RESEARCH REPORT

Study on factors related to loss of lower extremity muscle mass in elderly acute stroke patients

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Abstract The present study investigated the factors contributing to the loss of upper and lower extremity muscle mass in three elderly stroke patients with right hemiplegia in whom our rehabilitation program could not be performed at 1-2 weeks after onset. The results revealed common factors such as prolonged accurate microinjection of hypotensive agents, severe hemiplegia (Brunnstrom stage Ⅰ or Ⅱ), diarrhea and delayed initiation of tube feeding at 3 to 8 days after onset. With regard to individual differences, while all patients were recovering in bed, the degree of decrease in muscle mass varied among patients because they moved their extremities differently.

Key words : elderly, acute stroke patients, loss of lower extremity muscle mass, related factors

Introduction

In recent years, the importance of rehabilitation during the acute phase of stroke is being recognized, and the notion that rehabilitation must begin during the acute phase is becoming more widely accepted. However, when providing nursing care to acute stroke patients, it is necessary to provide seemingly contradictory treatments, i.e., rest as part of acute patient management and exercise to prevent disuse syndrome. Hence, patients tend to remain rested in bed. Studies have been conducted using CT and DXA to analyze disuse muscle atrophy (reduced muscle mass) in cerebrovascular disorder patients[1－3]. Disuse muscle atrophy occurs on not only the paralyzed side, but also the unaffected side, and for prevention, studies have reaffirmed the necessity of placing patients in anti-gravity postures, such as sitting and standing positions, beginning in the acute phase[4－5]. However, in actual clinical settings, it is not possible to actively perform rehabilitation on elderly patients with cerebrovascular disorders due to complications such as fever and diarrhea.

Here, we examined three elderly stroke patients with right hemiplegia in whom our rehabilitation program could not be performed during the acute phase.

Objective

The present study investigated and compared three elderly patients with right hemiplegia in whom our rehabilitation program could not be performed at 1-2 weeks after onset in order to identify the factors related to the loss of lower extremity muscle mass. The re-

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sults of the present study should aid acute-phase recovery in elderly stroke patients.

Terminology

The early phase of stroke was defined as within two weeks of onset.

Methods

1. Subjects and Methods

Of stroke patients who were admitted on emergency to our hospital, subjects were those in whom a rehabilitation program designed by the authors could not be performed. In order to maintain consistency in disease conditions, three right-handed patients with right hemiplegia were selected.

The lower and upper extremity muscle mass of the three patients was measured by DXA (USA, Hologic Inc., QDR Delphi). The first measurement was performed at 3-5 days after onset, and the second measurement was performed at 7 days after the first measurement. Consciousness level, nutritional status, body weight and lower extremity circumference were measured twice at the same time as DXA. Other data were obtained from medical charts.

In the three patients, comparative analysis was conducted using the following 19 attributes and predictors for low lower extremity muscle : age, gender, disease, main therapy, accompanying disease, treatment, paralyzed side, affected-side motor function (Brunnstrom stage), consciousness level, swallowing disorder, aphasia, communication level, other relevant symptoms, nutritional status (TP : total protein), start of oral intake after admission, diet, length of infusion, activity level, body weight and lower extremity circumference.

The rehabilitation program that we designed was an exercise program that was separate from the rehabilitation programs designed by nurses and physical therapists. The rehabilitation program was not performed when patients did not meet the program criteria.

2. Ethical considerations

The present study was conducted after receiving the approval of the Ethics Committee for Clinical Research at Tokushima University Hospital. The contents of the study were explained to the subjects and their families. Upon verbal and written explanation that participation was voluntary, that nobody would be disadvantaged in medical treatment and nursing due to discontinuation or lack of participation in the study, and that privacy would be protected, agreement to participate was obtained in writing.

Results

1. Decreased muscle mass

Table 1 shows the muscle mass and the degree of decrease in the upper and lower extremities on the paralyzed and unaffected sides, as assessed by DXA.

