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RESEARCH

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RENAL FUNCTION IN ADMISSION OF PATIENTS WITH SEPSIS IN INTENSIVE CARE UNIT

Função renal na admissão do paciente com sepse em uma unidade de terapia intensiva

La función renal en admisión del paciente sepsis en unidad de cuidados intensivos

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ABSTRACT

Objective: To evaluate renal function, severity, prognosis at admission and outcome of patients with sepsis admitted to an Intensive Care Unit. **Method:** cross-sectional and retrospective study in which sociodemographic variables, severity scores and prognosis were raised. Renal function was assessed by the RIFLE score and the estimation of glomerular filtration rate. **Results:** 96 patients were included, of which 42 (43.7%) had normal renal function, 13 (13.5%) risk, 19 (19.7%) injury and 22 (22.9%) failure. Severity and prognostic scores were higher in patients with impaired renal function, but with no difference between patients with normal and altered renal function in relation to death. **Conclusion:** The evaluation of renal function on admission of patients with sepsis in the unit care showed that 56.2% had some alteration. In addition, patients with altered renal function were more severe and had a worse prognosis.

DESCRIPTORS: Sepsis; Acute Kidney Injury; Nursing; Intensive Care Units; Mortality.

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RESUMO

Objetivo: Avaliar a função renal, a gravidade, o prognóstico na admissão e o desfecho dos pacientes com sepse internados em uma Unidade de Terapia Intensiva. **Método:** Estudo transversal e retrospectivo no qual foram levantadas as variáveis sociodemográficas, escores de gravidade e prognóstico. A função renal foi avaliada pelo escore RIFLE e pela estimativa da taxa de filtração glomerular. **Resultados:** Foram incluídos 96 pacientes, dos quais 42 (43,7%) apresentavam função renal normal, 13 (13,5%) risco, 19 (19,7%) lesão e 22 (22,9%) falência. Os escores de gravidade e prognóstico mostraram-se mais elevados nos pacientes com alteração da função renal, porém, sem diferença entre os pacientes com função renal normal e alterada em relação ao óbito. **Conclusão:** A avaliação da função renal na admissão de pacientes com sepse na unidade intensiva mostrou que 56,2% apresentavam alguma alteração, além disso, pacientes com alteração da função renal se apresentaram mais graves e com pior prognóstico.

DESCRITORES: Sepse; Lesão Renal Aguda; Enfermagem; Unidades de Terapia Intensiva; Mortalidade.

RESUMEN

Objetivo: evaluar la función renal, la gravedad, el pronóstico al ingreso y el resultado de los pacientes con sepsis ingresados en una Unidad de Cuidados Intensivos. **Método:** estudio transversal y retrospectivo en el que se plantearon variables sociodemográficas, puntuaciones de gravedad y pronóstico. La función renal se evaluó mediante la puntuación RIFLE y la estimación de la tasa de filtración glomerular. **Resultados:** se incluyeron 96 pacientes, de los cuales 42 (43.7%) tenían función renal normal, 13 (13.5%) riesgo, 19 (19.7%) lesión y 22 (22.9%) falla. Las puntuaciones de gravedad y pronóstico fueron más altas en pacientes con insuficiencia renal, pero sin diferencias entre los pacientes con función renal normal y alterada en relación con la muerte. **Conclusión:** la evaluación de la función renal al ingreso de pacientes con sepsis en la unidad intensiva mostró que el 56,2% presentaba alguna alteración, además, los pacientes con función renal alterada eran más graves y tenían peor pronóstico.

PALABRAS CLAVE: Sepsis; Lesión Renal Aguda; Enfermería; Unidades de Cuidados Intensivos; Mortalidad.

INTRODUCTION

Sepsis is a complex syndrome characterized as an organ dysfunction resulting from the body's response to an infection.¹ It is a syndrome that has no specific signs and symptoms that facilitate diagnosis, so it can go unnoticed until later stages, such as septic shock.² The longer the time for diagnosis, the greater the chances of the condition becoming more severe and increasing mortality.² In Brazil, it is estimated that 230,000 deaths per year occur.¹

In sepsis there are clinical manifestations resulting from the activation of the inflammatory response of the body to an aggressive agent that result in circulatory alterations such as hypotension and dehydration, which in turn can compromise the function of the circulatory system to oxygenate tissues causing dysfunction of organs such as the lung, heart, kidneys and brain.³

