ORIGINAL ARTICLE

Patient´s organ dysfunction in the intensive care unit according to the Logistic Organ Dysfunction System

DISFUNÇÕES ORGÂNICAS DE PACIENTES INTERNADOS EM UNIDADES DE TERAPIA INTENSIVA SEGUNDO O *LOGISTIC ORGAN DYSFUNCTION SYSTEM*

DISFUNCIONES ORGÁNICAS DE PACIENTES INTERNADOS EN UNIDADES DE CUIDADOS INTENSIVOS SEGÚN EL LOGISTIC ORGAN DYSFUNCTION SYSTEM

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ABSTRACT

The aim of this study was to analyze the association between the probability of death, number and type of organ dysfunction at the admission in the Intensive Care Unit (ICU) according to the Logistic Organ Dysfunction System (LODS) and the variables: length of stay (LOS), discharge and readmission in the Unit. This prospective longitudinal study included 600 adult patients from general ICU of four hospitals in São Paulo City. The results showed association between probability of death and discharge of the Unit. (p<0.001). It was also observed association between the number of organ dysfunction and the variables discharge (p<0.001) and LOS in the Unit (p<0.001). Besides, there was association between the type of organ dysfunction and LOS only in the group of patients with neurological (p<0.001), pulmonary (p<0.001) and renal (p<0.001) dysfunctions. No association was observed between readmission in the ICU and the variables analyzed.

KEY WORDS

Intensive care units.
Severity of Illness Index.
Patient discharge.

RESUMO

Foi objetivo do estudo verificar as associações entre a probabilidade de morte, número e tipo de insuficiências orgânicas na admissão de pacientes na Unidade de Terapia Intensiva (UTI), segundo o Logistic Organ Dysfunction System (LODS), e as seguintes variáveis: tempo de internação, condição de saída e readmissão na unidade. Estudo prospectivo longitudinal de 600 pacientes adultos internados em UTI gerais de quatro hospitais do Município de São Paulo. Como resultados, a probabilidade de morte apresentou associação com as condições de saída da UTI (p<0,001). Também houve associação do número de insuficiências orgânicas com as condição de saída (p<0,001) e tempo de internação na UTI (p<0,001). Quanto ao tipo de insuficiências e tempo de internação na Unidade houve diferença apenas entre os pacientes com insuficiência neurológica (p<0,001), pulmonar (p<0,001) e renal (p=0,020). A readmissão dos pacientes na UTI não teve associação com nenhuma das variáveis estudadas.

DESCRITORES

Unidades de terapia intensiva.
Índice de gravidade da doença.
Alta do paciente.

RESUMEN

Fue objetivo del estudio verificar las asociaciones entre la probabilidad de muerte, número y tipo de insuficiencias orgánicas en la admisión en Unidad de Terapia Intensiva (UTI) según el Logistic Organ Dysfunction System (LODS) y las variables: periodo de internación, condiciones de salida y readmisión en la unidad. Estudio prospectivo y longitudinal de 600 pacientes de cuatro hospitales de la provincia de São Paulo. Como resultados, hubo asociación entre la probabilidad de muerte y condiciones de salida de la Unidad (p<0,001). También si observó asociación entre el número de insuficiencias orgánicas con las condiciones de salida (p<0,001) y periodo de internación en la UTI (p<0,001). Además hubo asociación entre lo tipo de insuficiencia y periodo de internación, apenas entre los pacientes con insuficiencia neurológica (p<0,001), pulmonar (p<0,001) y renal (p=0,020). La readmisión en la UTI no tuvo asociación con ninguna de las variables estudiadas.

DESCRIPTORES

Unidades de Terapia Intensiva.
Índice de severidad de la enfermedad.
Alta del paciente.

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INTRODUCTION

Since the 1980s, several prognostic indexes were developed to measure the severity of the critically ill patient admitted in Intensive Care Units (ICU), with the purpose of evaluating the performance of the Units and the therapeutic strategies used[1].

With the indexes of severity of illness, it is possible to perform several types of analysis: rating patients according to the gravity of their disease and prognosis; monitoring the patients' evolution and response to the assigned therapy; comparing the evolution of similar patients submitted to different types of treatment; evaluating the ICU performance; comparing observed and expected death rates; evaluating (indirectly) the cost/benefit of certain procedures for patients in different stages of a given disease[1].

Among the indicators of severity of illness for ICU patients, the Logistic Organ Dysfunction System (LODS) was developed to quantify organic dysfunctions among intensive care patients, based on objective criteria supported by physiological variables[2].

