Clinical characteristics of elderly patients with chronic kidney disease during hospitalization

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Abstract

Objective: The objective of the study was to analyze the sociodemographic, clinical, and laboratory factors that can increase mortality from chronic kidney disease (CKD) in susceptible older adults (≥ 60 years). **Material and methods:** This study is a retrospective case-control study. The characteristics of surviving patients and mortality early or 90 days after hospital stay were compared. **Results:** One hundred and eight patients with CKD were included. About 29.6% died less than 90 days after hospital admission; 70.4% were survivors. The most frequent comorbidities found were diabetes (90.7%) and hypertension (88%). The logistic regression showed early death risk variables, such as stay in the intensive care unit (ICU) (odds ratio = 19.25; CI 2.2-167.92; $p = 0.008$). **Conclusions:** Early mortality was 29.6%. The main risk factors were ICU stay. The main cause of death was septic shock.

Key words: Chronic kidney disease. Mortality. Uremia. Renal dialysis. Risk factors.

Introduction

Cases of chronic kidney disease (CKD) are constantly increasing, making it a significant public health problem¹, especially in older adults^{2,3}. Comorbidities in the population, such as hypertension, diabetes, obesity, and atherosclerosis, have increased, predisposing and exacerbating CKD in the older adult population^{4,5}. CKD is defined as structural or functional renal abnormalities lasting more than 3 months. It is also classified according to the estimated glomerular filtration rate (e GFR)⁶.

It is estimated that after the age of 30, the GFR progressively decreases at an average of 8 mL/min/1.73 m²/decade⁷. This causes a debate as to whether it should be considered a disease or a physiological process. Likewise, in the past 30 years, a significant increase in

renal replacement therapies (RRTs) has been observed in adults aged 65-74 years and 75 years or older^{8,9}.

The annual incidence of CKD in Mexico is significantly higher than in other countries¹⁰, and it is one of the top 10 causes of death in people over 45 years of age. In 2019, 14,630 deaths were due to renal failure, with an increase of 0.1% in the death rate per 10,000 inhabitants compared to the period of 2010-2018, making this the year with the highest rate in the past decade¹¹.

In the past 4 years, the hospital in Northeast Mexico where this study was conducted has admitted more than 400 older adult patients with CKD, many of whom required RRT and post-admission follow-up regardless of their in-hospital results.

This study aimed to analyze the sociodemographic, clinical, and renal function parameters that could

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increase mortality at 90 days in patients ≥ 60 years of age.

Material and methods

Study design and participants

This was a retrospective case-control study of older adult patients ≥ 60 years of age with GFR <30 mL/min/1.73 m² who required hospital admission (HA) at the “Dr. Jose E. González” University Hospital due to Uremic syndrome (US) diagnosed by a specialist in nephrology using medical history and clinical and laboratory test data. The clinical records of patients admitted from October 2015 to October 2020 were retrospectively reviewed and analyzed. Older adult patients were divided into two groups by early mortality (≤ 90 days) after HA and survivors (Fig. 1).

Epidemiological information, vital signs, symptoms, laboratory results on admission, and treatment and prognosis were obtained from the clinical record. Information that was not available from this source was obtained from the database of the hospital or directly from patients or relatives. Two independent physicians reviewed all information.

The medical history and clinical and biochemical characteristics of the early mortality and survival groups were compared. Files with incomplete information were excluded from the study.

Definitions

CKD was classified according to the Kidney Disease Improving Global Outcomes (KDIGO) guidelines by the calculated GFR; in this case, the CKD EPI equation. This classification places the GFR at ≥ 90 (Grade 1), 60-89 (Grade 2), 45-59 (Grade 3a), 30-44 (Grade 3b), 15-29 (Grade 4), and <15 (Grade 5)¹². The Charlson Comorbidity Index compares 10-year mortality with comorbidities and patient's age¹³.

Statistical analysis

Continuous variables are described with mean values (standard deviation, SD) and median values (interquartile range, IQR). Categorical variables are presented as n (%). The mean (SD) was compared with the Mann-Whitney U-test or Student's t-test depending on its normal distribution and homogeneity in the variance; the Kolmogorov-Smirnov test was used to define the normal distribution of continuous variables. Categorical

Figure 1. Flowchart of a case-control study. GFR: glomerular filtration rate.

variables were compared with the Chi-square test or Fisher's exact test. The multivariate analysis using logistic regression and variables as hospital stay, admission, patient background, vital signs, and laboratory tests was dichotomized. A $p \leq 0.05$ was considered statistically significant. The statistical analysis was developed with the SPSS 25.0 program (IBM Corporation, Armonk, NY, USA).

