Factors Affecting Home Discharge of Older Adults with Cervical Spinal Cord Injury in Japan Regional Population

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Abstract:

Introduction: Older adults with cervical spinal cord injury (CSCI) often have a poor prognosis due to the high number of complications, decreased motivation to rehabilitation, and poor response to treatment. This study aimed to investigate the characteristics of CSCI in Japanese older adults and examined the factors influencing their discharge home.

Methods: In this retrospective cohort study, we extracted data on consecutive cases with CSCI between 2005 and 2020 from the study hospital's database. Patients over 65 years old who were admitted to the hospital within 14 days of injury were selected. A univariate analysis was performed between the home discharge and out-of-home discharge groups. In addition, binary logistic regression analysis of admission findings and patient background was performed to examine independent factors influencing home discharge.

Results: Of the 219 patients included, 90 (41.1%) were eventually discharged to home. Comparing home discharge and out-of-home discharge groups revealed significant differences in age at injury, length of hospital stay, neurological level of injury (NLI), percentage of American Spinal Injury Association (ASIA) Impairment Scale (AIS: A), percentage of living alone, ASIA motor score (AMS), and Spinal Cord Independence Measure (SCIM) at initial visit and discharge. Binary logistic regression analysis revealed that old age (over 75 years old) at injury (odds ratio [OR]: 0.31, 95% CI: 0.16-0.60, P <.001), living alone (OR: 0.22, 95% CI: 0.03-0.42, P<.01), high level of injury (i.e., NLI: C1-4; OR: 0.22, 95% CI: 0.09-0.53, P<.0001), and percentage of AIS: A at admission (OR: 0.09, 95% CI: 0.04-0.24, P<.001) were independent factors that influenced home discharge.

Conclusions: More than 50% older adults with CSCI were discharged to a place other than their own home. Age, percentage of AIS: A, living alone, and high level of injury at admission were independent factors that influenced home discharge.

Keywords:

Cervical spinal cord injury, older adults, neurological level of injury

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Introduction

Japan is one of the countries with the highest population of older adults, which is expected to reach 33.3% by 2036[1)]. With this social context, the number of cervical spinal cord injury (CSCI) among older adults is expected to increase in Japan. In fact, in many countries with aging populations, the incidence of CSCI among older adults is rising[2-8)]. Older patients with CSCI most likely have a poor prognosis due to high number of complications, decreased motivation for rehabilitation, and poor response to treatment[3)]. In addition, even after overcoming acute death and complications, it is difficult for such patients to be discharged to their own home[9,10)]. Previous studies have reported that discharge of patients to a place other than their homes impairs the quality of life, physical health, and psychological well-being of the patients. Therefore, being discharged to their own home is preferable when possible[11)]. When treating older patients with CSCI, it is beneficial for patients and their families to generally understand the discharge goals from the acute phase.

In our hospital, we provide the full continuum of care for

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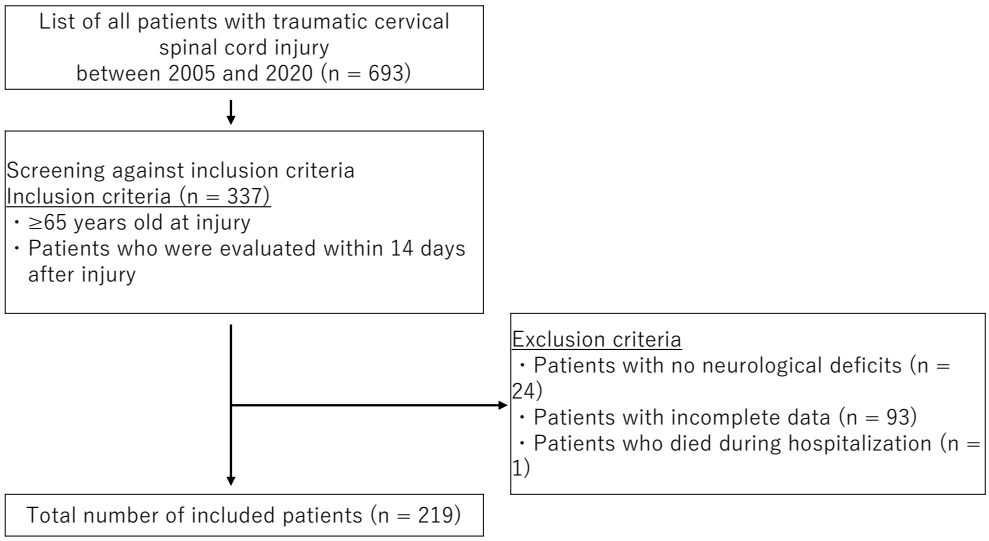

