Factors associated with the occurrence of adverse events in critical elderly patients

Fatores relacionados à ocorrência de eventos adversos em pacientes idosos críticos

Factores relacionados con el acaecimiento de eventos adversos en pacientes críticos de edad avanzada

Maria Cecilia Toffoletto[I], Ricardo Luis Barbosa[II], Rafaela Andolhe[III], Elaine Machado de Oliveira[IV], Adriana Janzantte Ducci[V], Katia Grillo Padilha[VI]

[I] *Universidad Andrés Bello, Facultad de Enfermería. Santiago, Chile.*
[II] *Universidade Federal de Uberlândia, Instituto de Geografia. Monte Carmelo, Minas Gerais, Brazil.*
[III] *Universidade Federal de Santa Maria, Department of Nursing. Santa Maria, Rio Grande do Sul, Brazil.*
[IV] *Universidade de São Paulo, School of Nursing. São Paulo, Brazil.*
[V] *Hospital Bandeirantes. São Paulo, Brazil.*
[VI] *Universidade de São Paulo, School of Nursing, Department of Medical-Surgical Nursing. São Paulo, Brazil.*

ABSTRACT

Objective: to identify the factors associated with the occurrence of adverse events in critical elderly patients admitted to intensive care unit according to demographic and clinical characteristics. **Method**: a retrospective cohort study was conducted in nine units of a teaching hospital. Data were collected from medical records and from monitoring of nursing shift change. We used the t-test/Mann-Whitney, chi-square and logistic regression to test associations. Significance level of 5% was used. **Results:** out of the 315 elderly, 94 experienced events. Those who experienced events were men (60.6%) with mean age of 70.7 years, length of hospital stay of 10.6 days and survivors (61.7%). Most of the 183 events were clinical processes and procedures (37.1%). There was an association between adverse event and length of hospital stay in the unit (p = 0.000; OR = 1.10, 95% CI [1.06, 1.14]). **Conclusion:** the identification of associated events and factors in the elderly subsidize the prevention of these occurrences before the vulnerability of this age group.
Descriptors: Aged; Intensive Care Units; Patient Safety; Nursing Care; Workload.

RESUMO

Objetivo: identificar os fatores relacionados à ocorrência de eventos adversos em pacientes idosos críticos internados em Unidade de Terapia Intensiva segundo características demográficas e clínicas. **Método**: estudo de coorte retrospectivo realizado em nove unidades de um hospital universitário. Os dados foram coletados dos prontuários e do acompanhamento de passagens de plantão de enfermagem. Utilizou-se o Teste-t/Mann-Whitney, Qui-quadrado e Regressão Logística para verificar associações. Nível de significância de 5%. **Resultados:** do total de 315 idosos, 94 sofreram eventos. Os que sofreram eventos eram homens (60,6%), com média de idade de 70,7 anos, permanência de 10,6 dias e sobreviventes (61,7%). Dos 183 eventos, houve predomínio do tipo processo clínico e procedimento (37,1%). Houve associação entre evento adverso e tempo de permanência na unidade (p = 0,000; OR = 1,10; IC95% = [1,06;1,14]). **Conclusão:** a identificação dos eventos e fatores associados no idoso subsidiam a prevenção dessas ocorrências perante as vulnerabilidades dessa faixa etária.
Descritores: Idoso; Unidades de Terapia Intensiva; Segurança do Paciente; Cuidados de Enfermagem; Carga de Trabalho.