Results

Epidemiological characteristics

From October 2015 to October 2020, a total of 108 older adult patients admitted to the hospital were identified with CKD Grade 4 ($n = 12$; 11.1%) and Grade 5 ($n = 96$; 88.9%) accompanied by US, defined clinically and by laboratory tests. The baseline sociodemographic characteristics of the 108 patients older than 60 years are shown in Table 1. The mean age of these patients was $68 (\pm 6.76)$; 54 (50%) patients were women. The most commonly encountered comorbidities were diabetes (90.7%), hypertension (88%), and obesity (34.2%). The most frequent symptoms for which patients came for evaluation were neurological in 44.4%, respiratory in 38%, cardiovascular in 21.3%, and peripheral edema in 28.7%. Cardiovascular damage was identified as congestive heart failure (19.4%), peripheral arterial disease (17.6%), and cerebrovascular disease (12%). Of the patients, 94.4% were on pharmacological therapies before admission; 31% of the patients used five or more drugs simultaneously, with angiotensin-converting enzyme inhibitors/angiotensin II receptor antagonists (57.4%) and calcium antagonists (39.8%) being the most frequent.

Table 1. Baseline clinical and demographic characteristics of older adult patients with CKD and US on admission

Characteristic	Total (n = 108)	Non survivors (n = 32)	Survivors (n = 76)	P-value
Personal data				
Female sex	54 (50%)	17 (56.7%)	37 (47.4%)	0.39
Age, years	68 ($\pm$ 6.76)	69 ($\pm$ 7.33)	68 ($\pm$ 6.54)	0.266
Reason for consultation				
Neurological (drowsiness, nausea, vomiting)	48 (44.4%)	14 (46%)	34 (43.6%)	0.773
Infectious (catheter infection, fever)	19 (17.6%)	7 (23.3%)	12 (15.4%)	0.331
Respiratory (dyspnea)	41 (38%)	5 (16.7%)	36 (46.2%)	0.005
Leg edema	31 (28.7%)	7 (23.3%)	24 (30.8%)	0.444
Gastrointestinal (digestive tract bleeding)	15 (13.8%)	8 (26.7%)	7 (9%)	0.017
Cardiovascular (symptomatic hypo/hypertension, AMI, cardiogenic shock)	23 (21.3%)	9 (30%)	14 (17.9%)	0.171
Medical record				
CKD diagnosed before admission	90 (83.3%)	27 (90%)	63 (80.8%)	0.249
Hypertension	95 (88%)	31 (96.9%)	63 (82.9%)	0.021
Diabetes	98 (90.7%)	27 (90%)	71 (91%)	0.869
Congestive heart failure	21 (19.4%)	6 (20%)	15 (19.2%)	0.928
Diabetic retinopathy	15 (13.9%)	5 (16.7%)	10 (12.8%)	0.605
Cerebral vascular disease	13 (12%)	3 (10%)	10 (12.8%)	0.687
Medications before hospital stay				
Use of 5 or more drugs at the same time	34 (31.5%)	12 (41.4%)	22 (28.2%)	0.193
[†] Use of nephrotoxic drugs	81 (75%)	21 (72.4%)	60 (84.5%)	0.162
Calcium antagonists	43 (39.8%)	13 (43.3%)	30 (38.5%)	0.643
Loop diuretics	31 (28.7%)	8 (26.7%)	23 (29.5%)	0.772
Angiotensin converting enzyme inhibitors/angiotensin II receptor blocker	62 (57.4%)	13 (43.3%)	49 (62.8%)	0.067
Insulin	35 (32.4%)	7 (23.3%)	28 (35.9%)	0.211
Metformin	21 (19.4%)	4 (13.3%)	17 (21.8%)	0.32
Acetylsalicylic acid	15 (13.9%)	7 (23.3%)	8 (10.3%)	0.078
Erythropoietin	13 (12%)	6 (20%)	7 (9%)	0.115
Statins	18 (16.7%)	8 (26.7%)	10 (12.8%)	0.084
Oral hypoglycaemics	16 (14.8%)	1 (3.3%)	15 (19.7%)	0.05
Beta blockers	16 (14.8%)	4 (13.3%)	12 (15.4%)	0.788
Antibiotics	5 (4.6%)	3 (10%)	2 (2.6%)	0.1
Vital signs and values on admission				
Heart rate 60-100 bpm	68 (63%)	17 (58.6%)	51 (65.4%)	0.518
Systolic BP	131.4 ($\pm$ 37.29)	119 ($\pm$ 35.81)	135 ($\pm$ 37.02)	0.017
Glycemia on admission, mg/dL	168.77 ($\pm$ 96.58)	174.32 ($\pm$ 132.20)	166.68 ($\pm$ 80.17)	0.584
In-hospital glycemia, mg/dL	144.57 ($\pm$ 48.97)	132.06 ($\pm$ 52.88)	147 ($\pm$ 47.38)	0.374
Obesity 30 kg/m ² or greater	37 (34.2%)	13 (43.3%)	24 (30.8%)	0.218
Mortality prognosis				
[†] Charlson Index (% 10-year survival)	0 (0-21)	0 (0-2)	0 (0-21)	0.431
Catheter				
Catheter before admission	45 (42.1%)	15 (50%)	30 (39%)	0.299

