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The Association Between Early Discharge and Long-Term Outcome of Patients with Traumatic Intracranial Hemorrhage

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Abstract

Background: Head trauma is associated with high morbidity and mortality. A common complication of head trauma is the intracranial hemorrhage (ICH). This study was performed to evaluate the association between early discharge and long-term outcomes of patients with traumatic ICH.

Methods: In this prospective cohort, patients with traumatic ICH referring to the emergency departments (EDs) of two teaching hospitals were investigated. Demographic and clinical characteristics of the patients were recorded in the checklists and then a radiologic assessment was done. According to the time of discharge, the patients were divided into two groups: early discharge ($\leq$ 24 hours) and late discharge ($>$ 24 hours). The collected data were analyzed using SPSS-24.

Results: A total of 28 patients (84.8%) in the early discharge group and 36 patients (81.8%) in the late discharge group completed the study. The age distribution was similar in the two groups. The most common clinical symptoms after discharge were a headache in the first group and a headache plus vertigo in the second group (n = 7, 25.0% vs. n = 4, 11.1%; P = 0.020). At the end of the follow-up, in the first group, 28 patients (100%) had a GOS of 5 and in the second group, 33 patients (91.7%) had a GOS of 5 and 3 patients (8.3%) had a GOS of 4, showing no statistically significant differences (P = 0.118).

Conclusions: The results of this study showed that traumatic ICH patients with early discharge had fairly similar outcomes to patients with late discharge.

Keywords: Traumatic Intracranial Hemorrhage, Early Discharge, Long-Term Outcome

1. Background

Trauma is one of the first causes of death and the leading cause of disability in the active population of developing countries (1-3). The mortality rate of trauma in the world and Iran is 88 and 39 people per hundred thousand populations, respectively (4).

Among the injuries to certain organs of the body, head trauma is associated with the highest mortality rates. People with the traumatic head injury compared to other people are three times more likely to experience death (5-8). One of the common complications of head trauma is intracranial hemorrhage (ICH) that is divided into two main categories including epidural hematomas and intradural hematomas (subdural and intracerebral hematomas). According to various studies, 58% of the patients underwent the operation for evacuation of hematoma and 21% of the patients with a severe head injury suffered from a subdural hematoma and the ratio of male to female in these studies were reported from 1:3 to 1:6 (9-12).

The most common mechanism of subdural hematomas are falling down and physical assault but in young people, the main cause is traffic accidents (13, 14). Currently in the United States, 3.5 million people live with disabilities due to head trauma (5, 8).

The problem related to data collection in epidemiological statistics of head injuries is that detailed information in this regard does not exist. Death from traumatic brain injuries can occur at different times from the event until years later. Previous studies have shown that overall 30 percent of deaths from trauma occur in the first 24 hours of patient admission to the hospital with leading causes includ-

ing head injuries, uncontrolled hemorrhage, and shock, which can result in cerebral ischemia and increased secondary brain damage (15-17).

Unfortunately, there was not accurate information on the outcome of brain injury patients discharged from hospitals in Iran. Due to the high incidence of accidents causing head trauma followed by the brain hemorrhage, and the importance of timely diagnosis and early treatment in the final outcome of the patients and their quality of life in the future, this study was performed to evaluate the association between early discharge and long-term outcome of patients with traumatic ICH.

2. Methods

2.1. Design and Subjects

This was a prospective cohort study performed on patients with traumatic ICH referring to two academic EDs (Firoozgar and Shohadaye Haft-e-Tir hospitals) in Tehran in 2016.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria included all patients with ICH caused by head trauma with a Glasgow coma scale (GCS) of 14 or 15 and informed consent to participate in the study.

Exclusion criteria were GCS of 13 or less, the need for surgery, death of the patient before discharge, patient's or his caregivers' dissatisfaction to participate in the study, and the lack of definitive diagnosis of the disease (Figure 1).

2.3. Data Collection

In this prospective cohort study, all eligible patients with traumatic ICH referring to EDs were investigated. The diagnosis of patients was confirmed based on history taking, complete clinical examination, and imaging such as skull X-ray, CT scan, or MRI of the brain. First, using checklists, demographic characteristics including age and sex were recorded. The level of consciousness of the patients on admission was determined based on GCS. Of these patients, the cases of minor head trauma including GCS of 14 or 15 were recruited. The patients' blood pressure was measured by standard sphygmomanometer and remained under monitoring. All radiologic information was collected with the observation by a neurologist or radiologist and radiology reports, the occurrence of ICH, the type of intracranial lesion, and radiographic findings were confirmed based on the obtained data.

