The clinical outcome of patients with acute renal failure in intensive care unit*

Evolução clínica de pacientes com insuficiência renal aguda em unidade de terapia intensiva

Evolución clínica de pacientes con insuficiencia renal aguda en la unidad de cuidados intensivos

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ABSTRACT

Objective: To evaluate the clinical outcome of acute renal failure (ARF) patients when submitted to dialysis and non-dialysis treatments in ICU. **Methods:** this prospective study included patients over 18 years of age and serum creatinine of >1.5 mg/dl. The patients were included in dialysis and non-dialysis groups. **Results:** The study included 70 patients, 19 (27.1%) comprised the dialysis group and 51 (72.9%) the non-dialysis group. In the dialysis group, mortality rate was 42.1% and in the non-dialysis group was 33.3% (p<0.58). **Conclusion:** There were multifactors of ARF in ICU, but ARF is not the single cause for the high mortality rate in ICU patients.
Keywords: Renal insufficiency, acute/therapy; Renal insufficiency, acute/epidemiology; Intensive care units; Nursing

RESUMO

Objetivo: Avaliar a evolução clínica de pacientes com insuficiência renal aguda (IRA) submetidos a tratamento dialítico e não-dialítico na UTI. **Métodos:** Estudo prospectivo onde foram incluídos pacientes com idade maior que 18 anos e com creatinina sérica > 1,5 mg/dl. Os pacientes foram divididos em grupo dialítico e não-dialítico. **Resultados:** Dos 70 pacientes incluídos 19 (27,1%) foram do grupo dialítico e 51 (72,9%) do grupo não-dialítico. A taxa de mortalidade foi de 42,1% no grupo dialítico e de 33,3% no grupo não-dialítico (p<0,58). **Conclusão:** Há multifatores determinando a IRA na UTI, porém, não é causa isolada das elevadas taxas de mortalidade dos pacientes na UTI.
Descritores*:* Insuficiência renal aguda/terapia; Insuficiência renal aguda /epidemiologia; Unidades de terapia intensiva; Enfermagem

RESUMEN

Objetivo: Evaluar la evolución clínica de pacientes con insuficiencia renal aguda (IRA) sometidos a tratamiento dialítico y no-dialítico en la UCI. **Métodos**: Se trata de un estudio prospectivo donde fueron incluídos pacientes mayores de 18 años y con creatinina sérica > 1,5 mg/dl. Los pacientes fueron divididos en grupo dialítico y no-dialítico. **Resultados**: De los 70 pacientes incluídos 19 (27,1%) fueron del grupo dialítico y 51 (72,9%) del grupo no-dialítico. La tasa de mortalidad fue del 42,1% en el grupo dialítico y del 33,3% en el grupo no-dialítico (p<0,58). **Conclusion**: Hay multifactores que determinan la IRA en la UCI, sin embargo, no es causa aislada de las elevadas tasas de mortalidad de los pacientes en la UCI.
Descriptores: Insuficiencia renal aguda/terapia; Insuficiencia renal aguda/epidemiología; Unidades de cuidados intensivos; Enfermería

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INTRODUCTION

Acute renal failure (ARF) is characterized by the sudden reduction of the Glomerular Filtration Rate, resulting in the kidney's inability to exert the functions of excretion, maintaining the acid-basic equilibrium, and the organism's hydroelectrolytic homeostasis. The ARF complications significantly contribute with the elevation of the morbidity and mortality rates in critical patients[1-2].

The incidence of ARF in hospitalized patients is 5%, but in the Intensive Care Unit (ICU) its incidence varies between 17% and 35%, and 49% to 70% of the patients need dialysis treatment. The mortality rate varies between 50% and 90%, and is associated to extended hospitalization time, the use of technologically advanced therapies, type of ICU and population studied[3-6].

The main risk factors to the development of the ARF in ICU are: ischemic, nephrotoxic, infectious, and obstructive events, hypotension, shock (hypovolemic, cardiogenic, and septic), cardiovascular, hepatic and respiratory insufficiency, neoplasia and mean hospitalization time greater than seven days[7-8]. The identification of the ARF development's risk factors directs the type of treatment , dialysis or non-dialysis[9].

Despite the technological advances, the increase in the population's survival rate, and the therapeutic improvement ARF remains one of the most frequent complications found in ICUs. The combination of risk factors, clinical outcome, and the multiple interventions in the ICU patient helped to upkeep the ARF's elevated morbidity and mortality rates, without any significant improvement for, at least, two decades[2-3,10].

