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ORIGINAL

Limitation of life-sustaining treatment in severe trauma in the elderly after admission to an intensive care unit☆

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KEYWORDS
Polytrauma;
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Abstract
Objective: To analyze the factors associated to limitation of life-sustaining treatment (LLST) measures in elderly patients admitted to an intensive care unit (ICU) due to trauma.
Design: A retrospective, descriptive, observational study was carried out.
Setting: ICU.
Patients: A total of 149 patients aged 65 years or older admitted to the ICU due to trauma. Hospital mortality, the decision to limit life-sustaining treatment and the factors associated to these measures were analyzed.
Interventions: None.
Results: The mean patient age was 76.3 ± 6.36 years. The average APACHE II and ISS scores were 15.9 ± 7.4 and 19.6 ± 11.4 points, respectively. LLST was used in 37 patients (24.8%). Factors associated to the use of these measures were patient age (OR 1.16; 95% CI 1.08–1.25), APACHE II score (OR 1.11; 95% CI 1.05–1.67), ISS score (OR 1.03; 95% CI 1.01–1.06), admission due to neurological impairment (OR 19.17; 95% CI 2.33–157.83) and traumatic brain injury (OR 2.89; 95% CI 1.05–7.96).
Conclusions: LLST is frequently established in elderly patients admitted to the ICU due to trauma, and is associated to hospital mortality. Factors associated with the use of these measures are patient age, higher APACHE II and ISS scores, admission due to neurological impairment, and the presence of head injuries.

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PALABRAS CLAVE
Politraumatismo;
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Ancianos;
Limitación de tratamiento de soporte vital

Limitación del tratamiento de soporte vital en el traumatismo grave en edades avanzadas tras el ingreso en una unidad de cuidados intensivos

Resumen
Objetivo: Analizar los factores asociados al proceso de limitación del tratamiento de soporte vital (LTSV) en los pacientes de edad avanzada que ingresan en una unidad de cuidados intensivos (UCI) tras un traumatismo.
Diseño: Estudio observacional, descriptivo, retrospectivo.
Ámbito: UCI.
Pacientes: Ciento cuarenta y nueve pacientes con una edad igual o mayor de 65 años ingresados en UCI tras un traumatismo. Se analizó la mortalidad intrahospitalaria, la decisión de LTSV y los factores asociados a dicho proceso.
Intervenciones: Ninguna.
Resultados: La edad media fue de 76,3 ± 6,36 años. La puntuación media en la escala APACHE II fue de 15,9 ± 7,4 puntos, y en la escala ISS, de 19,6 ± 11,4 puntos. Se decidió LTSV en 37 pacientes (24,8%). Los factores asociados a este proceso fueron la edad (OR 1,16; IC 95% 1,08-1,25), la puntuación en el APACHE II (OR 1,11; IC 95%1,05-1,67), la puntuación en el ISS (OR 1,03; IC 95% 1,01-1,06), el ingreso como consecuencia de un deterioro neurológico (OR 19,17; IC 95% 2,33-157,83) y el traumatismo craneoencefálico (OR 2,89; IC 95% 1,05-7,96).
Conclusiones: La LTSV se establece con frecuencia en los pacientes de edad avanzada que ingresan en la UCI tras un traumatismo, y se asocia con la mortalidad intrahospitalaria. Los factores asociados al proceso de LTSV son una mayor edad, una mayor puntuación en las escalas APACHE II e ISS, el ingreso como consecuencia de un deterioro neurológico y la presencia de traumatismo craneoencefálico.

