Trauma Monthly 2022; 27(5): 581-592

10.30491/tm.2022.324048.1431

Trauma Monthly

Original Article

Relationship Between the Length of Stay in Emergency Departments and Clinical Outcomes of Head Trauma

Masoumeh Salimi [1], Sadra Ashrafi [2*], Alireza Salimi [3], Mostafa Soodmand [4], Tahereh Khaleghdoost Mohammadi [5], Atefeh Ghanbari[6], Ehsan Kazemnezhad Leily [7]

[1] MSc of Intensive Care Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.
[2] Student Research Committee, Chronic Kidney Disease Research Center (CKDRC), Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[3] Student of Dentistry Research Committee Department of Oral and Maxillofacial Surgery, School of Dentistry, Zanjan University of Medical Sciences, Zanjan, Iran.
[4] PhD Student of Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.
[5] Instructor, Department of Medical-Surgical Nursing, Social Determinants of Health Research Center, Shahid Beheshti Faculty of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.
[6] Associate Professor, Department of Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.
[7] Associated Professor of Biostatistics, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.
***Corresponding Author**: Sadra Ashrafi, MD, School of Medicine, Koodakyar St. Danshjoo Blv, Velenjak, Shahid Chamran Highway, Tehran, Iran, Tel: +989120157583, Email: sadra.ashrafi@sbmu.ac.ir, sadra.ashrafi@gmail.com.

Received 2022-01-23; **Accepted** 2022-10-23; **Online Published** 2022-11-20

Abstract

Background: Length of stay is necessary when discussing health care and cost reduction. There is a complex relationship between hospitalization in the emergency department and the outcomes of patients transferred to the ICU. This study aimed to determine the relationship between the length of stay in the emergency department and the results in head trauma patients.

Methods: This retrospective analytical cross-sectional study was conducted on 257 patient files selected from 3810 cases from a medical center in Iran over five years. The data included personal and clinical information of the patients.

Results: The primary outcomes indicated that cardiopulmonary resuscitation (31.77%, n=88) and mortality (31.41%, n=87) had occurred the most. The mean, standard deviation, and median of the duration of intubation were 10.6±8.2 and 8.4 days. The three mentioned values were 10.4±8.5 and 7.8 days for the length of stay in the ICU and 16.1±11.5 and 12.4 days for the length of hospital stay. Moreover, results indicated that the patients who stayed a shorter time in the trauma emergency department had a shorter duration of intubation and hospital stay.

Conclusion: Length of stay in the emergency department is related to the primary and secondary clinical outcomes. Treatment time for patients with trauma in the emergency department should be minimal.

Keywords: Length of Stay, Clinical Outcomes, Head Trauma.

Introduction

Traumatic Brain Injury (TBI) is one of the world's most critical public health issues. Studies have shown that about 1.5 million people worldwide die from TBI yearly, most of which occur in developing countries [1]. TBI is the most common type of trauma referred to the emergency department (ED). Many patients with TBI die before reaching the hospital. Approximately 90% of pre-hospital trauma deaths involve brain injury. Brain injuries can be classified into three categories, mild (75%) with a GCS score of 13 to 15, moderate (15%) with a GCS score of 9 to 12, and severe (10%) with a GCS score of 8 or less. TBI includes skull fractures and intracranial lesions (contusion, hematoma, diffuse injury, and swelling) [2].

The management of patients presenting with TBI requires integrated medical care starting from pre-hospital care and continuing to ED, leading to admission to the Intensive Care Unit (ICU) in most cases [3]. The prevention of secondary brain damage is one of the most important ways to improve the patient's clinical outcomes. After the primary assessment of

patients with TBI, they should be transferred to a trauma center without hesitation. This transfer is essential for the highest level of care for these patients in a department like the ICU [2].

Critically ill patients require the highest intensity of care, have a high mortality rate, and are at increased risk of adverse events [4]. Prolonged ED stay correlates with adverse outcomes in critically ill patients [5]. These outcomes can be categorized into two groups, based on recent studies: the primary outcomes (the possibility of complications, including death in the ICU, cardiopulmonary resuscitation in the ICU, pulmonary complications, coagulopathy, infections, acute renal injuries, organ compartment syndrome and gastrointestinal complications) and the secondary outcomes (length of ICU and hospital stay, duration of intubation). Studies on trauma and the need for direct transfer to the ICU are limited in number and have shown conflicting results [6].

Since most ICU patients are admitted from ED, the limited number of ICU beds increases the length of stay (LOS) in ED [7]. According to the results of a retrospective cohort study, LOS in ICU for TBI admissions is longer than expected based on the all-diagnosis admissions [8]; therefore, LOS is an essential factor in the discussion of health care and cost reduction [1,9,10].

