RISK FACTORS FOR MORTALITY IN GERIATRIC PATIENTS ADMITTED TO THE INTENSIVE CARE UNIT AT A PUBLIC HOSPITAL

Fatores de risco para mortalidade em idosos admitidos em unidade de terapia intensiva de hospital público

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ABSTRACT

OBJECTIVE: To evaluate risk factors for mortality in geriatric patients admitted to an intensive care unit (ICU). **METHODS:** We studied older patients admitted to the ICU in a historical cohort study. Convenience sampling was performed for all patients aged 60 years or older, admitted to the 20 beds of an ICU of a highly complex hospital. Cox regression analysis was performed to estimate risk factors associated with mortality. The significance level used was 5%. **RESULTS:** The proportion of geriatric patients represented 45% of ICU admissions in the period. In-hospital mortality was 38.4%. The postoperative emergency surgery variable and the Acute Physiology and Chronic Health Evaluation (APACHE II) and Sequential Organ Failure Assessment (SOFA) admission scores were identified as independent risk factors for in-hospital mortality. **CONCLUSION:** Risk factors associated with mortality were APACHE II and SOFA scores for admission and postoperative emergency surgery.

KEYWORDS: aged; health services for the aged; intensive care units.

RESUMO

OBJETIVO: Avaliar fatores de risco para mortalidade em pacientes idosos com internação em uma unidade de terapia intensiva (UTI). **MÉTODOS:** Foram estudados pacientes idosos admitidos em UTI, em um estudo de coorte histórica. Foi realizada amostragem de conveniência de todos os pacientes com 60 anos ou mais, internados nos 20 leitos de uma UTI de um hospital de alta complexidade. Foi realizada análise de regressão de Cox para estimar os fatores de risco associados à mortalidade. O nível de significância utilizado foi de 5%. **RESULTADOS:** A proporção de pacientes idosos representou 45% das admissões em UTI no período. A mortalidade hospitalar foi de 38,4%. A variável pós-operatório de cirurgia de urgência e os escores *Acute Physiology and Chronic Health Evaluation* (APACHE II) e *Sequential Organ Failure Assessment* (SOFA) da admissão foram identificados como fatores de risco independentes para mortalidade hospitalar. **CONCLUSÃO:** Os fatores de risco associados à mortalidade foram os escores APACHE II e SOFA da admissão e pós-operatório de cirurgia de urgência.

PALAVRAS-CHAVE: idosos; serviços de saúde para idosos; unidades de terapia intensiva.

INTRODUCTION

The population of older adults in the world is growing; and population aging in Brazil warns of the need for new planning and care policies for aged adults.[1] Studies in Nordic countries estimate a percentage of intensive care unit (ICU) admissions of patients aged 80 and over of 13 to 17.3%, with in-hospital mortality of up to 33.7%.[2]

The aging of the world population has increased the hospitalization of geriatric ICU patients, which makes this subject pertinent to discussion. In New Zealand and Australia at the beginning of this century, admissions of patients aged 80 and over tended to increase, with an annual increase of hospitalizations by 5.6%.[3] In Brazil, the average age of patients admitted to the ICU is 62 years old.[4]

For better management of the geriatric inpatient, it is necessary that the physician know the physiology of aging and its clinical repercussions, especially those caused by the decrease in body systems reserve. Therefore, knowing the clinical characteristics and prognosis of the geriatric patient admitted to the intensive care unit is fundamental for the planning of good clinical management of this population.[5] In the United States, the primary causes of admission of geriatric patients into the ICU are predominantly sepsis, cardiac and respiratory causes, and the increased diagnosis of sepsis in recent years stands out.[6]

The risk factors for mortality in the geriatric patients described in the literature are age, especially above 80; prognostic scores, such as the Acute Physiology and Chronic Health Evaluation (APACHE II); change in level of consciousness; presence of infection; acute kidney injury (AKI); postoperatively, especially from emergency procedures; and acute heart failure.[7-10]

The aim of this study was to evaluate risk factors for mortality in geriatric patients admitted to an ICU.