Renal impairment is manifested by Acute Kidney Injury (AKI), which is one of the most frequent and severe pathophysiological changes in hospitalized patients, especially those (between 20 and 40%) treated in Intensive Care Units (ICU).⁴ It is estimated that 50% of patients diagnosed with sepsis develop AKI.⁵

The AKI is comprised of a sudden decline in the Glomerular Filtration Rate (GFR), which manifests itself in a sustained increase in creatinine and a reduction in urine elimination, which can be accompanied by retention of nitrogen products and hydro electrolyte disturbances.⁶

The pathophysiology of AKI in the context of sepsis is complex, multifactorial, and is not yet clear. Thus, septic patients develop intrarenal hemodynamic changes that may generate renal hypoflow, reduced glomerular filtration rate and finally AKI.⁷

The incidence of AKI in hospitalized patients represents the worsening in clinical evolution and is associated with increased use of intensive resources, mortality and increased length of stay.⁸ Identifying and recognizing early the predisposing factors that are related to the development of AKI in patients with sepsis becomes of paramount importance to be able to guide the health care team so that it can intervene and execute actions to prevent or minimize this complication.⁹

Nurses and their teams are in a strategic position for early recognition of the AKI, especially those with sepsis. These professionals, due to their proximity to the patient and constant monitoring, should be able to identify clinical changes early and contribute to a better prognosis. In this perspective, the objective of this study was to evaluate the renal function, severity, prognosis at admission and outcome of patients with sepsis admitted to an ICU.

METHOD

This is a cross-sectional, retrospective study, with treatment of quantitative approach data. Patient tracking was performed through the hospital's electronic recording system, using the international classification code of diseases A41.9 (sepsis not specified). Data were collected from physical and electronic records of patients in the ICU for adults of a high complexity public tertiary care hospital located in the interior of the state of São Paulo, Brazil.

The inclusion criteria adopted were: registration in the medical chart of the diagnosis of sepsis or septic shock, age over 18 years, who had stayed at the unit for at least 24 hours from January 2012 to December 2012. Patients with renal injury and/or chronic renal disease prior to ICU admission, pregnant women, people living with HIV/AIDS and polytrauma patients were excluded due to the clinical peculiarities of these patients that could interfere with the outcome of this study.

After identification of the medical diagnosis recorded in the medical chart, the data of each patient were collected until their clinical outcome (discharge or death), using a semi-structured form prepared for this purpose. The form contained the variables: age, gender, color, presence of comorbidities such as systemic arterial hypertension and diabetes mellitus, results of laboratory tests such as sodium, potassium, urea, creatinine, total bilirubin, complete blood count, arterial gasometry, neurological evaluation (Glasgow Coma Scale), heart and respiratory rates, blood pressure, body temperature, length of stay in days in the ICU, type of treatment (clinical or surgical) and clinical outcome (discharge or death). All data from the first 24 hours of admission were collected.

The RIFLE score was used for the assessment of renal function, which uses relative changes in creatinine serum level or urinary volume. The acronym RIFLE refers to the following terms RISK (risk of renal dysfunction), Injury (kidney injury), Failure (failure of renal function), Loss (loss of renal function) and End Stage renal disease. Thus, the renal function of the patients was classified as: risk: an increase of creatinine between 1.5 and 2 mg/dL; injury: when the creatinine values were between 2 and 3 mg/dL; failure: when the creatinine was between 3 and 4 mg/dL.¹⁰ The evolutionary criteria of RIFLE were not considered: loss of renal function (Loss) and end-stage renal disease (End-stage renal) due to the patients' acute clinical condition. The first three terms are calculated using changes in serum creatinine level or in the glomerular filtration rate (GFR) from a baseline value and in the reduction of urinary volume calculated per kilogram of weight. The last two terms, considered more specific, are characterized by the time of renal function loss.

The estimate of the Glomerular Filtration Rate (eGFR) was obtained by an equation ($eTFG < 60 \text{ mL/min/1.73m}^2$) developed by the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) that takes into account the serum creatinine dosage, patient age, gender, and skin color (white or black). The formula for this estimation is described: $GFR = 141 \times \min\left(\frac{S_{crea}}{K}, 1\right)^\alpha \times \max\left(\frac{S_{crea}}{k}, 1\right)^{-1.209} \times 0,993^{age} \times 1,018$ [if female] $\times 1,159$ [if black]. Where $k = 0.7$ for female, $k = 0.9$ for male; $\alpha = 0.329$ for female, $\alpha = 0.411$ for male. The online tool Nefrocalc 2.0, provided by the Brazilian Society of Nephrology, was used to perform this

calculation. Creatinine was used for the RIFLE score and CKD-EPI for eGFR because it was not possible to accurately obtain the value of diuresis or the weight of all participants surveyed.

