

# Intradialytic complications in patients with acute kidney injury

Complicações intradialíticas em pacientes com injúria renal aguda  
Complicaciones intradialíticas en pacientes con insuficiencia renal aguda

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## Descriptores

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## Abstract

**Objective:** To identify the prevalence of intradialytic complications in patients with acute kidney injury (AKI) in an Intensive Care Unit (ICU) and their associated factors and verify what were the immediate professional behaviors adopted by the team.

**Methods:** This is a quantitative retrospective study, carried out in the ICU of a university and public hospital, located in southern Brazil. All patients admitted to an ICU with a medical diagnosis of dialysis AKI between January 2011 and December 2016 were included in this study. Data were collected from medical records. A statistical difference with a p-value < 0.05 was considered significant.

**Results:** A total of 76 patients were included, the majority aged between 41 and 65 years (n=44; 57.9%). All underwent intermittent hemodialysis. Of the total number of patients, 71 (93.4%) had complications during hemodialysis, with intradialytic hypotension being the most prevalent complication, affecting 51 (71.8%) patients. The most frequent immediate professional conduct for this complication was installation and/or control of vasoactive drug infusion (100% of cases). Age, mechanical ventilation, sepsis-related AKI, number and duration (hours) of dialysis sessions, as well as the time of starting dialysis were significantly associated with the frequency of intradialytic complications.

**Conclusion:** Patients had a high prevalence of intradialytic complications, and the most frequent immediate professional procedures aimed at reversing intradialytic hypotension and were performed mainly by the nursing team. Factors associated with complications were related to the severity of patients at the beginning of dialysis.

## Resumo

**Objetivo:** Identificar a prevalência de complicações intradialíticas em pacientes com injúria renal aguda (IRA) na unidade de terapia intensiva (UTI) e seus fatores associados; verificar quais foram as condutas profissionais imediatas adotadas pela equipe.

**Métodos:** Estudo retrospectivo, com abordagem quantitativa, realizado na UTI de um hospital universitário e público, localizado na região sul do Brasil. Foram incluídos neste estudo todos os pacientes internados na UTI com diagnóstico médico de IRA dialítica entre janeiro de 2011 e dezembro de 2016. Realizou-se coleta de dados contidos em prontuários. Considerou-se como estatisticamente significativo p-valor < 0,05.

**Resultados:** Foram incluídos 76 pacientes, sendo a maioria com idade entre 41 e 65 anos (n= 44; 57,9%). Todos realizaram hemodiálise intermitente. Do total de pacientes, 71 (93,4%) apresentaram complicações durante a hemodiálise, sendo hipotensão intradialítica a complicação mais prevalente, acometendo 51 (71,8%) pacientes. A conduta profissional imediata mais frequente para a referida complicação foi instalação

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e/ou controle da infusão do medicamento vasoativo (100% dos casos). Idade, ventilação mecânica, IRA relacionada à sepse, número e tempo de duração (horas) das sessões dialíticas, bem como o momento de início da diálise foram significativamente associados à frequência das complicações intradialíticas.

**Conclusão:** Os pacientes apresentaram alta prevalência de complicações intradialíticas, sendo que as condutas profissionais imediatas mais frequentes objetivaram reverter hipotensão intradialítica e foram realizadas majoritariamente pela equipe de enfermagem. Os fatores associados às complicações estiveram relacionados à gravidade dos pacientes no início da diálise.

## Resumen

**Objetivo:** Identificar la prevalencia de complicaciones intradialíticas en pacientes con insuficiencia renal aguda (IRA) en la unidad de cuidados intensivos (UCI) y sus factores asociados; verificar qué conductas profesionales inmediatas fueron adoptadas por el equipo.

**Métodos:** Estudio retrospectivo, con abordaje cuantitativo, realizado en la UCI de un hospital universitario y público, ubicado en la región sur de Brasil. Se incluyeron en este estudio todos los pacientes ingresados a la UCI con diagnóstico médico de IRA dialítica entre enero de 2011 y diciembre de 2016. Se realizó la recopilación de datos de los prontuarios. Considerados estadísticamente significante p-valor < 0,05.

