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CASE REPORT

EFFECTS OF EXERCISE THERAPY ON POLYMYOSITIS COMPLICATED BY POST-MYOCARDITIS CARDIOMYOPATHY: A CASE REPORT

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Background: **A 42-year-old woman with chronic polymyositis complicated by post-myocarditis cardiomyopathy underwent supervised and unsupervised exercise therapy with staged increases in intensity.**
Methods: **Supervised exercise therapy, which included adopted standards for patients with heart failure, was performed for 6 months. After one month, unsupervised exercise therapy was commenced, in the form of 15 min walking, the duration of which was increased to 30 min after 2 months.**
Results: **Improvements in muscle strength, balance, gait velocity, and exercise tolerance were observed, with no exacerbation of myositis or heart failure. At 6 months, the level of physical activity reached that of an age-matched healthy person.**
Conclusion: **With appropriate care to avoid exacerbation of heart failure and myositis, staged increases in the volume of supervised and unsupervised exercise therapy can safely and effectively maintain and improve physical capacity, exercise tolerance, and overall physical activity.**

Key words: polymyositis; heart failure; physical activity; exercise therapy; post-myocarditis cardiomyopathy; physical capacity.

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Exercise therapy is recognized as safe and effective for patients with polymyositis, regardless of disease stage (1–3). As myositis is complicated by organ dysfunction, primarily cardiopulmonary lesions, it is important to consider the cardiopulmonary burden. However, previous studies (1) have not included patients with cardiopulmonary lesions.

There are few reports on the efficacy and safety of unsupervised exercise therapy (3), and, to our knowledge, no reports on levels of physical activity.

Therefore, we tested a method that quantitatively increased the load volume of both supervised and unsupervised exercise therapy with the aim of improving physical capacity and exercise tolerance in a patient with chronic-stage polymyositis complicated by post-myocarditis cardiomyopathy.

CASE REPORT

A 42-year-old woman was admitted on 30 May 2013, with a blood pressure of 180/100 mmHg. Multifocal ventricular extrasystoles were observed on 12-lead electrocardiography, with an enlarged cardiac silhouette on chest radiography, global hypokinesis on echocardiography, and a left ventricular ejection fraction of 40%, with left ventricular end-diastolic diameter 54 mm, left ventricular end-systolic diameter 43 mm, left atrial diameter 41 mm, and E/e' 9. Creatine kinase (CK) level was 2,559 IU/l; CK-MB, 44 IU/l; lactate dehydrogenase (LDH), 478 IU/l; aspartate aminotransferase (AST), 67 IU/l; and alanine aminotransferase (ALT), 41 IU/l; with a positive troponin T result. No significant stenosis was observed on coronary angiography. Subsequently, myocarditis was diagnosed based on cardiac magnetic resonance imaging, myocardial perfusion scintigraphy, and endomyocardial biopsy. Because of proximal muscle weakness, elevated myogenic enzyme levels, and myogenic changes on electromyography, a muscle biopsy was also performed, leading to a diagnosis of polymyositis with accompanying myocarditis. Prednisolone was commenced at 45 mg/day, along with high-dose intravenous γ-globulin therapy, which resulted in a reduction in myogenic enzyme levels, but only a slight improvement in cardiomyopathy. Subsequent administration of β-blockers reduced the frequency of extrasystoles and protected cardiac function, and prednisolone dose was reduced to 35 mg/day on discharge. As prolonged hospital admission resulted in considerable muscle weakness and reduced exercise tolerance, rehabilitation was commenced. Upon rehabilitation commencement, the CK level was 201 IU/l; CK-MB, 15 IU/l; LDH, 412 IU/l; AST, 39 IU/l; ALT, 33 IU/l; and C-reactive protein (CRP), 0.10 mg/dl; with a prednisolone dose of 20 mg/day.

METHODS

Exercise therapy was performed with caution due to myositis and heart failure. Myositis was monitored through changes in muscular symptoms, fever, malaise, and CK levels. Heart failure was monitored through changes in subjective symptoms, weight gain (increases ≥2 kg/week), increased heart rate, and N-terminal pro-B-type natriuretic peptide (NT-proBNP) levels. In the absence of these indicators, staged increases in exercise volume were attempted.

