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ORIGINAL ARTICLE

Patients with Isolated Musculoskeletal Trauma Have Lower Mental Status Scores

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Abstract The subjective concerns and needs of patients who have experienced trauma are important to recovery. However, the mental status of patients with isolated musculoskeletal trauma is not known. Is the mental status of such patients different and does the severity, site, and type of trauma affect this difference? We evaluated the mental status of 195 patients hospitalized for isolated musculoskeletal trauma and determined the characteristics of the factors that affect mental status; 197 patients hospitalized for elective surgery and not exposed to acute trauma constituted the control group. We administered the Mini-Mental State Examination to study and control groups within the first 24 hours of hospitalization. Age, gender, and educational status in the study and control groups were recorded. In addition, the severity, site, and type of trauma in the study group were recorded. Mini-Mental State Examination scores of the trauma group were lower than those of the control group. Mini-Mental State Examination scores decreased with increasing trauma severity. The mental status of the patients sustaining isolated musculoskeletal trauma was affected by the severity, site, and type of trauma.

Level of Evidence: Level I, prognostic study. See the Guidelines for Authors for a complete description of levels of evidence.

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Introduction

The subjective concerns and needs of patients who have experienced trauma are important to recovery. Head trauma may directly affect mental status, and abdominal or thoracic trauma may disturb metabolism and indirectly affect mental status. In general, one might presume the mental status of patients sustaining isolated musculoskeletal trauma remains unaffected; however, this reportedly is not true for all patients [2, 5]. The concerns and needs of the patients may not be defined sufficiently, especially during the first hours or days; furthermore, these have not been defined adequately in the literature yet may pose medical and legal difficulties for orthopaedists (difficulties related to inadequate self-explanations).

We suspected the mental status of patients with isolated musculoskeletal trauma would be worse than that of patients with nontraumatic musculoskeletal disorders. The social and medical effects of trauma must be investigated to confirm our suspicion. The medical effects include trauma-induced psychologic stress, fracture-induced pain, and fracture-induced intravascular blood loss. Similarly, the social effects on the patient include accident- or trauma-induced material costs, loss of income, the possibility of death, dwelling on the possible effects of trauma on his or her subsequent life, and concerns about the effects on family and friends. These and other factors could lead to accident- or injury-induced depression. We presume a patient under the pressures from such trauma would unlikely be able to apply rational cognition.

We therefore first asked whether the mental status scores of patients who have sustained isolated musculoskeletal trauma are lower than those of patients who have not sustained trauma. If we found the mental status scores of a patient with isolated musculoskeletal trauma were lower, we examined whether severity, site, and type of trauma influenced mental status.

Materials and Methods

For our study group we prospectively identified 195 patients hospitalized for trauma from among 357 consecutive patients admitted through the emergency room and hospitalized for trauma. The control group consisted of 197 patients selected from among 325 consecutive patients who had been hospitalized for elective surgery in the same service; the patients in the control group were on the waiting list of our clinic, and they were called in the order in which they were listed. A power analysis suggested we needed a minimum of 133 patients for the difference between the groups to be 10% at 90% power and a significance level of 0.05 ($p = 0.10$ and $1 - \beta = 0.90$).

We defined "patients hospitalized for trauma" as those with a fracture of any bone except the craniocervical bones; these patients were excluded to alleviate concerns regarding their ability to take the mental status test. The selection criteria for the study group were: (1) patients who had a neurosurgical examination and followup or had no symptoms of trauma-related head injury; (2) patients who had thoracic and abdominal examinations and followup or had no symptoms of trauma-related thoracic or abdominal injuries; (3) patients who had no intentional injuries; (4) patients who were transferred from the emergency room to the adult service in no more than 4 hours (for standardization, the study group); (5) patients who were transferred from the site of trauma to the adult service in no more than 8 hours (for standardization, the study group); (6) patients who had not been diagnosed with hemorrhagic shock; (7) patients who had not used any medication that had definitely affected their mental status (not even narcotic analgesics); (8) patients who had not sustained an injury at the dominant upper extremity that might limit their ability to answer the Mini-Mental Status Examination (MMSE) [8] questions; (9) patients with good reading and writing skills to be able to answer the MMSE questions; (10) patients without a neurologic disease that can affect responses to the MMSE (from the previous and/or new medical record); (11) patients without a history of drug dependence or alcoholism (from the previous and/or new medical record); (12) patients who were able to perform their daily duties without help before experiencing trauma; and (13) patients who provided informed consent. The selection criteria for the control group were: (1) patients who were admitted to the adult orthopaedic and traumatology department for elective orthopaedic surgery; and (2) selection criteria points 9, 10, 11, 12, and 13 described for the study group also were applicable to the control group. The exclusion criteria and number of excluded patients in the study and control groups are summarized (Table 1). We found no differences in the study and control groups regarding age (t: −0.58; $p = 0.556$), gender (chi square:

