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The Interval Between External Ventricular Drain (EVD) Implantation and Time to Mobilization in Patients at the Neurosurgery ICU

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ABSTRACT

AIM: Due to increased intracranial pressure, neurosurgery patients with external ventricular drain (EVD) who are admitted to the intensive care unit (ICU) frequently remain at rest, resulting in prolonged ICU and hospital LOS, mechanical ventilator (MV) duration, and other adverse effects. In this study, we aim to describe the time between EVD implantation and mobilization in neurosurgery ICU patients with EVDs.

MATERIAL and METHODS: A retrospective descriptive study was conducted on 131 neurosurgery patients admitted to the ICU with subarachnoid hemorrhage (SAH) or intracerebral hemorrhage (ICH) who underwent EVD. Time of mobilization, level of mobilization, ICU and hospital LOS, MV duration, and other factors were evaluated for patients who met the inclusion criteria.

RESULTS: Of the 131 patients, 67 survived, and 61 began to mobilize in varying degrees of dangling (26.22%), standing (44.26%), and walking (29.5%). The mean number of days between EVD implantation and mobilization was 10.15. According to the findings, the mean ICU-LOS in patients was 14.56 days, the MV duration was 7.13 days, the time of ICU discharge from EVD removal was 7.08 days, and the hospital-LOS was 16.98 days. In addition, seven patients (10.44%) developed DVT, and three developed PE (4.47%).

CONCLUSION: Prolonged immobility in patients with EVD is associated with negative outcomes such as PE and DVT, as well as an increase in MV duration, ICU-LOS, and hospital-LOS. Therefore, designing an appropriate and standard mobilization protocol and training nursing staff to assist patients in safely mobilizing can significantly reduce the complications above, reduce postoperative care, and empower patients.

KEYWORDS: Neurosurgery, External versicular drain, Mobilization, ICU length of stay

INTRODUCTION

An external ventricular drain (EVD) helps neurosurgeons and patients with brain injuries treat increased intracranial pressure (ICP) and hydrocephalus (15). Due to elevated ICP, these patients typically remain at rest. Concerns regarding the mobilization of these patients include catheter shedding, improper cerebrospinal fluid drainage, and bleeding (10).

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Prolonged immobilization of patients with EVD in the intensive care unit (ICU) increases the incidence of Deep Vein Thrombosis (DVT) and Pulmonary Emboli (PE), increases musculoskeletal that is common, persistent, and often severe, and decreases functional ability, causes delirium that results in longer ICU stays, delayed hospital discharge, hospital-acquired infection, and long-term disability (6,8,10,16,19). Evidence suggests that hospitalized stroke patients who began exercise and rehabilitation programs early had more favorable outcomes when they regained mobility earlier (1,4). In addition, they reported improvements in patients' physical performance (16) and reductions in muscle atrophy and weakness (14).

As a result, devising a well-written schedule for early mobilization using methods such as physiotherapy and occupational therapy can help improve muscle strength, increase physical and cognitive function, decrease the duration of delirium, improve quality of life, decrease the length of stay (LOS) in ICU, early discharge from hospital, and reduce costs (3,6,7,9). The type of mobilization varies from sitting on the bed, dangling, and standing to walk (13).

There are limited studies on this topic (17); thus, we aim to describe the time between EVD implantation and mobilization in neurosurgery ICU patients with EVD.

MATERIAL and METHODS

After Shahid Beheshti University, Tehran, Iran, approved the primary proposal and provided the code of ethics No. IR.SBMU.MSP.REC.1399.690, a retrospective descriptive study, was conducted on 131 neurosurgery patients admitted to the ICU of Loghman Hospital, Tehran, Iran, who underwent EVD. The study included patients who had SAH or ICH with EVD implants. Patients with a reduced level of consciousness, active bleeding from the catheter or wound, heart rate greater than 120 or less than 50, ICP greater than 25 mmHg, severe sweating, pain or paleness, severe anxiety, blood oxygen level less than 90%, blood pressure greater than 180 mmHg or less than 90 mmHg, and diastolic blood pressure greater than 105 mmHg were excluded.

The patient's demographic and clinical characteristics were then recorded. This data included gender, age, drug dependence, disease history, GCS on admission, GCS on ambulation, and ICU admission reasons. Subsequently, the timing and type of EVD placement to initiate mobilization were investigated. The evaluation of mobilization activity in patients included dangling, standing, and walking. In addition, other variables, such as time to EVD removal, time to ICU discharge from EVD, hospital-LOS, and ICU events, including DVT, PE, meningitis, MI, rebleeding, and potential adverse event patient responses to mobilization, such as systolic blood pressure less than 90 or greater than 180 mmHg, diastolic blood pressure greater than 105 mmHg, orthostatic systolic blood pressure of 20 mmHg following position change, the persistence of peripheral blood oxygen saturation level less than 90%, increased headache, nausea, and bloody vomiting were examined.

