Original Article
Effects of early rehabilitation on postoperative healing and complications in patients with spinal cord injuries

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Received September 11, 2018; Accepted November 10, 2018; Epub January 15, 2019; Published January 30, 2019

Abstract: Objective: The aim of this study was to investigate the effects of early rehabilitation on functional recovery and complications in patients with spinal cord injuries. Methods: This study retrospectively analyzed 342 cases of spinal cord injuries. A total of 158 patients receiving rehabilitation 30 days after surgery were included as the control group. A total of 184 receiving rehabilitation within 30 days after surgery constituted the observation group. The two groups were compared regarding motor and sensory function (American Spinal Injury Association scores), activities of daily living (modified Barthel index), functional independence (functional independence rating), and complications (pressure sores, deep vein thrombosis, pain, lung infection, and urinary tract infections). Results: There were no significant differences in motor function scores, sensory function scores, activities of daily living, or functional independence scores between the two groups before treatment (P>0.05). Significant differences were seen after treatment. Incidence of complications was significantly lower in the observation group than the control group (P<0.05). Incidence of pressure sores, pain, lung infections, and urinary tract infections was lower in the observation group than the control group (P<0.05). Conclusion: Early rehabilitation is beneficial to the recovery of motor function and sensory function. It can improve the activities of daily living, increase functional independence, and reduce occurrence of complications.

Keywords: Early rehabilitation, spinal cord injury, activities of daily living, complications

Introduction

Spinal cord injury refers to a transverse injury of the spinal cord, resulting in impaired motor, sensory, sphincter, and autonomic function. It is highly lethal and disabling [1, 2]. The annual incidence of spinal cord injuries has been increasing, seriously affecting the living standards of patients and placing a significant burden on society [3, 4].

In recent years, various new drugs and treatments, such as neurotrophic factors and stem cell transplantation, have been introduced. Their curative effects, however, for spinal cord injuries have not been satisfactory. Therefore, active rehabilitation therapy shows prominent value for patients, families, and society [5, 6].

Rehabilitation therapy is often started after the end of clinical treatment, leading to longer bed-rest times and higher complication rates. Moreover, in the acute phase of spinal cord injuries, some patients do not receive appropriate and effective rehabilitation. Some even have negative experiences that further add negative effects to the recovery [7, 8]. Active rehabilitation is a very effective means of promoting the remodeling of spinal cord function [9]. It can effectively alleviate progressive damage to spinal cord function, reducing occurrence of complications and enabling patients to better utilize the remaining functional abilities. This restores functional independence and improves quality of life [10]. In recent years, studies have reported that early rehabilitation can better stabilize patient conditions. However, some hospitals do not emphasize early rehabilitation and the timing of rehabilitation remains unclear.

This study retrospectively analyzed the medical records of 342 patients with spinal cord inju-
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Materials and methods

Research subjects

This study retrospectively analyzed 342 cases of spinal cord injuries treated between April 2012 and May 2017. A total of 158 patients that started rehabilitation 30 days after surgery were included as the control group, while 184 that started rehabilitation within 30 days after surgery were selected as the observation group. All patients met the guidelines of the Spinal Cord Injury Association, 5th edition. Patients were aged 21-58 years and included 213 males and 129 females. Disease duration lasted no more than 3 months. None of the patients had undergone rehabilitation therapy before the study and the vital signs of patients were stable. The patients had no abnormalities of the heart, liver, or kidneys and had no severe abdominal injuries, abnormal bleeding or coagulation, or history of alcoholism. Patients with combined limb fractures, incomplete data, history of gastritis, postoperative spinal instability, severe bone and joint disease, or mental or learning impairment were excluded. This study was approved by the Ethics Committee and written informed consent was obtained for each patient.

Treatment methods

Both groups of patients received treatment for the primary disease, including the use of corticosteroids, neurotrophic factors and other drugs, spinal decompression, and vertebral fusion with plate fixation. At the same time, rehabilitation was performed. Rehabilitation treatment time in this study was not more than 3 months. Both groups received comprehensive rehabilitation and physiotherapy for 3 months. This mainly included instruction in correct posture changes, exercise therapy, vascular adjustment training, promotion of systemic and limb circulation, neuromuscular electrical stimulation, bladder function training, and rectal function training. A rehabilitation treatment plan was formulated for each patient.

Observation indicators

American Spinal Injury Association (ASIA) grades were used to assess the degree of spinal cord injuries [11]. The ASIA score was used to evaluate motor and sensory function, while the modified Barthel index score was used to evaluate the performance of daily living activities. The functional independence rating scale was applied. Complications, including pressure sores, deep vein thrombosis, pain, lung infections, and urinary tract infections, were assessed in all patients.

