et al.* [9]	India	2009	≥67	3.1%
Pascual *et al.* [8]	Spain (Madrid)	1998	≥80	39%
Pascual *et al.* [8]	Spain (Madrid)	1998	65 - 79	48%
Turgutalp *et al.* [20]	Türkiye	2017	65 - 75	5.8%
Turgutalp *et al.* [20]	Türkiye	2017	≥75	11%
Our study	Senegal	2011-2015	>60	3.34%

fibrosis, a decrease in glomerular filtering surface area, thickening of glomerular and tubular basement membranes, arteriosclerosis and decreased afferent arteriolar luminal area [26] [27]. These structural changes contribute to functional alterations among which we have a reduction in renal blood flow (RBF) of up to 50% from age 20 to age 80 [3] and a decline in glomerular filtration rate (GFR) [3]. The decrease in RBF and GFR, taken together, represents a loss of renal functional reserve in elderly and contributes to an increased risk for development of ARF [26]. In our study, the average age was 70.31 ± 6.5 years. This average corresponds to the age of vulnerability to ARF as described in the literature. This result could be superimposed on the values found by Diallo *et al.* [14] in Senegal and Koffi [28] in Côte d'Ivoire, who found an average age of 70.94 years and 71.8 ± 7 years respectively. Our result was also close to the mean reported by Selmi *et al.* [29], Ishani *et al.* [9] and Gorsane *et al.* [30] who respectively found average ages of 74.2 years, 78.34 years and 79.2 years in relation to the patient selection threshold in these series that were between 65 and 67 years old.

4.1.3. Gender

The implication of gender in the susceptibility of developing AKI remains a subject of debate. Female sex is listed among the shared susceptibility factors that confer a higher risk of ARF according to the Kidney Disease Improving Global Outcomes (KDIGO) clinical practice guidelines for acute kidney injury [5]. At present, there are no randomized controlled trials examining sex as a susceptibility variable for ARF. Most clinical cohort studies are confounded by the inclusion of women across all age groups including pre- and post-menopausal women in an uncontrolled way [31]. A meta-analysis by Neugarten *et al.* demonstrated that female sex is associated with protection against ARF and undermined the previously established belief that female sex is a significant risk factor for ARF. On the contrary, male sex seems to enhance the susceptibility to ARF [32]. The choice of classification would also have an impact on the results of studies on the susceptibility of developing ARF depending on gender. Srisawat *et al.* showed that the incidence of ARF was greater in men than women when

KDIGO criteria were used to define ARF, but that sex-related differences in ARF disappeared when RIFLE criteria were used [33]. We did not look for statistical correlation between gender and ARF in our study. We just observed that the male gender was predominant. This same trend was found in the vast majority of studies. This male predominance would be related to an acceleration of renal aging in men secondary to the stimulation of androgen production [18]. Diallo *et al.* [14] in Senegal and Koffi [28] in Côte d'Ivoire reported a sex ratio of 3.5 and 4.55 respectively, which was close to that of our series.

4.2. Clinical Data

4.2.1. Comorbidities

The older patients present several comorbidities increasing the susceptibility to kidney injury. These comorbidities include hypertension, diabetes mellitus, heart disease, pre-existing chronic kidney disease (CKD), and cancer.

Hypertension: In our study, hypertension was one of the most common comorbidities (68.9%). This high frequency of elderly suffering from ARF is explained by the fact that hypertension affects more than 50% of the general elderly population. Continued high blood pressure will lead to increased smooth muscle and hyaline content of the media. This will result in thickening of arterial wall and stenosis of the lumen, which in turn induces reduction of the RBF. These alterations make the kidney more prone to develop pre-renal ARF in case of hypo-perfusion [34].

Diabetes mellitus: In patients with diabetes mellitus, the high-glucose concentration damages blood vessels (microvascular damage) also in the glomerular structure, leading to several toxic effects and consequent micro-infarcts with reduced renal functional reserve. The persistence of hyperglycemia induces the formation of advanced glycation end-products (AGE), which lead to increased production of extracellular matrix, occlusion of the glomerular capillaries and cellular damage [35] [36]. Hyperglycemia also promotes serious infections. All these factors make the elderly diabetic patient predisposed to ARF. In a prospective case-control study of older adults, Mittalhenkle *et al.* evaluated the ARF incidence in a cohort of 5731 older individuals and found a significant association of diabetes mellitus, hypertension, and current smoking with incident acute renal failure (ARF) [37]. In our study, diabetes was the 3rd most common comorbidity (31.1%).