Supervised exercise therapy

Supervised exercise therapy involved calisthenics, endurance exercise on a bicycle ergometer, and upper- and lower-limb resistance training (1-h per session). For calisthenics, static stretches were performed in a seated or lying position, with each stretch held for at least 15 s. Endurance exercises were carried out on a bicycle ergometer (Aerobike 2100R; Konami Sports & Life Co. Ltd, Tokyo, Japan). Exercise intensity was commenced at 20 W (approximately 50% of maximal heart rate) and perfor-

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Table I. Blood tests

Variable	Baseline	1 month	2 months	3 months	4 months	5 months	6 months
Creatine kinase, IU/l	201	149	125	164	182	210	282
Creatine kinase-MB, IU/l	15	8	8	5	8	8	8
Lactate dehydrogenase isozyme, IU/l	412	286	246	216	194	188	182
Aspartate aminotransferase, IU/l	39	35	28	25	23	26	25
Alanine aminotransferase, IU/l	33	21	18	16	16	15	15
C-reactive protein, mg/dl	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Erythrocyte sedimentation rate 30 min, mm		3		5	3	4	4
Erythrocyte sedimentation rate 60 min, mm		8		15	10	12	13
Erythrocyte sedimentation rate 120 min, mm		22		37	26		32
White blood cells, $\times 10^3/\mu l$	7.1	9.2	10.5	7	7.3	9.7	6.2
N-terminal pro-B-type natriuretic peptide, pg/ml	3,606		1,060		597	567	505

med at a rating of perceived exertion (RPE) of approximately 12–13 on the Borg scale. The target total exercise duration in the initial period was 5–10 min. The programme proceeded as follows: 2 min × 4 sets (weeks 1–6), 3 min × 4 sets (week 7), 4 min × 4 sets (week 8), 5 min × 4 sets (week 9), 7 min × 3 sets (week 10), 8 min × 3 sets (week 11), 9 min × 2 sets (week 12), and 20 min × 2 sets (week 13 onwards).

Resistance training was conducted at an intensity of 50–60% of 1 repetition maximum (1 RM), with 3 upper-limb exercises and 2 lower-limb exercises. Two sets of 10 repetitions were performed for each upper-limb exercise and 3 sets for each lower-limb exercise.

Unsupervised exercise therapy

The primary exercise was walking, commenced one month after supervised exercise therapy, and performed at an RPE of approximately 12–13 on the Borg scale. The duration of exercise was 15 min after 1 month and 30 min from 2 months onwards, with a target frequency of 5 times/week.

Physical capacity

Muscle strength, balance, flexibility, gait velocity, agility, and exercise tolerance were assessed through hand grip and knee extension power tests (4), standing on 1 leg (eyes open), chair sit-and-reach test (4), 10-m maximum walking speed, timed up-and-go test (4), and six-minute walk test (SMWT) (4), respectively.

Level of physical activity

An Active Style Pro activity monitor (HJA-350IT; OMRON Corp., Kyoto, Japan) was positioned on the patient's lumbar region and worn for 24 h/day for 1 week (except when bathing and sleeping). A BI-LINK activity monitor (Professional Edition ver. 1.0, HMS-HJA-IC01J; OMRON) was used to calculate the activity calories, exercise volume, number of steps, and walking duration.

Study components

Blood tests, medication progress, physical capacity, exercise tolerance, and physical activity were surveyed at baseline and at 6 months.

Ethical considerations

The aims of this study were fully explained to the patient, and the patient provided written informed consent. The ethics committee of our institution approved the study.

RESULTS

From baseline to 1 month, only supervised exercise therapy was conducted. CK levels remained low throughout the 6 months of exercise (Table I). Prednisolone was used to achieve reductions in CK levels, and the

Table II. Medication progress

Medication	Baseline	1 month	2 months	3 months	4 months	5 months	6 months
Bepridil hydrochloride hydrate (Bepricor Tablets), mg	100	100	100	100	100	100	100
Carvedilol (Artist Tablets), mg	5	5	5	5	5	5	5
Mexiletine hydrochloride (Mexitil Capsules), mg	150	150	150	150	150	150	150
Zolpidem tartrate (Myslee Tablets), mg	5	10	5	5			
Flunitrazepam (Silece), mg	1						
Perospirone hydrochloride hydrate (Lullan), mg	4	4					
Etizolam (Depas Tablets), mg	0.5						
Sodium picosulfate hydrate (Laxoberon Solution), ml	10	10					
Prednisolone, mg	20	17.5	15	12.5	10	9	9
Sulfamethoxazole trimethoprim (Baktar Combination Tablets), μg	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Rabeprazole Sodium (Pariet), mg	10	10	10	10	10	10	10
Calcium lactate hydrate, g	2	2	2	2	2	2	2
Ursodeoxycholic acid, mg	900	900	900	600	600		600
Glycyron, tablets	6	6	6	6	6		6
Miya-BM, tablets	3	3	3	3	3	3	3
Rosuvastatin calcium (Crestor Tablets), mg	2.5	2.5	2.5	2.5	2.5	2.5	
Minodronic acid hydrate (Bonoteo Tablets), mg		50	50	50	50	50	50
Loxoprofen sodium hydrate (Loxonin Tablets), mg						180	
Rebamipide (Mucosta Tablets), mg						300	
Sodium ferrous citrate (Ferromia), mg							50

