Practical Aspects of Exercise Therapy for Obesity

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Abstract: It has become apparent from many clinical and epidemiological follow-up studies that appropriate dietary restriction and physical exercise improve in vivo insulin resistance and are useful for the prevention and treatment of lifestyle-related diseases, including obesity. The field of clinical practice in Japan has witnessed the implementation of Healthy Japan 21, a project aimed at preventing the development of lifestyle-related diseases and prolonging healthy life, as well as the enactment of the Health Promotion Law. Specifically, it is recommended that aerobic exercises such as walking and jogging should be carried out for 10–30 minutes at least 3–5 times per week, at mild to moderate intensity (generally at a pulse rate of 120 beats/min, or 100 beats/min for those in their 60s and 70s). Resistance training of mild intensity with the use of light dumbbells and stretch cords should be combined in elderly individuals who have decreased muscle strength. Because obesity is related to lifestyle, those who are too busy to designate a specified time for exercise should be encouraged to incorporate exercise into their daily life activities, e.g., using stairs rather than elevators or escalators.

Key words: Lifestyle-related disease; Insulin sensitivity; Aerobic exercise; Resistance training

Introduction

Evidence-based medicine (EBM) is an important component of medical care and research. In the field of exercise therapy for obesity, the results of a number of large-scale clinical studies have demonstrated that weight loss resulting from lifestyle modification, including physical exercise, is useful for decreasing the development of diabetes mellitus among obese people with impaired glucose tolerance (IGT). The mechanisms of the effects of exercise also are being elucidated by molecular biological approaches. These and other studies have accumulated evidence that suggests the usefulness of exercise therapy for reducing obesity.

The Japanese Ministry of Health, Labor and Welfare has emphasized the concept of lifestyle-
related diseases, including type-2 diabetes mellitus as a typical example. In addition, Healthy Japan 21, a large-scale project aimed at decreasing diabetes and other lifestyle-related diseases has been enacted. This project aims to prolong healthy life by reducing obesity and other risk factors through physical activity/exercise and the modification of nutrition, eating habits, and other components of lifestyle. As a legal basis for this program, the Health Promotion Law was enacted in May 2003.

Because obesity is a condition in which the body accumulates excessive amounts of fat, the basis of its treatment is to reduce adipose tissue by manipulating food intake and output of energy over a prolonged period of time. More specifically, in addition to dietary restriction, physical exercise should be implemented to increase the body’s basal metabolic ratio, which tends to decrease with dietary restriction, and to induce lipolysis in adipose tissue and efficient consumption of its product, free fatty acid (FFA), in skeletal muscles.

However, as described later, the reduction of adipose tissue tends to be slight with high-intensity exercise. Therefore, the goal in prescribing exercise is to create increased physical activity in the patient’s daily life, rather than prescribing specific sports.

Physical Activity and Obesity: Results of Epidemiological Studies

1. Increased insulin resistance caused by lack of exercise

As modern life has become increasingly less demanding, physical activity has decreased while obesity and other lifestyle-related diseases have increased. Further, the adoption of an increasingly high-fat western diet has exacerbated the problem of obesity. Lack of exercise induces insulin resistance in muscle, leading to disorders of carbohydrate metabolism. Insulin resistance results in compensatory hyperinsulinemia, leading to type-2 diabetes mellitus, hypertension, hyperlipidemia, and atherosclerosis, as well as obesity, playing an important role in the development and progression of the pathological condition known as syndrome X, multiple-risk-factor syndrome, the deadly quartet, the insulin resistance syndrome, the visceral-fat syndrome, or the metabolic syndrome.

2. Results from epidemiological studies

Many epidemiological studies have demonstrated that appropriate dietary restrictions and physical exercise improve in vivo insulin sensitivity, and thus are useful for the prevention and treatment of all diseases related to insulin resistance (metabolic syndrome/lifestyle-related diseases).2,6)

(1) Our follow-up study carried out in obese students demonstrated that level II life activity, which represents daily physical activity of moderate intensity (5th edition of “Dietary Allowances in Japanese People”), was significantly more frequent in students with improved obesity than in those with unimproved obesity (Fig. 1).7)

(2) Diet therapy and implementation of exercise (3 times per week) improved insulin resistance in people with mild obesity (Oslo Diet and Exercise Study, Norway).8)

(3) When 522 patients with IGT, including obese patients, assigned to either the lifestyle intervention group or the control group, were followed, the incidence of diabetes was lower in the intervention group than in the control group. In addition, the effects of guidance on diet therapy, exercise, and weight loss were scored, and the incidence of diabetes was found to be significantly lower in patients who had higher achievement rates in both the intervention and control groups (Finland Diabetes Prevention Study, Finland).3)

(4) A total of 3,234 patients with IGT who had a mean body mass index of 34.0 were divided into a group subjected to lifestyle modification (group L: 7% weight loss by exercise of moderate intensity, 150 minutes per week, together with caloric restriction and a low-fat diet), a group subjected to drug therapy...
by skeletal muscle. Physical exercise combined with dietary restriction prevents or eliminates obesity.