**Resultados:** Se incluyeron 76 pacientes, en su mayoría con edades entre 41 y 65 años (n= 44; 57,9 %). Todos realizaron hemodiálisis intermitente. Del total de pacientes, 71 (93,4 %) presentaron complicaciones durante la hemodiálisis, con hipotensión intradialítica como la complicación más prevalente, acometiendo a 51 (71,8 %) pacientes. La conducta profesional inmediata más frecuente para la referida complicación fue la instalación o el control de la infusión del medicamento vasoactivo (100 % de los casos). Edad, ventilación mecánica, IRA relacionada a la sepsis, número y tiempo de duración (horas) de las sesiones dialíticas, así como el momento de inicio de la diálisis estuvieron significativamente asociados con la frecuencia de las complicaciones intradialíticas.

**Conclusión:** Los pacientes presentaron alta prevalencia de complicaciones intradialíticas y las conductas profesionales inmediatas más frecuentes tuvieron el objetivo de revertir la hipotensión intradialítica y se realizaron mayoritariamente por el equipo de enfermería. Los factores asociados a las complicaciones se relacionaron con la gravedad de los pacientes al inicio de la diálisis.

## Introduction

In the hospital setting, the highest incidence and mortality rates for acute kidney injury (AKI) are described for critically ill patients admitted to an Intensive Care Unit (ICU).<sup>(1-3)</sup> Due to the deleterious effects, many patients with severe AKI in the ICU require dialysis therapy, which prolongs hospital stay, entails greater financial expenses, demands more human and technological resources for care and incurs in higher mortality.<sup>(4,5)</sup> On the other hand, it is considered the therapeutic option of choice for the removal of toxins and excess nitrogen excreta and reversal of the uremic state, aiming to reduce the risk of generalized organic-functional failure, a situation in which there is also a considerable risk of death to patients.<sup>(5)</sup>

Thus, the multidisciplinary health team must present knowledge, skills and attitudes that guarantee the safety of patients with dialysis AKI during the procedures, identifying early and acting appropriately in the event of complications.<sup>(6)</sup> In this sense, knowing the complications that can occur during dialysis procedures performed in an ICU will support nurses in carrying out an accurate clinical diagnosis, which will serve as a basis for planning nursing care and, therefore, implementation of care to ensure patient safety during procedures.<sup>(7,8)</sup>

However, despite its importance, scientific research in this context is still incipient and production of knowledge in nursing on the subject is limited. Thus, this research aimed to identify the prevalence of intradialytic complications in patients with AKI in an ICU and their associated factors, as well as to verify which were the immediate professional conducts adopted by the team.

## Methods

The presentation of this study was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).<sup>(9)</sup>

This is a quantitative retrospective observational study, carried out in the ICU of a university and public hospital located in southern Brazil. It is a mixed ICU (clinical and surgical), with 15 beds, which has four dialysis machines. This study included all patients hospitalized in an ICU with a medical diagnosis of dialysis AKI between January 2011 and December 2016, who were at least 18 years old and spent more than 48 hours in the unit.

Data were collected from medical records in January 2018 using a semi-structured instrument. Data related to the general characteristics of patients (gender, race, age, comorbidities), ICU ad-

mission data (patient origin and medical diagnosis), AKI etiology, dialysis data (modality, number of procedures, time) were extracted (hours) of the sessions, time between the date of AKI diagnosis and the first dialysis, use of mechanical ventilation and sepsis during dialysis and death in the ICU.

To identify intradialytic complications and immediate professional conduct, all notes of nursing professionals involved in the care of patients under these conditions were analyzed. Thus, the prevalence of complications was identified by the general quantity of records, also verifying how many patients were affected by each complication during dialysis sessions.

All collected data were tabulated in Excel spreadsheet\* and statistical analyzes performed with the aid of XLSTAT® version 2018. Categorical data were expressed by frequencies (absolute and relative), while continuous data were expressed as mean ± standard deviation and/or median and interquartile percentile. To identify factors associated with intradialytic complications, variables of interest were submitted to bivariate analysis using the chi-square test, with a p-value less than 0.05 being considered statistically significant.

