Exercise-Induced Hypertension in Normotensive Patients With NIDDM

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The aim of this study was to determine whether blood pressure during mild to moderate exercise is abnormal in patients with non-insulin-dependent diabetes mellitus (NIDDM). The study group consisted of 11 patients with NIDDM and 11 nondiabetic subjects of comparable age and body mass index. All subjects were sedentary and basally normotensive. Bicycle ergometry was used to assess the effect of exercise on blood pressure at a steady state of 70–75 W, with a target duration of 20 min. Blood pressure was measured basally and every 5 min. Greater exercise-induced systolic blood pressure (mean max 208.0 ± 6.0 vs. 177.0 ± 3.0 mmHg) occurred in the NIDDM group ($P < 0.001$). Neither pulse rate nor diastolic blood pressure differed between the groups before or during exercise. Return to basal pulse and blood pressure was similar. Mild to moderate exercise induces greater systolic blood pressure in sedentary patients with NIDDM. Because exercise is recommended as one therapeutic modality, intraexercise blood pressure should be considered in assessing the safety of this form of treatment. *Diabetes Care* 13:799–801, 1990

Physicians often recommend exercise for patients with non-insulin-dependent diabetes mellitus (NIDDM). In this study, we compared blood pressure changes during mild to moderate exercise in patients with NIDDM to a group of control subjects of comparable age, body build, and pattern of physical activity. We found that changes during exercise were greater than expected in the NIDDM group.

RESEARCH DESIGN AND METHODS

Eleven men with NIDDM and 11 nondiabetic men were chosen for age and body build ranges that were similar. Patients and control subjects were selected on the basis of leading a sedentary pattern of physical activity. This is because most patients in our clinic are sedentary, which is defined as <45 min of aerobic exercise/wk. Another criterion for the study was the absence of a previous hypertensive history and absence of hypertension on the day of the exercise test. Normotension was considered to be present if the mean of two blood pressure readings (taken 5 min apart) before exercise was ≤140/90 mmHg.

Eight NIDDM patients were receiving insulin, one received no hypoglycemic medication, and two were taking oral agents. None had ever experienced ketoacidosis, and seven patients had onset of NIDDM later than age 35 yr. The remaining four patients had onset of NIDDM at 23, 26, 28, and 34 yr of age. Mean duration of diabetes was 9 ± 3 yr (range 0.08–23 yr).

All subjects had body mass indices (body weight [kg]/height [m^2]) >25, except for 1 control subject and 2 NIDDM patients. None of the 22 subjects had a previous history of chest pain, heart disease, or peripheral vascular disease.

Blood glucose levels were estimated by fingersticking before exercise with a Glucoscan 3000 glucose meter (Lifescan, Mountain View, CA). We attempted to reproduce conditions in which typical sedentary subjects might perform mild to moderate exercise. Thus, most patients and control subjects had had a usual breakfast ~1 h before the exercise test. In most cases, exercise testing was conducted between 0700 and 1100. Hypoglycemic medications were taken as usual the morning of the test.

Blood pressure was measured with a precalibrated mercury column sphygmomanometer (Py Mah, Somerville, NJ). The blood pressure cuff was adjusted for arm size. Blood pressure was first measured for screening while seated in a chair and then twice again 5 min apart in the left arm while seated at rest on the bicycle ergometer just before exercise.

The bicycle ergometer (Collins, Braintree, MA) was electrically stabilized with a pedal mode. Seating, leg length, and arm position were adjusted for comfort. Exercise was begun at a constant effort of 70–75 W (~450 kpond/min) at a pedal rate of 60 rpm with a target duration of 20 min. Pulse and blood pressure were taken every 5 min during exercise and 5 min after exercise. Physicians were present during all tests. Informed consent was obtained from all participants.

Statistical analysis was performed by comparing NIDDM patients with control subjects with the use of the unpaired *t* test. Analysis of variance was used when group responses were compared over time. Pearson's correlation coefficients were used for regression analyses. Data are expressed as means ± SE.

RESULTS

The following statistically similar clinical characteristics were present (NIDDM vs. control): body mass index 28.7 ± 1.0 vs. 29.0 ± 1.0, age (yr) 47.5 ± 3.0 vs. 42 ± 2.0, basal pulse 79 ± 2.0 vs. 76 ± 2.0, basal systolic blood pressure (mmHg) 121 ± 3.0 vs. 118 ± 4.0, and basal diastolic blood pressure (mmHg) 82 ± 2.0 vs. 83 ± 2.0. The NIDDM group had an abnormal preexercise glucose level (180 ± 24 vs. 84 ± 4.0 mg/dl, $P <$ 0.007). Other clinical characteristics in both of the study groups (NIDDM vs. control) were current smokers, 4 vs. 4; family history of hypertension, 3 vs. 3; and family history of diabetes, 10 vs. 3. Three patients in the NIDDM group versus 6 in the control group were Black.

Figure 1 demonstrates that in both groups systolic blood pressure rose with exercise; however, systolic blood pressure was greatest in the NIDDM group. Mean maximum systolic blood pressure was determined with the highest systolic blood pressure during exercise (208 ± 6.0 for the NIDDM patients and 177 ± 3.1 for the control subjects, $P < 0.001$). As soon as exercise was completed, the systolic blood pressure fell. Return to baseline was similar in both groups (within 5 min). Maximum diastolic blood pressure for NIDDM patients compared with the control group (91 ± 4.0 vs. 93 ± 2.0) was not different between the groups.