Data are presented as mean (SD) or n (%). [†]The Charlson index was expressed with the median (IQR). CKD, Chronic kidney disease; US, Uremic syndrome; AMI, acute myocardial infarction; BP, blood pressure; DM2, type 2 diabetes mellitus; BMI, body mass index; SD, standard deviation.

Vital signs, as well as blood glucose levels, were included on admission with a mean of 168.77 ($\pm$ 96.58) mg/dL and a body mass index (BMI) with a mean of 28.37 ($\pm$ 5.10) kg/m².

The Charlson index was used to evaluate the life expectancy of patients at 10 years, using variables such as acute myocardial infarction, congestive heart failure, cerebrovascular disease, dementia, ulcers, diabetes, and their respective organic damage, among others,

obtaining a median of 0% (IQR 0-21%). No differences were found for sex, age, catheter use, or the Charlson index. Of the total population studied, 29.6% of the patients presented early mortality.

Clinical characteristics and results

On admission, the complete blood count had a mean hemoglobin level (Hb) of 9.41 ($\pm$ 2.05) g/dL; values

Table 2. Laboratory findings of older adult patients with CKD and US on admission

Laboratory finding	Total (n = 108)	Non survivors (n = 32)	Survivors (n = 76)	P-value
Haemoglobin g/dL	9.41 (± 2.05)	9.10 (± 1.88)	9.53 (± 2.11)	0.298
Leukocytes k/ μ L	12.15 (± 7.28)	15.01 (± 8.92)	10.97 (± 6.18)	0.012
Neutrophils, %	79.66 (± 10.88)	83.04 (± 10.94)	78.26 (± 10.62)	0.022
Lymphocytes, %	11.35 (± 7.68)	8.94 (± 6.17)	12.35 (± 8.06)	0.038
Platelets, k/ μ L	213.18 (± 91.37)	199.81 (± 103.56)	218.75 (± 85.96)	0.175
Normocytic anemia	75 (69.4%)	26 (86.7%)	49 (66.2%)	0.035
Microcytic anemia	6 (± 8.1%)	0	6 (± 8.1%)	0.108
Clinical Chemistry				
Blood glucose, mg/dL	152.54 (± 103.28)	166.23 (± 126.03)	146.91 (± 92.76)	0.376
Blood urea nitrogen, mg/dL	80.41 (± 41.36)	74.87 (± 40.18)	82.68 (± 41.90)	0.126
Creatinine in blood greater than 10 mg/dL	26 (24%)	12 (40%)	14 (19.2%)	0.027
Creatinine in blood, mg/dL	8.14 (± 4.96)	8.09 (± 5.62)	8.1 (± 4.71)	0.629
Albumin, g/dL	2.66 (± 0.755)	2.05 (± 0.71)	2.9 (± 0.62)	0.001
Creatinine in urine, mg/dL	79.29 (± 45.78)	86.5 (± 63.60)	77.27 (± 40.95)	0.656
Urinalysis				
Proteins at 300 mg/dL or more	23 (21.3%)	7 (33.3%)	16 (36.4%)	0.811
[†] Proteins, mg/dL	128.5 (0-2212)	100 (0-2212)	150 (0-1600)	0.576
Erythrocytes/field	12.34 (± 26.73)	8.42 (± 23.66)	14.12 (± 28.10)	0.32
Leukocytes/field	25.2 (± 35.90)	38 (± 36.77)	24 (± 35.65)	0.207
Renal variables in-hospital				
CKD grade 5	96 (88.9%)	26 (86.7%)	70 (89.7%)	0.649
CKD EPI GFR on admission, ml/min/1.73m ²	8.64 (± 8.37)	8.21 (± 10.91)	8.02 (± 7)	0.838
CKD EPI GFR at discharge, ml/min/1.73m ²	10.86 (± 10.88)	11.38 (± 14.37)	10.66 (± 8.98)	0.721