LODS uses 12 physiological variables and identifies from one to three levels of dysfunction for six organic systems: neurological, cardiovascular, renal, pulmonary, hematologic and hepatic. The total LODS score varies from zero to 22 points: zero indicates no dysfunction and 22 the highest degree of gravity. The LODS algorithm considers both the relative severity among the organic systems and the level of damage in each organic system. By using a fixed table, the LODS value is converted into a probability of death at the hospital[2].

Even though it is useful as a parameter of severity of illness for ICU patients, the LODS has not been widely mentioned in international or in Brazilian literature.

Even though it is useful as a parameter of severity of illness for ICU patients, the LODS has not been widely mentioned in international or in Brazilian literature. Consequently, in our midst, there is little systematic information about the characteristics of the ICU patients according to the application of this rating. In addition, LODS was developed to offer an effective assessment of the patient's severity in the first day of ICU admission, and can be used to objectively determine the risk of death and specific functional organic alterations. Consequently, this index can be considered a method of interest to evaluate organic failures in patients in the first day of ICU admission and predict results or outcomes of intensive treatments.

As such, and considering that indexes of severity of illness provide important information for the assessment of the unit and the healthcare provided, especially when combined with other instruments of measurement, the present study was proposed with the following objectives: describing the probability of death, the number and type of organic insufficiencies present in ICU patients, according to the LODS; verifying possible associations between the probability of death, the number and type of organic insufficiencies present in ICU admissions and the following variables: length of stay (LOS), discharge and readmission in the unit.

METHOD

This quantitative, prospective, cross-section study was developed in four general ICUs for adult patients in two public and two private hospitals in the city of São Paulo. The hospitals were selected according to the following criteria: being physically located in the city of São Paulo; average, large or extra-large capacity; presence of a general ICU and intermediate unit, in addition to inpatient units. The exclusion criteria for hospital selection were: exclusively pediatric clientele; number of ICU beds lower than 6% of the total number of hospital beds; fewer than five beds in intermediate units[3].

The sample comprises 600 patients aged 18 years or older, admitted in the selection ICUs, from August 2006 to January 2007, who remained in this unit for 24 hours or longer. After being approved by the respective Hospitals Ethical Committees (SMS52/2006; HU650/06; HSL2006/03 and AE06/510) and first contact with the nurses in charge of the ICU, the data collection was started. New patients were sought and those who had already been inserted in the study were monitored on a daily basis. The patients were monitored until discharged from the ICU, in order to obtain data from the first and last 24 hours of their stay in the unit.

The *Logistic Organ Dysfunction System* (LODS) was used to measure the patients' severity of illness and to calculate the probability of death in the first 24 hours of ICU admission, with the data being extracted from the patients' medical records.

The programs Stata for Windows 8.0 and SPSS 13.0 for Windows were used for statistical analysis. In addition to the descriptive statistics for the characterization of the patient sample, Pearson's correlation coefficient was calculated when the dependent variable was the LOS compared to the probability of death and the number of organic insufficiencies.

Mann-Whitney's test was used for the analysis of the probability of death and the number of organic insufficiencies with the variables condition at discharge and ICU readmission, as well as the analysis of the association between the type of organic insufficiencies and LOS at the Unit. Pearson's chi-square test was applied for the study of the type of insufficiencies with the conditions at discharge and ICU readmission. A level of significance $p < 0.05$ was used for all the analyses.

RESULTS

Among the demographic characteristics of the patients, most of the sample consisted of seniors (53.34%). Average and median ages were 60.68 and 61.50 years, respectively. Male patients were predominant, representing 56.70% of the total ICU patients.

Regarding origin, most came from emergency services or outpatient clinics (36.34%), with a slightly lower percentage coming from the operating room (35.50%). In the analysis of the comorbidities according to the ICD-10 categories, the most frequent background characteristics were related to cardiovascular diseases (58.00%). The average LOS in the ICU was 8.9% (±10.90 days), median length 4, and the death rate was 20.00%. Among the survivors (n=480), 64.60% were discharged to intermediate units and 32.90% were transferred directly to the inpatient unit. An observed 20.00% of the patients died during their ICU stay. Of the survivors (n=480), the percentage of ICU readmissions during the same length of stay at the hospital was 9.10%.

The analysis of the descriptive measurements of risk of death at the ICU showed that the probability of death according to the LODS was 21.43 (± 18.66), and median value was 15%. The average score observed was 4 points (±3).

