Factors Associated With Psycho-Cognitive Functions in Patients With Persistent Pain After Surgery for Femoral Neck Fracture

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Abstract

Background: The aim of the study was to address issues arising from fracture of the femoral neck in elderly individuals, the prevalence of which continues to increase in Japan. The prevalence is increasing in Japan and there have been many reports on physical functions such as prevention of a fall. However, there have been a few studies that focus on psycho-cognitive functions. We must examine factors in patients with fractured femur necks to develop methods to assist affected patients. The current study aimed to examine factors associated with psycho-cognitive functions after surgery for fractured femoral neck in the Japanese elderly.

Methods: In this study, we examined the relationships among sex, age, fracture site, operative procedure, body mass index, lifestyle, psycho-cognitive functions, and types of pain in 142 patients, performed multiple regression analysis using the mini-mental state examination (MMSE) and the Montgomery-Asberg depression rating scale (MADRS) scores as dependent variables, and created MMSE and MADRS models.

Results: Analysis of MMSE and MADRS models identified night pain and the number of family members as factors that affected mental function in a population with persistent pain for 1 week after surgery for fractured femoral neck. In addition, the number of family members was identified in multiple regression analysis models as a factor associated with psycho-cognitive functions. Pain, and night pain in particular, affect psycho-cognitive functions.

Conclusions: We speculated that emotional changes were associated with number of family members. Patients living with family members maintained psycho-cognitive functions better than did those living alone, even when they experienced pain in their daily lives.

Keywords: Psycho-cognitive functions; Persistent pain; After surgery for femoral neck fracture; Multiple regression analysis models

Introduction

In the 1990s, Japan achieved the status of having the longest lifespan worldwide for both men and women [1]. The proportion of elderly individuals is sharply increasing, with a concomitant increase in new social problems. Various measures have been taken to prevent disorders and diseases and promote good quality of life among the elderly [2, 3]. However, fracture accounts for approximately 10% of the causes of individuals becoming bedridden [4], and femoral neck fracture affects basic activities of daily living (ADL), such as posture and walking. In particular, bone tissue develops disuse syndrome if gravity-influenced exercises are not performed.

It is generally difficult for elderly individuals to learn and adapt because of psychological characteristics associated with old age [5], and older people tend to become depressed. Therefore, patients with femoral neck fractures who must undergo rehabilitation to completely relearn certain basic functions will need assistance that differs from that given to younger patients. Unfortunately, the prevalence of femoral neck fractures continues to increase in the general population in aging societies. Therefore, it would be useful to determine critical factors that must be considered when developing prevention measures and methods to assist elderly patients with broken bones.

The pain after surgery for femoral neck fracture occurs around the hip joint where the fracture and surgical wound occurred, and disappears as the bone fuses and the wound heals. In such cases, the degree of pain a week after the surgery and psycho-cognitive functions may become factors that impede or delay initiation of a rehabilitation program. Arai et al report

Table 1. Participant Characteristics (n = 142)

Variable		No. (%)
Total		142
Sex		
Men		32 (22.5%)
Women		110 (77.5%)
Age (years)		82.6 ± 8.9
Fracture site		
Right hip neck fracture		60 (42.3%)
Left hip neck fracture		82 (57.7%)
Operative procedure		
Bipolar hip arthroplasty		66 (46.5%)
γ-nail		45 (31.7%)
Compression hip screw		21 (14.8%)
Hansson Pin system		10 (7.0%)
	Mean	Median (25-75%)
Body mass index	20.3	20.2 (17.9 - 22.0)
Mini-mental state examination	21.4	22 (17.0 - 26.8)
Montgomery-Asberg depression rating scale	8.7	7.0 (2.0 -13.0)
Number of family members	1.6	1.0 (0.0 - 2.0)

in their study in Japan about the factors necessary for femoral neck fracture patients to walk and be independent that the important factors that independently influence the ability of these patients to walk are the muscle strength to extend the knees, complications and cognitive function [6]. An investigation about "Walking function of postoperative femoral neck fracture patients" by Uezono and Kato also reports that cognitive functions influence rehabilitation [7].