Table 1 Comparison of upper and lower extremity muscle mass among the three patients

	Case A	Case B	Case C	Mean (SD)
Lower extremity muscle mass (DXA)				
Paralyzed side, first test (g)	4,831	6,307	5,664	5,600 (661)
Paralyzed side, second test (g)	4,568	5,752	5,073	5,131 (502)
Difference (Second test-First test) (g)	−263	−555	−591	−469 (179)
Degree of decrease (%)	−5.4%	−8.8%	−10.4%	
Unaffected side, first test (g)	4,743	6,060	4,958	5,253 (706)
Unaffected side, second test (g)	4,382	5,526	4,780	4,896 (580)
Difference (Second test-First test) (g)	−361	−534	−174	−357 (178)
Degree of decrease (%)	−7.6%	−8.9%	−3.5%	
Upper extremity muscle mass (DXA)				
Paralyzed side, first test (g)	2,427	2,727	2,282	2,478 (227)
Paralyzed side, second test (g)	2,194	2,833	2,221	2,416 (361)
Difference (Second test-First test) (g)	−274	106	−61	−62 (169)
Degree of decrease (%)	−11.3%	+3.9%	−2.7%	
Unaffected side, first test (g)	1,912	2,275	2,000	
Unaffected side, second test (g)	1,812	2,398	1,934	2,062 (189)
Difference (Second test-First test) (g)	−100	123	−66	2,051 (305)
Degree of decrease (%)	−5.2%	+5.4%	−3.3%	−11 (111)

Degree of decrease = (Second-test muscle mass-First-test muscle mass) / First-test muscle mass × 100%

On both the paralyzed and unaffected sides, lower extremity muscle mass during the first measurement was lower than that during the second measurement, and the difference between the two measurements was 469 g (SD：179) on the paralyzed side and 320 g (SD：178) on the unaffected side. In Case B, upper extremity muscle mass during the second measurement was higher than that during the first measurement, but in the other two patients, upper extremity muscle mass during the first measurement was higher than that during the second measurement.

2．Predictors for low lower extremity muscle mass

Table 2 compares the factors for low muscle mass in

Table 2．Profile of three patients

	Case A	Case B	Case C
Age and gender	80 year-old man	77 year-old man	73 year-old woman
Disease	Cerebral bleeding	Cerebral infarction	Cerebral bleeding
Main therapy	Precise microinjection of hypotensive agent for 5 days	Precise microinjection of hypotensive agent for 5 days	Precise microinjection of hypotensive agent for 9 days
Complications	Hypertension	Hypertension and DM	Hypertension
Consciousness level GCS : first test Second test	E 4 M 6 V 3 E 4 M 6 V 3	E 4 M 6 V 1 E 4 M 6 V 1	E 3 M 5 V 3 E 3 M 6 V 3
Paralyzed side	Right	Right	Right
Paralyzed-side movement Brunnstrom stage Lower extremity Upper extremity	 Ⅰ Ⅰ	 Ⅱ Ⅱ	 Ⅰ Ⅰ
Physical activity (within 10 days of onset)	Remained in bed Getting up：30－45°	Remained in bed Getting up：45－90°	Remained in bed Getting up：45－90°
Swallowing disorder	Yes	Yes	Yes
Aphasia	Yes	Yes	Yes
Communication	Communicate using gestures	Communicate only through eye contacts	Communicate using gestures
Other relevant symptoms	Diarrhea, restlessness, and physical restraint for restlessness	Diarrhea, fever, and passive movements of upper extremities	Diarrhea, and able to raise the unaffected knee and elevate the hips
Nutritional state total protein (g/dl) on admission First test Second test	 7.3 5.4 5.7	 7.8 5.6 6.8	 7.2 6.4 6.5
Start of oral intake (after admission)	4 days	8 days	3 days
Food intake	Tubal feeding	Tubal feeding	Tubal feeding
Duration of drip infusion (days)	15	17	8
Discharge from SCU after admission	Sixth day	Sixth day	Tenth day
Body weight (kg) First test Second test Difference (Second test-First test)	45.9 44.8 －1.1	58.8 56.8 －2.0	48.2 46.1 －2.1
Lower extremity circumference (cm) Paralyzed side, first test second test Difference (Second test-First test)	 34.2 33.9 －0.3	 38.7 37.6 －1.1	 40.9 40.6 －0.3
Unaffected side, first test second test Difference (Second test-First test)	34.4 33.7 －0.7	38.3 36.0 －2.3	39.3 37.6 －1.7