The study was previously approved by the Institutional Review Board of the *Universidade Estadual do Oeste do Paraná*. Nevertheless, all ethical-legal precepts established by Resolution 466/2012 of the Brazilian National Health Council (*Conselho Nacional de Saúde*) were respected, as well as those recommended by the Declaration of Helsinki (CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 57042316.2.0000.0107).

## Results

A total of 76 patients with dialysis AKI in an ICU were included. There was a predominance of males (n=42; 55.3%), aged between 41 and 65 years (n=44; 57.9%) and with hypertension (n=28; 36.8%). Sepsis was the main etiology of AKI (n=27; 35.5%) and all (n=76; 100%) patients underwent intermittent hemodialysis (IHD). In total, 511 di-

alysis procedures were carried out, with an average of four (2 – 7) sessions per patient (Table 1).

**Table 1.** General characteristics of patients with AKI dialysis in an ICU

Variables	n(%)
Sociodemographic data	
Sex (male)	42(55.3)
Race (Caucasian)	66(86.8)
Age (years)	52 ± 15 (19 – 85) <sup>a</sup>
18 – 40	17(22.4)
41 – 65	44(57.9)
≥ 65	15(19.7)
Comorbidities	
Hypertension	28(36.8)
DM	18(23.7)
CVD	9(11.8)
Cancer	4(5.3)
ICU admission data	
Origin	
Emergency care	51(67.1)
Operating center	16(21.1)
Ward	9(11.8)
Medical diagnosis	
Clinical	37(48.7)
Surgical	39(51.3)
Admission type	
Planned	21(27.6)
Not planned	55(72.4)
AKI etiology	
Sepsis	27(35.5)
Associated with major surgery	5(6.6)
Shock	23(30.3)
Multiple organ failure	4(5.3)
Rhabdomyolysis	8(10.5)
Others	9(11.5)
Dialysis data	
Modality (IHD)	76(100)
Number of sessions/patient	4(2 – 10) <sup>b</sup>
Session/patient time (hours)	3.5(3 – 4) <sup>b</sup>
Time between AKI diagnosis and beginning of dialysis (days)	4(2 – 7) <sup>b</sup>
IMV during dialysis	68(89.5)
Sepsis during RRT	38(50)
Death in the ICU	47(61.8)

<sup>a</sup>Mean ± standard deviation (minimum – maximum); <sup>b</sup>Median (P25 – P75). AKI – acute kidney injury; ICU – Intensive Care Unit; DM – diabetes mellitus; CVD – cardiovascular disease; IHD – intermittent hemodialysis; IMV – invasive mechanical ventilation; RRT – renal replacement therapy.

A total of 251 intradialytic complications were identified, and five patients did not present any complications during the sessions. The prevalence of intradialytic complications was 93.4%, with an approximate average of three complications per patient and one complication every two procedures. Of the total number of patients with complications, it was observed that 51 (71.8%) had intradialytic hypotension and the most frequent

immediate professional approach for this complication was installation and/or control of vasoactive drug dose infusion (100%). This was also the prevalent immediate approach (54.2%) in cases of hemodynamic instability, recorded in 24 (31.6%)

patients. Hypoglycemia was the second complication that most affected patients (n=28; 36.8%) and the administration of glucose 50% was the immediate professional approach adopted in all cases (Chart 1).