Many factors can increase the LOS of patients in ED. One of the issues interfering with emergency treatment and conditions is the ED's overcrowding. This problem will cause poor clinical outcomes [11,12]. The ED was designed for immediate and emergency care, not critical care [7]. One of the problems in the ED regarding the care of patients with acute conditions is that doctors and nurses in ED are not trained adequately in the continuous management of mechanical ventilation.

The ratio of nurses to patients in the ED is less than that in the ICU. In this context, these factors can influence the increase in the LOS of patients in ED, decrease in the quality of care, and finally, increase in the mortality rate in this department [13,14]. On the arrival of patients to the trauma center, emergency medical personnel quickly and accurately record the measures taken to manage patients during their transfer to the center. Then, physical examination and appropriate imaging tests will be performed to identify life-threatening injuries. The protocol used in most trauma centers for managing the patients is "Advanced Trauma Life Support," a complete and approved protocol for managing trauma patients. Any life-threatening injuries should be treated immediately upon discovery 3,15. Though some advanced care can be performed in ED, the definitive care for some patients is surgery or transfer to the ICU [6].

The previous studies have indicated a complex relationship between the LOS in ED and the clinical outcomes of the patients transferred to the ICU 13,16,17. Therefore, investigating these relationships can help identify the most critical factors that prolong the patient's stay in the ICU and the subsequent clinical outcomes. In this context, the present study aimed to study the relationship between the LOS in the trauma emergency department and the primary and secondary clinical outcomes for patients with TBI.

Methods

Setting and participants

This study was a retrospective analytical cross-sectional research under the ethical code IR.GUMS.REC.1397.491. The data were collected from the medical files of head trauma patients referred by EMS to the Pursina Medical Educational Center ED in Rasht from April 2014 to April 2019. The city of Rasht, with an area of 180 km2, is the capital of Guilan province. It is in the northern part of Iran. According to the latest census, this city's population is 67995 people. Of course, due to its beautiful nature and view of the Caspian Sea, the population of this city during the holidays and tourist seasons reaches more than 2 million people. The sample size was determined as $n \geq 257$, with a confidence level of 95% and a test power of 90% based on the study of Siltz et al. and the two-domain test in 2017. Three thousand eight hundred ten medical files submitted to the medical center over five years were reviewed. Out of 3810 cases, 287 were collected that met the inclusion criteria. Among these, 10 cases were excluded from the study due to the lack of the following information: 1: Unclear timing of intubation to extubation of patients, 2: Failure to register intubation location (ED or ICU), 3: Lack of clarity about the times, the patients entering, and leaving the ICU. By referring to the HIS unit, all the files of trauma patients were requested. Since the study aimed only to consider TBI patients, they were isolated,

and 277 cases were assessed according to the inclusion and exclusion criteria.

Inclusion and Exclusion criteria

The inclusion criteria were the files of patients presenting with TBI either penetration or closed (including road traffic accident, quarrels, alignment or non-alignment falls, stab, bullets, and the heavy body falls and collision with the patient's head), age of 15-year-old or more, patients with head trauma and GCS of 8 or less, the direct entry of patients from the scene of the accident to the hospital, patients who didn't have the primary outcomes of the study at the time of admission to the ED, triage level of 1 and 2 based on ESI (Emergency Severity Index). The emergency severity index is a five-level triage algorithm (levels 1 to 5). Lower levels represent a more urgent situation and the need for life-saving interventions without hesitation. These levels include: ESI level one needs immediate intervention; two is high risk or critical; three is stable but requires two or more resources; four is stable and only needs one help; and five needs no resources 18. If the patients had multiple trauma, the information such as time of admission and transfer from ED or duration and location of intubation (ED or ICU) and the primary and secondary outcomes were missed in their files; their triage levels were 3 to 5, the patients were admitted from other hospitals and who had the preliminary clinical results of the study at the time of admission to the ED were excluded from the study.

Data collection

Sources

The sources of data collection were the files in HIS that were selected based on the inclusion and exclusion criteria. The LOS in ED before transferring the patients to the ICU was recorded. Patients were divided into two groups: patients with a longer LOS in ED and those with a shorter LOS than the mean.

Data collection tools

The collecting data tools included: personal and clinical information of patients (age, sex, tobacco use, history of underlying diseases (including asthma, neurological disease, thalassemia, history of gastrointestinal disorders, hepatitis, cancer), trauma mechanism (penetrating or non-penetrating), admission GCS, triage level based on ESI system, the history of neurosurgery during hospitalization and drug use, based on the information in the patients' files. Moreover, the checklist of clinical outcomes was completed in both primary and secondary forms, and its relationship with the LOS in ED was evaluated. The preliminary results included the possibility of complications, including death in the ICU, cardiopulmonary resuscitation in the ICU, stroke, sepsis, pneumonia, aspiration pneumonia, pulmonary embolism, pulmonary edema, deep vein thrombosis, urinary tract infection, adult respiratory distress syndrome, acute renal injuries requiring dialysis, organ compartment syndrome, bedsores, infection of blood catheters, unplanned relocation to the ICU, and stress ulcer. The secondary outcomes (including LOS in the ICU, the length of hospitalization, and the intubation duration) were also measured as separate variables in days. This information was extracted from the files, medical and nursing notes, and the ICU flowcharts. They were compared with the LOS in ED.