RESUMEN

Objetivo: identificar los factores relacionados con el acaecimiento de eventos adversos en pacientes críticos de edad avanzada según características demográficas y clínicas, internados en Unidades de Terapia Intensiva. **Método**: estudio de corte retrospectivo realizado en nueve unidades de un hospital universitario. Se recolectaron datos de los prontuarios y del acompañamiento de la guardia de enfermería. Las asociaciones se comprobaron mediante la Prueba de Mann-Whitney, la distribución de Pearson (ji cuadrado) y la Regresión Logística. El nivel de significación fue del 5%. **Resultados:** sufrieron eventos 94 personas mayores del total de 315, siendo del sexo masculino el 60,6%, con edad promedio de 70,7 años, permanencia de 10,6 días y sobrevivencia del 61,7%. De los 183 eventos, predominó el proceso clínico y el procedimiento (37,1%). Se observó que el evento adverso y el tiempo de permanencia en la unidad estaban relacionados (p = 0,000; OR = 1,10; IC95% = [1,06;1,14]). **Conclusión:** la identificación de los eventos y de los factores asociados a la vejez auxilia en la prevención de dichos sucesos frente a la vulnerabilidad de ese grupo de edad.

Descriptores: Anciano; Unidades de Terapia Intensiva; Seguridad del Paciente; Cuidados de Enfermería; Carga de Trabajo.

CORRESPONDING AUTHOR   Maria Cecilia Toffoletto   E-mail: mtoffoletto@unab.cl

INTRODUCTION

Between 2000 and 2050, the proportion of people over 60 years old will double from 11% to 22%[1]. Associated with aging, multi morbidity is characterized by a combination of diseases with a variety of implications, including the poor quality of life, disability, high utilization of health care, hospitalization, high public spending on health and mortality[2].

The high utilization of health care for the elderly in health institutions, specifically in the Intensive Care Unit (ICU) is evidenced by the increasing mean age in these units[3-7], raising concerns of health professionals with real effectiveness of treatment and care for this age group[7].

The literature claims that elderly in the ICU have mean age of 75.8 years. They are coming mostly from emergency services, mainly hospitalized for clinical changes, and high length of stay in the unit, with mean of 13.9 days[8]. Regarding mortality, a study conducted in the Netherlands, in ICUs of 21 universities found an overall mortality of 31.3%, with a mean age of 83.4 years in this cohort[9].

Studies have shown that, in health care, the elderly are the protagonists in the occurrence of adverse events (AEs)[10-13] which, according to the World Health Organization (WHO), are defined as incident or circumstance that causes significant and unnecessary damage to the patient[14]. Among the AE, medication administration errors[10,15-16], falls[11,17] unscheduled removal of therapeutic artifacts[10,15-16] and pressure ulcers[18] have a higher prevalence and are directly related to nursing care.

Regarding mortality and the occurrence of these events, a prospective study conducted in an ICU in France with 18 beds showed that the most serious AE occurred in elderly patients with greater lengths of hospital stay and invasive ventilation time in the ICU. They also noted that the preventable deaths were associated with AE[13].

The literature shows how factors related to the occurrence of adverse events increased nursing workload, hospital costs and length of hospital stay[19-20]. However, evidence specifically related to the elderly and the impact of AE on the clinical status and mortality are still incipient.

Thus, in the context of increasing population and increased use of more complex health resources, such as the ICU, interest in objectively investigate the factors associated with the occurrence of AE is justified not only by the theoretical gap, but provide subsidies for follow-up and monitoring of patients before the characteristics of this age group. Therefore, this research aims to identify the factors related to the occurrence of adverse events in critical elderly ICU patients according to demographic and clinical characteristics.

METHODS

Ethical aspects

The project was approved by the Research Ethics Committee of the Hospital Research Projects Analysis.

Design, study site and period

This is a retrospective cohort study conducted in nine ICUs specialties (Surgical, Medical Clinic, Medical Emergency Clinic, Infectious Disease, Nephrology, Neurology, Pulmonary Medicine, Trauma and Burns), a public hospital of high complexity, located in São Paulo, Brazil, which together account for approximately 75 beds of intensive care in the months of September, October and November 2012.

Population or sample: inclusion and exclusion criteria

In this investigation, the non-probabilistic sample was composed of 315 elderly hospitalized in ICUs, aged over 60 years, of any medical specialty, undergoing medical or surgical treatment, with a minimum length of stay of 24 hours in ICUs.