METHODS

This study was approved by the Research Ethics Committee of the Universidade Estadual de Londrina (UEL) under approval no. 1.791.251; CAAE 61125316.7.0000.5231.

Geriatric patients admitted to the ICU were analyzed in a historical cohort study. Convenience sampling was performed for all patients aged 60 years or older, admitted to the 20 ICU beds of the University Hospital (UH), from January to December 2015. The studied ICU is a reference in the northern part of the state of Paraná, Brazil, representing patients admitted to a high-complexity tertiary hospital.

Clinical and laboratory data were collected from all patients from ICU admission to hospital discharge or death. Individuals aged 60 years or older were considered geriatric patients.

Data collection included, upon admission, clinical and demographic data. We collected: age (in years), sex, length of hospital and ICU stay (in days), diagnosis and reason for ICU admission, presence of AKI at admission, hemodialysis, use of mechanical ventilation, use of vasoactive drugs, and hospital outcome. The following scores were calculated: APACHE II;[11] *Sequential Organ Failure Assessment* (SOFA),[12] and *Simplified Therapeutic Intervention Scoring System* (TISS 28)[13] at admission to the unit.

These scores are routinely calculated at the research site, as provided by the Brazilian Health Regulatory Agency Collegiate Board Resolution No. 7/2010.[14] The APACHE II score is a widely used prognostic score that reflects the severity of the disease and enables the calculation of predicted mortality. The SOFA score allows daily assessment of organic dysfunctions, as well as their alterations in response to instituted therapies. The TISS 28 score is a system that allows evaluating therapeutic interventions performed daily and estimating the nursing workload, contributing to the scaling of human resources in intensive care units. Despite being collected daily for the purpose of prognostic assessment, the SOFA and TISS 28 scores analyzed in this study were those collected on the first day of ICU admission.

The AKI was diagnosed by the Kidney Disease Improving Global Outcomes (KDIGO) criteria.[15] The diagnosis of sepsis was based on the Sepsis-3 criteria.[16]

The normality of the variables was verified by the Kolmogorov-Smirnov test. Results of continuous variables were described by median and interquartile range (IQR). Categorical data were presented as frequency. Cox regression analysis was performed to assess the association between risk factors and survival, using the enter method for bivariate analysis and the stepwise method for multivariate analysis, establishing $p < 0.05$ to enter the model and $p > 0.1$ to remove the variable; the results were described as hazard ratio (HR) and 95% confidence interval (95%CI). In-hospital mortality was described as frequency and by Kaplan-Meier survival curve analysis.

The significance level used was 5% and the analyses were performed using MedCalc for Windows version 18.9 (MedCalc Software, Ostend, Belgium).

RESULTS

During the study period, 289 patients over 60 years of age were hospitalized, corresponding to 45% of the 641 ICU

admissions. The hospitalization of patients aged 80 years or older corresponded to 8.6% of all admissions. The median age was 72 years (IQR = 66.0–77.2). Patients aged 65 to 79 years predominated in 60.9% of cases. Male sex was more prevalent, in 173 (59.9%) hospitalizations. The diagnosis of sepsis was the most frequent, in 112 (38.8%) hospitalizations. AKI was present in 131 cases (45.3%) at admission and in-hospital mortality was 38.4%. (Table 1).

The median length of hospital stay was 17 days (IQR = 9.0–32.25) and the ICU stay was 4 days (IQR = 2.0–13.0). Prognostic scores had a median of 22 (IQR = 15.0–30.0) for APACHE II; 7 (IQR = 3.0–11.0) for SOFA at admission and 27 (IQR = 21.0–31.25) for TISS 28 at admission.

Postoperative frequency of emergency surgery, hospitalization for clinical reasons, diagnosis of sepsis, AKI at admission, hemodialysis, mechanical ventilation and vasoactive drugs were higher in patients who did not survive. The APACHE II, SOFA at admission, and TISS 28 at admission scores were higher in the group of patients who died, as shown in Table 2.