Figure 1. Patient selection flowchart.

spinal cord injury—from the acute phase of the injury to the chronic phase until discharge from the hospital. Consequently, we have access to detailed information from the time of injury until discharge from the hospital.

There have been several reports on the low rate of home discharge for cases of CSCI in the elderly, but these reports are from countries other than Japan. We believe that it is important to investigate the situation in Japan, considering that various factors such as medical level, culture, and the available resources for caregiving can influence the home discharge rates. Thus, our study aims to contribute to the understanding of this issue in the context of Japan's unique circumstances.

This study aimed to investigate the characteristics of CSCI in patients over 65 years old and examine the factors that influenced their discharge to home.

Materials and Methods

Study population

For this study, we reviewed the data from past medical records and our database. This included the data of 693 consecutive patients with CSCI who were hospitalized and treated at our hospital between 2005 and 2020. Of these, 262 patients who were over 65 years old and were admitted to the hospital within 14 days of injury were included in the study. Furthermore, patients without neurological deficits, those with incomplete data, and those who died during hospitalization were excluded. Finally, 219 cases were retrospectively examined (Fig. 1). The mean age of the target group was 74.1 (65-96) years, comprising 173 males and 46 females.

Survey items

Age, sex, cause of injury, length of hospital stay, neurological level of injury (NLI), injury requiring surgery, presence of bone injury, American Spinal Injury Association (ASIA) Impairment Scale (AIS), ASIA motor score (AMS), Spinal Cord Independence Measure (SCIM) at admission and discharge, cohabitant, and final discharge destination were investigated.

Statistical analysis

We compared the previously mentioned survey items between the two groups, i.e., those who were finally discharged to their own home and those who were discharged to other places. The Mann-Whitney U test and Chi-square test was used to compare the medians of continuous variables and the proportions of categorical variables between the two groups, respectively. In addition, a residual analysis was performed to further investigate the significant differences found in the Chi-square test. The level of significance was set at $P<0.05$. Moreover, we performed binary logistic regression analysis to examine independent factors related to discharge to home, based on the admission status. We used the following characteristics as independent variables: old age (over 75 years) at admission, sex, living alone, presence of bone injury and surgery, high level of injury (NLI: C1-4), complete injury (AIS: A) at initial examination, and SCIM at admission, considering that these data can be collected at the time of admission and can help clinicians make an informed estimation of a patient's discharge outcomes at the initial stages of their treatment. We used home discharge as the dependent variable.

All statistical analyses were conducted using the JMP software program for Macintosh (version 6.0.2; SAS Institute Japan, Tokyo, Japan).

Ethics

The Institutional Review Board of our hospital approved this study. The requirement for patient consent was waived due to the retrospective nature of the study.

Table 1. Patient Characteristics.

