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ORIGINAL ARTICLE

Functional abilities, incidences of complications and falls of patients with spinal cord injury 6 months after discharge

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Study design: A prospective study.
Objectives: To evaluate the changes of functional abilities, incidences of complications and falls of patients with spinal cord injury (SCI) 6 months after discharge.
Setting: A major tertiary referral hospital, Thailand.
Methods: Forty-four patients with SCI completed the study. Their average age and post-injury time were 45.23 ± 13.78 years and 51.52 ± 47.87 months respectively. Functional abilities of the subjects were measured by using the Spinal Cord Independence Measure II (SCIM II). Incidences of complications and falls were prospectively assessed every month by using a questionnaire.
Results: After 6 months, the SCIM II scores of subjects showed a slight decrease (58.60 ± 21.22–58.37 ± 22.06 scores). The significant decrement was illustrated in self-care and mobility scores of subjects with chronic motor incomplete SCI ($P<0.05$). Forty subjects experienced at least one medical complication (range 1–5 times) which 11 of them had to re-admit for 3–30 days. Twenty-four subjects sustained at least one fall in 6 months (range 1–24 times) which one subject had metatarsal bone fracture after fall.
Conclusion: The functional ability of subjects with SCI, particularly those with chronic motor incomplete SCI, significantly decreased after discharge. The subjects also encountered a high risk of complications and falls that might associate with the decrement of functional ability. The findings confirmed important roles of community rehabilitation after discharge.
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Keywords: spinal cord injury; rehabilitation; functional ability; medical complication; fall

Introduction

Patients with spinal cord injury (SCI) suffer from a broad range of medical, social, psychological and economic problems, often because of the fact that the injury commonly occurs in young individuals.[1,2] In terms of medical problems, SCI results in voluntary musculature paralysis and reduces ability to control motor functions that affect vocational, avocational and self-care activities.[3] Evidences of patients with subacute SCI suggested that the patients can improve their functional ability after participation in a rehabilitation program.[4–6] However, this ability did not continue after discharge because of environmental constraints such as lack of home adaptation and assistive devices.[4] The reduction of motor performance while engaging in the same environmental conditions may induce hypoactive lifestyle, risk of injury and secondary health problems after discharge. Until now, this information has received little attention in literatures. There have only been a few studies that reported the changes in physical performance, incidences of complications and falls of SCI patients after discharge.[4,5] These studies investigated performance of the patients within the context of developed countries. Thailand is one of the developing countries which may have some aspects that hinder ability of the patients to continue the program and increase risk of complications and falls. Therefore, this study aimed to prospectively evaluate the changes of functional abilities, incidences of medical complications and falls of patients with SCI 6 months after discharge. The findings of this study would provide important insight into treatment modification to optimize the ability of the patients to be independent.

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Methods

The study recruited patients with complete and incomplete SCI, at least 18 years of age, from a major tertiary referral hospital in the northeastern area of Thailand. The eligible

subjects needed to have SCI from traumatic injuries or non-progressive diseases at a subacute or chronic stage of injury. The changes of functional abilities of subjects were assessed by using the Spinal Cord Independence Measure II (SCIM II).[7] The data were collected two times in a time period of 2–3 days before discharge, and 6 months later. During this time, the researcher (JW) phoned subjects every month to interview their incidences and consequences of medical complications and falls. The findings were confirmed by their care givers or relatives to ensure the information accuracy. All procedures were in accordance with the standards of the local ethics committee and with the Declaration of Helsinki. Subjects gave written consent before participation in the study.

The study was conducted from December 2008 to February 2010. Eighty-seven subjects were willing to participate in the study but only 50 subjects completed the first measurement. Six subjects dropped out during the period of 6 months follow-up. Therefore, the study reported data of 44 subjects. There were 35 males and 9 females whose average age was 45.23 ± 13.78 years (Table 1). Thirty-seven subjects were at a chronic stage of injury, with an average post-injury time of 51.52 ± 47.87 months. Twenty-one subjects were diagnosed as motor complete SCI (ASIA Impairment Scale: AIS A and B) and 23 subjects were motor incomplete SCI (AIS C and D). Other subject demographics were demonstrated in Table 1.

Statistical analyses
The study utilized the descriptive statistics to explain demographics and results of the study. The Wilcoxon signed rank test was applied to compare the changes of SCIM II total scores and its subitems after discharge. Levels of significant differences were set at P-value < 0.05.

Table 1 Demographics of subjects

Variables	*Results (N = 44)*
Age: mean ± s.d. (years)	45.23 ± 13.78
Gender (male:female) (*n*)	35:9
Post-injury times: mean ± s.d. (months)	51.52 ± 47.87
Stages: subacute/chronic (*n*)	7/37
Level of injury (tetraplegia:paraplegia) (*n*)	18:26
AIS (A:B:C:D) (*n*)	19:2:10:13

Abberviation: AIS, ASIA impairment scale.