In the Cox regression analysis for factors independently associated with in-hospital mortality, the variable "postoperative of emergency surgery" and the APACHE II and SOFA admission scores remained in the multiple regression (Table 3). Survival analysis shows the use of mechanical ventilation associated with higher 30-day mortality (Log-rank, p = 0.0029).

The cumulative 30-day survival for the population studied is 48.3%, as shown in Figure 1.

DISCUSSION

This study, which evaluated older adults admitted to an ICU over a period of 1 year, identified higher mortality associated with admissions due to the postoperative period of emergency procedures and higher APACHE II and SOFA scores at admission.

The use of organ dysfunction scores and prognostic indices has been a reality for decades in the ICU. These scores are used as indicators of severity, calculating predicted mortality based on clinical and laboratory variables.[17] The SOFA score is independently associated with mortality in ICU hospitalization studies, since it quantifies the number of patients' organic dysfunctions.[18,19] The APACHE II score evaluates the patient's first 24 hours in the ICU, and also scores age and presence of comorbidities. Correlation between the APACHE II score and frailty in older adults has been shown.[20]

The frequency of intensive care bed occupancy found in the present study is similar to that of large centers in Brazil.

When the fraction of hospitalized patients aged 80 and older is analyzed, the percentage of this study is lower than in other countries, especially in Europe. This finding can be explained by the demographic structure found in these countries, with the most significant population aging.[2,21]

The increase in the number of geriatric patients in intensive care is also a reflection of the number of geriatric patients undergoing surgical procedures. The physiology of aging delays or does not allow compensatory mechanisms

Table 1 Characterization of hospitalizations of geriatric patients admitted to an intensive care unit at a university hospital (n = 289), 2015.

Characteristics	All patients n (%)
Age range (years)	
60 to 64	58 (20.1)
65 to 79	176 (60.9)
Above 80	55 (19.0)
Sex	
Female	116 (40.1)
Male	173 (59.9)
ICU admission diagnosis	
Sepsis	112 (38.8)
High risk postoperative period	35 (12.1)
Postoperative neurosurgical procedure	32 (11.0)
Postoperative gastrointestinal procedure	16 (5.5)
Postoperative peripheral vascular procedure	14 (4.8)
Others	80 (27.8)
Reason for ICU Admission	
Clinical	118 (40.8)
Postoperative elective procedure	95 (32.9)
Postoperative emergency procedure	76 (26.3)
Presence of acute kidney injury at admission	131 (45.3)
Hemodialysis	86 (29.8)
Use of mechanical ventilation	170 (58.8)
Vasoactive drug use	126 (43.6)
Hospital mortality	111 (38.4)

ICU: intensive care unit.

in response to surgical trauma, thus placing the critical geriatric group at risk in the postoperative, especially in emergency procedures.[10] Postoperative admissions for emergency procedures are associated with higher mortality in geriatric patients. The need for interventions such as mechanical ventilation and the presence of AKI

Table 2 Comparison of clinical parameters of geriatric patients admitted to an intensive care unit at a university hospital according to hospital stay outcome, 2015.

	Survival (n = 178)	Death (n = 111)	p
Age in years – median (IQR)	72.0 (65.0–77.0)	72.0 (68.0–78.75)	0.2015*
Male – n (%)	101 (56.7)	72 (64.9)	0.1713†
Elective postoperative – n (%)	83 (46.6)	12 (10.8)	< 0.0001†
Emergency postoperative – n (%)	34 (19.0)	42 (37.8)	0.0004†
Clinical hospitalization – n (%)	61 (34.3)	57 (51.4)	0.0041†
Sepsis diagnosis – n (%)	54 (30.3)	58 (52.3)	0.0002†
AKI at admission – n (%)	57 (32.0)	74 (66.7)	< 0.0001†
Hemodialysis – n (%)	34 (19.1)	52 (46.8)	< 0.0001†
Mechanical ventilation – n (%)	78 (43.8)	92 (82.9)	< 0.0001†
Vasoactive drug – n (%)	45 (25.3)	81 (73.0)	< 0.0001†
APACHE II – median (IQR)	17.0 (14.0–24.0)	29.0 (23.0–36.75)	< 0.0001*
SOFA at Admission – median (IQR)	4.0 (2.0–8.0)	11.0 (8.0–14.0)	< 0.0001*
TISS 28 at admission – median (IQR)	24.0 (18.0–29.0)	30.0 (27.0–33.75)	< 0.0001*