Data collection procedure

The researcher collected the required information according to the checklist within two months by referring to the hospital's health information management department (Medical files) and reviewing the files.

Data analysis

The data were analyzed using SPSS version 21 (IBM Company). Mean, standard deviation, maximum and minimum were used to describe quantitative variables. Frequency and percentage were used for qualitative variables. In this study, the average LOS of patients in ED was calculated, and patients were divided into two groups, less than average (short) and more than average (extended) stay. Also, to compare the relationship between the LOS in the ED with primary and secondary outcomes, the Shapiro-Wilk test first evaluated the LOS's normality distribution.

Regarding the non-normal distribution of this variable, the Mann-Whitney U test and the Kruskal Wallis test were used to compare the individual-clinical variables with primary outcomes. Further, we assessed the correlation between individual-clinical variables with secondary effects by the Spearman correlation coefficient. The relationship between primary clinical outcomes and LOS in the ED was evaluated by multiple logistic regression after adjusting individual and clinical variables. The simple linear regression model and coefficient R2 (coefficient of determination) were

used to assess the effect of LOS in ED on secondary clinical outcomes, including ICU LOS, hospital LOS, and duration of intubation. The significance level was considered P<0.05 in all analyses.

Result

In this study, 3810 electronic medical files were examined regarding the variables under investigation and the relationship between the LOS in ED and clinical outcomes. Finally, 277 files were reviewed following the inclusion criteria.

According to personal and clinical information, the mean and standard deviation of age in the samples were 40.53±19.23 years old, and 93.5% of the patients were male. The consciousness level of 78.7% of the patients, according to the Glasgow Coma Scale (GCS), was between 6-8. Furthermore, according to the ESI triage system, 67.17% of the patients were in level one triage, and 60.08% had non-penetrating trauma (Table 1).

Moreover, the mean, standard deviation, and median days of stay in ED were 1.6± 2.4 and 0.6 days. 69.96% of patients (191 patients) had short (Less than mean (and 30.04% of them (82 patients) had long (More than Mean (stay in the ED.

The results of the examination of primary outcomes indicated that the two primary clinical outcomes, including cardiopulmonary resuscitation (31.77%, n=88), mortality (31.41%, n=87), and bedsore (27.80%, n=77), had the highest occurrence, respectively.

Data analysis showed that the incidence of primary clinical outcomes was significantly related to age, GCS and blood pressure, and history of heart disease (P<0.05).

Analysis of the effect of LOS in ED on secondary clinical outcomes showed that the mean, standard deviation, and median of the duration of intubation were 10.6±8.2 and 8.4 days. The three values were 10.4±8.5, 7.8 days for LOS in the ICU, and 16.1±11.5 and 12.4 days for the LOS in the hospital, respectively. Further, the results indicated that the patients who stayed for a shorter time in ED had a shorter duration of intubation and LOS in the hospital (Table 2).

According to the Mann-Whitney U and Kruskal-Wallis tests, there were significant relationships between the duration of intubation of patients with gender, diabetes, hypertension, and ESI levels(P<0.05). Also, significant relationships were found between the ICU LOS with diabetes and ESI levels(P<0.05). There was no meaningful relationship between hospital length of stay and individual and clinical variables.

In our study, there were significant relationships between the LOS in the emergency department and the incidence of primary clinical outcomes (P=0.015). Investigation of the correlation between secondary clinical outcomes and LOS in ED showed that intubation duration (r=0.246, P<0.001) and the LOS in hospital (r=0.253, P<0.001) had a positive and significant correlation with the LOS in ED. However, the LOS in ED had no meaningful relationship with the LOS in the ICU (Table 3).

Figure 1 shows that 4.7% of the changes in the intubation duration depend on the LOS in ED; based on the estimated regression model, an average of 0.74 hours would be added to the time of the patients' intubation with an increase of 1 hour of stay in ED. According to Figure 1, 4.2% of changes in LOS in the hospital depend on the LOS in ED; an increase of 1 hour of stay in the emergency department leads to 0.93 hours longer stay in the hospital. In this study, there was no significant relationship between LOS in ED with LOS in the ICU.

The multiple linear regression model was used to evaluate the relationship between secondary outcomes and the average LOS in ED, controlling the personal and clinical variables. The results indicated that the patients with a more extended stay in ED (β=0.744, P<0.001), history of diabetes (β=87.3, P=0.027), and hypertension (β=95.7, P=0.003) had a longer duration of intubation. Also, the male patients (β= -89.3, P=0.05) and the patients in triage level 2 (β= -69.2, P=0.006) had a shorter duration of intubation. Furthermore, the diabetic patients had longer stay in the ICU (β=133.1, P=0.001), and the patients who were in triage level 2 had a shorter stay in the ICU (β= -86.9, P=0.001) (ICU LOS is non-significant with ED LOS).

