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STUDY OF EDEMA REDUCTION PATTERNS DURING THE TREATMENT PHASE OF COMPLEX DECONGESTIVE PHYSIOTHERAPY FOR EXTREMITY LYMPHEDEMA

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ABSTRACT

Shortening the treatment phase of complex decongestive physiotherapy (CDP) is extremely important both for individual patients and medical economics. In 83 patients with stage II unilateral secondary extremity lymphedema (31 upper extremities and 52 lower extremities), the daily changes in the volume of affected extremities during the treatment phase of CDP were prospectively investigated. For the upper extremity lymphedemas, the biggest change was seen between days 1 (100% residual edema rate) and 2 (46.0 ± 2.7%; mean ± SD) of therapy with a 54.0% reduction ($p<0.0001$). Between days 2 and 3 (38.0 ± 2.6%) of therapy, there was an 8.0% reduction ($p<0.05$). From days 3 to 6 of therapy, slight changes ranging from 0.2 to 3.2%/day were seen. For the lower extremity lymphedemas, the biggest change was seen between days 1 (100%) and 2 (44.5 ± 2.1%) of therapy with a 55.5% reduction ($p<0.0001$). Between days 2 and 3 (33.5 ± 2.6%) of therapy, there was an 11.0% reduction ($p<0.001$). The daily volume changes from days 4 to 6 were slight, ranging from 0.1 to 1.0%/day. During the treatment phase of CDP, the largest volume changes were seen soon after the start of therapy.

Keywords: combined physical therapy, complex decongestive physiotherapy, complete decongestive therapy, complex decongestive therapy, lymphedema, reduction rate

Lymphedema is a chronic disease (1-3), and many patients face physical and psychological pain, as well as economic burdens of treatment. Complex decongestive physiotherapy (CDP) generally involves a two-stage treatment, i.e., treatment phase and maintenance phase, and is known as the standard therapy for lymphedema (1). However, in many countries, including Japan, proper treatments are not necessarily administered, and it is not an overstatement to say that the main emphasis had been on curing cancer, while the existence of secondary lymphedema had been basically ignored. This situation changed after the American Cancer Society hosted a lymphedema workshop in New York in 1998, and a supplement on this workshop was published (2,4-7). Many oncologists believed that there were no effective treatments for secondary lymphedema, and this workshop finally brought awareness of the standard therapeutic approach for lymphedema which had previously been reported by Földi (8,9) and Casley-Smith (10). In Japan, the first clinic to perform CDP opened in 2000, and in 2002, the Medical Lymph Drainage Association of Japan (NPO) was founded in order to educate therapists involved in the treatment of lymphedema.

At present, CDP for the treatment of lymphedema is not covered by national health insurance in Japan. Hence, we have been performing CDP on an outpatient basis and attempting to shorten the treatment phase of CDP without compromising therapeutic effects in an effort to reduce the economic burden on patients (11). Shortening the treatment phase of CDP is extremely important not only for individual patients but also medical economics (4) but to our knowledge, there has not been a study statistically investigating edema reduction patterns during the treatment phase of CDP.

Here, in order to determine the feasibility of further shortening the treatment phase, we investigated the daily lymphedema reduction patterns during the treatment phase of CDP at our clinic.

PATIENTS AND METHODS

We prospectively investigated 83 patients with stage II (showing no pitting, no effect of elevation, and no lymphatic elephantiasis) (1) unilateral secondary extremity lymphedema who started CDP at our clinic between September 1, 2005, and February 20, 2008 (31 patients with upper extremity lymphedema and 52 patients with lower extremity lymphedema). The median age of the patients was 62.0 years (range: 30-81 years), and the median BMI (body mass index) was 23.0 (range: 17.6-32.8). The underlying disease for all 31 patients with upper extremity lymphedema was breast cancer, and of the 52 patients with lower extremity lymphedema, 24 patients had endometrial cancer, 13 patients had cervical cancer, 12 patients had ovarian cancer, 1 patient had colon cancer, 1 patient had endometrial cancer complicated by colon cancer, and 1 patient had inguinal soft tissue sarcoma.