Introduction

Socio-sanitary advances have been associated with increased numbers of elderly populations with high functional independence, and physical activity.[1,2] In a parallel way, during the last year we have been able to see an increased number of traumas in this population.[2–4] Compared to younger populations, in the elderly, traumas are associated with more serious clinical conditions, higher mortality rates, and worse prognosis when it comes to morbidity and further disability.[2,5,6] However, the intensive management of these patients may improve prognosis.[7,8]

On the other hand, the decision-making process on the limitation of life-sustaining treatment (LLST) should be aimed at avoiding situations of suffering in cases where treatment is considered potentially inadequate.[9–13]

The elderly have a series of characteristics that distinguish them from younger populations such as physiological changes associated to aging, higher comorbidities, the use of chronic medications, reduced functional reserves, and lower responses to stressful situations – all factors associated with higher mortality rates.[4,14,15] These same characteristics make it necessary to perform detailed assessments of the use of intensive therapies in an attempt to avoid therapeutic cruelty in these patients, since the LLST needs to take into consideration the patient's capacity of recovery with a quality of life adjusted to the expectations of every individiual.[11,16] However, few studies have been focused on the study of LLST in elderly patients who suffer from severe trauma.[17]

This is why the decision-making process in the setting of intensive medicine and critically-ill patients is hard for reasons of urgency, contextuality, and uncertainty surrounding the prognosis on admission.[10,11] For this reason, it is possible that many decisions that have to do with the use of a series of intensive measures are delayed until achieving one diagnostic process that allows us to make the appropriate decisions.[11,18]

One of these scenarios is the management of critically-ill elderly patients who have suffered from a severe trauma. However, to date, no study has ever described in a specific way the situations associated with LLST once this type of patients are admitted to intensive care units (ICUs). For this reason we think it is necessary to review the factors that may have some correlation with the use of these measures and the description of the type of limitations being established. The goal of this study is to determine the factors associated with the LLST process in elderly patients admitted to ICUs after suffering from traumas.

Patients and method

Restrospective, descriptive, observational study conducted in a tertiary-hospital ICU. All patients ≥65 years old who needed admission to the ICU as a consequence of a trauma were included from September 2011 until August 2016.

Table 1 Modified Rankin scale.

Score	Classification	Description
0	Healthy	Asymptomatic
1	Patient without limitations	Performs usual labor and social activities
2	Mild limitations	Unable to perform some activities and take care of one's own needs without help
3	Moderate limitations	Significant limitation of lifestyle or issues moving freely. Walks with the assistance of someone else
4	Serious limitations	Incapacity to walk and take care of one's own needs. Walks with the assistance of someone else and needs help to perform basic daily activities
5	Incapacitated	Patient stays in bed most of the time. Incontinent. Needs constant care
6	Exitus	

The data were obtained after reviewing the clinical histories. Then the data were recorded in a database for further statistical processing. This study has been approved by the corresponding clinical research ethics committee. Given the retrospective nature of the study and the absence of intervention no prior informed consent was considered necessary.

The patients' functional status prior to the trauma based on the score obtained at the modified Rankin scale at ICU admission was recorded (Table 1) and later categorized based on the degree of dependence.[19]

Age was presented in full years, and sex was presented as a dichotomic variable (male or female). The clinical severity was assessed using the score obtained in the Acute Physiology and Chronic Health Evaluation (APACHE) II scale,[20] and the severity of trauma was assessed using the Injury Severity Score (ISS).[21] These were the variables included: the regions affected by the trauma (cranioencephalic, facial, thoracic, abdominal, pelvic, vertebral, and skeletal), the main reason for ICU admission (clinical monitoring, hemodynamical instability, respiratory failure, and neurological disorder), and the mechanism of the lesion causing the trauma (falls from height, falls, run over accidents, traffic accidents as an occupant of the vehicle, aggressions, or unknown).

The type of LLST used was individualized using Gómez-Rubí's classification appearing in his book *Ética en Medicina Crítica*, based on the higher degree of LLST used during ICU admission, and regardless of the degree of LLST used previously (Table 2).[22] Mortality was considered as patients' deaths during hospital stay due to the same episode.

Table 2 Modified Gómez-Rubí's classification for LLST.

Degree of LLST	Description
1	Total life support except for CPR
2	Invasive measures based on progression
3	No invasive measures are administered
4	Initial measures are kept and no new measures administered
5	Withdrawal of life support

LLST: limitation of life-sustaining treatment; CPR: cardiopulmonary resuscitation.