(2) Exercise, particularly that of higher intensity, causes increased secretion of insulin counter-regulatory hormones, such as glucagon and catecholamine. High-intensity, heavy exercise induces an increase in lipid peroxides (thiobarbituric acid reactive substances [TBARS]) in blood as a result of free-radical production, and causes organ damage that facilitates the progression of age-related changes.1,2)

(3) During exercise of moderate or lower intensity, both carbohydrates and FFA are used as sources of energy for muscle. However, as the intensity of exercise increases, the proportion of energy derived from carbohydrates increases, leading to a decrease in the blood FFA level (phenomenologically, inhibition of lipolysis). In exercise therapy for obesity, it is necessary to elevate the rate of utilization of fat stored in adipose tissue, in addition to muscle training. Therefore, exercise of moderate or lower intensity [lactate threshold (LT) level] is preferable.1,2)

Effects of Physical Exercise on Obesity

1. Acute metabolic effect

(1) A large amount of energy is consumed...
2. Physical training effects

Regular physical exercise improves *in vivo* insulin sensitivity. We previously investigated the effects of exercise from various aspects using the glucose clamp technique, and obtained the following results.1,2)

(1) Ongoing physical exercise combined with dietary restriction improves the insulin resistance of peripheral tissue, particularly adipose tissue and weakened muscle, in obese people.

(2) If patients with simple obesity or obese type-2 diabetes continue appropriate dietary restrictions and physical exercise, insulin resistance improves markedly together with weight loss, and body fat, mainly in the abdominal visceral region, is selectively decreased, whereas lean body mass (LBM), representing muscle and other non-fat tissue, is unchanged. There is a significant positive correlation between improvement of *in vivo* insulin resistance and number of steps taken per day as determined by pedometer. In contrast, extreme dietary restriction without accompanying exercise therapy achieves no decrease in body fat, but causes a decrease in LBM and fails to improve insulin resistance.

(3) Long-term physical exercise of mild intensity that does not affect maximal oxygen uptake (VO2max) in non-obese people increases insulin sensitivity even when there is no change in body weight.

(4) Aerobic exercises such as jogging are more useful for improving *in vivo* insulin resistance than anaerobic exercises such as weight-lifting. However, resistance training using stretch cords or light dumbbells is also useful for elderly people who have decreased muscular strength and mass.9)

(5) The training effect characterized by improvement of insulin resistance attenuates within 3 days and disappears within 1 week.

(6) Visceral fat, rather than subcutaneous fat, promotes the formation of insulin resistance-related atherosclerosis. Physical exercise selectively decreases visceral fat.

(7) The implementation of exercise brings about a decrease in plasma triglyceride level, an increase in high-density lipoprotein (HDL) cholesterol, and improvement of mild hypertension. Thus, physical exercise exerts an inhibitory effect on the development and progression of atherosclerosis through a number of mechanisms.

(8) Continued exercise increases basal metabolic ratio (BMR), which tends to decrease with dietary restriction, and diet-induced thermogenesis (DIT) in obese individuals.

Practical Aspects of Exercise Prescription

1. Indications of exercise therapy and medical examinations

Before initiating exercise therapy, various examinations should be carried out to determine whether the patient has conditions (including knee or ankle joint problems) that could worsen as a result of exercise. Patients for whom exercise therapy is not indicated, e.g., those with secondary obesity, should be excluded and referred to the respective specialists, including surgeons.10)

2. Types of exercise and methods of practice

Free fatty acids produced from lipolysis through physical exercise are converted to acetyl coenzyme A (CoA) via β-oxidation, and are metabolized in the tricarboxylic acid (TCA) cycle. Therefore, it is easy to understand why the exercises prescribed for exercise therapy are restricted to those of an aerobic nature.

Specifically, patients are instructed to engage in aerobic exercises that involve the muscles of the entire body, e.g., walking, jogging, gymnastic exercises, bicycle ergometer, and swimming, with the latter two particularly suitable for obese patients. Exercise of moderate intensity, generally aiming at pulse rate of 120/min (100/min for patients aged 60–70 years), should be performed for 10–30 min at a time (60 min for patients who have sufficient physical
EXERCISE THERAPY FOR OBESITY

strength), at least 3–5 days a week. In regard to exercise intensity, LT (lactate threshold) should be determined if possible, to perform exercise of the LT level. If the patient has no time to carry out a regular exercise regimen, he or she should be instructed to incorporate physical activity into daily life activities, such as using stairs instead of elevators, or getting off the bus one bus stop early and walking to work. Pedometers and Lifecorder® are useful for assessing the amount of exercise in daily living. The goal should be at least 10,000 steps/day (or at least 7,500 steps/day), and the patient’s number of steps should be checked at visits to the outpatient clinic.

3. Cautions in implementation of exercise therapy

(1) Exercise alone is not sufficient and needs to be combined with diet therapy.

(2) Proper warm-up and cool-down should be performed before and after exercise, respectively.

(3) Since obese patients are likely to suffer injuries to the knee or foot, the use of athletic shoes with thick soles is recommended.

(4) Exercise should begin at mild intensity and for a short period of time, then gradually increase to higher intensity and a longer period.

(5) Patients should be instructed to eat fruits and vegetables to prevent any increase in free radicals caused by exercise, and vitamins C and E should be administered if necessary.

(6) Techniques of group therapy and behavior modification therapy should be introduced.

Conclusion

Evidence for the usefulness of exercise therapy for obesity has been described, with an outline of the practical aspects of exercise prescription. Obesity is a typical lifestyle-related disease, requiring long-term modification of eating and exercise habits. It should be emphasized that it is important to instruct the patient to incorporate exercise of mild or moderate intensity into daily life activities.

REFERENCES