Therefore, the current study aimed to examine factors associated with psycho-cognitive functions after surgery for fractured femoral neck in the Japanese elderly.

Materials and Methods

Participants and procedure

Our retrospective study was approved by the Local Ethics Committee of Yamato University. Informed written consent was obtained from all patients. Patients included in our study group were community-dwelling elderly individuals who underwent operative treatment and rehabilitation for a traumatic hip fracture. All patients had been living independently prior to their hip fracture and could communicate sufficiently. Patients with a mental disorder, neurological disease, fractures at other sites of the lower limb, or severe dementia were excluded. The following demographic and clinical variables were extracted from medical records: age, sex, body mass index (BMI), type of fracture, operative treatment received, and relevant medical history. Patients' functional levels prior to injury were ob-

tained through interviews, either with the patient or with his/her family. Interviews were conducted by a nurse or physical therapist and an occupational therapist, with confirmation of agreement with the information in the patient's medical record.

Acute postoperative pain measures

Intensity of postoperative pain was assessed using the verbal rating scale (VRS). The VRS is an ordinal five-point scale, with pain intensity quantified as follows: 1, no pain; 2, slight pain; 3, moderate pain; 4, considerable pain; and 5, extreme pain. Previous research has shown the VRS to have a lower rate of non-compliance than the visual analog scale (VAS) for assessment of postoperative pain, including that after hip fracture surgery [8, 9]. Using the methods recommended by Briggs and Closs, we presented the VRS on an A4-sized sheet with the pain adjectives displayed in large print [5]. Patients were asked to point to the printed adjective that most closely described their pain during ADL. Pain intensity was measured on seven consecutive days after surgery.

Mental and cognitive measures

The Montgomery-Asberg depression rating scale (MADRS) was used to evaluate patients' mental function. The MADRS was developed as a subscale of the comprehensive psycho-pathological rating scale and is widely used in research and practice [9]. Cognitive function was assessed using the mini-mental state examination (MMSE). The MMSE, developed by

Table 2. Change in Pain (Verbal Rating Scale) Reported by Participants Over 7 Days (n = 142)

Types of pain	Verbal rating scale, mean score							Total (average)
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	
Pain at rest	1.863	1.576	1.420	1.374	1.252	1.210	1.214	1.416
Pain at motion	3.115	2.770	2.532	2.547	2.309	2.210	2.115	2.514
Night pain	2.920	1.949	1.706	1.613	1.723	1.435	1.431	1.825
Pain during activities of daily living	3.689	3.215	2.932	2.903	2.669	2.630	2.582	2.946

Table 3. Simple Correlation Coefficients Between the MMSE, MADRS-S, Number of Family Members, and Pain Type (n = 142)

Types of pain	BMI		MMSE		MADRS-S		Number of family members	
	r	P-value	r	P-value	r	P-value	r	P-value
Pain at rest	-0.060	0.483	-0.060	0.484	0.191*	< 0.05	0.082	0.346
Pain at motion	-0.129	0.130	-0.052	0.540	0.208*	< 0.05	0.037	0.673
Night pain	0.088	0.304	0.223**	< 0.01	0.131	0.134	-0.028	0.749
Pain during activities of daily living	0.035	0.683	0.004	0.965	0.298**	< 0.01	0.009	0.921

*Correlation coefficient is significant at 5% level. **Correlation coefficient is significant at 1% level. BMI: body mass index; MADRS-S: Montgomery-Asberg depression rating scale; MMSE: mini-mental state examination.

Folstein et al for the assessment of dementia, is the standard tool for cognitive testing worldwide [10]. The MADRS and 10 items selected from the MMSE were assessed on postoperative day 7. This time frame was based on the strength assessment findings of Jarvinen et al, who reported recovery of strength by 3 - 7 days after injury to a skeletal muscle, with infiltration of muscle satellite cells into the wound occurring by post-injury day 7 [11]. Therefore, because we speculated that physical functions and pain could be influential factors, we assessed mental and cognitive functions on the seventh day after surgery.