Based on this information, the present study has the purpose to evaluate the clinical outcome of ARF patients subjected to dialysis and non-dialysis treatment in ICU.

METHODS

This prospective and observational study was performed at a general ICU of a private hospital in the City of São Paulo. The study took place between August 2002 and January 2003, with approval by the Ethics in Research Committee of the Federal São Paulo University and by the Ethics Committee of the hospital in which the research was performed. The data was collected from the patients' medical records, and written consent was not necessary.

Patients (both genders)were included if they were older than 18 years, and presented serum creatinine>1.5 mg/dl at admission or along the hospitalization in ICU (11-12). Patients were excluded if they had Chronic Renal Insufficiency, were subjected to renal transplant and or had been organ donors.

The collected variables were gender, age, co-morbidity, hospitalization diagnosis in the ICU (clinical or surgical), type of ARF (pre-renal, renal, post-renal), clinical and surgical complications throughout ICU hospitalization, type of dialysis treatment, permanence time in the study, ICU hospitalization time, laboratorial evaluation (creatinine, urea, sodium, potassium) at the ARF onset and when discharged from ICU, ICU patient destination (discharge or death) and cause of death.

The Data collection was performed on a daily basis, using the medical records. The patients were analyzed by type of treatment: dialysis and non-dialysis groups. The type of treatment was chosen by the ICU medical staff or by the nephrologist. The non-dialysis treatment was characterized by volemic expansion, diuretic use, vasoactive drug use, and aggressor agent's removal. The dialysis treatment consisted of the use of peritoneal dialysis and hemodialysis. The non-dialysis patients that evolved with little or lack of response to the treatment and needed dialysis were included in the dialysis group.

The data collection was interrupted when the patient, after the treatment, dialysis and non-dialysis, presented creatinine less than or equal to 1.5 mg/dl, and this variable is defined as the patient´s permanence time in the study.

The software used to analyze the statistical data was the SPSS (*Statistical Package for the Social Sciences),* version 11.0 for Windows, employing the tests: Person chi-square or the Fisher Exact Test, with a confidence interval of 95.0% (CI 95.0%); Student's t Test for the independent variables and Relative Risk (RR). In all tests, $p<0.05$ was established to indicate statistical significance.

RESULTS

Along the data collection period, 759 patients were admitted in the ICU. Of those, 70 (9.2%) evolved with ARF; 51 (72.9%) patients were included in the non-dialysis group and 19 (27.1%) in the dialysis group. There was no statically significant difference between groups concerning gender, age, ICU hospitalization diagnosis, clinical or surgical, and co-morbidity (Table 1).

The average co-morbidity by patient, shown in the ICU admission was 2.1 in the dialysis group and 2.2 in the non-dialysis group.

Table 2 displays the data regarding the patients' outcome in ICU. Renal ARF was greater ($p<0.001$) in the dialysis group, compared to the non-dialysis type.

Along the ICU hospitalization, the patients showed clinical or surgical complications associated to the ARF. The pulmonary and metabolic complications were statistically more frequent in the dialysis group, respectively ($p<0.03$ and $p<0.01$). The permanence time in the study and the hospitalization time in ICU were significantly greater ($p<0.004$ and $p<0.008$) in the dialysis group.

Of the 19 patients in the dialysis group, 15 (78.9%)

Table 1 – ARF patients' characteristics from the dialysis and non-dialysis groups, in ICU's admittance

Characteristics	Dialysis n = 19		Non-Dialysis n = 51		p
Gender	**n**	**%**	**n**	**%**	
Male	15	78.9	34	66.7	
Female	4	21.1	17	33.3	0.32
Age (years),X (± DP)	67±	14±	70±	14±	0.41
ICU hospitalization diagnosis					
Clínical					
Pulmonary	7	36.8	22	43.1	0.78
Cardiovascular	3	15.8	11	21.6	0.74
Neurological	3	15.8	10	19.6	1.00
Gastrointestinal	3	15.8	6	11.8	0.69
Infectious	2	10.5	5	9.8	1.00
Metabolic	1	5.3	1	2.0	0.47
Surgical					
Gastrointestinal	2	10.5	7	13.7	1.00
Cardiological	0	0	5	9.8	0.31
Vascular	1	5.3	4	7.8	1.00
Orthopedic	0	0	2	3.9	1.00
Pulmonary	1	5.3	2	3.9	1.00
Neurological	0	0	1	2.0	1.00
Urologic	1	5.3	1	2.0	0.47
Co-morbidity					
Cardiovascular	11	57.9	31	60.8	0.82
Neoplasia	5	26.3	18	35.3	0.67
Gastrointestinal	9	47.4	17	33.3	0.40
Neurological	1	5.3	13	25.5	0.09
Metabolic	7	36.8	12	23.5	0.36
Pulmonary	4	21.0	10	19.6	1.00
Other	4	21.0	14	27.4	0.76

* Statistically significant for p<0.05

Table 2 – ARF patients' outcome, from dialysis and non-dialysis groups, throughout ICU hospitalization.