Characteristic	Value (n=219)
Age, mean (±SD) years	74.1 (±6.5)
Female, n (%)	46 (21.0)
Cause of injury, n (%)	
Falling down (<1 m)	104 (47.5)
Fall	86 (39.3)
Traffic accident	28 (12.8)
Entrapment under a heavy object	1 (0.5)
Living alone, n (%)	
No	199 (90.9)
Yes	20 (9.1)
No bone injury, n (%)	159 (72.6)
No surgery, n (%)	166 (75.8)
Hospital stay, mean (±SD) days	186.5 (±136.49)
Admission NLI, n (%)	
C1	2 (0.01)
C2	8 (3.7)
C3	95 (43.4)
C4	54 (24.7)
C5	34 (15.5)
C6	20 (9.1)
C7	6 (2.7)
C8	0 (0)
Admission AIS grade, n (%)	
AIS: A	57 (26.0)
AIS: B	30 (13.7)
AIS: C	79 (36.1)
AIS: D	53 (24.2)
AIS: E	0 (0.0)
Final AIS grade, n (%)	
AIS: A	52 (23.7)
AIS: B	6 (2.7)
AIS: C	42 (19.2)
AIS: D	108 (49.3)
AIS: E	11 (5.0)
Mean AMS, mean (±SD)	
Admission	35.0 (±31.0)
Final	57.0 (±35.0)
Mean SCIM, mean (±SD)	
Admission	9.6 (±5.0)
Final	45.0 (±34.0)

AIS, American Spinal Injury Association Impairment Scale; AMS, American Spinal Injury Association motor score; NLI, neurological level of injury; SCIM, Spinal Cord Independence Measure; SD, standard deviation

Results

Table 1 shows patient characteristics. The most common injury was caused by falling on level ground (47.5%). Patients without bone injury accounted for 72.6% of all cases, of which 46.1% had only a spouse living with them, 44.7% had a non-spouse living with them, and 9.1% lived alone. NLI was most commonly observed at the C3 level (43.4%). At the time of initial evaluation, AIS: A was present in 26% of the patients.

In our study, we found that 41.1% (90/219) of patients were discharged to their own home. When categorized by the AIS grade at initial examination, the percentages of patients discharged to their own home were as follows: 14.3% for AIS: A, 33.3% for AIS: B, 48.1% for AIS: C, and 64.2% for AIS: D. Furthermore, among patients aged 65 to 74 years, 50% were discharged to their own home, while for those aged 75 years and older, 33% were discharged to their own home ($P<0.05$). Of the 129 out-of-home discharge patients, 114 were transferred to other hospitals and 15 were discharged to nursing homes.

Univariate analysis was performed between the home discharge and out-of-home discharge groups (Table 2), which revealed significant differences between the two groups regarding age at injury, length of hospital stays, NLI, the ratio of AIS grades at admission and discharge, and percentage of living alone and AMS and SCIM at admission and discharge. In addition, the residual analysis confirmed that the proportion of AIS: A was significantly higher in the out-of-home discharge group than in the home discharge group.

Binary logistic regression analysis revealed that old age, living alone, high level of injury (NLI: C1-4), and percentage of AIS: A at admission were independent factors that influenced home discharge of patients over 65 years old with CSCI (Table 3).

Discussion

Home discharge rate

In this study, 41.1% of patients over 65 years old with CSCI were discharged to their own home. Damadi et al. reported that 40% of patients with cervical spine fracture living at home returned home after discharge[12]. However, since their study only included cases with bone injuries and some cases without neurological deficits, it cannot be directly compared with ours. We believe that the medical professionals should understand that more than half of the older patients with CSCI cannot be discharged to their home and should be treated accordingly.

Mortality rate

In our study, one patient with total CSCI was excluded due to death in the hospital. This mortality rate was much lower than that in previous reports[2,9,10,12,13]. Even if we assume that all 17 patients who were transferred to other hospitals due to medical complications subsequently faced death, this remains a low rate. We believe that this is because our hospital specializes in spinal cord diseases and has many medical and nursing professionals with specialized skills in spinal cord injury care.

Age

This study demonstrated that a higher age at the time of injury is associated with a lower rate of being discharged to home. This identification of age as an independent factor in

Table 2. Comparison of Return-to-home and Out-of-home Return Groups.