**Chart 1.** Intradialytic complications according to type, number of patients affected, immediate professional conduct, frequency and professional category involved

Intradialytic complications	Patients (n = 71)	Immediate professional conduct	Frequency %	Professional category involved*
Hypotension	51(71.8)	Vasoactive drug dose (VAD) installation/management	100	Nursing
		Volume administration (SS 0.9% and/or Ringer lactate)	23.5	
		Hypertonic sodium solution administration (20% NaCl)	2.0	
		Blood pump flow reduction	3.9	
		Dialysis modality alteration (only hemofiltration)	9.8	
Hypoglycemia	28(36.8)	Glucose administration 50%	100	Nursing
		GS administration 10%	3.6	
Haemodynamic instability	24(31.6)	VAD installation/dose management	54.2	Nursing
		Sedative drug dose installation/management	4.2	
		Blood pump flow reduction	25	
		Dialysis modality alteration (from IHD to hemofiltration)	16.7	Medicine
		Dialysis dose alteration	4.2	
		Dialysis time rescheduling	4.2	
		Orotracheal intubation	4.2	
Discontinuation of dialysis	12.5			
Discomfort, effort or ventilatory drive	28(36.8)	Sedative drug dose installation/management	14.3	Nursing
		Nebulization administration	7.1	
		Neuromuscular relaxant/blocker administration	71.4	
		Anesthetic administration	21.4	
		Non-invasive oxygen therapy installation	7.1	Physical therapy
Coagulation of dialysis circuit (filter and/or lines)	16(21.1)	Management of IMV parameters	53.6	Physical therapy
		Circuit change	37.5	Nursing
		Patient placement in Trendelenburg position	6.3	
		Anticoagulant administration	18.8	
		Circuit line inversion	12.5	
Hyperthermia	15(19.7)	Discontinuation of dialysis	25	Medicine
		Antipyretic administration	100	Nursing
		Decrease in dialysis machine temperature	20	
		Blood collection for laboratory examination	40	
Low blood flow in the catheter	11(14.5)	Application of cold compresses	6.7	
		Inversion of dialysis lines	27.3	Nursing
		Patient placement in Trendelenburg position	9.1	
		Catheter traction	63.6	Medicine
Tachycardia	11(14.5)	Discontinuation of dialysis	9.1	Nursing
		VAD installation/dose management	63.6	
		Non-invasive oxygen therapy installation	9.1	
		Mannitol administration	9.1	
		Blood pump flow reduction	36.4	Medicine
Dialysis modality alteration (from IHD to hemofiltration)	18.2			
Hyposaturation	8(10.5)	Discontinuation of dialysis	9.1	
		Management of IMV parameters	100	Physical therapy
		Manual hyperventilation	12.5	
Hypertension	6(7.9)	Sedative drug dose installation/management	37.5	Nursing
		VAD installation/dose management	100	Nursing
Increased venous pressure (machine)	6(7.9)	Catheter traction	33.3	Medicine
		Discontinuation of dialysis	16.7	
		Dialysis line inversion	16.7	Nursing
		Patient placement in Trendelenburg position	66.7	

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Continuation.

Intradialytic complications	Patients (n = 71)	Immediate professional conduct	Frequency %	Professional category involved*
Catheter coagulation	5(6.6)	Anticoagulant administration	60	Nursing
		Patient placement in Trendelenburg position	20	
		Catheter traction	100	
		Catheter replacement	20	Medicine
		Discontinuation of dialysis	20	
Hyperglycemia	5(6.6)	Insulin dose installation/management in an infusion pump	57.1	Nursing
		Insulin administration subcutaneously	71.4	
Mental confusion and psychomotor agitation	4(5.6)	Antipsychotic drug administration	100	Nursing
		Mechanical patient restraint in bed	50	
Emesis	4(5.6)	Antiemetic administration	75	Nursing
		Switching from NET to gavage	25	
Bradycardia	3(4.2)	Sodium bicarbonate administration	33.3	Nursing
		Antiarrhythmic administration	100	
Tachydyspnea	3(4.2)	Management of IMV parameters	100	Physical therapy
Gasping	3(4.2)	Sedative drug dose installation/management	100	Nursing
Sweating with skin paleness	3(4.2)	Volume administration (SS 0.9% and/or Ringer lactate)	33.3	Nursing
		Glucose administration 50%	66.7	
Acute pain	2(2.8)	Analgesic administration	100	Nursing
Decreased level of consciousness	1(1.4)	Sedative drug dose installation/management	100	Nursing
		Orotracheal intubation	100	Medicine
PIC elevation	1(1.4)	Sedative drug dose installation/management	100	Nursing
Gastric stasis	1(1.4)	Dietary compound administration	100	Nutrition/Nursing
Acidemia	1(1.4)	Sodium bicarbonate administration	100	Nursing
Bleeding on catheter insertion	1(1.4)	Compressive restraint	100	Nursing
Capillary breakage	1(1.4)	Capillary change	100	Nursing
Technical-electrical failure in the machine	1(1.4)	Discontinuation of dialysis	100	Medicine
		Return of blood from the circuit to patient	100	Nursing
Accidental catheter removal (by tpatient)	1(1.4)	Discontinuation of dialysis	100	Medicine
Atrial fibrillation	1(1.4)	VAD installation/management	100	Nursing
Ventricular fibrillation	1(1.4)	VAD installation/management	100	Nursing
		Blood pump flow reduction	100	
		Cardiac defibrillation	100	Medicine
		Discontinuation of dialysis	100	
Cardiac arrest	1(1.4)	Discontinuation of dialysis	100	Medicine
		Antiarrhythmic administration	100	Nursing
		Cardiopulmonary resuscitation	100	Medicine/Nursing/Physiotherapy