Study protocol

Data collection was performed through the analysis of medical records of patients and monitoring of a random sample of 10% shift change of the period, randomized by date, shifts and ICU. The hours of morning, afternoon and night corresponded to the standard in the units, that is, 7, 13 and 19 hours, and included a total of 390 shift changes.

The analysis of the medical records was performed by a group of analysts, composed of fifteen nurses, previously trained by the researches, and two specialist nurses in intensive care. To collect the data, each analyst received a set of medical records related to the ICU in PDF format, scanned

by 14 technicians from the Department of Medical Records (DMR) of the institution, duly authorized.

For the storage and organization of data, a specialist in Information Technology (IT) developed and implemented a system with a SQL (Structured Query Language) database hosted in a database server of the School of Nursing at the *Universidade de Sao Paulo*. This system is called Universal, and it has been installed on the personal computer of each of the collectors (analysts) of the study, who were previously trained for their management, which access was performed through their login and individual password. In this database, analysts fulfilled information regarding patient identification, severity parameters, therapeutic interventions and events with/without damage (AE) under the WHO taxonomy[14].

Regarding the shift change, the data were collected by trained tutors, nurses and nursing graduates who accompanied the shift of a pre-determined team, considering the unit and time, these were randomized and nursing professionals reports were recorded by hand. Subsequently, the reports produced were sent by email to the researchers, who performed the data analysis and classification of AE, entering them in the database.

For the analysis of AE we used the International Classification for Patient Safety (ICPS) of the World Health Organization (WHO)[14].

In order to standardize the identification and classification of AE after consensus among researchers and nurses, it has developed a handbook with the description and classification of possible situations considered incidents and AE.

The dependent variable, AE was defined according to WHO[14] as an incident that causes injury or death to a patient. The types of events, according to the same organization, were classified in the following categories: clinical management; clinical process/procedure; documentation; healthcare-associated infection; medication/IV fluids; blood/blood products, nutrition, oxygen/gas/vapour, medical device/equipment, behavior, patient accidents, infrastructure/building/fixtures, and resources/organizational management. It is noteworthy that all AE identified were considered for the analysis in the medical records and recorded in the shift change, duplicates that occurred during the stay of the elderly in ICUs were excluded.

Also according to the WHO[14], the variables type of AE and degree of harm were classified respectively as pathophysiology, injury and other and degree of harm as: mild, moderate and severe. For purposes of this study the AE considered were those with degree of moderate and severe harm.

The independent variables related to the elderly were: gender (male/female), age (in years), length of stay (full days in the ICU), nursing workload obtained through the Nursing Activities Score instrument (NAS score), probability of death obtained by the instrument Simplified Acute Physiology Score II (score SAPS II), comorbidities obtained through the Charlson comorbidity score (score ICC), origin to the ICU of critical areas (operating room, emergency room, another ICU, hemodynamics) and noncritical areas: outpatient, inpatient unit, another hospital and discharge condition (survivor/no survivor).

We should note that the NAS instrument is designed to measure the nursing workload, according to the care needs presented by patients. With a maximum score of 176.8%, calculated by the total score of NAS, resulting from the sum of the items scored, expressed by the percentage of time spent by the nursing staff in assisting the patient in critical condition[21].

Analysis of results and statistics

The data were analyzed by the Statistical Package for Social Sciences (SPSS) version 18.0. The variables were described as absolute and relative frequencies, mean and standard deviation (SD). For the analysis of groups that have experienced or not AE we applied the chi-square test and t-test when the Levene test indicated homogeneity of variance, and the Mann-Whitney test, when the Levene test indicated no homogeneity of variances. Logistic regression with Backward strategy for the selection of variables was used to analyze the association between sociodemographic and clinical variables of the elderly and the moderate and severe AE. The significance level used was 5%.