Table III. Physical capacity, exercise tolerance, physical activity levels

	Baseline	1 month	2 months	3 months	4 months	5 months	6 months
Hand grip test, kg	11.0	12.8	14.1	17.4	17.4	16.0	16.7
Knee extension power test, %BW	26.6	37.9	37.2	50.4	52.6	48.4	51.1
Standing on 1 leg (eyes open), s	8.3	51.1	107.3	120.0	120.0	120.0	120.0
Chair sit-and-reach test, cm	−23.2	−8.2	−16.7	−10.4	−7.4	−8.2	−13.2
10-m maximum walking speed, s	7.4	4.9	5.2	4.7	4.3	4.3	4.2
Timed up-and-go test, s	8.4	6.0	5.3	5.3	4.8	4.9	4.7
Six-minute walk test, m	189.4	428.5	517.5	570.6	601.2	605.9	601.6
Total walking calories, kcal/week	246.0	277.0	502.0	854.0	760.0	698.0	1,138.0
Total lifestyle calories, kcal/week	2,175.0	3,106.0	2,722.0	3,171.0	2,476.0	2,970.0	3,236.0
Total calories, kcal/week	2,421.0	3,383.0	3,224.0	4,025.0	3,236.0	3,668.0	4,374.0
Total walking exercise, METs × h/week	0.7	2.7	5.7	11.4	11.6	8.2	16.0
Total lifestyle exercise, METs × h/week	2.0	5.5	7.9	12.3	7.9	9.1	11.5
Total exercise, METs × h/week	2.7	8.2	13.5	23.6	19.6	17.3	27.6
Total steps, steps/week	12,575.0	19,422.0	27,433.0	43,107.0	36,205.0	34,695.0	52,821.0
Walking duration, min/week	225.0	196.0	294.0	520.0	440.0	436.0	669.0

METs: metabolic equivalents.

dose was reduced to 2.5 mg/month (Table II). Between 1 and 2 months, unsupervised exercise therapy was added (walking 15 min/day, 5 times/week). Between 2 and 3 months, unsupervised exercise therapy was increased (walking, 30 min/day, 5 times/week). The NT-proBNP level was 3,606 pg/ml at baseline, 1,060 pg/ml at 2 months, and 500–600 pg/ml at 4 months onwards. The results for physical capacity and SMWT improved between baseline and 3 months, and the improvements were sustained through to the 6th month (Table III).

During the intervention period, there were no instances of exacerbation of heart failure or myositis requiring hospital admission or other measures.

DISCUSSION

It was difficult to determine whether elevated CK levels were due to myocarditis or an exacerbation of polymyositis. However, myocarditis was diagnosed based on magnetic resonance imaging, myocardial perfusion scintigraphy, and biopsy findings.

In this case a patient in the chronic stage of polymyositis complicated by post-myocarditis cardiomyopathy was treated with a combination of supervised and unsupervised exercise therapy. Resistance training was primarily conducted as part of supervised exercise therapy. From baseline to 1 month, the results indicated improvements in physical capacity and exercise tolerance through supervised exercise therapy. From 1 to 2 months, the results indicated further improvements in physical capacity and exercise tolerance, with a synergistic effect from the addition of unsupervised exercise therapy. The fact that exercise duration was increased to 30 min, 2 months onwards, indicates the possibility of further improvement. The prednisolone dosage was reduced, with a corresponding increase in exercise volume; however, no exacerbation of myositis was observed. Moreover, a decrease in NT-proBNP levels was observed, without exacerbation of heart failure.Thus, our protocol of exercise therapy was performed safely and effectively.