\*The immediate procedures developed by non-medical professionals were carried out based on their prescription, indication and/or follow-up. VAD – vasoactive drug; SF 0.9% - Saline at 0.9%; 20% NaCl - 20% sodium chloride; SG 5% - 5% glucose serum. SG 10% - 10% glucose serum; IHD – Intermittent hemodialysis; IMV – Invasive Mechanical Ventilation; NET - Nasoenteric tube

Table 2 shows that age, mechanical ventilation, AKI etiology, number and time (in hours) of dialysis sessions, as well as time of onset of renal replacement therapy (RRT) were the factors that presented a statistically significant association with the recorded intradialytic complications in the studied sample.

## Discussion

The development of this research made it possible to identify the prevalence of intradialytic complications in patients with AKI in the ICU and their associated factors, in addition to enabling knowledge

about the immediate professional conduct adopted by the team. The study contributes to the relevant literature, as it provides specific information, focusing not only on the prevalence, but also on factors associated with the occurrence of complications and immediate professional conduct. Furthermore, the study results highlight the importance of advanced nursing practice, based on technical and scientific knowledge, developed through permanent education and professional qualification. Nevertheless, the importance of nursing work in carrying out dialysis procedures in the ICU and in the safety of patients undergoing these therapies is also verified.

In addition to highlighting the important role of nursing in the care process of dialysis patients

**Table 2.** Factors associated with intradialytic complications (n = 251)

Variables	n(%)	p-value*
Sex		0.230
Female	135(53.8)	
Male	116(46.2)	
Age		<0.001
18 - 40	69(27.5)	
41 - 65	129(51.4)	
> 65	53(21.1)	
Mechanical ventilation		<0.001
Yes	226(90.0)	
No	25(10.0)	
Sepsis		0.088
Yes	139(55.4)	
No	112(44.6)	
AKI etiology		<0.001
Sepsis	80(31.9)	
Associated with major surgery	8(3.2)	
Shock	75(29.9)	
Failure	8(3.2)	
Rhabdomyolysis	36(14.3)	
Others	44(17.5)	
Dialysis sessions		<0.001
> 4	176(70.1)	
≤ 4	75(29.9)	
Time (hours) of each session		<0.001
≤ 3.5 h	167(66.5)	
> 3.5 h	84(33.5)	
Start of dialysis		<0.001
Early (≤ 2 days)	90(35.9)	
Late (> 2 days)	161(64.1)	
Death		0.411
Yes	132(52.6)	
No	119(47.4)	

\*Chi-square test; AKI - acute kidney injury

in the ICU, the results demonstrate that there is a need for interaction by the multidisciplinary health team, ensuring holistic care. The complexity of the process requires knowledge, skills and behavior from professionals that support the systematization of care and the development of advanced nursing practices. The team member responsible for performing the dialysis procedures must have a solid technical understanding of the technological apparatus used (equipment, dialysis circuit and other material resources), in addition to clinical reasoning and decision-making skills based on knowledge about the pathophysiology of AKI and the various physiological mechanisms involved in the process of dialysis therapy in critically ill patients.