Outcome	Dialysis n = 19		Nom-Dialysis n = 51		p
ARF Types	**n**	**%**	**n**	**%**	
Pre-renal	5	26.3	35	68.6	
Renal	14	73.7	15	29.4	0.001*
Post-renal	-	-	1	2.0	
Complications	**n**	**%**	**n**	**%**	
Cardiovascular	17	89.5	43	84.3	0.71
Infectious	7	36.8	18	35.3	1.00
Pulmonary	12	63.2	17	33.3	0.03*
Metabolic	12	63.2	14	27.4	0.01*
Hematological	8	42.1	11	21.6	0.13
Gastrointestinal	4	21.0	10	19.6	1.00
Surgical Review	3	15.8	6	11.8	0.69
Neurological	2	10.5	5	9.8	1.00
Rhabdomyolysis	-	-	1	2.0	0.27
Other	2	10.5	6	11.8	1.00
	X±	**DP±**	**X±**	**DP±**	
Permanence Time in the Study (days)	20.6±	15.1±	7.9±	7.9±	0.004*
Hospitalization Time in ICU (days)	25.0±	17.1±	10.8±	10.8±	0.008*
Destiny	**n**	**%**	**n**	**%**	
Discharge	11	57.9	34	66.7	0.58
Demise	8	42.1	17	33.3	

* Statistically significant for p<0.05

were previously included in the non-dialysis group. In the dialysis group, the renal replacement therapies used by the patients were: 11 (50.0%) were treated with the classic hemodialysis type (CHD), 7 (31.8%) with H hemodiafiltration (HDF), 2 (9.1%) with intermittent peritoneal dialysis (DPI) and 2 (9.1%) with continuous ambulatory peritoneal dialysis (DPAC). Three (15.8%) patients were subjected to more than one dialysis treatment type; two had been treated first with DPI and later with DPAC, and one (33.3%) patient was treated first with HDF and later with HDC.

The mean initial creatinine for the dialysis group was 4.6 md/dl, statistically greater (p<0.001) than for the non-dialysis group (2.1 mg/dl). There was no statistical difference in the values of urea, sodium and potassium, for both groups. In the ICU discharge day, the creatinine values were 3.6 mg/dl for the dialysis group, and 1.5 mg/dl for the non-dialysis group(p<0.007).

Of the 11 (57.9%) patients of the dialysis group that were discharged, three (27.3%) recovered the renal function and eight (72.7%) had to remain on dialysis techniques after discharge from ICU. In the non-dialysis group, 34 (66.7%) patients received discharge from ICU, 19 (56.0%) of which evolved with creatinine less than or equal to 1.5 mg/dl, and 15 (44.0%) patients with a serum creatinine level greater than 1.5 mg/dl.

Regarding the patients' mortality in ICU, 8 (42.1%) patients from the dialysis group and 17 (33.3%) patients from the non-dialysis group evolved to death, with no statistical difference (p<0.58). The relative death risk for the dialysis group was 26.0% greater than that for the non-dialysis group (RR=1.26, IC 0.66 and 2.43). For the dialysis group, the patient mortality rate in continuous renal replacement treatment was statistically greater (p<0.01) than in the intermittent treatment.

The cause of death in the dialysis group was: six patients (75.0%), multiple organ failure; one patient (12.5%), respiratory insufficiency, and one patient, sepsis. In the non-dialysis group, six patients (35.3%), respiratory insufficiency; six patients (35.3%), multiple organ failure; two (11.7%), sepsis; one (5.9%), ARF; one (5.9%), hemorrhagic vascular cerebral stroke, and one (5.9%), cardiorespiratory insufficiency.

DISCUSSION

The lack of consensus about the definition of ARF in ICU, the great diversity and complexity of the inclusion criteria in the study samples and, consequently, the lack of results' homogeneity complicates the comparison with the literature. The many ARF definitions and a lack of protocols for treatment optimization results in countless ARF interventions[3,10].