As reported previously (11), our CDP program consists of treatment and maintenance phases. During the treatment phase, four steps, i.e., meticulous skin care, manual lymph drainage, multiple layer compression bandaging and remedial exercises, are administered to reduce affected extremities. At our clinic, all daily treatment sessions are 60-minutes. In the present study, manual lymph drainage and multiple layer compression bandaging were initiated on Monday and were repeated every 24 hours. When therapy continued into the next week, multiple layer compression bandaging was repeated every 24 hours from Monday to Saturday, and from Saturday to the next Monday bandaging was continued for 48 hours. On the following Monday, bandaging was again repeated every 24 hours.

In the maintenance phase of CDP, edema reduction reached a plateau, and CDP was continued to maintain the status of reduced affected extremities with the use of compression garments. A transition to the maintenance phase was made when no further improvement was detected by monitoring the volume of affected extremities and changes in ultrasound findings on a daily basis.

The volume of affected extremities was assessed by measuring circumference at the following seven sites: the elbow, 20, 15 and 10 cm above the elbow, and 20, 15 and 10 cm below the elbow for the upper extremity; and the knee, 30, 20 and 10 cm above the knee, and 30, 20 and 10 cm below the knee for the lower extremity. Extremity volume was calculated using a formula reported by Casley-Smith (12): $V=h(C^2+Cc+c^2)/12\pi$, where, V is volume, C and c are the circumferences at both ends, and h is the height at both ends. Edema reduction rate (%) was calculated as: (affected extremity volume before therapy - affected extremity volume following therapy)/(affected extremity volume before therapy - unaffected extremity volume) x 100. Residual edema rate was calculated: 100 - edema reduction rate (%).

Complete CDP and measurements of extremity circumference were performed by the same therapist.

The Mann Whitney *U*-test and Student's *t*-test were used to statistically analyze the volume of affected extremities. All analyses

TABLE 1
Therapeutic Results During the Treatment Phase of Complex Decongestive Physiotherapy

Mean Whitney *U*-test	Median (range)	
Upper extremity lymphedema (n=31)		
Duration of the treatment phase of CDP (days)	4 (2-10)	
Affected extremity volume before therapy (ml)	2,048 (1,429-3,958)	] P<0.0001
Affected extremity volume after therapy (ml)	1,782 (1,254-2,626)	
Initial lymphedema volume (ml)	495 (152-1,904)	
Edema reduction volume (ml)	262 (129-1,332)	
Edema reduction rate (%)	59.1 (34.8-131.9)	
Lower extremity lymphedema (n=52)		
Duration of the treatment phase of CDP (days)	5 (2-17)	
Affected extremity volume before therapy (ml)	7,878 (5,403-14,010)	] P<0.0001
Affected extremity volume after therapy (ml)	6,265 (4,684-10,006)	
Initial lymphedema volume (ml)	2,057 (643-6,242)	
Edema reduction volume (ml)	1,576 (518-4,248)	
Edema reduction rate (%)	73.5 (52.7-120.2)	

were carried out using StatView J-5.0 PPC ® (SAS Institute Inc., Cary, NC, USA) with the level of significance set at $p<0.05$.

RESULTS

Table 1 shows the therapeutic results during the treatment phase for the patients in the present study. The median duration of the treatment phase, or the median number of days for edema reduction to reach a plateau for upper and lower extremity lymphedemas was 4.0 days (range: 2-10 days) and 5.0 days (2-17 days), respectively, and the median edema reduction rate was 59.1% (34.8-131.9%) and 73.5% (52.7-120.2%), respectively.