There are many reports on aerobic exercise carried out at an intensity of 50–75% of maximum heart rate by polymyositis patients (2, 3, 5). Furthermore, although there are reports documenting progressive increases in exercise intensity (1), very few reports document increasing the exercise duration. Meanwhile, aerobic exercise for heart failure patients was initiated on a bicycle ergometer at 10–20 W for approximately 5–10 min (6), and subjective symptoms and physical findings were used as guides to gradually increase the duration and intensity during a period of approximately 1 month. The climax was conducted at 40–60% of peak oxygen uptake, 50–70% maximum heart rate, and 11–13 Borg scale.

Since there were 2 conditions in this case, with major differences in established recommended exercise intensity, endurance exercise was commenced on a bicycle ergometer at low loading and for short durations while continually checking subjective symptoms, and then the exercise volume was increased. Carrying out aerobic exercise in accordance with the rehabilitation process for heart failure enabled safe and effective increases in exercise tolerance to be achieved, with indications that this may also have been effective for polymyositis.

Most reports on aerobic exercise as an unsupervised exercise therapy in patients with polymyositis involve walking for 15 min, 5 times/week (3). However, quantitative monitoring of the exercise volume was not conducted in these cases, and there are no reports describing cases in which the exercise duration was increased. Meanwhile, group-based exercise did not improve the level of physical activity in patients with chronic heart failure (7). In the present case, the walking duration was increased for the unsupervised exercise therapy to up to 30 min. As a result, the mean activity level for the patient after 6 months was 7,546 steps/day, 96 min/day, and 27.6 metabolic equivalents × h/week. In com-

parison, the National Health and Nutrition Survey (8) conducted in Japan in 2012 reported the mean number of steps for women aged 40–44 years as 7,003; thus, this patient reached the same level of activity as her age-matched peers. This is a marked increase from the 1,796 steps/day activity level at 1 month. Although this is only one case, progressive increases in activity levels can safely improve and maintain physical capacity and exercise tolerance. This case report also demonstrated the possibility of achieving this result with no observed exacerbation of polymyositis or heart failure.

Conducting high-intensity (2) resistance training in patients with chronic polymyositis improves muscle strength and has not been shown to increase CK levels. However, there are few reports documenting improvements in muscle strength with only moderate loading.

Meanwhile, resistance training for patients with heart failure is recommended in the form of strength training conducted at 8–15 repetitions, 2–3 times per week, at an intensity of 40–60% 1 RM (9).

Carrying out resistance training for this patient in accordance with the prescriptions for patients with heart failure enabled safe exercise therapy with respect to both polymyositis and heart failure. Moreover, the results indicate the possibility that patients with polymyositis can also obtain improvements in muscle strength through the moderate loading resistance training recommended for patients with heart failure. It is thought that improvement in muscle strength with exercise at moderate intensity reflected the pronounced decrease in muscle strength in the patient's untrained state. There are also reports of improvements in balance due to muscle strengthening exercises (10), suggesting that these exercises may have contributed to the improvements in balance observed in the patient.

The International Myositis Assessment & Clinical Study was not in widespread use in Japan at the time of the study, and this is a topic for future discussion.

SMWT, upper and lower limb muscle strength, and gait velocity are shown to be relevant for prognosis and readmission of patients with heart failure. Previous reports have also evaluated SMWT, upper and lower limb muscle strength, and gait velocity in polymyositis. In Japan, measurement equipment for lower limb muscle strength is inexpensive, and is often used to evaluate isometric knee extension power. We are aware of reports that have used the Manual Muscle Test and 5 Voluntary Repetition Maximum to evaluate polymyositis. However, we chose our measurement method based on 2 factors: first, its quantitative nature means it can serve as a prognostic/predictive indicator for heart failure; Secondly, we could present patients with comparative, age-matched data, to motivate them to improve their performance.

We are aware that heart failure and polymyositis patients both exhibit decreased overall physical capacity. Thus, it is important to assess physical capacity based on multiple factors. We incorporated many of the measurement items generally used to evaluate physical capacity in patients with heart failure. We believe that these items are also suitable for use in patients with polymyositis.

In conclusion, in this case, aerobic exercise in accordance with perceived exercise intensity and resistance training at a moderate level, in accordance with heart failure rehabilitation procedures, improved muscle strength, balance, gait velocity, and exercise tolerance. Moreover, staged increases in unsupervised exercise therapy enabled the patient to reach the same level of activity as healthy individuals in the same age group, along with reduction in the prednisolone dosage and stabilization of CK levels. Therefore, exercise therapy according to prescriptions for patients with heart failure may be safe for patients with polymyositis and low cardiac function complicated by cardiomyopathy.

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