In spite of the above, it is important to note that this is a study developed in a single Brazilian center, with data analysis from a relatively small sam-

ple. The retrospective design, with secondary data collection (records in medical records) limited the inclusion of important variables for a deeper understanding of the researched aspects, especially due to the lack of records on valuable information related to dialysis procedures and the care provided by the health team. Moreover, the fact that the medical diagnosis was the reference to identify AKI occurrence may have included patients with different clinical conditions and degrees of kidney damage, which makes it difficult to compare the clinical profile of the sample.

Thus, it is highlighted that the data from this research cannot be generalized and the researchers encourage the development of more comprehensive investigations on the occurrence of intradialytic complications in critically ill patients with AKI. Future research should aim to identify the main prevention and treatment measures implemented in practice and recognize the associated factors, highlighting the characteristics of the subgroup of patients most susceptible to complications during procedures in the different modalities of dialysis therapy available and practiced in different centers.

That said, it is noteworthy that technically performing dialysis procedures requires preparation of the health team both for the training of professionals to control the signs and symptoms presented by patients, as well as for the critical analysis and safe handling of the technological resources involved with this therapy.<sup>(10)</sup> This study found that all patients included in the sample underwent dialysis therapy through IHD. It was observed that, at the beginning of dialysis therapy, patients were in severe clinical conditions. This fact contributes to the increase in complications during dialysis procedures in the ICU<sup>(5,11-12)</sup> and may partly explain the high prevalence of intradialytic complications identified in the analyzed sample (93.4%). In a similar study, researchers analyzed the medical records of 65 patients with dialysis AKI in another Brazilian ICU, and found that patients underwent 618 hemodialysis sessions, while the prevalence of complications during the procedures was 47.9%.<sup>(13)</sup>

Regarding the types of complications, it was found that hypotension was the most prevalent

complication, occurring in 51 (71.8%) patients. In a prospective, randomized clinical trial, other Brazilian researchers evaluated the occurrence of intradialytic complications in patients undergoing extended daily dialysis (with sessions of 6 hours or 10 hours). The authors reported that hypotension (82.6%) and dialysis filter clotting (25.3%) were the main complications, regardless of the duration of therapy. On the other hand, patients undergoing dialysis sessions lasting 10 hours showed greater resistance to the immediate professional conduct adopted for hypotension episodes, in addition to the need to stop dialysis more frequently.<sup>(14)</sup>

Intradialytic hypotension is considered the most common complication described in the literature, and it is generally associated with rapid or exacerbated volume removal, causing translocation of fluid from the extra space to the intravascular space, increased vascular resistance and cardiac contractility.<sup>(15)</sup> Its occurrence is determinant in episodes of hemodynamic instability during dialysis, it is often associated with the need to interrupt the procedure and compromises the recovery of renal function, due to the promotion of hypoperfusion (and ischemic damage) of the target organ.<sup>(14)</sup>

According to the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (K/DOQI), intradialytic hypotension can be defined as a decrease of  $\geq 20$  mmHg in systolic blood pressure or 10 mmHg in mean blood pressure, when associated with suggestive symptoms such as nausea, vomiting, dizziness, fainting and anxiety.<sup>(16)</sup> However, the application of these criteria is routinely unfeasible in the ICU, considering that critically ill patients, in most cases, do not have the necessary degree of awareness for issues related to the general clinical status and also for need for mechanical ventilation and sedation for long periods. Thus, there are different definitions in the literature for the condition of intradialytic hypotension in patients with AKI in the ICU, among which the need to start vasopressor support is highlighted, in the presence of mean arterial pressure (MAP)  $<65$  or  $70$  mmHg or with 20% reduction in MAP.<sup>(15)</sup>