Characteristic	Returning home (n=90)	Out-of-home return (n=129)	*P value*
Age, mean (±SD) years	71.8 (±5.7)	75.8 (±6.5)	<0.01
Female, n (%)	23 (25.6)	23 (17.8)	0.1673
Cause of injury, n (%)			
Falling down (<1 m)	41 (45.6)	63 (48.8)	0.7542
Fall	38 (42.2)	48 (37.2)	
Traffic accident	11 (12.2)	17 (13.2)	
Entrapment under a heavy object	0 (0)	1 (0.8)	
Living alone, n (%)			
No	87 (96.7)	112 (86.8)	<0.05
Yes	3 (3.3)	17 (13.2)	
No bone injury, n (%)	64 (71.1)	95 (73.6)	0.8156
No surgery, n (%)	69 (76.7)	97 (75.2)	0.6584
Hospital stay, mean (±SD) days	224.8 (±144.3)	159.7 (±123.8)	<0.01
NLI, n (%)			
C1-4	57 (63.3)	102 (79.1)	0.01
C5-8	33 (36.7)	27 (20.9)	
Admission AIS grade, n (%)			
AIS: A	8 (8.9)	49 (38.0)	<0.0001
AIS: B	10 (11.1)	20 (15.5)	
AIS: C	38 (42.2)	41 (31.8)	
AIS: D	34 (37.4)	19 (14.7)	
AIS: E	0 (0)	0 (0)	
Final AIS grade, n (%)			
AIS: A	6 (6.7)	46 (35.7)	<0.0001
AIS: B	0 (0)	6 (4.7)	
AIS: C	6 (6.7)	36 (27.9)	
AIS: D	68 (75.6)	40 (31.0)	
AIS: E	10 (11.1)	1 (0.8)	
Mean AMS, mean (±SD)			
Admission	51.5 (±30.9)	23.0 (±26.0)	<0.001
Final	81.4 (±22.1)	40.0 (±32.0)	<0.001
Mean SCIM, mean (±SD)			
Admission	10.8 (±6.9)	9.0 (±3.0)	0.0017
Final	72.1 (±27.4)	25.4 (±23.8)	<0.0001

AIS, American Spinal Injury Association Impairment Scale; AMS, American Spinal Injury Association motor score; NLI, neurological level of injury; SCIM, Spinal Cord Independence Measure; SD, standard deviation

Table 3. Results from Binary Logistic Regression Analysis.

Risk factor	*P value*	Odds ratio	95% confidence interval
Age (≥75)	0.0005*	0.307	0.158-0.598
Male	0.1479	0.564	0.158-0.598
Living alone	0.0015*	0.223	0.025-0.418
Bone injury	0.2304	2.093	0.626-7.000
Surgery	0.0811	0.321	0.090-1.151
NLI: C1-4	0.0007*	0.223	0.094-0.533
AIS A	<0.001*	0.094	0.037-0.241
SCIM	0.0616	1.167	0.993-1.373

AIS, American Spinal Injury Association Impairment Scale; NLI, neurological level of injury; SCIM, Spinal Cord Independence Measure

binary logistic regression analysis was consistent with findings from previous studies[9,10]. In general, older age is associated with poorer functional outcomes[14,15], with an increased likelihood of comorbidities and secondary complications[3]. Although this study was limited to patients over 65 years old, age was identified as an independent risk factor, indicat-

ing its strong influence on the ability to return home.

The impact of living alone on home discharge decisions

Eastwood et al. evaluated 3904 patients with traumatic spinal cord injury and reported that the rate of home discharge was significantly higher in married patients than in unmarried ones[16]. In this study, the proportion of solitary residents was significantly greater in the out-of-home return group than in the return-to-home group in univariate analysis. In addition, in the binary logistic regression analysis, being single was identified as a significant factor that inhibited home discharge. Patients with CSCI require much care on a daily basis, and the presence of a caregiver may be critical for home discharge.