Mean, standard deviation, median, range, frequency, and percentage were used to express the data for analysis.

RESULTS

This study included a total of 131 ICU-admitted patients who received EVD. Table I provides a summary of baseline patient demographic and clinical information. The mean age was 50, and 79 patients (60.3%) were male, while 52 patients (39.7%) were female. Concerning drug dependency, 27 patients (20.6%) were smokers, and 28 patients (21.4%) had an opium addiction. The mean GCS on admission was 11±2 with a median of 11 (range, 9-15), and the mean GCS on ambulation was 14.48±1 with a median of 15 (range, 12-15). The most common principal diagnosis was traumatic SAH (3.8%), followed by spontaneous SAH (grades 2, 3, and 4 at 14.3%, 19%, and 66.7%, respectively), ICH (6.1%), and SDH (9.9%). The most prevalent disease in patients' medical histories was hypertension (59.5%), and the least prevalent was chronic obstructive pulmonary disease (COPD) (1.5%). In terms of prevalence, other diseases included ischemic heart disease (IHD) (21.4%), diabetes mellitus (DM) (17.6%), hyperkeratosis lenticularis perstans (HLP) (9.9%), seizures (7.6%), H/O cerebrovascular accident (CVA) (6.1%), psychiatric disorders (6.1%), chronic kidney disease (CKD) (5.4%), cancer (3.8%), and asthma (3.1%), respectively.

Additional studies of ICU information for surviving patients revealed the mean number of ICU-LOS in patients was 14.56 days with a median of 10 days (range, 1-45), mechanical ventilator (MV) duration was 7.13 days with a median of 3 days (range, 0-46), Time to EVD removal was 7.05 days with a median of 5 days (range, 2-25), Time to ICU discharge from EVD removal was 7.08 days with a median of 5 days (range, 1-20), and hospital LOS was 16.98 days with a median of 13 days (range, 3-110). Moreover, among ICU events, tracheostomy (11.94%) and meningitis (11.94%) were the most prevalent, while MI (2.98%) was the least frequent. In addition, 10.44% had DVT, and 4.47% had PE. Notably, one patient simultaneously developed DVT and PE (Table II).

Of the 67 surviving patients, 61 began to mobilize. Patient mobilization data are summarized in Table III. The mean number of days from EVD implantation to mobilization was 10.15, while the median was 7 (range 1-28). The mobility levels of patients were dangling (26.22%), standing (44.26%), and walking (29.5%).

DISCUSSION

According to our findings, the mean duration to mobilize patients with SAH or ICH with EVD in the neurosurgery ICU was 10.15 days, and the highest level of mobilization achieved was standing (27 patients). This time was associated with patients' normal mobility without physiotherapy or nursing interventions. Previous research has demonstrated that this time can be decreased by implementing these interventions. Yataco et al. examined the mobilization times of patients at a clinic that employs a standard care model for early patient mobilization. This model combined physiotherapists, occupational therapists, and rehabilitation technicians into a single team. SAH was diagnosed in 61.4% of patients, while intracranial EVD was diagnosed in 17.0%. Furthermore, in 76.5% of patients, the time between EVD placement and

Table I: Baseline Patient's Demographic and Clinical Information

	Variable		Summary (N=131)
Demographic information	Sex, n (%)	Male	79 (60.3)
		Female	52 (39.7)
	Drug dependency, n (%)	Smoking	27 (20.6)
		Opium addiction	28 (21.4)
	Age, M, median (range)		50, 57 (10-85)
GSC	GCS on admission, M± SD, median (range)		11 ± 2, 11 (9-15)
	GCS on ambulation, M± SD, median (range)		14.48 ± 1, 15 (12-15)
Reasons for ICU admission	Traumatic SAH, n (%)		5 (3.8)
	Spontaneous SAH, n (%)	Grade 2	15 (14.3)
		Grade 3	20 (19)
		Grade 4	70 (66.7)
	ICH, n (%)		8 (6.1)
	SDH, n (%)		13 (9.9)
History of disease	DM, n (%)		23 (17.6)
	HTN, n (%)		78 (59.5)
	IHD, n (%)		28 (21.4)
	CKD, n (%)		7 (5.4)
	Cancer, n (%)		5 (3.8)
	COPD, n (%)		2 (1.5)
	Seizures, n (%)		10 (7.6)
	HLP, n (%)		13 (9.9)
	Asthma, n (%)		4 (3.1)
	H/O CVA, n (%)		8 (6.1)
	Psychiatric Hx, n (%)		8 (6.1)
	Rheumatologic disease, n (%)		2 (1.5)

mobilization was 38 hours. The authors concluded that early mobilization of these neurosurgery ICU patients is possible and practical (17).