The ARF is defined, in most studies, as when there is

elevation in the creatinine level between 1.3 mg/dl and 5.0 mg/dl, or when there is a need for dialysis treatment[8-9,12-14]. In this study, it was considered as serum creatinine levels greater than 1.5 mg/dl[11-12].

When considering the sample's characteristics regarding male gender predominance, age and clinical diagnosis in the ICU hospitalization, pulmonary and cardiovascular diseases, the data was similar to that in the literature[9,15-17].

The elevated number of co-morbidities by patient can be explained by the great number of patients with age greater than or equal to 65 years.

There is scarce information in the literature about the analysis of relationships between co-morbidities and acute renal failure. The studies show an association of a determined co-morbidity that may or may not affect the appearance of ARF in ICU[8,11,17]. In this study, the restrictive factor located was the small number of co-morbidities that, when grouped, did not allow to identify them as a risk factor to ARF.

The occurrence of clinical and/or surgical complications related to ARF was statistically greater for the dialysis group. The need for using technologies and therapeutic resources for these patients along their treatment in ICU contributed to the elevated number of complications[2-3].

In the moment of the patients' inclusion in the study, the mean creatinine level for the dialysis group was statistically greater. Taking into consideration the lower limit of serum creatinine variation in both groups, it was observed that the proximity of these values to the indication or decision of the medical conduct about the definition of a dialysis or non-dialysis treatment.

Factors like the lack of a concept definition for ARF, its combination with preexisting diseases, nephrotoxic therapeutic interventions, existence of complications during ICU hospitalization, and the intensive care physician's and/or the nephrologist's experience are all questionings that the literature has yet to answer, with the objective of lowering the elevated mortality rates of ARF patients in ICU.

Many authors have been discussing about which is the best dialysis modality for ARF patients in ICU. However, there is still no consensus about which renal replacement therapy would have the best results in ARF treatment, i.e., mortality rates reduction, efficiency, sessions frequency and clinical efficacy of the treatment modality[10,18-19]. The renal replacement therapies' alterations occurred according to the hemodynamic stability, or not, of the patients, and to the nephrologist's evaluation.

In the dialysis group, the patients' mortality in the continuous renal replacement therapy was statistically greater than the mortality in the intermittent renal replacement therapy. There is an inclination to use the continuous renal replacement therapy over the intermittent therapy, because of the better hemodynamic stability and better patient's volemic, metabolic and nutritional control[10]. However, other authors, comparing the results of this these two renal replacement treatments, demonstrated an equal or lower survival rate in patients subjected to continuous renal replacement therapy[9,4,19].

The permanence time in the study and the hospitalization time in ICU was statistically greater for the dialysis group. Another study verified that the average ICU hospitalization time was ten days for the non-dialysis group and 15.2 days for the dialysis group, and was statistically greater in the ($p<0.003$) for the dialysis group as well[9]. The majority of the studies performed comparisons between patients with and without ARF in ICU, demonstrating an increase in ARF patients' hospitalization time[8,11,16].

In this study, there was no difference between the morbidity rates for the dialysis and non-dialysis groups, although the relative death risk had been greater for the group subjected to dialysis treatment. The only study that compares mortality rates between dialysis and non-dialysis treatments found a greater mortality rate for the dialysis patient group[9]. Others studies analyzed surviving or non-surviving patients regardless of the type of treatment[2,11,16].

The death causes in the non-dialysis group were respiratory insufficiency and multiple organ failure. In the non-dialysis group, multiple organ failure prevailed. Another study analyzed the death cause between ARF survivors and non-survivors, and verified that multiple organ failure and sepsis were the main causes[12].

CONCLUSION

In this study, there were fewer patients subjected to dialysis treatment compared to patients subjected to non-dialysis treatment. The co-morbidity indentified with greater frequency in both groups was of cardiovascular origin. The permanence time in study and the ICU hospitalization time were significantly greater for the dialysis group.

The events most frequently associated to ARF, for both groups, were those of cardiovascular and infectious nature, while the pulmonary and metabolic events predominated in the non-dialysis group.

This study's results suggests that there are multiple factors determining the critical patients outcome to ARF. Thus, it seems that ARF is not, per se, the only factor causing the high mortality rates that affect patients hospitalized in ICU.