Results

The changes of SCIM II total scores after discharge
The SCIM II total scores of all subjects slightly decreased (from 58.60 ± 21.22 to 58.37 ± 22.06 scores) 6 months after discharge ($P > 0.05$: Table 2). When analyzing the results based on severities and stages of injury, the median SCIM II scores of subjects with subacute SCI, both complete and incomplete lesions, demonstrated a greater change than those of subjects with chronic SCI (Table 2). However, there were no significant differences of SCIM II total scores of all analyses ($P > 0.05$).

The changes of SCIM subitem scores after discharge
The scores of subjects with subacute SCI, both motor complete and incomplete, increased in self-care, transfer and mobility items, but decreased in respiration and sphincter management items after discharge (Table 3). However, the alteration was not significantly different ($P > 0.05$). For subjects with chronic SCI, the scores of all subitems, apart from respiration and sphincter management, decreased during the follow-up time (Table 4). The significant differences were found in the decrement of self-care and mobility scores of subjects with motor incomplete SCI ($P < 0.05$, Table 4).

Incidences of medical complications 6 months after discharge
Forty subjects (91%) experienced at least one medical complication during the follow-up time (range 1–5 times/subject: Table 2). The complications that were frequently found included neuropathic pain (28 subjects, range 1–2 times/subject), urinary tract infection (UTI: 16 subjects, range 1–4 times/subject) and pressure ulcers (8 subjects, range 1–3 times/subject, Figure 1). The complications were found in every subject with motor complete SCI both subacute and chronic stages of injury. For subjects with incomplete SCI, the complications were found in every

Table 2 SCIM scores and incidences of complications and falls during 6 months after discharge

Severity of injury	*Stage of injury*	*SCIM scores (100 scores)*		P-*value*[a]	*Complications* (n)*:Range (times)*	*Falls (n):Range (times)*
		SCIM 1 (median ± s.d.)	*SCIM 2 (median ± s.d.)*			
All subjects (*n* = 44)		58.60 ± 21.22	58.37 ± 22.06	0.83	40:1–5	24:1–24
Motor complete SCI (AIS A and B) (*n* = 21)	Subacute (*n* = 3)	33.00 ± 10.21	39.00 ± 4.16	1.000	3:1–4	0
	Chronic (*n* = 18)	50.00 ± 15.64	51.00 ± 16.97	0.298	18:1–5	7:1–8
Motor incomplete SCI (AIS C and D) (*n* = 23)	Subacute (*n* = 4)	72.50 ± 26.51	81.50 ± 33.14	0.197	4:1–2	3:1–3
	Chronic (*n* = 19)	72.00 ± 17.01	70.00 ± 16.90	0.368	15:1–4	14:1–24

Abbreviations: SCIM, spinal cord independence measure; SCIM 1, SCIM scores before discharge; SCIM 2, SCIM scores at 6 months after discharge.
[a]*P*-value from Wilcoxon signed rank test.

Table 3 SCIM subitem scores 6 months after discharge of subjects with subacute SCI

Subitems	*Motor complete SCI (n = 3)*			*Motor incomplete SCI (n = 4)*		
	First test	*Second test*	P-*value*[a]	*First test*	*Second test*	P-*value*[a]
Self-care (20 scores)	12.00 ± 4.00	12.67 ± 4.16	0.66	8.75 ± 9.56	10.75 ± 9.74	0.20
Respiration and sphincter (40 scores)	20.00 ± 5.57	16.67 ± 3.21	0.59	35.00 ± 8.00	33.25 ± 9.60	0.18
Mobility (40 scores)	5.33 ± 2.08	8.33 ± 2.08	0.08	19.50 ± 12.40	25.75 ± 17.00	0.07

Abberviations: First test, SCIM subitem scores before discharge; Second test, SCIM subitem scores at 6 months after discharge.
[a]*P*-value from Wilcoxon signed rank test.

Table 4 SCIM subitem scores 6 months after discharge of subjects with chronic SCI

Subitems	*Motor complete SCI (n = 18)*			*Motor incomplete SCI (n = 19)*		
	First test	*Second test*	P-*value*	*First test*	*Second test*	P-*value*
Self-care (20 scores)	12.39 ± 5.24	12.17 ± 5.50	0.64	16.95 ± 3.44	15.68 ± 3.20	0.01[a]
Respiration and sphincter (40 scores)	22.06 ± 8.61	21.56 ± 7.79	0.86	28.79 ± 8.18	30.58 ± 8.53	0.41
Mobility (40 scores)	12.39 ± 5.39	11.59 ± 6.17	0.47	26.11 ± 9.00	24.32 ± 9.68	0.008[a]

Abbreviations: First test, SCIM subitem scores before discharge; Second test, SCIM subitem scores at 6 months after discharge.
[a]Significant differences from Wilcoxon signed rank test.