Cause of injury and the presence or absence of bone injury and surgery

Most patients (71.7%) in our study had CSCI without bone injuries, of which 47.5% of the injuries were caused by falls from a height of less than 1 m. This is consistent with previous reports that state that most cases of CSCI in older adults are caused by minor trauma such as falling[9,10,17-19]. Preexisting cervical spinal canal stenosis and ossification of the posterior longitudinal ligament have also been reported as risk factors in such cases[20,21]. It is generally believed that incomplete injury is common in such minor injury cases. Interestingly, there was no significant difference between the two groups in this study regarding the mechanism of injury, presence or absence of bone injury, or presence or absence of surgery. Therefore, we believe that there is hope for positive outcomes in patients with cervical spinal cord and bone injuries requiring surgery.

Length of hospital stay

The length of hospital stay was significantly longer in the home discharge group than in the out-of-home discharge group. This could be due to the fact that greater advanced activities of daily living (ADL) is required for being discharged to home. In addition, some patients in the out-of-home discharge group were transferred to other hospitals early due to medical complications, which may have contributed to the difference in the length of hospital stay.

NLI

In this study, the rates of NLI: C1-4 were significantly higher in the out-of-home discharge group than in the home discharge group in the univariate analysis. In addition, higher level of injury was identified as an independent factor inhibiting home discharge in the binary logistic regression analysis. This was consistent with a previous report[22]. It was inferred that higher NLI required a higher level of care, thus making home discharge more difficult.

Neurological findings

AIS: A at the time of injury was identified as an independent factor for being discharged home. Gulati et al.[10] reported that none of the cases with complete injury among patients over 65 years old with CSCI were discharged to home. In our study, 6 of the 57 (10.5%) patients with complete injury could be discharged to home, suggesting that patients with a complete injury can be discharged to home if appropriate rehabilitation and environmental conditions are provided at the time of discharge. Therefore, even if a patient has a complete injury at the initial consultation, he/she should not give up on the goal of being discharged to home.

Regarding AMS, higher value at admission corresponds to higher likelihood of home discharge. It is not difficult to imagine that a mild degree of paralysis at the initial visit determines the subsequent prognosis.

SCIM

SCIM at admission and discharge was significantly different between the two groups in a univariate analysis. Previous reports indicate that improvement in ADL is important for being discharged to home in patients with CSCI using the Functional Independence Measure[3,10]. Our study suggests that SCIM may also be used as a measure for home discharge. However, SCIM at the initial visit was not identified as an independent factor in binary logistic regression analysis, as it was uniformly low in patients with CSCI and does not help in estimating the prognosis. The aforementioned AIS and AMS are likely to be useful when considering the prognosis at the initial visit.

Limitations

This study had some limitations. First, we did not consider environmental factors such as housing situation (owned vs. rented) and insurance (e.g., workers' compensation or traffic accident insurance), which might have influenced the destination of discharge of the patients. Second, our analysis did not examine the impact of factors such as pressure ulcers or internal medical complications on the outcomes of the patients. These aspects warrant further investigation in future studies to provide a more comprehensive understanding of the factors that affect the destination of discharge for elderly patients with CSCI.

Conclusion

This study aimed to investigate the characteristics of older patients with CSCI and the factors that influenced home discharge. We discovered that age at admission, complete injury at the initial examination, living alone, and high level of injury at the initial examination were independent factors that influenced home discharge in older patients with CSCI.

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SS developed the study concept and design of the work; SS, TH, MM, OK, and TM acquired data; SS produced the figures; SS and MM statistically interpreted the data; SS drafted the work; OK, TY, and TM revised the work critically for key intellectual content.

Ethical Approval: The Institutional Review Board of the Spinal Injuries Center approved the study (approval number, 21-8-05). The requirement for patient consent was waived due to the retrospective nature of the study.

Informed Consent: The need for formal consent was waived due to the retrospective and noninvasive nature of the study.

Data Availability Statement: All data generated or analyzed during this study are included in the published article.

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