FÈDÈRATION INTERNATIONALE DE MÈDECINE DU SPORT /
THE INTERNATIONAL FEDERATION OF SPORTS MEDICINE

FIMS Position Statement: October 1996

Diabetes Mellitus and Exercise

Introduction

Diabetes mellitus is a common metabolic disease characterized by insulin insufficiency resulting in impaired ability to transport glucose across the cell membrane for its subsequent oxidation. Also, muscle and liver glycogen resynthesis, triglyceride synthesis in adipose cells, inhibition of their breakdown (antilipolytic effect), as well as protein synthesis and storage (anabolic effects) are being impaired. Insulin insufficiency thus leads to metabolic disturbances leading to such common symptoms as fatigue, weakness, weight loss, hunger, overeating, polyuria, and signs of glycosuria, and ketosis.

Though being clinically silent for many years, diabetes mellitus often leads to serious pathological complications of various organ systems (eyes, kidneys, peripheral nerves, coronary and peripheral arteries) which may substantially impair quality of life and reduce life expectancy. There are two distinct forms of diabetes, termed insulin dependent diabetes mellitus (IDDM) and non-insulin dependent diabetes mellitus (NIDDM).

IDDM is an autoimmune disease in which the body attacks and ultimately destroys insulin-producing pancreatic beta-cells. In addition to a genetic component, evidence supports a viral infection triggering an autoimmune process either due to similarities with beta cell protein or sensitization to destructed beta-cells.

The key pathogenetic factor of NIDDM is relative insufficiency of insulin due to insulin resistance and/or defective insulin secretion. Insulin resistance is often associated with hypertension, lipid disturbances, and obesity. Apart from genetic dispositions, diet and obesity, animal experiments as well as epidemiological data suggest that a lack of physical activity may also contribute to a relative deficiency of insulin.

Diabetes may be precipitated by, or a similar syndrome brought about by endocrine disorders (e.g. hypercorticosteroidism, acromegaly, hyperthyroidism, pheochromocytoma), drugs (e.g. glucocorticoids, thyroid hormones, contraceptives, thiazidess), and pancreatic or liver disease.

Rationale for exercise in prevention and therapy

Due to an insulin-like effect on muscle contraction (an increase of membrane permeability to glucose) exercise has a potential to increase insulin sensitivity, lower blood glucose and increase its utilization. Improved glucose tolerance positively influences the glycemic profile that can be detected by lower concentration of glycosylated hemoglobin. A better glycemic

profile may postpone and reduce the risk of late complication. Since this effect is rather short-lived, regular frequent exercise sessions are needed to maintain such a benefit.

Also reducing body fat due to the increased energy expended and its effect on the basal metabolic rate may, indirectly, but significantly decrease insulin resistance.

In addition to obesity, exercise has the potential to favorable alter other risk factors of cardiovascular disease, namely elevated blood lipids and hypertension. In this way an already increased risk of coronary heart disease (3 times higher than general population) may be reduced.

Last but not least, exercise may reduce psychological stress, positively influence a feeling of well being, and improve the quality of life.

Exercise guidelines

Clearance by a knowledgeable physician is recommended prior to the initiation of an exercise program. In addition to a general assessment, screening should include an exercise stress test to detect latent cardiovascular disease. Requisites include an absence of ketoacidosis and glycemia under 300 mg.%. When late complications are evident such as hypertension or renal impairment, the risks and benefits should carefully be considered.

During the initial stages of an exercise program, close medical supervision which includes blood glucose monitoring is strongly recommended in order to adjust diet and medication (insulin or PAD doses) to the exercise altered metabolic situation.

Modes of exercise

Aerobic activities carried out at moderate intensity such as brisk walking, cycling, jogging or running, cross-country skiing are preferred modes of exercise. Since the majority of diabetics are obese, non-weight bearing exercise like cycling and swimming may pose less stress on the locomotor system and contribute to better compliance. General daily activities or a habitual nature are encouraged in addition to the exercise sessions.
In the past, resistance exercise has not been recommended because of the potential for a dangerous increase in blood pressure, especially in those with vascular complications. Recent findings indicate that appropriate forms of resistance exercise are safe and may potentiate the positive effects of aerobic exercise. A circuit training approach aimed at all major muscle groups is recommended. The resistances should allow 10 to 12 comfortable repetitions.

Intensity of exercise

The exercise intensity should be between 50 and 70% of VO2max. Higher intensities excessively activate the sympathoadrenal

system with subsequent increase of glycemia. With caution, hear rate can be used as an indicator of intensity. In patients with autonomic neuropathy, heart rate may not accurately reflect exercise intensity. As an alternative, perceived exertion of METs (metabolic equivalents) should be used for the exercise prescription.

Duration of exercise

Exercise sessions between 20 and 60 minutes are recommended. Less than 20 minutes yields little cardiovascular benefit, longer exercise tends to increase the risk of hypoglycemia.

Frequency of exercise

Daily exercise is suggested because such an approach enables easier insulin adjustment and diet planning. A more realistic and practical goal may be 4 to 6 sessions a week.

Practical remarks

Patients should be educated about the effects and potential risks of exercise, namely hypoglycemia.

The participants should wear identification indicating their diabetic condition and should exercise with a knowledgeable partner in case of hypoglycemia, including loss of consciousness.

When possible exercise should be performed at the same convenient time with similar intensity and duration.

Because of the pro insulin effect of exercise, insulin dependent diabetics should reduce insulin doses by 20% or adequately increase food intake upon initiating an exercise program.

To avoid hypoglycemia a small carbohydrate snack should be eaten 30 minutes prior to exercise. During more prolonged activity a 10 g carbohydrate snack (fruit, fruit juice, or soft drink) should be ingested for each 30 minutes of exercise.

Pay careful attention to the feet of the exercising diabetic patient. Loss of sensation due to neuropathy and/or impaired peripheral circulation increases the risk of injuries. Good footwear and careful foot hygiene are essential to avoid injuries like calluses, corns and blisters that may lead to serious complications.

Warm-up and cool-down periods should be an integral part of an exercise program.

Suggested reading:

Chisholm DJ. Diabetes mellitus. In: Bloomfield J, Fricker PA, Fitch KB (Eds.. *Textbook of science and medicine in sports*. Oxford: Blackwell Science Ltd, 1992: 560-

Wallberg-Henriksson H. Exercise and diabetes mellitus. *Exer. Sport Rev* 1992; 20: 339-368.

Schneider SH, Ruderman NB Exercise and NIDDM. *Diabetes Care* 1990; 13: 785-789.

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