The patients were observed continuously during the hospitalization and if any patient died, his/her death was recorded. They were followed after discharge at intervals of 24 hours, 1 month, and 3 months later by phone calls or return visits to the ED and their final outcomes including death, sustained lesion, and relative or complete improvement were determined. Finally, patients with early discharge (within 24 hours) from ED (the first group) and patients with routine hospitalization and later discharge (the second group) were compared in terms of the final outcome (on the basis of Glasgow outcome score).

The Glasgow outcome score (GOS) is a scale that classifies patients with brain trauma into groups and allows the standardized descriptions of the objective degree of recovery. The first description was presented in 1975 by Jennett and Bond (18). The GOS is used for patients with brain injury allowing the objective assessment of their recovery in five categories. This scale can predict the long-term course of rehabilitation to return to work and everyday life.

2.4. Statistical Analysis

All statistical analyses were performed using IBM SPSS 24 software (IBM Corporation, Armonk, NY, USA). The frequency of the study variables was determined using mean $\pm$ SD and percentage. and and figures were employed to display the distribution of data. After assessing the normality of data distribution, chi-square (χ^2) and independent *t*-test were used for comparing the obtained values between the groups. In all analyses, $P < 0.05$ was considered statistically significant at a 95% confidence interval.

2.5. Ethics Statement

The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences and all patients' data remained confidentially.

3. Results

In total, 77 patients with traumatic ICH were investigated. Of these, 33 patients (42.9%) were discharged in less than 24 hours and 44 patients (57.1%) after 24 hours from the time of admission. Accordingly, the patients were divided into two groups: early discharge (n = 33) and late discharge (n = 44). In patients with early discharge, 28 patients (84.8%) could complete the study and they were fully followed up. Five patients (15.2%) due to failing to answer the phone calls and the impossibility of complete follow-up discontinued the study. In the late discharge group, 36 people (81.8%) finished the study and underwent the complete follow-up, but eight patients (18.2%) discontinued the study with an incomplete follow-up.

None of the patients in the two study groups had a recent history of using anticoagulation or antiplatelet drugs and all patients on arrival to the ED had a GCS of 14 or 15.