Figure 1 shows the changes in residual edema rate (100-edema reduction rate) during the treatment phase for the upper extremity lymphedemas. The change in residual edema rate was greatest between days 1 (100%, n=31) and 2 (46.0 ± 2.7%; mean ± SD, n=31) of therapy with a 54.0% reduction ($p<0.0001$). Between days 2 and 3 (38.0 ± 2.6%, n=31) of therapy, there was an 8.0% reduction ($p<0.05$), which was smaller when compared to the change between days 1 and 2 of therapy. From days 3 to 6 (n=14) of therapy, the degree of volume change was slight, ranging from 0.2 to 3.2%/day.

Figure 2 shows the changes in residual edema rate during the treatment phase for lower extremity lymphedemas. With regard

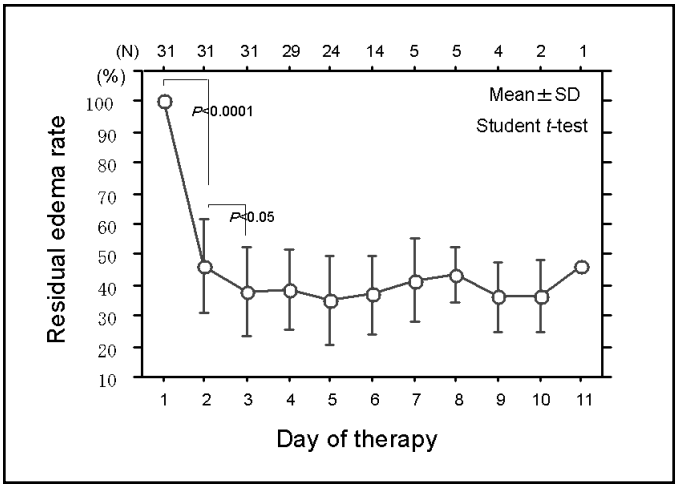

Fig. 1. Changes in the residual edema rate during the treatment phase of CDP for upper extremity lymphedema are shown. The largest changes were seen between days 1 and 2 of therapy, and the volume reductions after day 3 of therapy were slight. As patients migrated to maintenance phase of treatment, number of subjects (N) in active phase reduced.

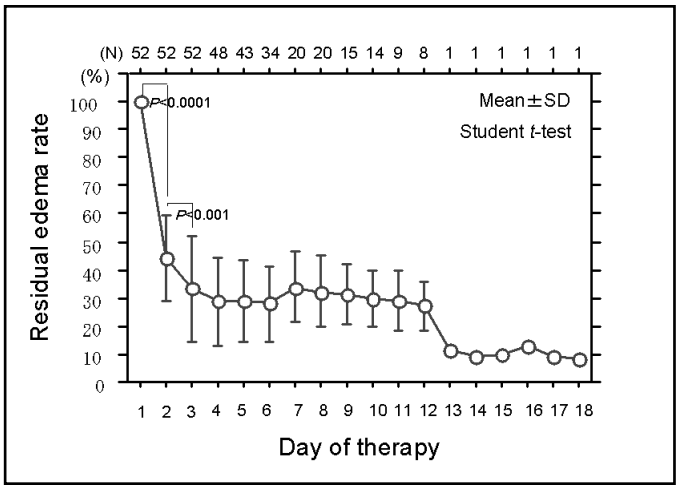

Fig. 2. Changes in the residual edema rate during the treatment phase of CDP for lower extremity lymphedema are shown. The volume reduction patterns for lower extremity lymphedema were similar to those for upper extremity lymphedema. As patients migrated to maintenance phase of treatment, number of subjects (N) in active phase reduced.

to daily volume changes, the biggest change was seen between days 1 (100%, n=52) and 2 (44.5 ± 2.1%, n=52) of therapy with a 55.5% reduction (p<0.0001). Between days 2 and 3 (33.5 ± 2.6%, n=52) of therapy, there was an 11.0% reduction (p<0.001), which was smaller when compared to the change between days 1 and 2 of therapy. Between days 3 and 4 (28.8 ± 2.3%, n=48) of therapy, there was a 4.7% reduction, but no significant difference was seen. From days 4 to 6 (n=34) of therapy, volume changes were slight, ranging from 0.1 to 1.0%/day.