RESULTS

From the 315 elderly, 221 (70.2%) did not experience any kind of moderate and severeAE, while 94 (29.8%) participants were victims of such occurrences. This group of patients (94), most (57- 60.63%) were male, which was also observed in the group of elderly who have experienced such AE (114-51.6%).

It is observed in Table 1 that mean age of the total sample is 71.30 years and a mean of 70.76 in the group that did not experience moderate and severe AE and 71.53 years in the group that underwent this type of incident. Regarding length of stay in the ICU, the elderly who experienced AE had a mean length of stay of 10.62 days, greater than the mean of 5.06 days of elderly who experienced moderate and severe AE. It was also higher in the elderly who have experienced AE, NAS mean score (74.27%), the likelihood of death (22%) and the Charlson mean score[2,11] compared with those who did not experience AE (71.20%, 18% and 1.76, respectively). Despite these findings, there was no significant difference between the groups for age (p=0.438), NAS (p=0.082), SAPS II (p=0.167) and Charlson (p=0.150), but rather for the variable length of stay in the ICU (p=0.000).

Among the patients who experienced events, 44 (46.8%) proceeded to critical stage and 36 (38.3%) died, different proportions from the group that did not experience AE, with 73 (33.1%) coming from the critical area and 53 (24.0%) without survivors. There was a significant difference between the groups for the variables admission to the ICU (p=0.021) and discharge (p=0.010) (Table 2).

As for AE, the total of 94 elderly experienced 183 moderate and severe AE, with mean of 1.95 AE per patient.

It is observed in Table 3 that moderate and severe AE were related to clinical process/procedures with 37.1% (68), followed by patient accidents (57- 31.1%) and healthcare-associated infection (45-25.5%).

Table 4 shows the total of AE, the types of harm in descending order were: pathophysiological harm (54.7%), injury (39.3%) and other (6.0%).

Regarding the severity of the AE, the majority, 148 (80.9%) were moderate and 35 (19.1%), severe.

Table 1 – Comparison of sociodemographic and clinical variables among the elderly who have experienced/not experienced moderate or severe adverse events in the Intensive Care Unit, Sao Paulo, Brazil, 2012

Variabless	Adverse Event	n	Mean	Standard deviation	*p* value
Age	No	221	71.53	8.20	
	Yes	94	70.76	7.84	0.438*
	Total	315	71.30	8.09	
Length of hospital stay	No	221	5.06	6.48	
	Yes	94	10.62	9.30	0.000†
	Total	315	6.72	7.84	
Nursing Activities Score	No	221	71.20	13.50	
	Yes	94	74.27	15.95	0.082*
	Total	315	72.12	14.32	
Simplified Acute Physiology Score-II	No	221	0.17	0.20	
	Yes	94	0.22	0.24	0.167†
	Total	315	0.18	0.21	
Charlson	No	221	1.76	1.85	
	Yes	94	2.11	2.24	0.150†
	Total	315	1.86	1.98	

*Note: *t test; †Mann-Whitney*

Table 2 – Chi-square test for the variables admission and discharge status among the elderly who have experienced/not experienced moderate or severe adverse events in the Intensive Care Unit, São Paulo, Brazil, 2012

		Adverse Event				
Variables		No		Yes		
		n	%	n	%	*p*
Admission	Notcritical	148	66.9	50	53.2	
	Criticalstage	73	33.1	44	46.8	0.021
	Total	221	100	94	100	
Discharge	Survival	168	76.0	58	61.7	
	No survivor	53	24.0	36	38.3	0.010
	Total	221	100	94	100	

Table 3 – Distribution of types of moderate and severe adverse events experienced by elderly in the Intensive Care Unit, São Paulo, Brazil, 2012

Types of moderate and severe adverse events	n	%
Clinical process/procedure	68	37.1
Patient accidents	57	31.1
Healthcare-associated infection	45	24.5
Clinicaladministration	6	3.2
Medication/IV or fluids for administration	4	2.5
Medical device/equipment	2	1.1
Resources/organizational management	1	0.5
Total	183	100