Statistical analysis

SPSS 19.0 (Asia Analytics Formerly SPSS China) was used for statistical analysis. Enumeration data are expressed as [n (%)]
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![Figure 1. Evaluation of motor function, *indicates P<0.05.](image1)

![Figure 2. Evaluation of sensory function, *indicates P<0.05.](image2)

![Figure 3. Evaluation of the ability to perform activities of daily living, *indicates P<0.05.](image3)

Results

General information

The control group comprised 158 patients, including 101 males and 57 females, with an average age of 43.2 ± 7.6 years. There were 184 patients in the observation group, including 112 males and 72 females, with an average age of 44.1 ± 6.9 years. There were no significant differences regarding sex, age, education level, place of residence, ASIA classification, and spinal cord injury levels between the two groups (P>0.05) (Table 1).

Patient motor ability evaluation

There were no significant differences in motor function scores between the two groups before treatment (P>0.05). After treatment, there were significant differences in motor function scores between the two groups (P<0.05). The motor function score in the observation group was significantly higher than that in the control group (P<0.05). Motor ability scores of the two groups after treatment were significantly higher than those before treatment (P<0.05) (Figure 1).

Patient sensory function scores

There were no significant differences in sensory function scores between the two groups before treatment (P>0.05). After treatment, there were significant differences in sensory function scores bet-
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There were no statistical differences in scores between the two groups before treatment (P>0.05). After treatment, there were significant differences in scores between the two groups. Scores in the observation group were significantly higher than those in the control group (P<0.05). Activities of daily living scores in the two groups after treatment were significantly higher than before treatment (P<0.05) (Figure 3).

Functional independence evaluation

There were no statistical differences in functional independence scores between the two groups before treatment (P>0.05). After treatment, there were significant differences in functional independence scores between the two groups (P<0.05). Functional independence scores in the observation group were significantly higher than those in the control group (P<0.05). Functional independence scores in the two groups after treatment were significantly higher than before treatment (P<0.05) (Figure 4).

Statistical analysis of patient complications

The total complication rate was 61.39% (97 cases) in the control group and 36.96% (68 cases) in the observation group. There were statistically significant differences in total complication rates between the two groups (P<0.05). Incidence of complications in the observation group was significantly lower than that in the control group (P<0.05). There were also statistically significant differences in incidence of pressure sores, pain, lung infections, and urinary tract infections between the two groups. Incidence rates in the observation group were all lower than those in the control group (P<0.05), but the incidence rate of deep vein thrombosis was not statistically different (P>0.05) (Table 2).

Discussion

Spinal cord injuries cause impaired sensation, movement, and autonomic function, adversely...
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Affecting physical and psychological conditions [12]. Early rehabilitation can improve motor function, prevent complications, and improve the ability to perform activities of daily living [13]. This retrospective study examined the importance of early rehabilitation in 342 cases of spinal cord injuries.

Medical records of 342 patients with spinal cord injuries that underwent rehabilitation were included in the present analysis. There were no statistically significant differences in sex, age, education, place of residence, ASIA classification, and injury location between the two groups. Therefore, they were comparable. After rehabilitation, scores of motor and sensory functioning in the two groups were higher than before treatment. Results indicated that active rehabilitation was beneficial to the recovery of motor and sensory function in spinal cord injuries. The present study also found that recovery of motor and sensory function with early rehabilitation was significantly higher than that without early rehabilitation, indicating that early rehabilitation can more effectively restore motor and sensory function in patients with spinal cord injuries. Rehabilitation and clinical treatment are equally important for patients with spinal cord injuries. A patient that does not receive timely rehabilitation will have inadequate clinical results, especially in cases of complete spinal cord injuries [14]. Although the recovery of motor and sensory function in patients with spinal cord injuries is the main goal of rehabilitation therapy, it also brings positive outcomes for restoration of activities of daily living and functional independence [15]. After rehabilitation, activities of daily living and functional independence scores in the two groups were higher than those before treatment. Therefore, rehabilitation can effectively restore activities of daily living and functional independence in patients with spinal cord injuries, indicating its curative value. Activities of daily living and functional independence scores with early rehabilitation were also significantly higher than those without early rehabilitation, suggesting timely early rehabilitation’s importance, in accord with previous reports [16, 17]. Moreover, incidence rates of complications in patients receiving early rehabilitation were significantly lower than in patients without early rehabilitation, in accord with previous reports [18, 19]. Patients undergoing early rehabilitation can change positions more often and have a shorter bedrest time, making the blood vessels more adaptable to pressure and reducing occurrence of pressure sores. The underlying mechanisms remain unclear, but pain can seriously affect psychological status, with adverse effects on treatment. Pulmonary infections are among the most serious complications in spinal cord injuries, mainly due to the interrupted connection between the spinal cord and central nervous system. Early rehabilitation can also reduce indwelling catheter time and decrease incidence of urinary tract infections [20, 21]. However, the present study did not find a difference in the incidence rates of deep vein thrombosis between the two groups, possibly because of the shorter study duration. Therefore, this study should promote further research on early rehabilitation for spinal cord injuries.

In summary, early rehabilitation is more conducive to recovery of motor and sensory function. It can improve activities of daily living, increase functional independence, and reduce occurrence of complications. Therefore, early rehabilitation may have a positive impact on the early return of patients with spinal cord injuries to society.

Disclosure of conflict of interest

None.

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