Table 1. Exclusion criteria and number of excluded patients

Exclusion criteria	Study group (number of patients)	Control group (number of patients)
Head injury	61	
Thoracic or abdominal injuries	42	
Intentional injuries	17	
Transferred from the emergency room to the adult service in more than 4 hours	62	
Transferred from the site of trauma to the adult service in more than 8 hours	41	
Hemorrhagic shock	42	
Medication that had definitely affected their mental status	48	
Injury at the dominant upper extremity	58	
Patients with poor reading and writing skills	52	77
Neurologic disease	37	48
Patients with a history of drug dependence or alcoholism	11	4
Patients who were unable to perform their daily duties without help	17	3
Patients who did not provide informed consent	6	0

0.37; p = 0.542), and educational status (chi square: 0.34; p = 0.987) (Table 2). Thus, the two groups were comparable by these parameters.

The MMSE was applied to both groups during the first 24 hours of hospitalization between 8:00 am and 8:00 pm. The MMSE has five heads. These include orientation (time and location), registration (repeating the name of objects), attention and calculation, recall (name of the objects), and language (understanding the orders, needs reading and writing skills). The cutoff level of the MMSE score is 24; a score less than 24 indicates cognitive impairment. We recorded the MMSE scores, ages, genders, and educational status of subjects from both groups. Education was categorized as: can read and write but had not attended school, attended primary school, attended middle school, attended high school, and university graduate.

In the study group, trauma severity was categorized according to the Abbreviated Injury Scale: minor, moderate, severe but not life-threatening, severe and life-threatening, and critical [2]. The site of injury was categorized as upper extremity, lower extremity, pelvis, spine, and a combination of sites. The type of trauma was categorized as a simple fall, fall from height, occupational accident, intravehicular accident (patient was inside the vehicle during the accident), and extravehicular accident (patient was outside the vehicle during the accident).

To test the comparability between the study and control groups, we compared the quantitative data (age, gender, and educational status) between the two groups by using an unpaired t test for age and a chi square test for gender and educational status. We compared the MMSE scores between the two groups by using an unpaired t test. To determine the individual effects of the severity of trauma, the individual effects of the site of trauma, and the individual effects of the type of trauma, we divided the study group into subgroups according to the severity, site, and type of trauma. For each of these parameters, we used one-way analysis of variance to compare the MMSE scores among the respective subgroups and Tukey's multiple comparisons to compare the MMSE scores within these subgroups. We performed our analysis using the GraphPad Prism V.3 program (GraphPad Software, Inc, San Diego, CA).

Results

The MMSE scores were lower (t: 4.41; p = 0.0001) in the study than in the control group (Table 2).

The mean MMSE scores varied (F: 5.83; p = 0.0001) by severity of trauma (Table 3). The mean MMSE scores of patients with severe but not life-threatening injuries were lower (p = 0.01 and 0.008, respectively) than scores

Table 2. Comparison of demographic data between groups

Demographic	Data and MMSE	Control group	Study group		p Value
Age (mean ± standard deviation)		50.24 ± 16.64	51.23 ± 16.70	t: −0.58	0.556
Mini-Mental State Examination (mean ± standard deviation)		25.89 ± 4.82	23.48 ± 5.96	t: 4.41	0.0001
Gender	Male	99 (50.3%)	104 (53.3%)	Chi square 0.37	0.542
	Female	98 (49.7%)	91 (46.7%)		
Educational status	Reader and writer	43 (21.8%)	45 (23.1%)	Chi square 0.34	0.987
	Primary school	59 (29.9%)	59 (30.3%)		
	Middle school	30 (15.2%)	28 (14.4%)		
	High school	44 (22.3%)	45 (23.1%)		
	University	21 (10.7%)	18 (9.2%)		

MMSE = Mini-Mental State Examination.

Table 3. Differences in trauma severity between patients in the two study groups

Trauma severity	Number	Age (years)	Mini-Mental State Examination Score (points)
Minor	14	46.14 ± 11.58	26.93 ± 1.49
Moderate	61	46.9 ± 15.52	25.84 ± 4.33
Severe but not life threatening	86	53.92 ± 18.93	22.65 ± 6.53
Severe and life threatening	30	54.43 ± 12.12	20.9 ± 6.93
Critical	4	53.25 ± 15.39	22.5 ± 1.73
F		2.25	5.83
p		0.065	0.0001

Values are mean ± standard deviation.