REFERENCES

1. Joannidis M, Metnitz PG. Epidemiology and natural history of acute renal failure in the ICU. Crit Care Clin. 2005; 21(2): 239-49.
2. Venkataraman R. Prevention of acute renal failure. Crit Care Clin. 2005; 21(2): 281-9. Review.
3. Mehta RL, Chertow GM. Acute renal failure definitions and classification: time for change? J Am Soc Nephrol. 2003; 14(8):2178-87. Comment in: J Am Soc Nephrol. 2003; 14(8):2176-7.
4. Yegenaga I, Hoste E, Van Biesen W, Vanholder R, Benoit D, Kantarci G, et al. Clinical characteristics of patients developing ARF due to sepsis/systemic inflammatory response syndrome: results of a prospective study. Am J Kidney Dis. 2004; 43(5): 817-24.
5. O´Reilly P, Tolwani A. Renal replacement therapy III: IHD, CRRT, SLED. Crit Care Clin. 2005; 21(2): 367-78. Review.
6. Soares M, Salluh JI, Carvalho MS, Darmon M, Rocco JR, Spector N. Prognosis of critically ill patients with cancer and acute renal dysfunction. J Clin Oncol. 2006; 24(24): 4003-10.
7. Schrier RW, Wang W, Poole B, Mitra A. Acute renal failure: definitions, diagnosis, pathogenesis, and therapy. J Clin Invest. 2004; 114(1):5-14. Erratum in: J Clin Invest. 2004; 114(4):598.
8. de Mendonça A, Vincent JL, Suter PM, Moreno R, Dearden NM, Antonelli M, et al. Acute renal failure in the ICU: risk factors and outcome evaluated by the SOFA score. Intensive Care Med. 2000; 26(7):915-21.
9. Mehta RL, Pascual MT, Gruta CG, Zhuang S, Chertow GM. Refining predictive models in critically ill patients with acute renal failure. J Am Soc Nephrol. 2002; 13(5):1350-7.
10. Van Biesen W, Vanholder R, Lameire N. Dialysis strategies in critically ill acute renal failure patients. Curr Opin Crit Care. 2003; 9(6):491-5.
11. Mataloun SE. Incidência, fatores de risco e fatores prognósticos da insuficiência renal aguda em pacientes admitidos numa unidade de terapia intensiva [tese]. São Paulo: Universidade Federal de São Paulo, Escola Paulista de Medicina; 2002.
12. Batista PBP. Prognóstico de pacientes com insuficiência renal aguda [tese]. São Paulo: Universidade Federal de São Paulo, Escola Paulista de Medicina; 1998.
13. Clermont G, Acker CG, Angus DC, Sirio CA, Pinsky MR, Johnson JP. Renal failure in the ICU: comparison of the impact of acute renal failure and end-stage renal disease on ICU outcomes. Kidney Int. 2002; 62(3):986-96.
14. Metnitz PG, Krenn CG, Steltzer H, Lang T, Ploder J, Lenz K, et al. Effect of acute renal failure requiring renal replacement therapy on outcome in critically ill patients. Crit Care Med. 2002; 30(9):2051-8. Comment in: Crit Care Med. 2002; 30(9):2156-7. Crit Care Med. 2003; 31(9):2417.
15. Silvester W, Bellomo R, Cole L. Epidemiology, management, and outcome of severe acute renal failure of critical illness in Australia. Crit Care Med. 2001; 29(10):1910-5. Comment in: Crit Care Med. 2001; 29(10):2028-9.
16. Silva Júnior GB, Daher EF, Mota RMS, Menezes FA. Risk factors for death among critically ill patients with acute renal failure. São Paulo Med J. 2006; 124(5): 257-63.
17. Vieira JM Jr, Castro I, Curvello-Neto A, Demarzo S, Caruso P, Pastore L Jr, et al. Effect of acute kidney injury on weaning from mechanical ventilation in critically ill patients. Crit Care Med. 2007; 35(1):184-91. Comment in: Crit Care Med. 2007; 35(1):316-7.
18. Ricci Z, Ronco C. Renal replacement II: dialysis dose. Crit Care Clin. 2005; 21(2): 357-66.
19. Vinsonneau C, Camus C, Cambes A, Costa de Beauregard MA, Klouche K, Boulain T, Pallot JL, Chiche JD, Taupin P, Landais P, Dhainaut JF; Hemodiafe Study Group. Continuous venovenous haemodiafiltration versus intermittent haemodialysis for acute renal failure in patients with multiple-organ dysfunction syndrome: a multicentre randomised trial. Lancet. 2006; 368(9533): 379-85. Comment in: ACP J Club. 2007; 146(1):15. Can J Anaesth. 2007; 54(10):845-7. Int J Artif Organs. 2006; 29(12):1190-2. Lancet. 2006; 368(9533):344-5. Lancet. 2006; 368(9546):1491; author reply 1492. Lancet. 2006; 368(9546):1491; author reply 1492.