the three patients. Patients were aged 80, 77 and 73 years. Two patients had cerebral bleeding and one patient had cerebral infarction. There were two men and one woman. The degree of paralysis as assessed by Brunnstrom's system was stage Ⅰ or Ⅱ (lower extremity), and in Case B, only slight active movements were possible for both upper and lower extremities (Brunnstrom stage Ⅱ). All three patients had aphasia, but Case B had severe aphasia and was only able to communicate through eye contact. All three patients had swallowing disorders, and after some period of fasting, transnasal feeding was initiated at 2-8 days after onset. With regard to complications, all patients had hypertension, and Case B had diabetes. Hypertension and diabetes were treated using hypotensive and antidiabetic agents while closely monitoring blood pressure and blood glucose. In addition, all three patients had diarrhea, and Case B had ≥38.0°C fever. While total protein was favorable immediately after admission, it dropped below 6.5 mg/dl at 3-4 days after onset. As to physical activity for the first ten days after onset, all patients stayed in bed. On average, body weight decreased by 1.7 kg and lower extremity circumference by 0.7-1.3 cm.

The following common items were extracted : (1) right hemiplegia ; (2) swallowing disorder ; (3) aphasia ; (4) diarrhea ; (5) precise continuous hypotensive agent injection as main therapy ; (6) total protein on admission was ≥7.0g/dl ; (7) oral intake was initiated ≥ 3 days after admission ; (8) loss of body weight ; (9) loss of lower extremity muscle mass ; and (10) decreased lower extremity circumference. The three patients differed in the following regards : Case A was restless, and it was necessary to restrain the unaffected side (left) ; in Case B, because a family member passively raised the upper extremities forward about two hours a day, upper extremity muscle mass increased ; and Case C raised the unaffected knee on her own.

Discussion

In order to identify the factors related to loss of lower extremity muscle mass, we examined elderly stroke patients with severe right hemiplegia (Brunnstrom stage Ⅰ or Ⅱ) in whom our rehabilitation program could not be performed at 1-2 weeks after onset.

Among the three patients, 19 attributes and predictors for low lower extremity muscle mass were analyzed, and ten common factors were extracted. Of these, particularly relevant factors included : severe hemiplegia (Brunnstrom stage Ⅰ or Ⅱ) resulting in no movement or minimal active movement on the paralyzed side ; diarrhea ; initially impossible oral intake, and tubal feeding started 3-8 days after onset ; and prolonged accurate microinjection of a hypotensive agent (5-9 days). With regard to movement in Cases A, B and C while lying down, Case A exhibited no intentional or spontaneous movement, but Case C frequently raised the unaffected knee on her own. Patient movements and the degree of decrease in upper and lower extremity muscle mass were analyzed over a 1-week period, and the degree of decrease was low for the areas of the body that were often moved. As has been suggested, loss of lower extremity muscle mass can be minimized by intentionally moving muscles or placing patients in anti-ravity postures[4-5]. However, the factors contributing to patients remaining immobile varied, and as a result, it is necessary to provide care while resolving each issue so that patients can be placed in anti-gravity postures. Based on the results obtained in the present patients, loss of lower extremity muscle mass can be prevented by placing patients in anti-gravity postures, such as sitting or standing, as much as possible, and minimizing the duration of fasting to prevent malnutrition. It is necessary to provide nursing care to resolve these issues.

A limitation in the present study was that only three patients were enrolled. In the future, we plan to continue to investigate factors that increase lower extremity muscle mass and establish nursing techniques to improve the QOL of acute stroke patients.

Conclusions

In three elderly stroke patients with right hemiplegia in whom our rehabilitation program could not be

performed at 1-2 weeks after onset, the factors contributing to the loss of lower extremity muscle mass were investigated. The results identified the following common factors : severe motor dysfunction and hemiplegia resulted in minimal mobility, diarrhea, and delayed initiation of tubal feeding at 3-8 days after onset.

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