Table 4. Comparison of differences in Mini-Mental State Examination Scores

Tukey's multiple comparison test	p Value
Minor/moderate	0.967
Minor/severe but not life-threatening	0.07
Minor/severe and life-threatening	0.01
Minor/critical	0.648
Moderate/severe but not life-threatening	0.008
Moderate/severe and life-threatening	0.001
Moderate/critical	0.789
Severe but not life-threatening/severe and life-threatening	0.597
Severe but not life-threatening/critical	0.998
Severe and life-threatening/critical	0.985

Table 6. Comparison of the differences in Mini-Mental State Examination Scores between sites

Tukey's multiple comparison test	p Value
Upper extremity/lower extremity	0.053
Upper extremity/pelvis	0.858
Upper extremity/spine	0.005
Upper extremity/combination of sites	0.036
Lower extremity/pelvis	0.17
Lower extremity/spine	0.323
Lower extremity/combination of sites	0.635
Pelvis/spine	0.031
Pelvis/combination of sites	0.057
Spine/combination of sites	0.998

of patients with minor and moderate injuries; the mean MMSE scores of patients with severe and life-threatening injuries were lower ($p = 0.001$) than scores of patients with moderate injuries (Table 4). Only four patients had critical injuries, of whom two were university graduates and one was a high school graduate.

The mean MMSE scores differed (F: 4.96; $p = 0.0001$) by site (Table 5). The MMSE scores of the patients with spine and combination injuries were lower ($p = 0.005$ and $p = 0.036$, respectively) than scores of patients with upper extremity injuries. Patients with spine injuries had lower ($p = 0.031$) MMSE scores than patients with pelvis injuries (Table 6).

The type of trauma influenced (F: 2.52; $p = 0.042$) the mean MMSE scores (Table 7). The mean MMSE scores of patients in the fall from height group were lower than scores of patients involved in an intravehicular accident and an extravehicular accident ($p = 0.034$ and $p = 0.033$, respectively) (Table 8).

Discussion

Based on our clinical experience we suspected the mental status of patients sustaining isolated musculoskeletal trauma would be worse than that of patients hospitalized for elective surgery. Furthermore, we believed the characteristics of inflicted trauma may affect the mental condition. It is important to consider how the severity, type, and site of trauma can affect the mental status of patients with isolated musculoskeletal trauma. These trauma-related factors influence the medical condition of such patients. In these situations, intellectual cognition of the patients may be affected adversely, leading to deterioration of their mental status. We therefore first asked whether the mental status scores of patients with isolated musculoskeletal trauma would be lower than scores of patients who had not sustained trauma. We then determined whether severity, site, and type of trauma influenced mental status.

Our study patients with isolated musculoskeletal trauma did not have the MMSE before injury. We did administer the MMSE within 24 hours of admission, so we presume some of the effects of prolonged hospitalization would not influence the test score but we cannot presume the short time would not have influenced the scores. However, whether the patients would have had a lower preinjury MMSE, the lower scores would likely influence their subsequent recovery. Compensated and mild hemorrhagic shock may remain undiagnosed in the emergency room; therefore, the study group may have included patients with

Table 5. Differences in the site of trauma among patients in the study groups

Site of trauma	Number	Age (years)	Mini-Mental State Examination Score (points)
Upper extremity	25	46.32 ± 17.62	26.92 ± 2.04
Lower extremity	137	50.97 ± 17.14	23.5 ± 6.04
Pelvis	4	57.75 ± 8.18	24.53 ± 2.67
Spine	18	54.11 ± 14.72	20.78 ± 6.7
Combination of sites	11	58.55 ± 11.22	21 ± 6.8
F		1.37	4.96
p		0.245	0.001

Values are mean ± standard deviation.

Table 7. Differences in types of trauma among patients in the study groups

Type of trauma	Number	Age (years)	Mini-Mental State Examination Score (points)
Simple fall	128	53.75 ± 16.72	23.49 ± 5.53
Fall from height	22	48.09 ± 13.68	20.82 ± 9.70
Occupational accident	4	46.25 ± 9.54	23.49 ± 2.84
Intravehicular accident	16	47.81 ± 18.02	24.13 ± 4.21
Extravehicular accident	25	44.44 ± 17.31	24.28 ± 4.22
F		2.37	2.52
p		0.063	0.042

Values are mean ± standard deviation.