Also, the extended stay in ED (β=0.881, P=0.001) and history of diabetes (β=135.539, P=0.007) caused extended stays in the hospital, and the patients who were in triage level 2(β=-82.464, P=0.016) had a shorter stay in the hospital (Table 4).

Table 1: Frequency distribution of the studied samples in terms of individual-clinical variables (n=277).

Individual-clinical variables		Frequency	Percentage
Age	20>	37	13.36
	21-40	133	44.40
	41-60	69	24.91
	61<	48	17.33
	Mean±Standard deviation	Max	Min
	40.53 ± 19.23	93	15
Sex	Women	18	6.50
	Men	259	93.50
Emergency severity index	Level 1	178	67.17
	Level 2	87	32.83
Glasgow coma scale (GCS)	3-5	59	21.30
	6-8	218	78.70
Trauma mechanism	Penetrating	103	39.92
	Non-penetrating	155	60.08
Tobacco use	Yes	54	20.30
	No	212	79.70
History of diabetes	No	247	89.17
	Yes	30	10.83
History of hypertension	No	227	81.95
	Yes	50	18.05
History of hyperlipidemia	No	317	96.39
	Yes	10	3.61
History of heart disease	No	250	90.25
	Yes	27	9.75
History of seizures	No	267	96.39
	Yes	10	3.61
History of underlying diseases Included: asthma, neurological disease, thalassemia, history of gastrointestinal diseases and hepatitis, cancer	No	255	92.06
	Yes	22	7.94
Neurosurgery during hospitalization	Yes	261	94.22
	No	16	5.78
History of drug use	Yes	80	28.88
	No	197	71.12

Table 2: The effect of length of stay in the emergency department on the secondary clinical outcomes.

Secondary clinical outcomes		Length of stay		p value*
		Short (less than 1.6 days)	Long (more than 1.6 days)	
The duration of intubation	Mean	10	11.8	0.004
	Standard deviation	8.5	7.4	
	Median	7.3	9.7	
Length of stay in the ICU	Mean	10.7	9.5	0.703
	Standard deviation	9	7.1	
	Median	7.8	7.5	
Length of stay in hospital	Mean	14.7	18.4	0.001
	Standard deviation	11	10.3	
	Median	11.5	16	

Table 3: The relationship between the odds ratio of primary clinical outcomes with the mean of stay in the emergency department(A); secondary clinical outcomes with the length of stay in the emergency department(B).

(A)

Length of stay in the emergency department (day)	Primary clinical outcomes			p value*
	No	Yes	Total	
Mean	1.2	1.9	1.6	0.015
Standard deviation	1.5	2.7	2.4	
Median	0.6	0.7	0.6	

Mann-Whitney U Test*

(B)

Length of stay in the emergency department		Secondary clinical outcomes		
		Duration of intubation	Length of stay in the ICU	Length of stay in hospital
Spearman's rho	r	0.246	0.043	0.253
	p	0.001	0.479	0.001
	N	273	273	273

Table 4: Regression coefficients of duration of the patients' intubation, lengths of stay in the ICU, and lengths of stay in hospital, based on the multiple linear regression model.

Model		Non-standardized coefficients		Significance level	95% Confidence interval	
		B	Standard deviation		Lower limit	Upper limit
The patients' intubation duration	Constant value	460.310	96.070	0.000	271.119	649.502
	Length of stay in the emergency department	0.744	0.197	>0.001	0.356	1.133
	Sex (men vs. women)	-89.315	45.689	0.052	-179.291	0.660
	Emergency severity index(level 2 vs. level 1)	-69.162	25.047	0.006	-118.486	-19.837
	History of diabetes	87.278	39.363	0.027	9.760	164.796
	History of hypertension	95.694	31.878	0.003	32.917	158.472
Length of stay in ICU	Constant value	347.714	37.154	0.000	274.550	420.879
	Emergency severity index (level 2 vs. level 1)	-86.948	26.854	0.001	-139.828	-34.067
	History of diabetes	133.116	39.574	0.001	55.187	211.044
Length of stay in hospital	Constant value	435.986	48.695	0.000	340.093	531.878
	Length of stay in the emergency department	0.881	0.267	0.001	0.354	1.407
	Emergency severity index (level 2 vs. level 1)	-82.464	33.943	0.016	-149.305	-15.623
	History of diabetes	135.539	50.023	0.007	37.033	234.046

Table 5: Regression coefficients and relative chances of factors of the occurrence of primary clinical outcomes based on logistic regression model.