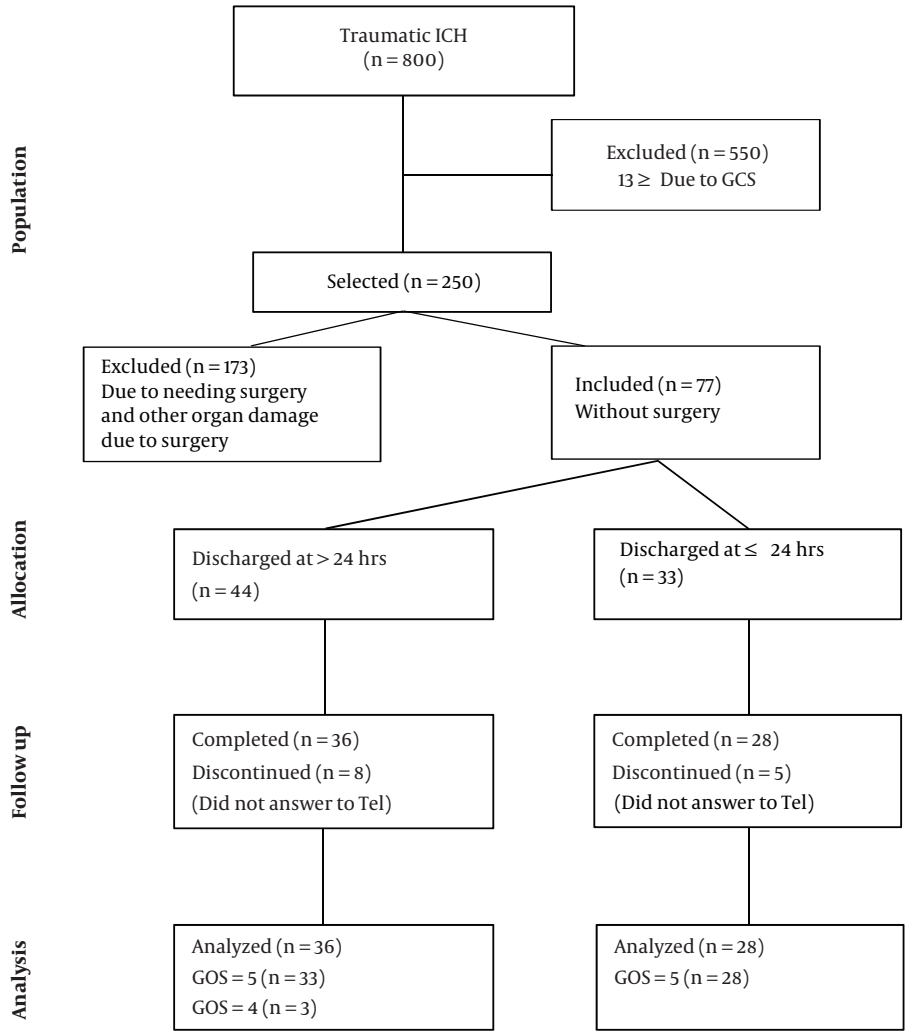

Figure 1. Flow diagram of patients classification

In addition, all of them had undergone a brain CT scan. A comparison of demographic and clinical characteristics of patients in the two groups is presented in Table 1.

There was no significant difference between the two groups in terms of age (P = 0.078), but regarding sex, a significant difference was found between the two groups (P = 0.021). In addition, systolic blood pressure was significantly different between the groups (P = 0.023) while this statistical difference was not observed in diastolic blood pressure (P = 0.429). In terms of the mechanism of head trauma in patients with traumatic ICH, in both groups, motor vehicle collision was the most common reason (18, 64.3% vs. 11, 30.6%) although the difference was statistically significant (P = 0.043).

In terms of radiologic findings, in the early discharge group, 10 patients (35.7%) had brain contusion and 18 patients (64.3%) had obvious cerebral hemorrhage, while in the late discharge group, one subject (2.8%) had brain contusion and 35 subjects (97.2%) had obvious cerebral hemorrhage that indicated a significant between-group difference (P = 0.001). Concerning the type of traumatic ICH, in both groups, epidural hemorrhage was the most common type of ICH (15, 53.7% vs. 27, 75.0%), which showed a statistically significant difference between the two groups (P = 0.005).

The assessment of clinical manifestations of traumatic ICH in the patients during follow-up after discharge showed that in patients with early discharge, 15 (53.6%) had

Table 1. Comparison of Demographic and Clinical Characteristics of Patients with Traumatic ICH Between Early and Late Discharge Groups

Characteristics	Early Discharge (N = 28)	Late Discharge (N = 36)	P Value
Age, mean ± SD	25.78 ± 11.26	30.94 ± 11.55	0.078
Sex (male), No. (%)	26 (92.8)	25 (69.4)	0.021
Systolic blood pressure (mmHg), mean ± SD	117.32 ± 7.51	123.33 ± 11.95	0.023
Diastolic blood pressure (mmHg), mean ± SD	78.03 ± 4.37	78.89 ± 4.16	0.429
Mechanism of trauma (motor vehicle collision), No. (%)	18 (64.3)	11 (30.5)	0.043
Radiologic finding (hemorrhage), No. (%)	18 (64.3)	35 (97.2)	0.001
Type of ICH (epidural hematoma), No. (%)	15 (53.7)	27 (75.0)	0.005
Clinical symptom after discharge (headache), No. (%)	15 (53.6)	10 (27.8)	0.020
Outcome 1 month after discharge (complete improvement), No. (%)	16 (57.1)	11 (30.6)	0.033
Outcome 3 months after discharge (complete improvement), No. (%)	28 (100.0)	33 (91.7)	0.703
GOS (5), No. (%)	28 (100.0)	33 (91.7)	0.118

the symptoms and 13 (46.4%) were asymptomatic; the most common clinical symptom in this group was a headache (7, 25.0%). In the late discharge group, 10 cases (27.8%) had the symptoms and 26 cases (72.2%) were asymptomatic; the most common clinical symptom in this group was a headache with vertigo (4, 11.1%). The frequency of clinical symptoms was significantly higher in patients with early discharge than in those with late discharge (P = 0.020) (Table 2).