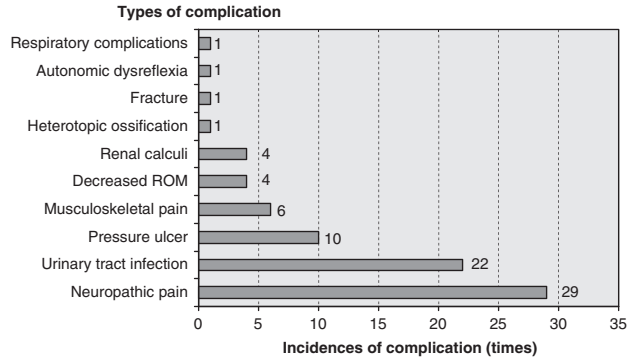

Figure 1 Incidences of medical complications of subjects 6 months after discharge.

subject with subacute injury. However, the incidences were also high (79%) in subjects with chronic SCI (Table 2). Eleven subjects had to re-admit because of UTI and pressure ulcer for 3–30 days (1–4 times/subject). Among these, two subjects had pressure ulcers (grade 4) that required operation and had to limit mobility for 14 days.

Falls during 6 months after discharge

Twenty-four subjects (55%) sustained at least one fall during 6 months after discharge (1–24 times/subject: Table 2). The falls occurred mostly in subjects with incomplete injury (17 in 23 subjects). Subjects with motor complete SCI fell mostly from a wheelchair whereas subjects with motor incomplete SCI fell during standing, but mostly while walking. Most falls occurred within and around the house from noon to evening. The falls were expected to be caused by balance impairment and hazardous environments. Most subjects had no subsequent injuries after falls but seven subjects had bruises, one reported muscular pain and one experienced metatarsal bone fracture that required medical attention and re-admission for 14 days with the limitation of weight bearing.

Discussion

This study reported the changes of functional abilities of subjects with SCI, 6 months after discharge. The study also prospectively evaluated incidences and consequences of medical complications and falls of the subjects during this time. Forty-four subjects completed the study. Functional abilities (SCIM scores) of subjects slightly altered after discharge (Tables 2–4). The SCIM scores of subjects with subacute SCI increased in self-care, transfer and mobility items, but decreased in respiration and sphincter management items after discharge (Table 3). On the contrary, the scores of all subitems, apart from respiration and sphincter management items, of subjects with chronic SCI decreased during the follow-up time. The significant differences were found in the reduction of self-care, transfer and mobility scores of subjects with chronic motor incomplete SCI (Table 4). Subjects reported a high incidence of medical complications (91%) and falls (55%) during this follow-up time. The complications were found in every subject with motor complete SCI and subacute incomplete SCI. The incidences were also high in subjects with chronic incomplete SCI. Furthermore, more than half of all subjects experienced at least one fall (range 1–24 times/subject) during the 6 months follow-up. The falls were mostly found in subjects with incomplete SCI during upright, mostly walking, activities.

At a subacute stage of injury, body systems are still in the plastic stage or have high capability for physical improvement

whereas, at a chronic stage of injury, the systems of the subjects becoming very rigid and difficult to show any changes.[8] This may enable subjects with subacute SCI, but not those with chronic SCI, to improve self-care, transfer and mobility scores after discharge. However, the decrement of acute rehabilitation length of stay, as reported by several studies[9–12], may place the subjects with subacute SCI to have a high risk of UTI because of the reduction of structured training and proper feedback in bladder management after discharge.[11,13] Thus, subjects showed the decreased scores of respiration and sphincter subitem. In contrast, at a chronic stage of injury, the patients have more capability of bladder management as illustrated in the literatures that intermittent catheterization program became less common and condom catheterization increased in these population.[11,14] Thus, the subjects demonstrated the increment of respiration and sphincter subitem scores after discharge.