Data on the criteria used to define intradialytic hypotension in patients in the present study were not

identified in the analyzed medical records, only the record of complications. Despite this, it was found that the immediate professional conducts, aimed at controlling this complication, involved the administration of vasoactive medication, volume infusion (saline solution and/or ringer lactate) and hypertonic solution, change of dialysis parameters and, with less frequently, discontinuation of the procedure (Chart 1). Additional approaches may include reducing the ultrafiltration rate (UF), reducing the dialysate temperature and sodium/UF ratio, reducing plasma osmolarity (especially in IHD) and intradialytic administration of hypertonic mannitol.<sup>(14,15)</sup>

The immediate professional conducts for the treatment of intradialytic hypotension were also applied to other complications recorded, and it is important to highlight the necessary multiprofessional interaction in the care approach of the various complications presented by patients during dialysis and, mainly, for the realization of immediate conducts. Together with physicians, physiotherapists and a nutritionist, the nursing team played an essential role in patient care, being responsible for carrying out most of immediate professional behaviors considering the complications presented by the patients in this study.

The nursing workload in intensive care is admittedly high and can become even greater in the care of patients with AKI, especially those in need of dialysis.<sup>(17)</sup> In hospitals, dialysis procedures are performed by nursing professionals, a member of a specialized team outside the intensive care unit, or a professional belonging to the shared organization, external to the institution where patients are hospitalized.<sup>(18)</sup>

Due to the complexity of care, presenting knowledge, skills and attitudes that underpin advanced nursing practices is essential, and the activities performed by nursing during the performance of RRT include, but are not limited to, the preparation of solutions used during the procedures; connection, disconnection and removal of patient to extracorporeal therapy; management and change of dialysis parameters, as needed and medical prescription; management of alarms and/or warnings issued by the dialysis machine; in addition to intensive clinical care, with continuous monitoring of patients' hemodynamic status.<sup>(19,20)</sup>

In the present study, it was also identified that the frequency of complications was significantly related to age, the need for mechanical ventilation, AKI associated with sepsis, the number of dialysis procedures and time (hours) of each session. This scenario of factors has also been described for intradialytic complications, recorded in patients with chronic kidney disease undergoing outpatient hemodialysis.<sup>(7)</sup> Results from a single Brazilian study show that there was no statistically significant difference in the comparison of the main factors associated with the occurrence of intradialytic complications between chronic and acute patients, and the main factors analyzed in the total sample were age, number of dialysis sessions and duration (in hours) of each session.<sup>(8)</sup>

The scarce data in the literature regarding factors associated with intradialytic complications in critically ill patients with AKI make it difficult to perform a comparative analysis of the data presented here. However, it is understood that the identification and dissemination of knowledge regarding such complications encourages evidence-based practice, the development of continuing education strategies for nursing professionals, to include the early recognition of complications, decision-making with immediate conduct and effective, minimizing side consequences and negative outcomes, ensuring quality of care and patient safety, as well as proposing clinical care protocols for the prevention and treatment of complications.<sup>(18-20)</sup>

## Conclusion

Patients had a high prevalence of intradialytic complications, and the most frequent immediate professional procedures aimed at reversing intradialytic hypotension and were performed mainly by the nursing team. Factors associated with complications were related to the severity of patients at the beginning of dialysis.

## Collaborations

Santos RP, Carvalho ARS and Peres LAB contributed to the project design, data analysis and inter-

pretation, article writing, relevant critical review of intellectual content and approval of the final version to be published. Alves SR, Lordani TVA and Vattimo MFF collaborated with the relevant critical review of intellectual content and approval of the final version to be published.