Data are expressed as mean (SD) or n (%). [†]Proteins are expressed with median (IQR). CKD, chronic kidney disease; US, Uremic syndrome; CKD EPI, chronic kidney disease epidemiology collaboration; GFR, glomerular filtration rate; SD, Standard deviation.

below normal were found in 93.5% of older adult patients (Table 2). Leukocytes were below normal in 57 (52.8%) patients, and 39.8% had levels below the neutrophil reference values. A total of 101 (93.5%) patients had anemia. The mean serum creatinine level was 8.14 (± 4.96) mg/dL. Levels greater than 10 mg/dL were found in the early mortality group (12; 40% vs. 14; 19.2%; $p = 0.027$). Albumin levels were lower in the early mortality group than in the survivor group (2.05 ± 0.71 vs. 2.9 ± 0.62; $p = 0.001$).

CKD EPI GFR values on admission (8.21 ± 10.91 vs. 8.02 ± 7; $p = 0.838$) and at the end of their hospital stay (11.38 ± 14.37 vs. 10.66 ± 8.98; $p = 0.721$) were similar, whether due to hospital discharge or the death of the patient.

In the sample, 64 (59.2%) patients had a hemodialysis catheter and 35 (32.4%) had peritoneal dialysis; of these two catheter types, 45 (41.7%) were placed before admission and 49 (45.4%) were placed during hospitalization. Blood transfusions were required during the hospital stay of some of the patients, with a significant difference between the groups (12; 40% vs. 14; 17.9%;

$p = 0.016$) (Table 3). No information was found in five patients regarding the moment when the catheter was placed.

The mean days of hospitalization were 9 (± 6.08), and the early mortality group had a mean of 17 (± 0.450) days between admission and death. The main cause of early death was septic shock (43.7%).

Logarithmic rank tests were performed on unique risk factors in the patient's outcome regarding early death after hospital admission (Table 4). Factors such as the reason for gastrointestinal consultation (OR = 5.87; CI 2-17.19; $p = 0.001$), among other previous variables, drug use, and laboratory test data, were shown to be protective or risk factors by logistic regression.

Discussion

Our study is a comprehensive introduction to the epidemiological, clinical, and laboratory values in older adults from a state population with a high prevalence of diabetes and hypertension, as well as an adult population that is mostly overweight and obese nationwide

Table 3. Treatment and results of older adult patients with CKD and US on admission

Treatment	Total (n = 108)	Non survivors (n = 32)	Survivors (n = 76)	P-value
Use of HD catheter	64 (59.8%)	17 (56.7%)	47 (61%)	0.679
Use of PD catheter	35 (32.7%)	9 (30%)	26 (33.8%)	0.709
DP/HD in-hospital catheter placement	49 (45.8%)	13 (43.3%)	36 (46.8%)	0.75
Blood transfusions in-hospital	26 (24.1%)	12 (40%)	14 (17.9%)	0.016
Admission to the ICU	7 (6.5%)	6 (20%)	1 (1.3%)	0.001
Death after admission, days	17 ($\pm$ 0.450)	[†] 17 (1-90)		
More than 6 days of hospitalization	63 (58.3%)	14 (46.7%)	49 (63.6%)	0.109
Days hospitalized	9 ($\pm$ 6.08)	8 ($\pm$ 7.53)	9 ($\pm$ 5.46)	0.266

The data are present as mean (SD) or n (%). [†]Death after admission was expressed as a median (IQR). CKD, Chronic kidney disease; US, Uremic syndrome; HD, Hemodialysis; DP, Peritoneal dialysis; ICU, Adult intensive care unit; SD, Standard deviation.