Table 4 – Distribution of type of harm and moderate and severe adverse events experienced by elderly patients in the Intensive Care Unit, São Paulo, Brazil, 2012

Typeofharm	n	%
Physiopatology	100	54.7
Injury	72	39.3
Other	11	6.0
Total	183	100

Table 5 – Logistic regression of gender, age, discharge and length of stay factors in the Intensive Care Unit and adverse events, São Paulo, Brazil, 2012

Variable	Beta	Odds Ratio	95% CI		p value
Lengthofhospital stay	0.10	1.10	1.06	1.14	0.000
Constant	-1.94	0.14			

As data from Table 5, in the logistic regression model, the length of hospital stay in the ICU was the only variable that was associated with the occurrence of moderate and severe AE. Each extra day of ICU stay increased by 10.0% (p=0.000; OR=1.10, 95% CI [1.06, 1.14]) the chance of an elderly patient to experience moderate and severe AE during hospitalization in the unit (Table 5).

DISCUSSION

The results of this study with respect to demographic and clinical variables of ICU elderly corroborate evidence from other investigations related to this type of participants[3,6,8-9,12,22-24].

Most were males (60.6%), slightly above the results of studies that found more homogeneous distribution between genders, with prevalence of 56.3%[10] and 54.10%[22]. Regarding age, similar results are found in the literature, with means ranging from 72.2 to 83.4 years[6,8-9,23]. The dilemma of the elderly age in the ICU and therefore decisions on the cost-effectiveness of the treatment have been a subject of controversy in the literature. One study reported that age explains only a small part of the increase in mortality, which suggests that the functionality, pathological and cognitive conditions associated should be considered for prediction[24].

Concerning the length of hospital stay, there was a total mean of 6.72 days of stay in the ICU, while the elderly who experienced AE showed a higher length of stay of 10.62 days compared with the mean 5.06 days of elderly who did not experience AE. This result draws attention, since study of elderly patients who experienced AE found that these remained less time hospitalized (8.9 days)[16].

Regarding the nursing workload, there was a mean NAS score higher in the elderly who have experienced AE compared to those who did not experience them, although they did not present significant differences. Studies on AE and nursing workload caring adult patients corroborate the results of this study. Research that analyzed AE and workload found a mean NAS score of 70.03%[5]. On the other hand, research that analyzed the workload in patients who did not undergo AE and incidents found a lower score of 66.5%[22].

Groups of elderly who have experienced and have not experienced AE showed very similar results regarding critical and non-critical areas. In this sense, a Brazilian study developed in general ICUs showed that most patients admitted at the ICU come from critical units such as Emergency and Surgical Center[3], which indicates the importance of new studies that analyze this variable in depth to assess its association with moderate and severe AE.

Mortality of elderly in the ICU is addressed in several studies[3,6-7,9]. In this study, 38.3% of the elderly who experienced moderate and severe AE died. Contrasting, one study conducted in the Netherlands with elderly from 21 universities ICU found lower overall mortality of 31.3%[9].

Although in this study the mortality did not present association with AE, it is observed that the elderly who have experienced AE had higher mean length of stay in the ICU, greater likelihood of death, greater severity, higher NAS' means core and higher Charlson's means core compared to elderly who did not experience AE, which could justify the high mortality in this group.

The types of AE most prevalent were related to clinical processes and procedures, accidents with patients and infections. Although the details of moderate and severe AE related to clinical processes and procedures in this study have not been explored, problems were identified related to intubation (unscheduled withdrawn of endotracheal tube), the lack of performance of tests performed (blood glucose, blood tests) and care with catheters and drains (unscheduled withdrawals, poorly positioned drains).