For the assessment of the patient's severity, the Sequential Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health Evaluation (APACHE II) scores were calculated, the first being used to describe the degree of organ dysfunction, evaluating six systems: respiratory, coagulation, hepatic, cardiovascular, central nervous and renal, in which each parameter receives a score ranging from 0 to 4.¹¹ while the second uses 13 physiological variables, age and chronic disease that receive a score that is transformed into probability of death.¹² SOFA and APACHE II scores were calculated considering the worst values of laboratory and clinical parameters in the first 24 hours of admission.

The data was typed with the double typing technique in Microsoft Excel for Windows 2010. After the spreadsheet validation, the data were imported into the Statistical Package for the Social Sciences (SPSS), version 22.0. Descriptive analyses of absolute and relative frequency were performed for nominal or categorical variables, and analysis of central tendency (mean) and dispersion (standard deviation) for continuous variables. The Kruskal Wallis test was used to verify differences between variables with non-normal distribution. The value of $p < 0.05$ was adopted to denote statistical significance.

This study was approved by the Research Ethics Committee of the Ribeirão Preto School of Nursing – University of São Paulo under the number CAAE 92148718.4.0000.5393 and opinion 2768882, carried out according to resolution 466/2012 of the National Health Council.

RESULTS

The reference population screened was 716 people admitted to the ICU, however from the inclusion and exclusion criteria, the study population consisted of 96 medical records. It was observed that most patients were over 60 years old, female, white and the predominant clinical outcome was death. The renal function evaluation showed that 42 (43.7%) had normal renal function and 54 (56.2%) had altered creatinine parameters at admission. Patients with increased creatinine levels were categorized according to the RIFLE score, being 13 (13.5%) risk, 19 (19.7%) injury and 22 (22.9%) failure (Table 1).

The mean age according to the RIFLE score categorization was 52.9 (± 16.8) for those with normal renal function; 62.4 (± 14.8) for risk; 60.3 (± 17.8) for injury; 62.8 (± 13.7) for failure. No statistical significance was observed between ages ($p = 0.070$).

Table 1 – Description of the sociodemographic variables and outcome according to the RIFLE score of patients with sepsis at admission to the ICU. Ribeirão Preto, 2013

Variables	RIFLE classification				
	Total (n=96) 100%	Normal n=42 (43,7%)	Risk n =13 (13,5%)	Injury n=19 (19,7%)	Bankruptcy n=22 (22,9%)
Age					
≤ 59 years	53 (55,2%)	23 (54,8%)	5 (38,5%)	6 (31,6%)	9 (40,9%)
≥ 60 years	43 (44,8%)	19 (45,2%)	8 (61,5%)	13 (68,4%)	13 (59,0%)
Sex					
Female	58 (60,4%)	24 (57,1%)	5 (38,5%)	13 (68,4%)	16 (72,7%)
Male	38 (39,6%)	18 (42,9%)	8 (61,5%)	6 (31,6%)	6 (27,2%)
Color					
White	77 (80,2%)	30 (71,4%)	12 (92,3%)	15 (78,9%)	20 (90,9%)
Not White	19 (19,8%)	12 (28,6%)	1 (7,7%)	4 (21,1%)	2 (9,1%)
Comorbidities					
HAS	46 (47,9%)	18 (42,9%)	6 (46,2%)	10 (52,6%)	12 (54,5%)
DM	13 (13,5%)	9 (21,4%)	3 (23,1%)	6 (31,6%)	4 (18,1%)
Type of Treatment					
Clinical	39 (40,6%)	18 (42,9%)	5 (38,5%)	11 (57,9%)	5 (22,7%)
Surgical	57 (59,4%)	24 (57,1%)	8 (61,5%)	8 (42,1%)	17 (77,3%)
UTI waste					
Top	26 (27,1%)	15 (35,7%)	3 (23,1%)	4 (21,1%)	4 (18,1%)
Death	70 (72,9%)	27 (64,3%)	10 (76,9%)	15 (78,9%)	18 (81,8%)

Source: Authors' database.