Statistical analysis

First, a descriptive analysis of the sample was conducted. Results were presented in the form of absolute frequency and percentage for the categorical variables, and in the form of mean and standard deviation for the continuous quantitative variables. In cases of continuous quantitative variables, the Shapiro–Wilk test was used in order to verify the normalcy of such variables.

The comparative analysis was conducted using Pearson's chi-squared test or Fisher's exact test based on the expected values for the proportions comparison of the categorical variables. The comparison of quantitative variables and categorical variables was conducted using the Student's *t* test, with or without Welch's correction.

Finally, the correlation between the LLST process and the different variables was analyzed through logistics regression using one multivariate model aimed at correcting all the possible confounding factors based on the information available in the existing medical literature. These variables were determined a priori by selecting the age, sex, and severity of the patients based on the APACHE II and ISS scales.

For all cases p values <0.05 were considered statistically significant.

Results

During the study period, 149 patients were admitted with the reported selection criteria. The average age at hospital admission was 73.3 ± 6.6 years old. Ninety-eight patients (65.8%) were males. The average score in the APACHE II scale were 15.9 ± 7.4 points, and the average score in the ISS were 19.6 ± 11.4 points. Intrahospital mortality was 33.6% (50 patients). In 37 patients (24.8%) LLST was used. The results from the descriptive analysis are shown in Table 3.

Correlation between mortality and limitation of life-sustaining treatment

Out of the 50 dead patients, in 35 (70%) LLST was used. On the other hand, 86.6% of patients with no limitation whatsoever survived, and were discharged from the hospital (Table 4).

Table 3 Demographical data.

	Mean ± standard deviation	
Age (years)	76.3 ± 6.6	
APACHE II	15.9 ± 7.4	
Injury Severity Score	19.6 ± 11.4	
	Number of patients	Percentage
Sex		
Male	98	65.8
Mortality	50	33.6
LLST	37	24.8
Type of LLST based on Gómez-Rubí's classification		
1	3	2
2	1	0.7
3	3	2
4	19	12.8
5	11	7.4
Functional status (mRs)		
0–1	112	75.2
2	29	19.5
3	5	3.4
4	3	2
5	0	0
Regions affected		
Cranioencephalic trauma	98	65.8
Facial trauma	31	20.8
Thoracic trauma	48	32.2
Abdominal trauma	8	5.4
Pelvic trauma	15	10.1
Vertebral trauma	30	20.1
Skeletal trauma	45	30.2
Reason for admission		
Clinical monitoring	45	30.2
Hemodynamic instability	21	14.1
Respiratory failure	15	10.1
Neurological disorder	68	45.6
Mechanism of the lesion		
Fall[a]	74	49.7
Fall	23	15.4
Run over accident	21	14.1
Traffic accident[b]	8	5.4
Agression	5	3.4
Unknown	15	10.1
Otros	3	2

APACHE II: Acute Physiology and Chronic Health Evaluation II; mRs: modified Rankin scale; LLST: limitation of life-sustaining treatment.

[a] Fall from height.

[b] Traffic accident as an occupant of the vehicle.

Patient comparison based on the use of limitation of life-sustaining treatment

The patients in whom the LLST was used were older (80.9 ± 6.2 vs 74.8 ± 6 years old), the score in the APACHE II scale was higher (19.9 ± 6.6 vs 14.6 ± 7.1 points), and the score in the ISS was higher too (22.9 ± 7.1 vs 18.5 ± 12.3 points) (Table 4). On the other hand, patients in whom LLST was used showed higher percentages of cranioencephalic affectation due to trauma (83.7 vs 59.8%), and lower percentages of thoracic (18.9 vs 36.6%), or skeletal affectations (13.5 vs 35.7%) (Table 4).

Patients in whom LLST was used were re-hospitalized more frequently due to neurological disorders with signs of decreased levels of consciousness (81.1 vs 33.9%) (Table 4).