The findings of SCIM total scores did not associate with those of Wirth *et al*.[10]. The researchers investigated functional abilities of subjects with complete SCI 1 year after injury. The results showed the significant improvement of SCIM scores during inpatients rehabilitation and after discharge. The disagreement may be because of the differences of study design and characteristics of the subjects. Wirth *et al*. (2008) retrospectively investigated functional ability during inpatients and after discharge of subjects with subacute SCI. In contrast, this study prospectively collected the data in subjects mostly at a chronic stage of injury (37 subjects with average post-injury time of 51.52 ± 47.87 months). Subjects also experienced a high incidence of medical complications and falls (Table 2). Haisma *et al*.[13] reported that medical complications can interfere with the beginning of active rehabilitation, disappoint the patients during rehabilitation and frequently lead to re-hospitalization. Tinetti *et al*.[15] indicated that falls induce fear of falling which restricts ability to independently conduct daily activities. As a result, frequent medical complications and falls may attribute negative impacts on functional ability of the subjects, particularly with chronic SCI, after discharge. In addition, the alteration of functional ability may be affected by the contextual constraints that the subjects encountered after discharge. Most subjects lived in rural areas in the northeast of Thailand and had economic problems. These areas rarely contained places that were specifically modified for individuals with physical disability.[16] Economic problems also prevented them from having all mobility aids and home adaptation. It is reasonable to expect that the reduction of motor ability, but engaging in the same environmental conditions may induce a hypoactive lifestyle that enhances risk of secondary health problems and affects ability to independently carry out daily activities.

Most subjects encountered medical complications from one to five times during 6 months. The three complications that were most widely reported included neuropathic pain, UTI and pressure ulcers (Figure 1), of which the later two were the leading causes of re-hopitalization. The results coincided with those of previous studies.[11,13,17,18] Such complications and consequences might offer negative impacts on the improvement of functional abilities. Barrett *et al*. (2003) reported pain as the highest incidences of medical complications that caused re-hospitalization in patients with SCI. Pain was associated with psychosocial factors such as depression, anger and negative cognition.[17,19] Chronic pain also affected quality of life and physical function of patients with SCI.[13,17] UTI and pressure ulcer were accounted as largely preventable complications.[11] However, these complications were still common etiologies of re-hospitalization in the many studies.[11,18] Re-hospitalization affected quality of life and substantially increased care cost to the subjects. The complications were found in every subject with motor complete SCI. Haisma *et al*.[13] reported factors induced risk of complications including increased age, increased body mass index, traumatic lesion, tetraplegia and complete lesion. Cardenas *et al*.[11] also illustrated that subjects who were discharged with lower motor FIM scores have a greater likelihood of re-hospitalization.

The incidences of falls of this study were higher than those reported by Brotherton *et al*. (2007). The researchers investigated falls in independent ambulatory subjects with SCI and found that 75% of the subjects sustained at least one fall a year.[20] In this study, 24 subjects (55%) experienced falls in 6 months. Wheelchair-bound subjects fell from wheelchair (7 in 21 subjects: 33%, range 1–8 times) whereas ambulatory subjects fell while performing an upright activity (17 in 23 subjects: 74%, range 1–24 times). This indicated a high risk of falls, particularly in more mobile subjects (high SCIM scores: Table 2). Higher functional ability might encourage the subjects to frequently perform daily tasks. However, impairment of motor control and inappropriate environmental conditions might enhance risks of injury to the subjects. Krause (2004) concluded the risks associated with subsequent injuries following SCI, included being younger, having less lesion severity, higher sensation-seeking score, heavy drinking and medication use for pain, spasticity, depression and sleep.[21]

The findings of this study provide important contributions to rehabilitation for patients with SCI. The reduction of rehabilitation length of stay increased the potential for patients to be discharged at a lower functional level. The functional level can be worse after discharge because of inappropriate contextual conditions, which can dramatically increase risks of medical complications and falls as evidenced in this study. Thus, outpatient and community rehabilitation may have a crucial role to reduce the problems.

Limitations

First, the authors realized that the subitems of SCIM II should be scored by specialized members of the rehabilitation team that is, a nurse for self-care and sphincter management, an occupational therapist for transfer items and a physiotherapist for mobility items. However, most subjects were unable to come to the hospital in the second follow-up time. Thus, the researcher (JW) was trained to visit and score the subjects at their homes to minimize the number of dropped out subjects. Second, results of the study may be affected by levels of the lesions. However, only 44 subjects accomplished the study with comparable

number of subjects with tetraplegia and paraplegia in motor complete and incomplete groups (8 complete tetraplegia, 13 complete paraplegia, 10 incomplete tetraplegia and 13 incomplete paraplegia). This may minimize the differences because of levels of the lesions. Last, the scope of this study did not involve factors underlying the changes of functional ability, and incidences of complications and falls. Thus, further study on these factors may provide precise information for the development of preventive strategies.

Conclusion

This study evaluated the changes of functional abilities, incidences and consequences of complications and fall in subjects with SCI 6 months after discharge. Results of 44 subjects demonstrated the significant reduction of SCIM II scores, particularly in chronic subjects. Subjects also encountered high incidences of medical complications and falls. The results confirmed the important role of outpatients and community rehabilitation.

Conflict of interest

The authors declare no conflict of interest.

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