The number and type of organic insufficiencies presented by the patients admitted in the general ICUs showed the predominance of patients with 2 and 1 organic insufficiencies (respectively, 38.30% and 33.80%), median of 3 insufficiencies, with renal (68.60%) and pulmonary (50%) alterations being the most frequent types.

According to the data in Table 1, it can be observed that there was a statistically significant association between the probability of death according to the LODS and the group of survivors and non-survivors (p<0.001), which did not occur with the readmission in the unit (p = 0.145).

Table 1 - Association of the probability of death (RM LODS) with the conditions of discharge and readmission at the ICU - São Paulo - 2006/2007

		LODS admission			
		N	Average (standard deviation)	Median	P value¥
Condition of discharge	Alive	480	18.93 (16.82)	15.00	<0.001
	Dead	120	31.38 (22.13)	28.90	
Readmission	No	550	22.22 (18.62)	15.00	0.145
	Yes	41	25.80 (19.03)	28.90	

¥ Mann-Whitney's test for comparing independent groups.

The analysis of association between RM LODS and the LOS (length of stay) showed a weak correlation (r = 0.017), but statistically significant (p=0.001) among the variables.

According to Table 2, there was a significant association between the number of organic insufficiencies with the conditions of discharge of the patients (p<0.001). On the other hand, there was no significant difference between the number of organic insufficiencies of readmitted and non-readmitted patients at the ICU (p = 0.867).

Table 2 - Association of the number of organic insufficiencies with the conditions of discharge and readmission at the ICU - São Paulo - 2006/2007

		Nº of organic insufficiencies (N = 586)*		
		N	Median	P value¥
Conditions of discharge	Alive	468	2	<0.001
	Dead	118	2	
Readmission	No	550	2	0.867
	Yes	36	2	

*14 cases with no information.
¥ Mann-Whitney's test for comparing independent groups.

Table 3 - Association of the type of organic insufficiency with the conditions of discharge and readmission at the ICU - 2006/2007

Type of organic insufficiency		Conditions of discharge			Readmission		
		Alive	Dead		No	Yes	
		N (%)	N (%)	P value	N (%)	N (%)	P value*
Cardiologic LODS	No	365 (78.0)	76 (64.4)	0.002	414 (75.3)	27 (75.0)	0.971
	Yes	103 (22.0)	42 (35.6)		136 (24.7)	9 (25.0)	
Hematologic LODS	No	432 (92.3)	100 (84.7)	0.011	502 (91.3)	30 (83.3)	0.111
	Yes	36 (7.7)	18 (15.3)		48 (8.7)	6 (16.7)	
Hepatic LODS	No	465 (99.4)	115 (97.5)	0.067	544 (98.9)	36 (100.0)	0.529
	Yes	3 (0.6)	3 (2.5)		6 (1.1)	0 (0.0)	
Neurologic LODS	No	391 (83.5)	90 (76.3)	0.066	448 (81.5)	33 (91.7)	0.122
	Yes	77 (16.5)	28 (23.7)		102 (18.5)	3 (8.3)	
Pulmonary LODS	No	250 (53.4)	43 (36.4)	0.001	276 (50.2)	17 (47.2)	0.731
	Yes	218 (46.6)	75 (63.6)		274 (49.8)	19 (52.8)	
Renal LODS	No	164 (35.0)	20 (16.9)	<0.001	173 (31.5)	11 (30.6)	0.910
	Yes	304 (65.0)	98 (83.1)		377 (68.5)	25 (69.4)	

* Pearson's chi-square test

Regarding the LOS and the number of organic insufficiencies, a weak correlation was detected (r=0.221), although it had a statistically significant association (p<0.001).

The data in table 3 show a statistically significant association between the conditions of discharge of patients with cardiologic (p=0.002), hematologic (p=0.011), pulmonary (p=0.001) and renal (p<0.001) insufficiencies. However, no statistically significant differences were found among the different types of organic insufficiencies and readmission of patients at the ICU.

On the other hand, the analysis of the association between the type of organic insufficiency and the LOS at the Unit showed a statistically significant difference between patients with neurological (p<0.001), pulmonary (p<0.001) and renal (p<0.001) insufficiencies.

DISCUSSION

The characteristics of the sample were similar to other investigations regarding the following variables: age[4-6], gender[4-9], origin[7-9], comorbidities[7-9] and patient severity[6,8] at ICU admission.

The LOS at the Unit averaged at 9 days; however, patients admitted in the Unit for shorter periods were predominant. Such results are similar to other Brazilian studies[7-11]. As such, the presence of intermediate units in all study fields may have contributed to reduce the length of stay at the ICU. The LOS may be reduced when intermediate care areas are available.