IQR: Interquartile range; AKI: acute kidney injury; APACHE II: Acute Physiology and Chronic Health Evaluation II; SOFA: Sequential Organ Failure Assessment; TISS 28: Simplified Therapeutic Intervention Scoring System; *Mann-Whitney; †χ^2 test.

Table 3 Cox Model for bivariate and multivariate analysis of factors independently associated with in-hospital mortality in geriatric patients admitted to an intensive care unit at a university hospital, 2015.

	Bivariate Analysis			Multivariate Analysis		
	Hazard ratio	95%CI	p	Hazard ratio	95%CI	p
Age ≥ 80 years	1.4192	0.9082–2.2177	0.1242			
Sepsis diagnosis	1.1621	0.7978–1.6928	0.4336			
Emergency surgery PO	2.2421	1.5268–3.2925	< 0.0001	1.9273	1.3072–2.8417	0.0009
Hospitalization for clinical reason	0.9837	0.6752–1.4333	0.9320			
AKI at admission	2.2961	1.5460–3.4101	< 0.0001			
Hemodialysis	1.6123	1.1077–2.3467	0.0126			
Mechanical ventilation	2.0927	1.2683–3.4531	0.0038			
Vasoactive drug	3.5774	2.3527–5.4395	< 0.0001			
APACHE II	1.0760	1.0557–1.0967	< 0.0001	1.0385	1.0106–1.0671	0.0065
SOFA at admission	1.1779	1.1282–1.2298	< 0.0001	1.1026	1.0367–1.1727	0.0019
TISS 28 at admission	1.1045	1.0679–1.1423	< 0.0001			

95%CI: 95% confidence interval; PO: postoperative; AKI: acute renal failure; APACHE II: Acute Physiology and Chronic Health Evaluation II; SOFA: Sequential Organ Failure Assessment; TISS 28: Simplified Therapeutic Intervention Scoring System.

are also described as risk factors for death in this group of patients.[3]

The literature classifies octogenarians as very old intensive care patients, a group with increasing ICU admissions. The decision to hospitalize this group in the ICU has been increasingly discussed due to the increased life expectancy of the population, the benefit of hospitalization for this group of patients, hospital mortality, and post-discharge functional status. Very old patients over 80 years, had a similar prognosis to the other older patients in the present study sample. A possible explanation is that there are variables that determine prognosis more than age itself, such as comorbidities and functional and cognitive capacity.[18,22] This study did not analyze variables such as frailty scores and the pre-ICU status of the geriatric patients studied.

Therefore, age should not be an isolated factor in determining admission to the specialized bed. The most recent recommendations for ICU admission advise that this screening decision be made based on comorbidities, severity, patient choice for advanced support, and functional status.[23] Older adults admitted to the ICU have greater benefit than those not admitted.[24] Reason and severity of hospitalization determine the patient's prognosis, not age alone.[25]