Regarding the outcome in the ICU, in the general population the prevalence of death was observed. The percentage of deaths was higher among patients classified with some change in creatinine levels, however the results were not statistically significant in relation to the death outcome ($p=0.409$).

On average, heart and respiratory rates and body temperature were higher in patients classified as having injury and renal failure at admission. SOFA and APACHE II scores were higher among patients with altered renal function. The eTFG was 93.2 ml/min/1.73m² for patients with normal renal function in the first 24 hours in the ICU. For patients with risk of AKI eGRF was 36.2 ml/min/1.73m² (Table 2).

In order to better denote the importance of these differences and taking into account the non-normal distribution between the groups, the Kruskal Wallis statistical test was applied to evaluate some variables. The test showed statistical significance for the clinical variables eGRF, SOFA and APACHE II ($p=0.000$) and for the laboratory variables – urea and creatinine ($p=0,000$).

On average, the length of stay for all patients in the ICU was 11.3 (± 9.5) days and in hospital 23.4 (± 24.8) days. For patients with no change in the renal function the length of stay in the ICU

was 16.7 (± 15.2) days and in the hospital 17.4 (± 12.9) days, for patients classified as “risk” the length of stay in the ICU was 12.3 (± 9.8) days and in the hospital 20.6 (± 20.3) days and for those classified as “renal failure” the length of stay in the ICU was 9.2 (± 9.2) days and in the hospital 26.5 (± 28.5) days.

DISCUSSION

Evaluation of laboratory parameters together with the RIFLE score are auxiliary methods that contribute to early recognition of AKI in critically ill patients, specifically those with sepsis. In this study, the evaluation of creatinine showed that 43.7% had normal renal function and 56.2% had changes in this biomarker at admission.

Evaluation of laboratory parameters together with the RIFLE score are auxiliary methods that contribute to early recognition of AKI in critically ill patients, specifically those with sepsis. In this study, the evaluation of creatinine showed that 43.7% had normal renal function and 56.2% had changes in this biomarker at admission.

Table 2 – Description of clinical and laboratory variables according to the RIFLE score of patients with sepsis at admission to the ICU. Ribeirão Preto, 2013

Variables	RIFLE classification				
	Total (n=96)	Normal (n=42)	Risk (n=13)	Injury (n=19)	Bankruptcy (n=22)
		n (SD)	n (SD)	n (SD)	n (SD)
Frequência Cardíaca	115,0 (±24,6)	114,0 (± 19,1)	109,4 (± 30,9)	118,3 (± 19,9)	117,4 (±33,2)
Respiratory Frequency	35,4 (± 9,5)	39,7 (±10,7)	46,1 (± 8,0)	33,3 (± 11,5)	23,0 (±10,0)
Body temperature	37,1 (±1,4)	37,1 (±1,2)	36,5 (±1,9)	36,9 (±1,5)	37,6 (±1,4)
Mean blood pressure	60,0 (± 14,0)	61,7 (±14,4)	57,9 (±14,2)	61,9 (±11,3)	56,0 (±15,1)
SOFA	9,3 (±3,4)	7,3 (±2,6)	9,3 (±2,4)	9,9 (±3,0)	12,8 (±2,7)
APACHE II	32,3 (± 9,3)	26,8 (±6,9)	31,4 (±6,5)	33,5 (±8,5)	42,9 (±7,4)
Days in ICU	11,3 (± 9,5)	10,1 (± 6,6)	16,7 (±15,2)	12,3 (± 9,8)	9,5 (± 9,1)
eGRF	54,1 (± 43,2)	93,2 (± 37,0)	36,2 (± 9,0)	26,6 (± 7,7)	13,7 (± 6,0)
Sodium	140,1 (± 8,2)	140,8 (± 6,5)	139,6 (± 10,6)	136,5 (± 6,7)	141,9 (± 10,2)
Potassium	4,3 (± 0,9)	4,1 (± 0,8)	4,2 (± 0,6)	4,7 (±1,0)	4,4 (± 1,0)
Urea	87,8 (± 53,7)	48,6 (± 31,5)	102,7 (± 43,4)	105,7 (± 36,6)	138,3 (± 52,0)
Creatinine	2,1 (± 1,6)	0,9 (± 0,3)	1,7 (± 0,14)	2,4 (± 0,2)	3,5 (± 1,4)

SD= standard deviation.

Source: Authors' database.