Table 2. Comparing the Clinical Symptoms in Patients with Traumatic ICH Between Early and Late Discharge Groups

Clinical Symptoms	Early Discharge (N = 28), No. (%)	Late Discharge (N = 36), No. (%)
Headache	7 (25.0)	3 (8.3)
Vertigo	1 (3.6)	1 (2.8)
N/V	0 (0)	0 (0)
Agitation	2 (7.1)	0 (0)
Headache + N/V	3 (10.7)	0 (0)
Headache + Vertigo	0 (0)	4 (11.1)
Vertigo + Unilateral hearing loss	2 (7.1)	0 (0)
Vertigo + Blurred vision	0 (0)	1 (2.8)
Vertigo + Seizure	0 (0)	1 (2.8)
No symptoms	13 (46.4)	26 (72.2)

Abbreviation: N/V, nausea/vomiting.

Evaluating the follow-up and outcome of the patients within 24 hours after discharge showed that in both groups, none of the patients had a complete improvement, but all patients had a relative improvement. In addition, assessing the final outcome of patients on the basis of GOS at the end of the study showed that all patients with early discharge among those participating in the analysis (n = 28) had a GOS of 5, with a full recovery and return to their prior work, but among 36 patients with late discharge participating in the analysis, 33 cases (91.7%) had a complete improvement and return to their previous jobs, but three patients (8.3%) had a GOS of 4 who, due to moderate disability, were not able to return to their former jobs. The outcome of patients with traumatic ICH one month after discharge among patients with early discharge and those with late discharge was significantly different (P = 0.033), while there was no significant difference between the two groups in 3-month outcome and GOS at the end of the study (P = 0.703 and P = 0.118, respectively) (Figure 2).

No deaths were reported in the patients of the two study groups during follow-up after discharge.

4. Discussion

In this study, patients with ICH due to head trauma were followed after early discharge from the ED and their clinical outcomes at specified intervals were compared with the outcome of patients who were later discharged. Unfortunately, some patients during the follow-up period did not return to assess clinical status, and their post-discharge follow-up by phone calls was failed, as well. It is possible that patients who discontinued the study and did not participate in the analysis would have died or suffered from serious adverse consequences, which might affect the study results. However, the analysis of data obtained from patients, who successfully completed the study and were completely followed up, showed that patients with early discharge (group I) and late discharge (group II) were similar in terms of age, and their average age was between 25 and 30 years. The average age of the first group was 5