The present study found similar results to those in the literature on the critically ill geriatric patient regarding risk factors for hospital death. The limitations of this work are due to the fact that it was performed in a single center over a 1-year period and by the historical cohort design. Therefore, caution is required for generalizations. For other approaches, it is suggested that further studies be conducted over a longer period to cover more patients and verify the trend in the numbers studied, considering the demographic projection of the geriatric population increase in the coming years. Studies on geriatric patients in ICU are valid for a better organization of hospitals to assist this group of patients.
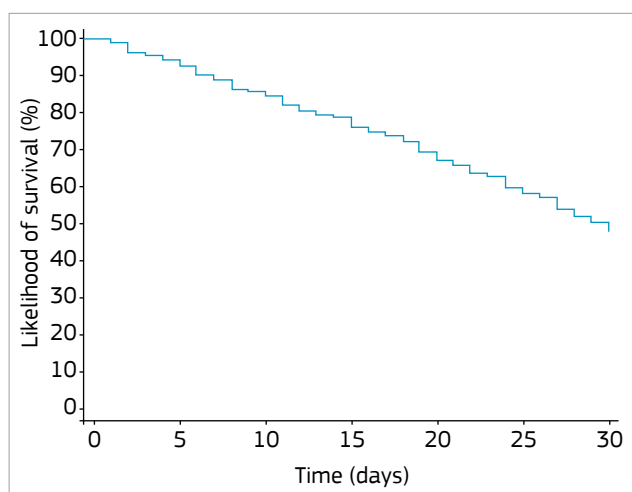

Figure 1 Cumulative 30-day survival probability for geriatric patients in an intensive care unit at a university hospital, 2015.

CONCLUSION

The percentage of geriatric patients represented 45% of ICU admissions during the study period. Sepsis was the most prevalent diagnosis of hospitalization. Risk factors associated with mortality were APACHE II and SOFA scores for admission and postoperative emergency surgery.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

REFERENCES

1. Neumann LTV, Albert SM. Aging in Brazil. Gerontologist. 2018;58(4):611-7. https://doi.org/10.1093/geront/gny019

2. Flaatten H. The impact of age in intensive care. Acta Anaesthesiol Scand. 2014;58(1):3-4. https://doi.org/10.1111/aas.12221

3. Bagshaw SM, Webb SA, Delaney A, George C, Pilcher D, Hart GK, et al. Very old patients admitted to intensive care in Australia and New Zealand: a multi-centre cohort analysis. Crit Care. 2009;13(2):R45. https://dx.doi.org/10.1186%2Fcc7768

4. Zampieri FG, Soares M, Borges LP, Salluh JIF, Ranzani OT. Epimed Monitor ICU Database®: um registro nacional baseado na nuvem, para pacientes adultos internados em unidades de terapia intensiva do Brasil. Rev Bras Ter Intensiva. 2017;29(4):418-26. http://dx.doi.org/10.5935/0103-507x.20170062

5. Marik PE. Management of the critically ill geriatric patient. Crit Care Med. 2006;34(9 Suppl.):S176-82. https://doi.org/10.1097/01.CCM.0000232624.14883.9A

6. Sjoding MW, Prescott HC, Wunsch H, Iwashyna TJ, Cooke CR. Longitudinal Changes in ICU Admissions Among Elderly Patients in the United States. Crit Care Med. 2016;44(7):1353-60. https://doi.org/10.1097/CCM.0000000000001664

7. Martin-Loeches I, Guia MC, Vallecoccia MS, Suarez D, Ibarz M, Irazabal M, et al. Risk factors for mortality in elderly and very elderly critically ill patients with sepsis: a prospective, observational, multicenter cohort study. Ann Intensive Care. 2019;9(1):26. https://doi.org/10.1186/s13613-019-0495-x

8. Vosylius S, Sipylaite J, Ivaskevicius J. Determinants of outcome in elderly patients admitted to the intensive care unit. Age Ageing. 2005;34(2):157-62. https://doi.org/10.1093/ageing/afi037

9. Blot S, Cankurtaran M, Petrovic M, Vandijck D, Lizy C, Decruyenaere J, et al. Epidemiology and outcome of nosocomial bloodstream infection in elderly critically ill patients: a comparison between middle-aged, old, and very old patients. Crit Care Med. 2009;37(5):1634-41. https://doi.org/10.1097/CCM.0b013e31819da98e

10. Menaker J, Scalea TM. Geriatric care in the surgical intensive care unit. Crit Care Med. 2010;38(9 Suppl.):S452-9. https://doi.org/10.1097/CCM.0b013e3181ec5697

11. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med. 1985;13(10):818-29.