Statistical analysis

We calculated the means of the measured attributes (sex, age, fracture site, and operative procedure), and then calculated the means, medians, and first and third quartiles of the BMI, MMSE scores, MADRS scores, and number of family members (Table 1) and measured changes in reported pain for 7 days (Table 2). We then calculated simple correlation coef-

ficients to assess the relationships among physique, lifestyle, psycho-cognitive functions, and types of pain. We performed multiple regression analysis using the MMSE and MADRS scores as dependent variables, and created an MMSE and an MADRS model (Table 3).

We performed the Shapiro-Wilk test and assessed the normality of the distribution of a histogram in advance. No variables significantly deviated from the normal distribution or exhibited uneven frequency distributions. Therefore, we did not perform conversion to dummy variables or a logarithmic transformation. We also checked a correlation matrix table and found that there were no variables with r > 0.9. As such, we used all variables in our analysis. Results of the multiple regression analysis of each model with the forced entry procedure (Tables 4 and 5) were significant, with an analysis of variance P < 0.001. R^2 values were 0.221 for the MMSE model and 0.204 for the MADRS-S model, indicating good model fit.

We also added, as dependent variables, the factors with high coefficients of correlation as independent variables in our analysis, taking into account multicollinearity. P-values of < 0.05 indicated statistical significance. All analyses were per-

Table 4. Result of Multiple Regression Analysis With MMSE as a Dependent Variable (n =142)

	B	SE	β	t-value	P-value	Partial correlation	VIF
Constant	15.962	3.689		4.327	0.000		
Number of family members	-0.191	0.074	-0.225	-2.572	<0.01	-0.228	1.168
Pain at rest	-0.900	1.060	-0.081	-0.848	0.398	-0.077	1.382
Pain at motion	-0.615	0.844	-0.078	-0.728	0.468	-0.066	1.727
Night pain	1.949	0.628	0.305	3.102	<0.01	0.271	1.469
Pain during activities of daily living	-0.084	0.774	-0.012	-0.109	0.913	-0.010	1.848

R^2 = 0.204, ANOVA, P < 0.001. MMSE: mini-mental state examination; VIF: variance inflation factor.

Table 5. Result of Multiple Regression Analysis With MADRS-S as a Dependent Variable (n = 142)

	B	SE	β	*t*-value	P-value	Partial correlation	VIF
Constant	9.280	4.820		1.920	0.050		
Number of family members	-0.880	0.376	-0.200	-2.335	<0.05	-0.215	1.060
Pain at rest	0.953	1.298	0.073	0.734	0.464	0.069	1.430
Pain at motion	0.047	1.020	0.005	0.046	0.963	0.004	1.750
Night pain	0.717	0.775	0.097	0.925	0.357	0.087	1.580
Pain during activities of daily living	1.582	0.920	0.193	1.719	0.088	0.160	1.820

$R^2 = 0.221$, ANOVA, P < 0.001. VIF: variance inflation factor.

formed using SPSS version 20.0 (IBM Corporation, Armonk, NY, USA).

Results

We examined a total of 142 patients, with a mean age of 82.6 ± 8.9 years. The most common operative procedure performed was bipolar hip arthroplasty, which was performed in 66 patients (42.3%). In contrast, the Hansson Pin system was least frequently used and was performed in one patient (7%). Subjects had average physiques, with a mean BMI of 20.3. The study population was strongly suspected of having a high proportion of patients with dementia, with a mean MMSE score of 21.4 and median MMSE score of 22.0 (17.0 - 26.8). Mean and median MADRS-S scores were 8.7 and 7.0 (2.0 - 13.0), respectively. The cut-off value for distinguishing depression from non-depression was set at 12 (normal: < 12, mild: 12 - 21, moderate: 22 - 30, severe: > 30), indicating that the study population tended to be normal to mildly depressed.