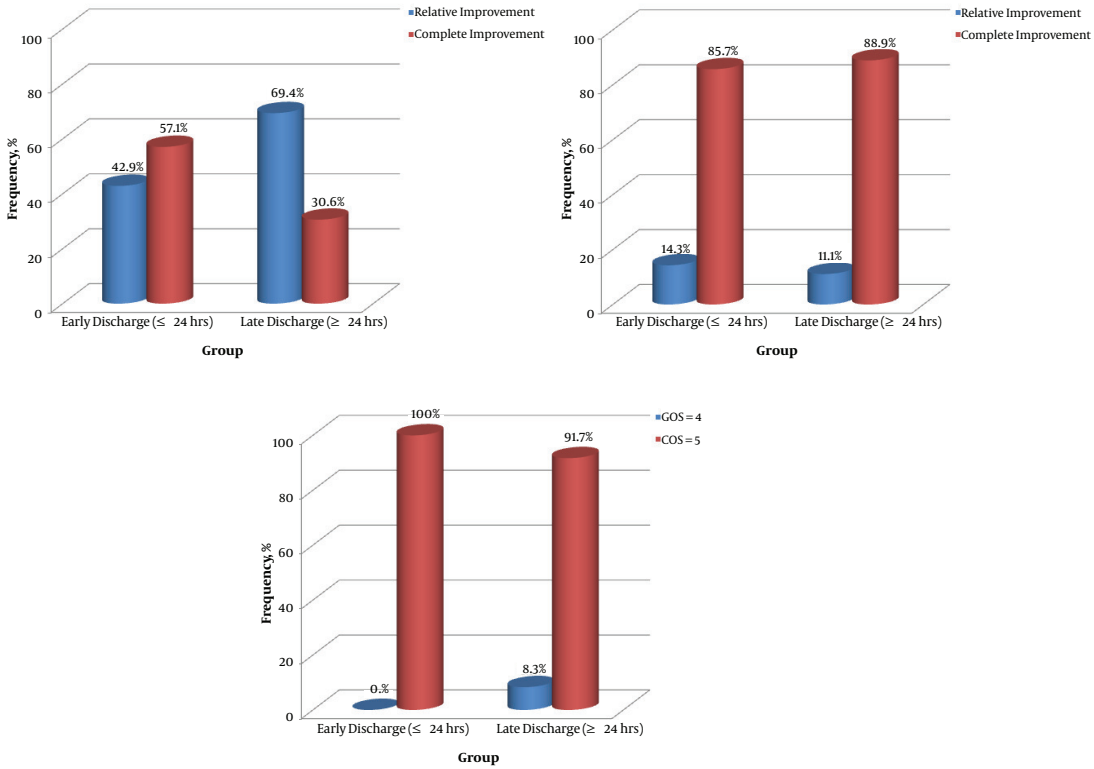

Figure 2. Comparing the 1-month and 3-month outcomes and GOS in patients with traumatic ICH between early and late discharge groups (left to right, respectively).

years less than that of the second group; therefore, it seems younger patients had better outcomes and were more suitable for early discharge from the ED. Nevertheless, in terms of gender, unlike age, two groups were not homogeneous and a significant difference was found between the two groups. In both groups, the number of female patients was significantly lower than the number of male participants and accordingly, they cannot be properly judged in terms of the effect of gender on the final outcome. In terms of systemic blood pressure, in patients with early discharge, systolic blood pressure increased significantly compared to the late discharge group. However, in both group, the average systolic blood pressure was in the normal range. However, both groups were similar in diastolic blood pressure and mean values were within the normal ranges. Comparing the mechanism of head trauma in the two study groups showed that most cases of traumatic ICH admitted to the ED were following the collision of two motor vehicles; thus, head trauma could be caused by the vehicle rollover or head on vehicle collision. The frequency of this mechanism of trauma was significantly higher in the first group than in the second group (more than 2 folds). In addition, falling down in the first group and pedestrian struck by a vehicle in the second group were ranked second in terms of frequency. The comparison of imaging results (brain CT scan) in the patients also showed that the frequency of brain contusion in the first group was far more than the frequency in the second group. This observation can improve the final outcome of these patients compared to those with cerebral hemorrhage in the initial radiological investigation. In addition, in terms of the type of ICH, the frequency of epidural hemorrhage was substantially less in the second group than in the first group. Thus, it can be argued that this type of traumatic intracranial hemorrhage, because of its specific clinical pattern and fluctuating level of consciousness that need more intensive care in the hospital, causes delays in the discharge from the ED, and it will face patients with more adverse consequences. A significant percentage of patients with early discharge (over 50%) after discharge showed various clinical symptoms that a headache was the most common symptom while in the late discharge group, the frequency of this symptom was almost half of the amount reported in first groups. In the late discharge group, a headache was mainly associated with vertigo.

Evaluation of outcomes in the two groups showed that

within 24 hours after discharge, none of the patients in both groups had complete improvement. Despite the significant improvement of patients' outcome in the first group in the first month after discharge compared to the second group, the final outcome of the patients in three months after discharge, according to the clinical criteria and GOS did not show significant differences between the two groups. On the other hand, no deaths were reported in patients with early discharge, as well as in patients with later discharge. Accordingly, the early discharge of patients with traumatic ICH, despite the increase in clinical symptoms during the post-discharge period, followed relatively similar outcomes to the late discharge of patients.