Table 8. Comparison of differences in Mini-Mental State Examination Scores for trauma categories

Tukey's multiple comparison test	p Value
Simple fall/fall from height	0.279
Simple fall/occupational accident	0.186
Simple fall/intravehicular accident	0.994
Simple fall/extravehicular accident	0.973
Fall from height/occupational accident	0.334
Fall from height/intravehicular accident	0.034
Fall from height/extravehicular accident	0.033
Occupational accident/intravehicular accident	0.38
Occupational accident/extravehicular accident	0.369
Intravehicular accident/extravehicular accident	0.998

compensated and mild hemorrhagic shock. None of the patients in the study or control groups used narcotic analgesics; however, they used nonsteroidal antiinflammatory agents for pain relief. The nonsteroidal antiinflammatory agents may have had adverse effects on the patients' mental status. The MMSE frequently is used to determine the mental status of patients. It is an easy and rapid method and tests the patients' orientation, immediate and short-term memory, concentration, arithmetic ability, language, and usual activity. However, it requires hand skill; therefore, we excluded patients with dominant upper extremity injuries. Despite this exclusion, we do not believe it jeopardizes our conclusions because we did include patients with nondominant upper extremity injuries [8, 10].

The mean MMSE score of the study group was 23.48 (less than 24) and that of the control group was 25.89 (greater than 24). The mean MMSE score of the study group was lower than the cutoff level; this may be attributed to the fact that all patients in the study group had sustained trauma.

According to their basic personality, the medical condition of patients sustaining isolated musculoskeletal trauma may not permit them to express their concerns and needs. This may pose medical and legal difficulties for orthopaedic surgeons and nurses. A patient unable to express himself or herself clearly may not be able to provide authentic trauma-related information. During followup, symptoms related to trauma may not be revealed appropriately and in a timely manner. In this situation, the medical condition of the patient may be worse than that perceived. Because doctors and nurses perceive the mental status of such a patient as normal, they can be considered responsible for the worsening of the patient's medical condition. The lack of a scientific guideline to anticipate possible worsening of the mental status of such patients may lead to the conviction of doctors and nurses in cases of negligence. Furthermore, these conditions have not been adequately defined in the literature; do patients with isolated musculoskeletal trauma possess sufficient mental ability to express their requirements? We believe the MMSE scores of patients sustaining isolated musculoskeletal trauma are lower than scores of the patients who have not sustained trauma, and this difference is affected by the severity, site, and type of trauma.

Using the MMSE in patients with head injury may be difficult because of conditions such as epidural hematoma, posttraumatic hydrocephalus, and intracranial hypertension. These pathophysiologic conditions may cause confusion and amnesia. Many factors may affect the mental status of patients experiencing musculoskeletal trauma, including acute stress disorder, posttraumatic stress disorder, hypovolemia, low hemoglobin levels, cerebral hypoxia, hypoglycemia, electrolyte imbalance, and fat embolism [6, 12, 15, 18]. The rates of undiagnosed traumatic brain injury in patients with spinal cord injury may be high and also affect the MMSE evaluation [3, 21].

The trauma severity includes the severity of body and psychologic injuries. Four patients in our study comprised the critical category. Of these, two had attended a university and one had attended high school. The MMSE scores of patients in the critical category were higher because of their high educational status. The high educational status of the four patients made the critical category heterogeneous; therefore, this category has not been discussed. The severity was classified as follows from the highest to the lowest scores: minor, moderate, severe but not life-threatening, and severe and life-threatening. Thus, the decrease in the mental status score occurs parallel to the increase in the severity of trauma [1, 9, 20].

Patients with extremity injuries may have concerns regarding their health, and this may result in continuous anxiety. The manifestations of the injury may be combined with the fear of disability [13, 22]. Our study showed injury to the spine, lower extremity, or a combination of sites negatively affected mental status.

The experience of near death or a dangerous injury induces fear, horror, and helplessness in patients. The memory of the incident may cause them to believe the incident will recur and if so, they may be affected by sleeplessness and nightmares. Patients may experience uneasiness and restlessness and become easily frightened. Carelessness is commonly observed in these patients [11, 16]. If this situation continues for a long time, posttraumatic stress disorder may develop [1, 4, 5, 7, 13, 17–19]. The incidence of posttraumatic stress disorder and psychological problems in patients sustaining trauma varies from 10% to 46% [1, 4, 5, 7, 11, 13, 17, 18].

The type of trauma affects mental status; our data suggest the mental status of patients experiencing an intravehicular or extravehicular accident was better than that of patients having a simple fall, occupational accident, or a fall from a height. Falling from a height or occupational accidents may increase the anxiety related to the trauma, and this may have negatively affected the patients' mental status [14].

We found the mental status of patients with isolated trauma was influenced by the severity, site, and type of trauma. The MMSE scores were worse in patients with severe trauma, injury to the spine, lower extremity, or combinations of sites, and simple fall, occupational accident, and fall from a height. Our data suggest the mental status of patients hospitalized for isolated musculoskeletal trauma is worse than the mental status of patients hospitalized for elective surgery.

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