TABLE 2
Previous Studies Investigating Therapeutic Results During the Treatment Phase of Complex Decongestive Physiotherapy

Authors	Affected Extremity	Treatment Phase (days)	Edema Reduction (rate %)	Reference
Casley-Smith JR, Casley-Smith JR	upper	28	60	10
Morgan RG, et al	upper	28	60.2	13
Ko D, et al	upper lower	15.1 16.3	59.1 67.7	14
Badger C, et al	upper and lower	18	68.9*	15
Hinrichs C, et al	lower	28	73**	16
Didem K, et al	upper	12	55.7	17
Yamamoto R, Yamamoto T	upper lower	6 10	58.9 73.4	11

*33.5/48.6 (%); ** compliant cases

DISCUSSION

In our previous study of patients who underwent CDP 3-6 days/week, edema volume for patients with upper extremity lymphedema decreased by 58.9% with a median of 6 treatments and by 73.4% with a median of 10 treatments for lower extremity lymphedema (11). These results on the rate of edema reduction are comparable to those obtained in the present study but duration of the treatment phase appears longer than in the present study. The edema reduction rate in the previous studies for upper and lower extremity lymphedema has ranged from 55.7 to 60.2% and from 67.7 to 73.4%, respectively, and although there have been no marked differences among the studies, the duration of the treatment phase has varied from 6 to 28 days for upper extremity lymphedema and from 10 to 28 days for lower extremity lymphedema *(Table 2)* (10,11,13-17). In some of these studies (11,13,16), therapy was performed for four weeks, before maintenance phase began in all cases. Morgan et al (13) stated that after a plateau in the reduction has been reached, the next two or three weeks of massage should concentrate on enlarging the collateral lymphatics linking the obstructed lymphotomes to normal ones. We believe that instructing patients and/or their families to give a manual massage everyday will achieve the same objective reported by Morgan et al (13), i.e., enlarging the collateral lymphatics linking obstructed lymphotomes to normal ones. Ko et al (14) and Didem et al (17) quickly moved patients to the maintenance phase after edema reduction reached a plateau, and they did not find that this compromised long-term therapeutic effects.

In countries where therapy for lymphedema is covered by national health insurance, it may be possible to admit patients for 28 days during the treatment phase for sufficient manual lymph drainage and self-care guidance. However, from the standpoint of medical economics (4), attempts should be made to shorten the treatment phase of CDP without compromising therapeutic effects in all countries, including Japan.

Due to the extra cost, it is not easy to conduct a clinical study by setting a certain period of time for therapy in Japan. As more patients move to the maintenance phase, the number of subjects decreases with time, and as a result, it is difficult to statistically analyze therapeutic results using the same patient population among the different days of therapy. In any case, the results of the present study clearly show that when performing CDP for lymphedema, there are large volume reductions immediately after the start of therapy, and CDP is subsequently performed to achieve slight improvements.

We realize that our population may not be representative of other lymphedema populations worldwide. Our patients did not exhibit pitting, which may have influenced treatment results. However, median BMI values were lower than reported in other studies (11), meaning that our population may have more fluid and less fat in the limbs, which may be amenable to more rapid volume reductions in the treatment phase of CDP.

Compression garments are mostly used to maintain extremities with reduced edema or to compensate for insufficient skin pressure because volume reductions cause the skin to sag. However, it has been reported (15) that the long-term use of elastic hosiery alone slightly reduced the volume of affected extremities, which suggests that comparable long-term therapeutic results may be achieved by using compression garments toward the end of the treatment phase of CDP.

In the future, it will be necessary to conduct a randomized clinical study to compare therapeutic results between the conventional CDP program and a novel program where the treatment phase of CDP is performed for 5 days and compression garments are used for the rest of therapy. If there is no significant difference in therapeutic results between the two programs, then the novel program will be greatly beneficial with regard to both lymphedema patients and medical economics.

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