Young et al. designed their study with three phases: no mobility (phase 0), therapy-driven (phase 1), and nurse-driven (phase 2). The results demonstrated that interventions decreased the time to mobilize in phases 1 and 2, from 20.1 days in phase 0 to six days in phase 1 and 4.9 days in phase 2 (18). These results show the significance of mobilization interventions and their capacity to mitigate the negative effects of immobility.

The most significant effects of early mobilization are a reduction in ICU-LOS, hospital-LOS, duration of medical ventilation, and time to EVD removal. According to our research, these durations were 14.56, 16.98, 7.13, and 7.05 days. Moreover, the implementation of interventions can reduce these durations. In another study, Moyer et al. designed interventions for early mobilization in patients with EVD and compared the outcomes to those of a control group. They observed that early mobilization was significantly different between the two groups, with a mean of 18 days in the control group and 6.5 days in the intervention group. Additionally, ICU-LOS, hospital-LOS, and mechanical ventilator usage days were reduced compared to the control group (10).

Our study differs significantly from previous research regarding time to mobilization after EVD implantation, ICU- and hospital-LOS, MV duration, and time to EVD removal. Since our study was retrospective and we did not conduct an intervention, the time to mobilization and other factors were longer than in intervention studies.

Table II: ICU Information in Patients Who Have Survived

Variable	Summary (N=67)
Days	
ICU LOS, M, median (range)	14.56, 10 (1-45)
Duration on MV, M, median (range)	7.13, 3 (0-46)
Time to EVD removal, M, median (range)	7.05, 5 (2-25)
Time to ICU discharge from EVD removal, M, median (range)	7.08, 5 (1-20)
Hospital LOS, M, median (range)	16.98, 13 (3-110)
ICU event	
Tracheostomy, n (%)	8 (11.94)
PE, n (%)	3 (4.47)
DVT, n (%)	7 (10.44)
Meningitis, n (%)	8 (11.94%)
MI, n (%)	2 (2.98)

Table III: Mobilization Information

Variable		Summary (N=61)
Time to mobilization (days), M, median (range)		**10.15, 7 (1-28)**
Level of mobility, n (%)	Dangling	16 (26.22)
	Standing	27 (44.26)
	Walking	18 (29.5)

Early mobilization of patients with EVD is problematic. Concerns include catheter movement, inadequate cerebrospinal fluid drainage (10), patient safety, and other factors (17). In a review article that focused on the barrier to early mobilization in ICU patients, an analysis of 40 studies revealed 28 barriers to early mobilization that are related to patients (such as a physical barrier, respiratory instability/distress, ventilator asynchrony, patient refusal, lack of motivation, and others), structural (such as limited staff, time constraints, and limited equipment, among others), ICU culture (such as lack of mobility culture, lack of support or staff buy-in, and others), and process-related barriers (such (like lack of planning and coordination, unclear expectations, roles and responsibility, risks for mobility providers -stress, and injuries, among other factors).

However, there are numerous strategies from which patients can benefit (5). Previous research demonstrated that patient mobilization could be beneficial and safe (2,11,12). A team consisting of neurologists, neurosurgeons, nursing staff, and rehabilitation therapists should be present during safety sessions (17). Implementing a standardized protocol and coordinated care programs can significantly mitigate the negative effects of immobility.

Since our study was not an intervention, the time to begin mobilizing patients was lengthy, and this immobility had numerous adverse effects, including an increase in ICU- and hospital-LOS, an increase in the duration of MV, DVT, and PE, and muscle weakness and mobilization. Avoiding bed rest through early mobilization in the ICU is a potential therapeutic option for reducing ICU-acquired weakness; therefore, by performing mobilization interventions, this time can be accelerated to prevent such complications, shorten the length of hospitalization, and reduce the occurrence of such complications the cost burden on patients.

CONCLUSION

In conclusion, prolonged immobility has negative consequences, such as PT and DVT, for patients with EVD. In addition, it increases the length of MV, ICU-LOS, and hospital-LOS. Consequently, designing an appropriate and standardized mobilization protocol and training nursing staff to assist patients in safely mobilizing can significantly reduce the complications above, shorten postoperative care, and empower patients.

AUTHORSHIP CONTRIBUTION

Study conception and design: KRB, MH
Data collection: KRB, MM
Analysis and interpretation of results: MM, MH
Draft manuscript preparation: KRB, RG, MZ
Critical revision of the article: MZ, MA
Other (study supervision, fundings, materials, etc...): MM, MH
All authors (KRB, MH, MM, RG, MA, MZ) reviewed the results and approved the final version of the manuscript.

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