Other researchers have found various results in their studies. Fujii et al. by investigation of the prognostic factors of outcome and early discharge of patients undergoing surgical intervention for ICH showed that younger age, higher GCS on admission, lack of coagulation disorders before surgery, lack of hypernatremia, and fever were the predicting factors of favorable outcome. In addition, increasing the duration of surgery and hospitalization was defined as the predictors of negative outcomes after surgery (19). In the present study, the direct relationship of age with the final outcome of patients and the odds ratio of unfavorable outcomes were not assessed but it seems that younger people, such as patients with early discharge, would be associated with relatively better outcomes, as one month follow-up after discharge showed that the outcome of these patients compared to patients with late discharge and higher average age was significantly different although this statistical difference was not seen in the final outcome of the two groups. Kreitzer et al. also assessed the clinical outcomes and radiographic findings in patients with TBI and acute traumatic ICH and repeating imaging showed that the subarachnoid hemorrhage was the most common type of traumatic ICH and less than 1% of the patients required neurosurgical intervention. As a result, discharge after a repeat brain CT scan and the short period of observation in ED allowed the early discharge of patients with acute TBI and traumatic ICH without late adverse outcomes (20). In the present study, epidural hemorrhage was the most common type of traumatic ICH that was significantly higher in patients with late discharge. It can be concluded that the type of hemorrhage can have an important role in the clinical outcome of the patients and cause at least a significant effect on the incidence of clinical symptoms due to head trauma, as, in the present study, the frequency of epidural hemorrhage was high in both groups; that is why the early discharge of patients increased the frequency of associated symptoms after the discharge. Shabiri et al. investigated the relationship between the findings of brain CT scan and the level of consciousness, surgical findings, and the outcomes of patients with traumatic ICH and showed that based on the results of the CT scan, epidural hemorrhage was the most common type of traumatic ICH and there was a significant relationship between the level of consciousness at discharge and the outcome of non-operated patients. As a result, the outcome of patients with head trauma depends on the level of consciousness and volume of the hematoma and midline shifts on CT scan has a reverse correlation with the level of consciousness of patients (21). In the present study, as well as in the above-mentioned study, epidural hemorrhage was the most common type of ICH in patients with head trauma, but all patients with a GCS of 14 or 15 had been recruited and thus, the effect of the outcome of consciousness was removed. Nishijima et al. in their cohort study assessed the risk of long-term unfavorable outcomes in older adults with traumatic ICH and the use of anticoagulant or antiplatelet before the injury with or without a history of using these drugs showing that the patients with a history of warfarin or clopidogrel use before the injury compared to patients without a history of drug use were more likely to develop an adverse outcome (22). Nevertheless, in the present study, none of the patients in both groups had a history of taking these drugs; therefore, the possible effects of these drugs on patients' outcome were removed. Skandaroghli et al. by investigation of the factors affecting the outcome of acute subdural and epidural hematomas in patients with head trauma showed that epidural hematoma (as in the present study) was the most common type of traumatic brain hemorrhage and based on the Glasgow system, the outcome of treatment in 70% of the patients was favorable and the mortality rate was high (13% and 53% of the patients had epidural hematoma and subdural hematoma, respectively). As a result, the type of injury (subdural or epidural hematomas), age, duration of ICU stay, and GCS on admission affected the outcome (23). In the present study, all patients with early discharge fully recovered and had a GOS of 5, but in the late discharge group, less than 10% of the patients had moderate disability and a GOS of 4, and for this reason, they could not return to their previous jobs; these results of this study was much better than the findings of the abovementioned study. On the other hand, no cases died in the present study (at least in the analyzed subjects) and even by assuming that all patients who discontinued the study during follow-up were dead, the mortality rate was much lower than the abovementioned study. The direct association of variables in the above study with the final outcome of the patients was not assessed in the present study, but evidence suggests that younger patients with non-epidural ICH will have a relatively better outcome after discharge and possibly in the long-term. Ebrahimifakhar et al. by evaluating the out-

come of patients with severe head trauma based on the GOS showed that more than 50% of the patients from admission until 2 years later died and the average score of GOS from discharge until 2 years later was increased (24). In the present study, the outcome of patients after discharge gradually improved over time, but no deaths were reported and the final outcome of patients with early discharge was slightly better than the patients with late discharge, although the difference was not statistically significant.

4.1. Limitations to the Study

Inadequate cooperation of the patients and their caregivers on admission and difficult follow-up of them were problems with the study. In addition, some patients discontinued the study due to the failure to answer the phone calls or loss to the follow-up and they were excluded from the analysis. If the exclusion has been due to the possibility of death or serious complications after traumatic ICH, it has distorted the accuracy of the results.

4.2. Conclusion

The results of this study showed that the early discharge of patients with traumatic ICH had a final outcome similar to the late discharge of patients. Thus, early discharge in selected patients reduces the cost of treatment and hospital stay and increases patient satisfaction.

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