Factors associated to the use of limitation of life-sustaining treatment

The multivariate analysis using logistics regression showed that the factors associated with the process of LLST were older age (OR-odds ratio 1.16 [95% CI; 1.08–1.25] for every year >65 years of age), higher scores in the APACHE II (OR 1.11 [I95% CI; 1.05–1.67] for each point) and ISS severity scales (OR 1.03 [95% CI 1.01–1.06] for each point), ICU admissions due to neurological disorders (OR 19.17 [95% CI; 2.33–157.83]), and presence of cranioencephalic traumas (OR 2.89 [95% CI; 1.05–7.96]) (Table 5).

Discussion

In our study, the LLST process was established in 24.8% of the patients. This percentage is higher than the one observed in the overall population of Spanish ICUs (ranging between 3 and 13% of the patients).[18,23] However, it is expected that in populations like our study population, the LLST process will be higher due to the conditions of age and prognostic expectations.[11,16,24–26] On the other hand, LLST was established in 70% of the patients who died. This number is similar to the one published by the Ethicus study, conducted in 37 ICUs of 17 countries[27] (reporting 71% of dead patients among those in whom LLST was established). However, we should bear in mind the difference of years passed between the date of publication of these studies and data gathering in our series. During all these years, significant changes have occurred that may have influenced decisively the way we make decisions when establishing LLST, and this should be taken into consideration when interpreting the results. On the one hand, the number of old people who seek healthcare as a consequence of a trauma has gone up,[2–4] which has increased the LLST process[18] in probable correlation with the age of patients admitted to ICUs and the prognostic expectations of such patients.[25,26]

On the other hand, in our series, the LLST process was associated with higher mortality rates, which reinforces the idea that during the last years many patients who died in ICUs did so under the conditions of LLST.[11] One of the main problems in the study of trauma-associated mortality in the elderly is getting to know the repercussion that the LLST process has on final outcomes. In this sense, a lower intensity of treatment in elderly patients who are admitted to ICUs has been documented, especially if we compare it to the youngest population,[24] which has lead us to believe that age may be a determinant factor both in the LLST process and ICUs.[24,25] Our results are consistent with these observations. However, we should remember that in the context of

Table 4 Comparative analysis of patients with and without LLST.

	With LLST	Without LLST	*p*
Survivors	2	97	<0.001
Deceased	35	15	
Age (years)	80.9 ± 6.2	74.8 ± 6	<0.001
Sex (male)	21 (56.8)	77 (68.8)	0.183
APACHE II	19.9 ± 6.6	14.6 ± 7.1	<0.001
Injury Severity Score	22.9 ± 7.1	18.5 ± 12.3	0.008
Functional status (mRs)			0.193
0–1	24 (64.8)	88 (78.6)	
2	9 (24.3)	20 (17.9)	
3	3 (8.1)	2 (1.8)	
4	1 (2.7)	2 (1.8)	
Regions affected			
Cranioencephalic trauma	31 (83.7)	67 (59.8)	0.008
Facial trauma	5 (13.5)	26 (23.2)	0.232
Thoracic trauma	7 (18.9)	41 (36.6)	0.046
Abdominal trauma	0	8 (7.1)	0.201
Pelvic trauma	2 (5.4)	13 (11.6)	0.359
Vertebral trauma	5 (13.5)	25 (22.3)	0.247
Skeletal trauma	5 (13.5)	40 (35.7)	0.011
Reason for admission			<0.001
Clinical monitoring	1 (2.7)	44 (39.2)	
Hemodynamic instability	2 (5.4)	19 (16.9)	
Respiratory failure	4 (10.8)	11 (9.8)	
Neurological disorder	30 (81.1)	38 (33.9)	

APACHE II: Acute Physiology and Chronic Health Evaluation II; mRs: modified Rankin scale; LLST: limitation of life-sustaining treatment. Data expressed as mean ± standard deviation, or number of patients (percentage).

Table 5 Factors associated with the use of limitation of life-sustaining treatment. Multivariate analysis.