Variables		B (regression coefficient)	S.E. (standard error)	Sig. (significance level)	Odds ratio	95% C.L. for OR	
						lower	Upper
Step 6[a] (the final model)	Age	0.453	0.219	0.038	1.574	1.025	2.416
	Consciousness level (3-5 vs. 6-8)	2.487	0.625	<0.001	12.028	3.530	40.979
	History of hypertension	2.246	0.714	0.002	9.450	2.330	38.337
	History of medication use	1.262	0.475	0.008	3.534	1.392	8.971
	Neurosurgery	-1.100	0.666	0.099	0.333	0.090	1.228
	Length of stay in the emergency department	0.008	0.003	0.018	1.008	1.001	1.014
	Constant	-2.402	1.317	0.068	0.090		

a. Variable (s) entered on step 1: age, sex, emergency severity index, consciousness level, history of diabetes, history of hypertension, history of heart disease, history of medication use, history of other diseases, neurosurgery, and length of stay in the emergency department.

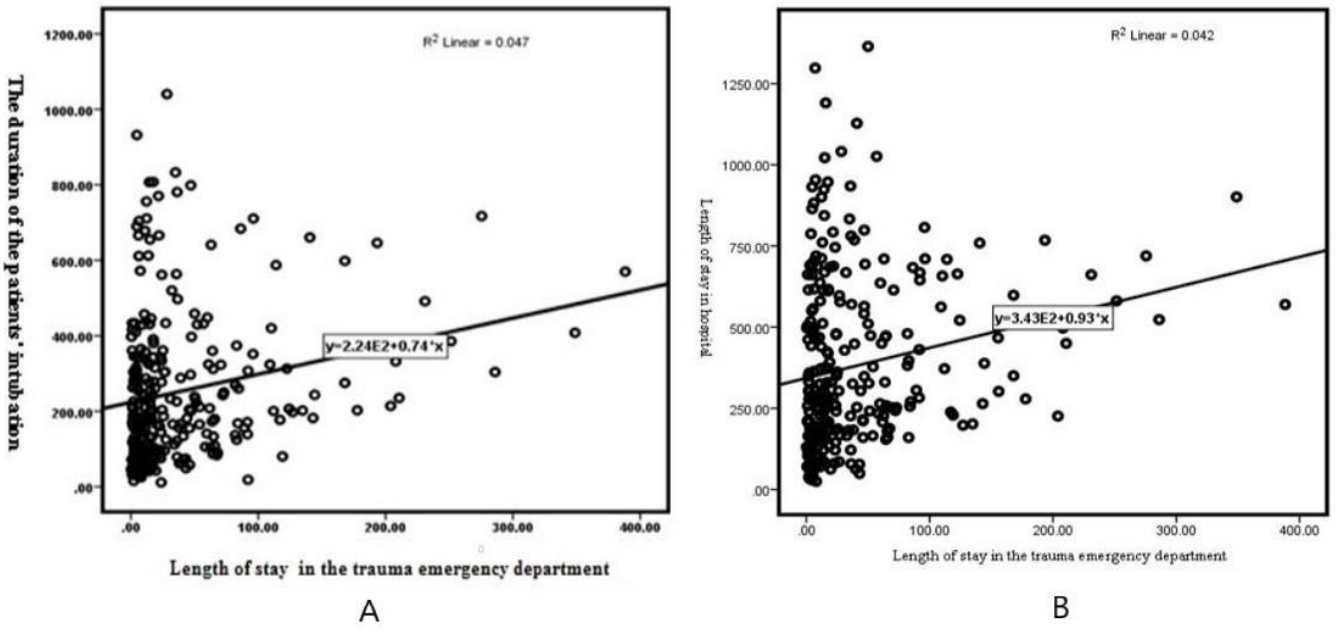

Figure 1: Distribution of the duration of the patients' intubation(A) and the length of stay in hospital(B).

The multivariable logistic regression model was also used to analyze the relationship between primary clinical outcomes and the average LOS in ED with the control of personal and clinical variables. By adjusted analysis, the LOS in ED remained as a variable related to the occurrence of primary clinical outcomes in the patients (P=0.018, CI 95% for OR: 1.001-1.014), in a way that one hour staying longer in the emergency department makes the odds ratio of the primary clinical outcomes as 1.01 fold more. The age (P=0.038, CI 95% for OR:1.025-2.416), consciousness level (P<0.001, CI 95% for OR: 3.530-40.979), history of hypertension (P=0.002, CI 95% for OR: 2.330-38.337), and history of medication use (P=0.008, CI 95% for OR: 1.392-8.971) were other factors related to the occurrence of primary clinical outcomes in the patients, hospitalized in the ICU. Older age increases the odds ratio of the primary clinical outcomes. The consciousness level of 3-5 at admission increases the odds ratio of primary clinical outcomes 12 times more compared to the level of 6-8. Moreover, the history of medication use and hypertension increases the odds ratio of primary clinical outcomes by 3.5 and 9.4 times more, respectively. Though neurosurgery remained a predictor in the finalmodel, it was not statistically significant (P=0.099, CI 95% for OR: 0.090-1.228) (Table 5).