A Mexican study that analyzed hospital AE in adults by age and gender corroborates the results of this investigation, as it was observed a higher proportion of moderate and severe events related to clinical processes and procedures related to the elderly and characterized by therapeutic interventions[12].

Regarding patients accidents, pressure ulcers were the most frequent among hospitalized elderly. A study analyzing the risk factors for pressure ulcer development in adult patients found a higher mean age among patients who developed ulcers compared to those without such lesions, demonstrating the possibility of having them with increasing age[18].

AE related to drug administration showed a low prevalence in this study; however, it is noteworthy that we considered only moderate and severe events which affected the elderly. A study shows that the total number of incidents (with and without harm), medication administration errors are the most frequent ones; however, it is not always they cause harm to patients[19].

From the types of damage found, the pathophysiological type was present in 54.7% of the elderly. The pathophysiological harm is a major cause of clinical instability and are mainly related to the increased length of stay and risk of infection[14].

In this study, the degree of harm, understood as the severity, duration and therapeutic implications derived from an event that was predominantly moderate. Before the presentation of symptoms and consequent need for interventions, the risk of longer hospital stays and other complications can result in permanent or long-term harm for the elderly[14].

As to the factors of the elderly associated with moderate and severe AE in the ICU, the regression analysis showed that only the length of stay in ICU (10.41 days) was associated with the events, explaining that each day of stay increased the chances of patients to experience AE at almost 11.0%.

It is observed in the literature that increasing length of hospital stay before the occurrence of adverse events is a known variable[13,16,22]. A French prospective study in an ICU with 18 beds showed that the most serious AE occurred in elderly patients with greater stay and duration of invasive ventilation

in the ICU[13]. Another study that identified AE in medical records in hospitalized elderly from two wards found a significant difference in length of hospital stay between cases where there was event registries[16].

Although mortality and nursing workload have not shown association with AE in this study, despite the methodological differences and different ways of grouping these, the literature shows mixed results. A US study examined the association between mortality and AE in 300 critical adult patients, they found that 6.1% of deaths and 36% of the events were preventable and that the deaths were associated with AE[13]. Regarding nursing workload, a study conducted in two Brazilian ICUs found that the mean of AE occurrences in the appropriate allocations of nurses was lower compared to inadequate with a statistically significant difference of 0.000[25].

However, more robust evidence about the AE with the elderly and the impact of these events on clinical outcomes and nursing care are still incipient.

In short, the length of hospital stay in the ICU was the only factor associated with the occurrence of adverse events in this sample, reiterating the evidence already documented, showing the need for careful evaluation of the elderly patient with a view to discharge. As shown in this study, reducing the ICU length of stay is an important measure for prevention of moderate and severe AE, besides reducing the cost.

Thus, in the context of an aging population, objectively evaluation of the behavior of these events was justified not only by the theoretical gap, but to provide support in tracking and monitoring characteristics of this age group.

A limitation of this study was performing the study in a single institution, the WHO classification complicated the comparison and exploitation of AE studies that had used the same classification. Regardless, a more detailed exploratory analysis about each type of moderate and severe AE found in critical care elderly is recommended for further studies. Also, the incipient evidence about AE in this population and the impact of AE on the clinical progression and mortality in this group of patients were other limitations for the comparison of the results with the literature.

CONCLUSION

The development of this study allowed us to conclude that ICU length of stay was the only variable that was associated with the occurrence of moderate and severe AE with elderly patients admitted to the ICU. Each day of stay increased the chance of a patient experiencing AE in 10.0%.

Contrary to what the evidence shows, the variables age, workload and mortality were not significantly associated with the AE.

Regardless, a more detailed exploratory analysis about each type of moderate and severe AE found in critical care elderly is recommended for further studies.

Furthermore, at the conclusion of this study, it is recommended that the elderly is carefully assessed on the adequate time to discharge from the ICU, so they stay the minimum time required in the unit to prevent not only the occurrence of AE, but reduced costs and impact on family members.

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