Table 4. Risk factors associated with mortality

Risk factors	OR	95% CI	P-value
More than 6 days of hospital stay	0.5	0.21-0.955	0.041
ICU stay	19.25	2.2-167.92	0.008
Reason for gastrointestinal consultation	5.87	2-17.19	0.001
Use of ACEI/AIIRA	0.453	0.192-0.991	0.029
Neutrophils 2-6.9 k/ μ L	0.212	0.073-0.616	0.003
Lymphocytes 10-59%	0.335	0.132-0.849	0.012
Albumin 3.2-5.5 g/dL	0.135	0.047-0.980	0.006

The p value was obtained by logistic regression. OR, odds ratio; Coefficient interval, CI; ICU, adult intensive care unit; ACEI/AIIRA, angiotensin-converting enzyme inhibitors/angiotensin II receptor antagonist.

(71.3%)^{14,15}. A total of 108 patients $\geq$ 60 years of age with a history of CKD admitted to the hospital with US were included in the study. The mean age of deceased patients was within the first decade after being considered older adults (60-69 years), with no significant difference between groups or the patients' gender. However, a worse prognosis has been reported in women¹⁶.

In our population, 90.7% of older adults had diabetes, and 88% were hypertensive. The latter significantly contributed to early death, as has been previously described. Arterial hypertension prevails in more than 70% of patients with advanced CKD, and it is exacerbated by not having treatment or poor drug adherence, which increases morbidity and mortality¹⁷.

We found that 26.7% of patients who died early presented a reason for a gastrointestinal etiology

consultation (26.7% vs. 9%; $p = 0.017$), mostly associated with some type of gastrointestinal bleeding. Digestive symptoms were found in around 60% of patients with Grade 5 CKD, including anorexia, nausea, vomiting, and gastrointestinal bleeding, related to Grade 5 CKD and carries an increased risk in those who receive RRT with hemodialysis. This increases patient mortality due to the severity of gastrointestinal bleeding^{18,19}. None of the other reasons for consultation were significantly related to an early death.

The Charlson index, a system for evaluating life expectancy at 10 years, showed data similar to the literature²⁰. A higher number of patients with previous RRT died early (50%) than survivors (30%). This may be due to a lack of catheter functionality in the patients of this study, a lack of access to health services^{21,22}, work, and emotional, economic, or transportation limitations, as has been previously reported in the literature²³. It would be important to carry out a prospective study that reports the causes that guide older adult patients with CKD to not comply with RRT if they need it since the benefit of this therapy on quality of life and life expectancy has been proven before^{24,25}.

The mean number of days between patient admission and death was 17; for this reason, we recommend strict monitoring of these patients during this period since mortality in this group occurs within the 1st month after hospital admission.

As described in other studies, CKD patients admitted to the intensive care unit (ICU) have a high risk of acute respiratory failure due to fluid overload and susceptibility to sepsis. Several studies have reported high mortality²⁶⁻²⁸ and morbidity²⁹ in patients after leaving the ICU; however, only 20% of patients with early mortality were referred to

the ICU, dying in the internal medicine ward or the emergency room. In our study, the use of packed red blood cell transfusions and admission to the ICU clearly reflects early mortality (6; 20% vs. 1; 1.3%; $p = 0.001$).

The presence of infection could be a cause that significantly increases mortality in the patient during the 1st days of stay or after discharge, which is consistent with the literature³⁰. Similarly, there are significant alterations in neutrophils and lymphocytes between groups.

The logistic regression analysis showed different risk and protective factors for early mortality in our group of patients. Having several laboratory studies in the normal range, such as neutrophils, lymphocytes, platelets, and albumin, results in a significant decrease in early mortality. Infections are a common cause of hospitalization in CKD patients and are related to decreased kidney function³¹. Infection as a cause of death in patients with CKD represents 50% of non-cardiovascular causes of death³⁰. Outpatient and in-hospital catheter care should be a priority in managing these patients to avoid bacteremia and sepsis³². Serum creatinine, an important variable for CKD, was a risk factor for early mortality when it was > 10 mg/dL. However, the GFR did not present a significant change between the patient's hospital admission and discharge. Variables such as admission to the ICU, history of blood transfusions, hypertension, and reason for gastrointestinal consultation were shown to be risk factors for early mortality.

There are limitations to our study. Since this is a retrospective case-control study based on clinical records, it was difficult to obtain specific information on a minimum number of patients. There is the possibility of some bias. Another possible weakness is that, at some point, during the patient interview on admission, the interpretations of the doctor or patient may differ.

Conclusions

About 29.6% of older adult patients with CKD and US who were hospitalized between October 2016 and October 2020 died in less than 90 days, with a mean of 17 days. Risk factors were identified by logistic regression, such as ICU stay and the reason for gastrointestinal consultation. The main cause of death was septic shock.

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Conflicts of Interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

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