Discussion

In the present study, it was observed that most patients were in the age group of 21-40 years, which was similar to the findings of three studies on trauma patients by Wu and Alirezaei 7,19. Many trauma patients in this age group can be explained by the fact that these people are in the most active period of life, and high-risk behaviors are more common among them.

In the present study, the majority of patients were male, indicating that men are more prone to trauma than women, and the possible reason could be due to more employment of men than women in outdoor work, which makes men more at risk for accidents at work as well as head injuries. In a study reported by Tardif, Barthélemy, and Lazaridis, similar to our study, the percentage of male patients was higher than that of female patients 1,8,20. Moreover, any society's cultural, social, and economic conditions can affect this ratio 21. This ratio is expected to change in the future with more employment of women in some communities. Regarding the trauma mechanism, the number of patients with non-penetrating trauma was more than patients with penetrating trauma. Folkerson et al. study found that most patients also had blunt trauma 2.

In our study, the patients with short-term (less than 1.6 days) in ED were more than those with long-term (more than 1.6 days). According to the Canadian Emergency Physicians Association, a stay of more than 6 hours in the ED is defined as an extended stay 13. The waiting time in ED to be admitted to the ICU ranges between 2 hours to several days in different hospitals and countries 22. In the present study, the reason for the delayed admission of patients to the ICU and the high mean of ED LOS, compared to the definition of the Canadian Emergency Physicians Association, was the lack of empty beds in the ICU. To prevent this, ICU beds should be increased so patients can be transferred to ICU as soon as possible.

According to the present study, the most common primary outcome, in order of occurrence, are pulmonary-cardiac arrest requiring resuscitation in the intensive care unit (31.8%), mortality in the intensive care unit (31.4%), and bedsore (27.8%). Similar to the results of our study, in Hung's study, the most common primary outcome was related to the mortality rate in the hospital 23. Regarding the relationship between ED LOS and the occurrence of primary clinical outcomes, the results showed that the patients who had longer stays in ED were more likely to have bedsores. Consistent with the results of the present study, Garcia Gigoro et al. showed that the patients with clinical outcomes in the ICU had longer ED LOS than those with no clinical outcomes, including kidney failure, shock, multiple organ failure, Acute Respiratory Distress Syndrome (ARDS), coagulopathy, and heart failure 24.

It can be concluded that the occurrences of different clinical outcomes in various studies can be due to different initial diagnoses, differences in care and treatment provided for the patients, as well as related protocols in other hospitals, such as observing the correct ratio of nurses to patients, differences in competent and active personnel. More trauma centers should be built, so the patients should be kept temporarily in these centers. Moreover, trained and efficient staff should be employed in these centers.

The data in this study showed that ED LOS had still been considered as a variable of primary clinical outcomes occurrence (P=0.018), which is 1.01 times more per hour longer stay in ED. Due to the overcrowding in the ED, it is necessary to provide immediate, appropriate, and optimal care to prevent consequences. Though some critical care can be performed in ED, the optimal and definitive care for some patients is transferring them to the intensive care unit as soon as possible. Since the personnel of the ICU is more trained to care for patients with critical conditions (such as ongoing management of mechanical ventilation)13. Then, there is the equipment required to care for these patients in the ICU; delay in transferring these patients to the ICU and more extended stay in ED can increase the odds ratio of clinical outcomes in these patients 13,24.

Regarding the secondary clinical outcomes, the duration of intubation of the patients with a shorter stay in ED was more concise than those with a more extended stay in this department. The results showed that the time of the patients' intubation increased by 0.74 hours per hour longer stay in ED. On the other hand, the patients who had a shorter stay in the ED had a more temporary stay in the hospital as well; the stay in the hospital becomes, on average, 0.93 hours longer per hour longer stay in ED. Nevertheless, there was no significant relationship between LOS in ED and the ICU. Alghahtani et al. showed that decreased duration of intubation led to shortened ED LOS but prolonged LOS in the ICU, which was consistent with the results of the present study 22. Hung et al. also concluded that delayed patient transfer from ED to the ICU is associated with a more extended stay in the hospital 25.

A vital care that can be useful for patients with critical and vulnerable conditions is respiratory support. According to the results of Fuller et al., starting ventilation with the right amount of airflow in the ED can be an effective strategy to reduce complications in these patients. Since creating ventilation with high airflow in the patients in the ED is common, it can increase pulmonary complications such as acute respiratory distress syndrome (ARDS) and ventilator-associated conditions (VAC) 26. On the other hand, these pulmonary complications that occur during mechanical ventilation can considerably change the treatment course and increase patients' LOS and duration of intubation. Due to the lack of empty beds in the ICU, the patients with critical conditions in this study were cared for in a supervised place with essential ICU equipment called trauma ED. However, nurses and physicians working in ED are less trained than their peers in the ICU to care for patients with special conditions.