12. Vincent JL, Moreno R, Takala J, Willatts S, De Medonça A, Bruing H, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. On behalf of the working Group on Sepsis-Related Problems of European Society of Intensive Care Medicine. Intensive Care Med. 1996;22(7):707-10.

13. Miranda DR, de Rijk A, Schaufeli W. Simplified Therapeutic Intervention Scoring System: the TISS-28 items--results from a multicenter study. Crit Care Med. 1996;24(1):64-73.

14. Agência Nacional de Vigilância Sanitária. Resolução RDC nº 7, de 24 de fevereiro de 2010. Dispõe sobre os requisitos mínimos para funcionamento de Unidades de Terapia Intensiva e dá outras providências. Diário Oficial da União. 2010;Seção 1.

15. Kidney International. KDIGO Clinical Practice Guideline for Acute Kidney Injury. Kidney Int Suppl. 2012;2(1):1-138.

16. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus definitions for sepsis and septic shock (Sepsis-3). JAMA. 2016;315(8):801-10. https://dx.doi.org/10.1001%2Fjama.2016.0287

17. Keegan MT, Soares M. O que todo intensivista deveria saber sobre os sistemas de escore prognóstico e mortalidade ajustada ao risco. Rev Bras Ter Intensiva. 2016;28(3):264-9. https://dx.doi.org/10.5935/0103-507X.20160052

18. Flaatten H, De Lange DW, Morandi A, Andersen FH, Artigas A, Bertolini G, et al. The impact of frailty on ICU and 30-day mortality and the level of care in very elderly patients (≥ 80 years). Intensive Care Med. 2017;43(12):1820-8. https://doi.org/10.1007/s00134-017-4940-8

19. Suarez-de-la-Rica A, Castro-Arias C, Latorre J, Gilsanz F, Maseda E. Pronóstico y predictores de mortalidad de los pacientes ancianos críticos. Rev Esp Anestesiol Reanim. 2018;65(3):143-8. http://dx.doi.org/10.1016/j.redar.2017.11.004

20. Kizilarslanoglu MC, Civelek R, Kilic MK, Sumer F, Varan HD, Kara O, et al. Is frailty a prognostic factor for critically ill elderly patients? Aging Clin Exp Res. 2017;29(2):247-55. https://doi.org/10.1007/s40520-016-0557-y

21. Oliveira VCR, Nogueira LS, Andolhe R, Padilha KG, Sousa RMC. Evolução clínica de adultos, idosos e muito idosos internados em Unidade de Terapia Intensiva. Rev Latino-Am Enfermagem. 2011;19(6). http://dx.doi.org/10.1590/S0104-11692011000600010

22. Flaatten H, De Lange DW, Artigas A, Bin D, Moreno R, Christensen S, et al. The status of intensive care medicine research and a future agenda for very old patients in the ICU. Intensive Care Med. 2017;43(9):1319-28. https://doi.org/10.1007/s00134-017-4718-z

23. Nates JL, Nunnally M, Kleinpell R, Blosser S, Goldner J, Birriel B, et al. ICU Admission, Discharge, and Triage Guidelines: A Framework to Enhance Clinical Operations, Development of Institutional Policies, and Further Research. Crit Care Med. 2016;44(8):1553-602. https://doi.org/10.1097/CCM.0000000000001856

24. Sprung CL, Artigas A, Kesecioglu J, Pezzi A, Wiis J, Pirracchio R, et al. The Eldicus prospective, observational study of triage decision making in European intensive care units. Part II: intensive care benefit for the elderly. Crit Care Med. 2012;40(1):132-8. https://doi.org/10.1097/CCM.0b013e318232d6b0

25. Ryan D, Conlon N, Phelan D, Marsh B. The very elderly in intensive care: admission characteristics and mortality. Crit Care Resusc. 2008;10(2):106-10.