The majority of the elderly population have health conditions arising from the aging process that increase the likelihood of the development of various pathologies such as chronic degenerative diseases, cardiovascular diseases, hypertension and diabetes mellitus.¹³ It is believed that these conditions may make the elderly more vulnerable to complications such as AKI.¹³

Several studies have shown that the AKI is more common in the elderly. This may occur by association with factors such as: morbidities that accumulate need for procedures, nephrotoxic drugs and structural and functional changes resulting from aging.¹⁴ Some conditions such as infections, hemorrhages, surgeries and sepsis may cause renal function to be more compromised and may lead the patient to greater severity and increased risk of death.¹⁵ A cohort study conducted in an ICU in the state of Bahia in Brazil shows that all age groups are susceptible to sepsis; however, the elderly represent more than half of emergency visits and hospitalizations.¹⁶

The classification of patients according to the RIFLE score at admission to the ICU showed that 13.5% of the patients were at risk; 19.7% were injured and 22.9% failed. In view of these results, it is observed that at admission, patients with sepsis already presented altered renal function. This condition requires more attention from the multidisciplinary team, as it is known that sepsis and AKI have been independently associated to increased morbidity and mortality, hospital stay and care costs.¹⁷⁻¹⁸

Thus, it is believed that the health care team should be able, through individualized clinical evaluation (considering indivi-

dual characteristics of the patients – age, comorbidities, gender), to implement supportive care that promotes better results for patients with sepsis.

In this study, patients classified as “at risk” for AKI had a mean length of stay in the ICU of 16.9 days. According to one study¹⁹, patients with AKI tend to be hospitalized 2.4 times longer than those with normal renal function. In addition, increased creatinine levels may be an indicator of severity and worse prognosis of the patient with sepsis. This can be demonstrated by the increase in mean SOFA and APACHE II scores found in this study.

Gomes and employees showed average APACHE II index values of 21.2 points, i.e., lower than that observed in this study. However, the age of the patients was also lower (55 years) when compared to this study, which may have contributed to this difference between the results.⁷

Regarding the clinical outcome of the patients included in this study, it was observed the occurrence of death in more than 75% for patients classified with altered renal function; while in patients with normal renal function at admission this percentage was lower – approximately 60%. The data of this study are similar to those of another, performed in a large hospital in the state of Minas Gerais, where sepsis was the main cause of AKI (65.9%) and mortality was 79.5% in patients undergoing hemodialysis renal replacement therapy.⁸

In view of the results obtained, it is believed that the RIFLE score can be an auxiliary tool in tracking changes in renal function associated with AKI, specifically in septic patients on admission

to the ICU. Although this score has limitations regarding its criteria (not very specific for AKI), the health care team can use it to complement the clinical evaluation and concomitantly to the individual characteristics of the patient (age, comorbidities, past history).

Changes in kidney function and the presence of risk for AKI at admission of the septic patient may help guide the team in adopting more judicious supportive care. The support cares are related to more rigorous monitoring of urine production and creatinine levels; early administration of antibiotics; identification and control of the infectious focus; adequate and careful resuscitation with intravenous fluids; use of vasoactive drugs for maintenance of renal blood flow; avoidance of nephrotoxic drugs, as well as contrast and hydroxyethyl starch; and, when necessary, early initiation of the most appropriate renal replacement therapy measures.²⁰

The nursing team should be able to include and promote systematic actions that prioritize care such as infection control, more rigorous preparation, dilution and administration of antibiotics, hydroelectrolytic control, rigorous urinary elimination control, acid-basic, electrolyte and hypervolemia controls, water monitoring with attention to signs of volume loss in SNG, drains and catheters²¹, daily weight control of critically ill patients as a preventive measure of health²² and observation of the neurological pattern that can change in the presence of uremia.²³

Although in this study the creatinine parameters have shown changes in the renal function in patients with sepsis, it can be mentioned as a limitation the impossibility to obtain the urinary output values due to its retrospective design.

CONCLUSION

The evaluation of renal function at ICU admission of patients with sepsis showed that (56.2%) presented some alteration of renal function at ICU admission. The results of this study show the importance of early screening for AKI in septic patients, since patients who presented some change in renal function, according to the RIFLE classification, presented more severe and with worse prognosis at admission when evaluated by SOFA and APACHE II scores. Thus, the nursing team should be able to perform early screening and implement more specific care. Use of these scores may be useful and complementary to clinical practice, in order to reduce patient worsening and contribute to decrease ICU mortality.

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