The mean VRS as an assessment of pain 1 week after the surgery was high for ADL and low for pain at rest, with values of 1.42 for pain at rest, 2.51 for pain at motion, 1.83 for night pain, and 2.95 for pain during ADL. Reviewing all items, we observed that patients had mild-to-moderate pain 1 week after surgery.

Correlation coefficients among physique, lifestyle, psycho-cognitive functions (BMI, MMSE, MADRS-S, and number of family members), and types of pain (Table 3) showed that there was no correlation between BMI and number of family members, but that there was a positive correlation between MMSE and night pain (r = 0.223).

MADRS was positively correlated with most types of pain, with r = 0.191 for pain at rest, r = 0.208 for pain at motion, and r = 0.298 for pain during ADL. Results of the multiple regression analysis indicated that number of family members (β = -0.23, P < 0.01) and night pain (β = 0.30, P < 0.01) were factors associated with MMSE, and that number of family members (β = -0.23, P < 0.01) was a factor affecting MADRS.

Discussion

Results of the MMSE and MADRS models in the present study revealed that night pain and number of family members were factors affecting psycho-cognitive functions in a population with persistent pain 1 week after surgery for femoral neck fracture.

Number of family members was found to be a significant factor in both multiple regression analysis models. Pain, and night pain in particular, affect psycho-cognitive functions. It was also suggested that emotional changes were associated with number of family members.

In the study on the living environment and psycho-cognitive functions, Pulkki-Raback et al followed up 3,500 men and women from 2000 to 2008 for the use of anti-depressant drugs, and asked them about the form of their living, education, environment and lifestyle habits (e.g., smoking and drinking). Results showed that the rate of anti-depressant drug purchases was 80% higher in the group living alone than in the other group [12]. Finally, Holwerda et al published a survey showing that the risk of developing dementia increases by 64% in people who are feeling lonely compared to those who are not. In the present study, results based on the MADRS-S model support the trends shown in these previous studies. Taken together, it seems that living alone may be a factor affecting the psycho-cognitive functions of people with persistent pain during the first week after surgery.

Therefore, by giving accurate explanations about the pain according to different stages of the postoperative period and accurately explaining the prognosis, we may be able to relieve patients' concerns as much as possible and contribute to the stabilization of their psycho-cognitive functions.

These results demonstrate that there are different kinds of postoperative pain for a fracture of the femoral neck and that characteristics of the pain can change in the same patient.

Pain is personal, and can be difficult for other people to understand. However, the present study demonstrated that a major cause is having a family for patients to feel isolated because their pain cannot be understood by other people. In addition, healthcare professionals see the importance of willingness to understand patients' pain and specific situations.

Limitations of the present study include the fact that it only examined patients 7 days after surgery for femoral neck fracture and involved a high proportion of male subjects. In future research, we must confirm the validity of the present results by increasing the sample size, including the evaluation of items for psycho-cognitive functions secondary to the primary ones, and including other diseases. In addition, we only evaluated MMSE and MADRS-S for psycho-cognitive func-

tions in the present study, and would like to add more factors for analysis in future studies.

It is known that people who sleep less have an increased chance of developing types of dementia including Alzheimer's disease. According to a study in an Asian population, for every hour of sleep lost, cognitive function decreases by 0.67% [13]. Subjects in the present study were approximately 83 years old, representing a sample of elderly individuals. Elderly individuals generally do not sleep deeply and often wake up during the night or early in the morning.

Previous research shows that on average, about one in five (e.g. "one in five adults") feels he/she has a sleep disorder, and this ratio becomes one in three in elderly individuals [14]. Common symptoms of sleep disorders include waking up several times during the night and lying awake in bed for long periods of time. It is therefore not difficult to imagine that quality of sleep can easily become even poorer if the individual also has night pain. Quality of sleep may be improved by improving the lifestyle to reduce pain.

Conclusion

Our study demonstrated that living alone and night pain may be a factor affecting psycho-cognitive functions of people with persistent pain during the first week after surgery.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

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