4.2.2. Polypharmacy

Commonly, the coexistence of several comorbidities in elderly patients needs multiple drugs (polypharmacy), which may be nephrotoxic alone or in combination [38]. The drugs may induce renal damage with several mechanisms, often combined, such as acute hypersensitivity, chronic accumulation and intoxication given the reduced excretion of elderly kidney. In West Africa, traditional alternative medicine is the first resort for nearly 80% of patients [39], polypharmacy therefore also includes the consumption of natural plants. In Dakar, Senegal,

46.7% of households use analgesic plants because they seem to be effective and less expensive [40]. The legitimate questions that must be asked are firstly, what are the harmful effects of these traditional medicines on the kidneys? And secondly, what are the interactions between these traditional medicines and the pharmaceutical products consumed for the management of comorbidities? Studies on the adverse effects of herbal medicine show that most of the harmful effects of medicinal plants are related not to the plants themselves, but to an error of identification, to involuntary contamination (by another plant, by heavy metals, by pathogenic microorganisms or by agrochemical residues), non-compliance with the adequate dose or an interaction with medications [41]. The error in identifying plants can be illustrated by the example of Belgium where more than 50 people suffered from kidney failure in 1996 after ingesting an herbal preparation containing *Aristolochiafangchi* (guang fang ji) a toxic plant, instead of *Stephaniatetrandra* (fang chi hang) following the confusion between these two species with very similar Chinese names [41]. Phytotherapy was found in the majority (68.9%) of patients in our study. However, we did not look for a correlation between the use of these traditional treatments and the occurrence of ARF.

4.3. Paraclinical Data

4.3.1. Mechanism of Acute Renal Failure

In our study, functional acute renal failure predominated at 46.6%, followed by obstructive acute renal failure at 35.6%. These results are similar to those of Diallo *et al.* [14] and Selmi *et al.* [29] in Tunisia. On the other hand, Koffi [28] in Côte d'Ivoire had found a predominance of organic renal failure.

Aging decreases the body's reserve capacities, which has the effect of making it more difficult for the body to adapt and making it more vulnerable in the event of aggression. In addition, thirst is particularly altered by aging. This could explain the predominance of functional acute renal failure in these studies.

4.3.2. Etiologies of Acute Renal Failure

The most common cause of ARF in our study was of tumoral origin (35.5%). It was followed by infection (20%). The series of Koffi [28] in Côte d'Ivoire and Gorsane *et al.* [30] in Tunisia found a predominance of infection among the causes of ARI. This difference could be justified by the fact that the urology department was one of the most represented referral departments.

4.3.3. Classification of KDIGO

It is currently the most widely used classification. In our study, Stage 3 was predominant with 66.67%, followed by Stage 2 with 17.78%. These results were similar to those of Koffi in Côte d'Ivoire [28], and that of Selmi *et al.* [29] in Tunisia, where Stage 3 was also the majority. On the other hand, Li *et al.* in China [42] found a predominance of Stage 1, with 47.2% followed by Stage 3 with 27.6%. This difference could be explained by the late transfer to the nephrology department in our context.

4.3.4. Evolution

The complications identified were mainly hyperkalemia, hyponatremia each found in 15 patients (33.3%) and poorly tolerated uremia in 7 patients (15.21%).

The evolution was favorable in 80% of the patients among whom 44.44% or 20 patients kept an alteration of the renal function, and unfavorable in 20% of patients with 4.44% of deaths.

In the literature, Diallo *et al.* [14] in Saint Louis in Senegal found a favorable evolution in 61.1% with recovery of renal function and unfavorable in 38.9% including 27.8% death. Koffi [28] in Côte d'Ivoire found similar results with an evolution that was favorable in 50.5% of cases; death in 46.7% of cases and among the patients who evolved favorably, impaired renal function persisted in 12 cases (11.2%).

5. Conclusion

Acute renal failure is a frequent reason for hospitalization in the general population as well as in the elderly and is associated with increased morbidity and mortality. Its prevalence in our study is 4.08%. The incidence of this pathology in the elderly is explained by the anatomical and structural modifications of the kidney linked to aging, the underlying chronic pathologies and polymedication. The causes of ARI are not different from those of the young subject. Nor are the diagnostic and therapeutic reasonings different from those of the young subject. Age should no longer be considered a limiting factor in the use of invasive treatments.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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