Regarding ED congestion, patients with critical conditions requiring long-term ventilation may not be cared for and may be at risk for clinical ventilator-associated complications13. Thus, the patient's duration of intubation and LOS would be increased. The staff in ICU are more trained than other wards in Iranian hospitals because they are sent on special training courses. These courses improve the staff's skills and knowledge in managing patients with critical conditions.

Furthermore, the patients' intubation duration was statistically significant in terms of sex, history of diabetes, history of hypertension, and ESI. The mean and median intubation durations for females hospitalized in the ICU were more than those for male patients. In this study, 18 female patients were included in the project, of which ten were older than 40 years old, and eight had a history of underlying diseases and medication use, which can be the reason for the high mean of female patients' intubation durations. The patients with diabetes and hypertension had a higher standard and median intubation duration. Also, based on the ESI, the patients at level 1 had higher mean and median intubation durations. Our literature review did not find any significant relationship between personal and clinical variables and the duration of patients' intubation.

LOS in the ICU, based on the ESI level and the history of diabetes, was significant. The patients at ESI level 1 had higher mean and median stay in the ICU than those at level 2. Moreover, the patients with diabetes had higher mean and median stay in the ICU than non-diabetic patients. LOS in the hospital has a significant relationship with a history of diabetes; the patient with diabetes had higher mean and median stays in the hospital. Vitas and Cameron identified age, sex, GCS score, the severity of the injury, and mechanical ventilation as risk factors for prolonged LOS 27,28, which was consistent with the results of our study.

Tardif et al. argued about six essential and influential factors in hospital LOS: patient's conditions at the time of admission to the hospital, disease and the associated damages, extracranial conditions, the severity of TBI, and mechanical ventilation, which comprise 80% of LOS 8. In the present study, underlying diseases such as diabetes and critical conditions of the patients in terms of the severity of damage (based on the ESI) were effective in increasing the LOS in the ICU, and diabetes was effective in improving the LOS in the hospital.

Conclusion

The occurrence of the primary clinical outcomes in the patients with a more extended stay in ED was more than in the patients with a shorter stay. Regarding the secondary products, the patients with a more temporary stay in the ED had a shorter stay in the hospital and intubation duration. Since ED LOS remained as a variable related to the occurrences of the primary and secondary clinical outcomes (the LOS in the hospital and increased intubation duration) after controlling the personal and clinical variables, it is suggested to manage the treatment of the patients with trauma in such a way that they have the minimum stay in ED. Managers can take appropriate measures, such as increasing the medical staff and preparing the equipment required to reduce the LOS in ED, perhaps to reduce the incidence of primary and secondary clinical outcomes.

Limitations

The results of our study are based on the information recorded in the file and have not been asked from the patients by the researcher himself; Therefore, this could be one of the limitations of this study.

Suggestions

Regarding the importance of speed in providing care in ED to decrease mortality and the resulting disabilities, it is suggested to design interventional research aiming at reducing the waiting time in ED and its effect on decreasing the primary and secondary clinical outcomes.

Abbreviations

NTRI: National Trauma Registry of Iran, BMI: Body mass index, GCS: Glasgow Coma Scale, AIS: Abbreviated Injury Scale, ISS: injury severity score, ICU: intensive care unit, WHO: World Health Organization, HIS: Hospital Information System, SDI: Socio-demographic Index, DALYs: Disability-adjusted life years.

Authors' contributions

All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by [MS], [SA], [AS], [MS], [TKM], [AG], and [EKL]. The first draft of the manuscript was written by [MS, TKM, and MS], and all authors commented on previous versions. All authors read and approved the final manuscript.

Acknowledgements

The researchers highly appreciate the trauma emergency department of the Pursina Medical Educational Center and the vice presidency for research at Guilan University of Medical Sciences.

Funding Sources

This work was supported by Guilan University of Medical Sciences [grant number: 952624].

Disclosure statement

The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Ethical Statement

Ethical approval for this study was obtained from Ethics committee of Guilan University of Medical Sciences (The ethical code: IR.GUMS.REC.1397.491).

References

1. Lazaridis C, Yang M, DeSantis SM, Luo ST, Robertson CS. Predictors of intensive care unit length of stay and intracranial pressure in severe traumatic brain injury. Journal of critical care. 2015;30(6):1258-1262.

2. Folkerson LE, Sloan D, Davis E, et al. Coagulopathy as a predictor of mortality after penetrating traumatic brain injury. The American journal of emergency medicine. 2018;36(1):38-42.

3. Vincent J.L AE, Moore F.A, Kochanek P.M, Fink M. text book of critical care. Elsevier. 2017:314-321.

4. Stocchetti N, Carbonara M, Citerio G, et al. Severe traumatic brain injury: targeted management in the intensive care unit. The Lancet Neurology. 2017;16(6):452-464.