## References

1. Hoste EA, Bagshaw SM, Bellomo R, Cely CM, Colman R, Cruz DN, et al. Epidemiology of acute kidney injury in critically ill patients: the multinational AKI-EPI study. *Intensive Care Med.* 2015;41(8):1411-23.
2. Bouchard J, Acharya A, Cerda J, Maccariello ER, Madarasu RC, Tolwani AJ, et al. A prospective international multicenter study of AKI in the intensive care unit. *Clin J Am Soc Nephrol.* 2015;10(8):1324-31.
3. Mehta RL, Burdmann EA, Cerdá J, Feehally J, Finkelstein F, García-García G, et al. Recognition and management of acute kidney injury in the International Society of Nephrology Oby25 Global Snapshot: a multinational cross-sectional study. *Lancet.* 2016;387(10032):2017-25. Erratum in: *Lancet.* 2016;387(10032):1998.
4. Bagshaw SM, Darmon M, Ostermann M, Finkelstein FO, Wald R, Tolwani AJ, et al. Current state of the art for renal replacement therapy in critically ill patients with acute kidney injury. *Intensive Care Med.* 2017;43(6):841-54. Review.
5. Heung M, Yessayan L. Renal replacement therapy in acute kidney injury: controversies and consensus. *Crit Care Clin.* 2017;33(2):365-78. Review.
6. Neyra JA, Goldstein SL. Optimizing renal replacement therapy deliverables through multidisciplinary work in the intensive care unit [Editorial]. *Clin Nephrol.* 2018;90(1):1-5.
7. Lessa SR, Bezerra JN, Barbosa SM, Luz GO, Borba AK. Prevalence and factors associated with the occurrence of adverse events in the hemodialysis service. *Texto Contexto Enferm.* 2018;27(3):e3830017.
8. Sousa MR, Silva AE, Bezerra AL, Freitas JS, Neves GE, Paranaguá TT. Prevalence of adverse events in a hemodialysis unit. *Rev Enferm UERJ.* 2016;24(6):e18237.
9. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol.* 2008;61(4):344-9.
10. Palomba H, do Amaral Campos PP, Corrêa TD, de Carvalho FB, Westphal G, Gusmão D, Lisboa T, Grion CM, de Assunção MS; DETRAKI (DEfining and TReating Acute Kidney Injury) Study investigators. Defining and treating acute kidney injury patients in Brazilian intensive care units: Results from a cross-sectional nationwide survey. *J Crit Care.* 2016;34:33-7.
11. Ricci Z, Romagnoli S, Ronco C. Renal replacement therapy. *F1000Res.* 2016;5(F1000 Faculty Rev):103. Review.
12. Ronco C, Ricci Z, De Backer D, Kellum JA, Taccone FS, Joannidis M, et al. Renal replacement therapy in acute kidney injury: controversy and consensus. *Critical Care.* 2015;19:146.
13. Silva GL, Thomé EG. Complicações do procedimento hemodialítico em pacientes com insuficiência renal aguda: intervenções de enfermagem. *Rev Gaucha Enferm.* 2009;30(1):33-9.

14. Albino BB, Balbi AL, Abrão JM, Ponce D. Dialysis complications in acute kidney injury patients treated with prolonged intermittent renal replacement therapy sessions lasting 10 versus 6 hours: results of a randomized clinical trial. *Artif Organs*. 2015;39(5):423-31.
15. Sharma S, Waikar SS. Intradialytic hypotension in acute kidney injury requiring renal replacement therapy. *Semin Dial*. 2017;30(6):553-8.
16. K/DOQI Workgroup. K/DOQI clinical practice guidelines for cardiovascular disease in dialysis patients. *Am J Kidney Dis*. 2005;45(4 Suppl 3):S1-153.
17. Coelho FU, Watanabe M, Fonseca CD, Padilha KG, Vattimo MF. Nursing active score and acute kidney injury. *Rev Bras Enferm*. 2017;70(3): 475-80.
18. Ricci Z, Benelli S, Barbarigo F, Cocozza G, Pettinelli N, Di Luca E, et al. Nursing procedures during continuous renal replacement therapies: a national survey. *Heart Lung Vessel*. 2015;7(3):224-30.
19. Joynes J. An analysis of component parts of advanced nursing practice in relation to acute renal care in intensive care. *Intensive Crit Care Nurs*. 1996;12(2):113-9. Review.
20. Houllé-Veyssièrè M, Courtin A, Zeroual N, Gaudard P, Colson PH. Continuous venovenous renal replacement therapy in critically ill patients: a work load analysis. *Intensive Crit Care Nurs*. 2016;36:35-41.