Of the 600 patients evaluated, 20.00% died during their ICU stay, a death rate that differs from Brazilian and foreign studies alike[6,12-13]. Different death rates can be attributed to the characteristics of the ICU and the clientele itself. A comparative analysis between general and specialized ICU of a large hospital in the city of São Paulo reiterates this idea, as higher death rates occurred in the general ICU, 17.0%, when compared to specialized units, 3% and 6%[6].

In the study sample, 9% of the patients were observed to have been readmitted in the ICU before being discharged from the hospital, a lower percentage than the results observed in a private institution in the city of São Paulo (10.7%)[10].

At ICU admission, the average risk of death according to the LODS was 21.45% (±18.66), a higher value to the results of a multi-centric international investigation[14]. However, the results of studies held in French ICUs in six hospitals[12] and in 4 ICUs of a Brazilian general hospital[6] are similar to those found in the present study. There are also articles[15-16] reporting average LODS score is between 4.9 and 8 points, a higher LODS risk than the one found in the present investigation. The differences may have occurred because the model was applied in populations with different characteristics that presented higher levels of severity of illness.

Since LODS is an index that allows for comparing observed and expected death rates at the ICU, the average risk of death of 20.00% was slightly lower than expected, i.e., 21.43%, which reflects the quality of healthcare in the ICUs studied.

By analyzing the probability of death and the variables LOS, condition at ICU discharge and readmission, only the first two were observed to have statistical significance, but with a very low correlation with the length of stay at the unit (r=0.017). Therefore, the association found between the risk of death and the condition at ICU discharge was expected and reaffirms that LODS is a good index to predict death and survival outcomes at the ICU.

Similar results were obtained when the number of organic insufficiencies was analyzed, as it presented a significant statistical association with the variables condition at ICU discharge and LOS, despite the weak correlation with the latter (r=0.221). Considering that the median of the number of organic insufficiencies in this study was 3, such findings are compatible with the high death rates observed and the LODS assumption that the number of organic insufficiencies presented by the patients is associated to the death and survival outcomes at the ICU.

The analysis of the association between the type of insufficiency and the other variables of interest in this study show that, of the seven types of insufficiency contained in the LODS, only 3 (i.e., neurological, pulmonary and renal alterations) presented a statistically significant association with the LOS at the ICU. These data are compatible with those observed in the clinic, since patients with these types of insufficiency, especially neurological and pulmonary, demand exclusive ICU care due to their complexity, with the consequent lengthening of their stay at the ICU.

On the other hand, the association between the type of insufficiency and the conditions at discharge showed that insufficiencies in the cardiologic, hematologic, pulmonary and renal systems were the ones that led to a higher probability of death for ICU patients. These findings may be justified by the characteristics of the sample, as it was made up mostly by elderly patients, with an average of 3 organic insufficiencies in addition to their previous comorbidities related to cardiovascular and endocrinal diseases and neoplasias, already present at ICU admission. As such, it is possible to assume that pulmonary and renal alterations are complications of the aforementioned pathological processes.

It was interesting to observe that, contrary to what was expected, no variable was associated with the ICU readmission, which points to the necessity of new studies to investigate this aspect of intensive care.

CONCLUSION

The results of the present study yielded the following conclusions:

• The patients' probability of death averaged at 21.43% (±18.66), and patients with two organic insufficiencies

were predominant (38.30%), with renal and pulmonary diseases being the most frequent.

• There was an association of the probability of death according to the LODS with the condition at ICU discharge (p<0.001) and the LOS at the Unit (p=0.001). Also, the number of organic insufficiencies was associated with those variables (p<0.001).

• Regarding the type of insufficiencies and the LOS at the ICU, differences were found only between the group of patients with neurological (p<0.001), pulmonary (p<0.001) and renal (p=0.020) insufficiency. Renal (p<0.001), pulmonary (p=0,001), hematologic (p=0.011) and cardiologic (p=0.0020) insufficiencies were the only ones to present statistically significant association with the condition at ICU discharge.

• ICU readmission was associated with no other studied variable.

It is believed that the present study will be relevant to increase knowledge about the possibility of identifying, by means of the LODS, the patients' level of organic dysfunction instead of simply seeking to predict survival or death. As such, quantitative descriptions of the level of organic failures of patients with serious diseases allow for the evaluation of therapeutic strategies and aiding in the organization of healthcare services.

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