	OR	95% CI	*p*
APACHE II	1.11	1.05–1.67	<0.001
Injury Severity Score	1.03	1.01–1.06	0.048
Age (years)	1.16	1.08–1.25	<0.001
Sex (female)	1.64	0.74–3.66	0.225
Functional statys (mRs)			
0–1		Reference	
2	1.14	0.43–3.03	0.799
3	3.53	0.52–23.85	0.195
4	0.74	0.05–10.79	0.824
Regions affected			
Cranioencephalic trauma	2.89	1.05–7.96	0.040
Facial trauma	0.54	0.19–1.57	0.257
Thoracic trauma	0.42	0.15–1.18	0.099
Abdominal trauma	–	–	–
Pelvic trauma	0.27	0.04–1.73	0.167
Vertebral trauma	0.58	0.19–1.78	0.338
Skeletal trauma	0.29	0.09–0.87	0.027
Reason for admission			
Clinical monitoring		Reference	
Hemodynamic instability	1.46	0.09–24.12	0.793
Respiratory failure	9.44	0.89–100.01	0.062
Neurological disorder	19.17	2.33–157.83	0.006

APACHE II: Acute Physiology and Chronic Health Evaluation II; mRs: modified Rankin scale; 95% CI: 95 per cent confidence interval; OR: odds ratio.

intensive medicine, the decision-making process may be hard to complete due to the urgency and absence of certainty in the prognosis of patients at the moment of admission.[10,11] Many patients who are initially admitted to the ICU and start life-support treatment are later re-evaluated and not considered eligible to keep receiving intensive measures, which then initiates the LLST process after an evaluation confirms the absence of reasonable expectations of survival.[11,18] For this reason, several guidelines and recommendations have been published.[13,28,29] Nevertheless, the implementation of these measures is still heterogeneous when it comes to the healthcare team implementing them.[10]

In our study, the factors associated with the LLST process were older age, higher scores in the APACHE II and ISS severity scales, ICU admissions due to neurological disorders, and presence of cranioencephalic trauma. These results are consistent with the observations and expectations already described.[11,16,17,24–27] Nevertheless, in our sample we were unable to establish a correlation between the functional status prior to the trauma and the decision to establish LLST. To date, only one study has focused on the decision-making process during the LLST process in elderly patients suffering from acute traumas,[17] and no study has focused on patients who are initially admitted to ICUs. For this reason, it is not possible to establish any comparisons between different series.

The main limitations of our work lay in its retrospective character in one single center only. In the first place, the LLST was strictly categorized based on Gómez-Rubí's criteria aimed at avoiding selection bias. Patients in whom the LLST measures changed along time were included in the highest degree-category. However, a decision was made to analyze all patients with LLST in only one block due to the small number of patients included in some of the sections.

On the other hand, the criterion from the specialist responsible for the patient may really influence the decision-making process[10] and, therefore, the results obtained. However, in our hospital we have a protocol on how to implement LLST since 2013. The LLST process is assessed in a clinical session by doctors upon request from the physician responsible for assisting the patient who will eventually make the decisions. During the process, decisions are made together with the patient's family while taking the patients' prior wishes and desires into consideration, and all abiding by the actual recommendations.[13] However, in our study we did not have any information on the patients' prior wishes and desires which is an important limitation we should take into consideration. Also, many of the variables that may have influenced the decision making process were not specifically taken into consideration such as comorbidities, the patients' cognitive situation, or the development of complications during the ICU stay.

The process of organ donation is more and more common when dealing with end-of-life care.[26] In our study we did not gather any information on organ and tissue donations although, in our hospital, these situations are more and more common and they are assessed individually with every patient. In this sense, taking organ donation into account may have modified the type of LLST established in certain patients.

Finally, the analysis only includes patients admitted to ICUs, so the results are only generalizable to this type of population. We would need more studies focused on other types of patients to be able to draw conclusions on this regard.

In sum, the LLST process is usually established in elderly patients admitted to ICUs after suffering from traumas and is associated with hospital mortality. The factors associated with this process are older age, higher severity based on the APACHE II and ISS severity scores, admissions due to neurological disorders, and presence of cranioencephalic trauma.

Conflicts of interests

We the authors declare that while conducting this paper there were no conflicts of interests linked whatsoever.

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