5. Kim J-s, Seo DW, Kim Y-J, et al. Prolonged Length of Stay in the Emergency Department and Increased Risk of In-Hospital Cardiac Arrest: A nationwide Population-Based Study in South Korea, 2016–2017. Journal of clinical medicine. 2020;9(7):2284.

6. Siletz A, Jin K, Cohen M, et al. Emergency department length of stay in critical nonoperative trauma. journal of surgical research. 2017; 214:102-108.

7. Wu D, Zhou X, Ye L, Gan J, Zhang M. Emergency department crowding and the performance of damage control resuscitation in major trauma patients with hemorrhagic shock. Academic Emergency Medicine. 2015;22(8):915-921.

8. Tardif P-A, Moore L, Boutin A, et al. Hospital length of stay following admission for traumatic brain injury in a Canadian integrated trauma system: A retrospective multicenter cohort study. Injury. 2017;48(1):94-100.

9. Sara A-G, Shoukri MM. Analysis of Length of Stay (LOS) Data from the Medical Records of Tertiary Care Hospital in Saudi Arabia for Five Diagnosis Related Groups: Application of Cox Prediction Model. Open Journal of Statistics. 2021;11(1):99-112.

10. Ramakrishnan BSR. Generalized robust statistics method for estimating average length of stay in hospitals. Indian Journal of Science and Technology. 2012;5(1)

11. Chalfin DB, Trzeciak S, Likourezos A, Baumann BM, Dellinger RP. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. Critical care medicine. 2007;35(6):1477-1483.

12. George F, Evridiki K. The effect of emergency department crowding on patient outcomes. Health Science Journal. 2015;9(1):1.

13. Rose L, Scales DC, Atzema C, et al. Emergency department length of stay for critical care admissions. A population-based study. Annals of the American Thoracic Society. 2016;13(8):1324-1332.

14. Manoach S. Mechanical Ventilation in the Emergency Department: A Call to Action in a Resource-constrained Era. Academic Emergency Medicine. 2013;20(7):746-748.

15. Urden LD SK, Lough ME. Priorities in critical care nursing: USA: Elsevier Health Sciences 2015;

16. Harris B, Bai JC, Kulstad EB. Crowding does not adversely affect time to percutaneous coronary intervention for acute myocardial infarction in a community emergency department. Annals of emergency medicine. 2012;59(1):13-17.

17. Akhtar N, Kamran S, Singh R, et al. Prolonged stay of stroke patients in the emergency department may lead to an increased risk of complications, poor recovery, and increased mortality. Journal of Stroke and Cerebrovascular Diseases. 2016;25(3):672-678.

18. Gilboy N, Tanabe T, Travers D, Rosenau AM. Emergency Severity Index (ESI): A triage tool for emergency department. Rockville, MD: Agency for Healthcare Research and Quality. 2011;

19. Rezaei Haddad A, Lythe V, Green AL. Deep brain stimulation for recovery of consciousness in minimally conscious patients after traumatic brain injury: a systematic review. Neuromodulation: Technology at the Neural Interface. 2019;22(4):373-379.

20. Barthйlemy EJ, Spaggiari R, Corley J, et al. Injury-to-admission delay beyond 4 hours is associated with worsening outcomes for traumatic brain injury in Cambodia. World neurosurgery. 2019;126: e232-e240.

21. Bonow RH, Barber J, Temkin NR, et al. The outcome of severe traumatic brain injury in Latin America. World neurosurgery. 2018;111: e82-e90.

22. Al-Qahtani S, Alsultan A, Haddad S, et al. The association of duration of boarding in the emergency room and the outcome of patients admitted to the intensive care unit. BMC emergency medicine. 2017;17(1):34.

23. Hung S-C, Kung C-T, Hung C-W, et al. Determining delayed admission to the intensive care unit for mechanically ventilated patients in the emergency department. Critical Care. 2014;18(4):1-9.

24. Garcна-Gigorro R, de la Cruz Vigo F, Andrйs-Esteban E, et al. Impact on patient outcome of emergency department length of stay prior to ICU admission. Medicina Intensiva (English Edition). 2017;41(4):201-208.

25. Hung SC KC, Hung CW. determining delayed admission to intensive careunit for mechanically ventilated patients in the emergency department. crit care. 2014;18(4):485.

26. Fuller BM, Mohr NM, Dettmer M, et al. Mechanical ventilation and acute lung injury in emergency department patients with severe sepsis and septic shock: an observational study. Academic Emergency Medicine. 2013;20(7):659-669.

27. Vitaz TW, Jenks J, Raque GH, Shields CB. Outcome following moderate traumatic brain injury. Surgical neurology. 2003;60(4):285-291.

28. Cameron CM, Purdie DM, Kliewer E, McClure RJ. Ten-year outcomes following traumatic brain injury: a population-based cohort. Brain Injury. 2008;22(6):437-449.