Maximum pulse rate attained during exercise was similar in both groups (124 ± 3.2 vs. 122 ± 4.0 beats/min, NIDDM vs. control, respectively). At each 5-min interval during exercise, pulse rates were similar for each group, never exceeding 120 beats/min. Pulse rate 5 min after exercise was similar (96 ± 4.0 vs. 104 ± 5.0, control vs. NIDDM, respectively).

The relationship of maximum exercise-induced systolic blood pressure with clinical features was examined. There was no correlation with either age or body mass indices in either group. Similarly, for NIDDM there was no correlation of maximum systolic blood pressure with either duration of diabetes or baseline glucose levels.

There was no difference in peak exercise systolic blood pressure when six NIDDM patients with duration of diabetes ≤4 yr (211 ± 9.0 mmHg) were compared to five patients with duration of diabetes >4 yr (205 ± 9.0 mmHg). No difference was found in either group in maximum systolic blood pressure during exercise in subjects that had a family history of hypertension compared with those that did not. There was no significant difference in maximum systolic blood pressure during exercise for smokers in either group compared with nonsmoking members of the same group. For both groups, Black individuals did not have different exercise blood pressure readings from White individuals. Finally, during exercise, maximum systolic blood pressure was not greater for eight insulin-treated patients than for three non–insulin-treated patients.

All subjects and patients tolerated exercise for at least 10 min. No subject stopped exercise because of chest pain. Three NIDDM patients and one control subject aborted the test because of fatigue; one NIDDM patient discontinued exercise because of pain in his extremities.

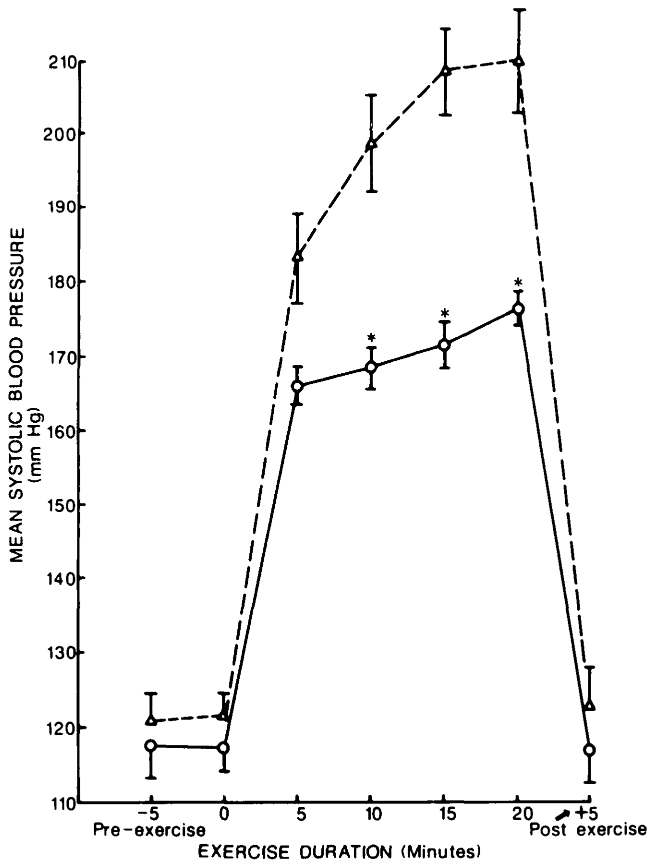

FIG. 1. Systolic blood pressure response to 70- to 75-W bicycle ergometry. At 15 min, $n = 9$ for diabetic subjects (∧); at 20 min, $n = 7$ for diabetic subjects and $n = 10$ for control subjects (○); all other times, $n = 11$. *$P < 0.001$ with analysis of variance.

DISCUSSION

Mild to moderate exercise in a group of sedentary patients with NIDDM evoked a greater than normal systolic blood pressure. In this experiment, we tried to simulate the variable time of day, meal-taking schedules, and exercise intensity that might be characteristic of most ambulatory sedentary individuals. In this small group of patients and control subjects, differences in blood pressure were not related to age, body mass index, preexercise blood glucose, duration of diabetes, race, insulin treatment, smoking habits, or family history of hypertension.

Differences in the home exercise program of the two groups are an unlikely reason for our observations. Both groups were sedentary, and pulse rates during and after exercise were similar for both groups.

Our data could prove useful as a guide to physicians recommending exercise for diabetic patients. Scarfors et al. (1), with the use of a moderately intensive exercise program in an older probably nonhypertensive NIDDM group, found in a 2-yr study that two of eight subjects in the exercise group suffered appearance or aggravation of coronary heart disease. In contrast, the control (nonexercised) group had no reports of new cardiac coronary events. It is conceivable that changes in blood pressure during stress, such as exercise, may promote cardiovascular or cerebrovascular deterioration.

Based on our studies, investigations of exercise as a therapeutic modality in diabetes might include blood pressure monitoring during exercise. Furthermore, studies of whether pharmacological or nonpharmacological intervention can lessen blood pressure during exercise seem indicated. This is especially true if data confirms mild to moderate exercise-induced elevation of blood pressure and greater than expected morbidity and mortality in patients with NIDDM who are to undergo moderately intense exercise programs.

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Screening for Thyroid Disease in Children With IDDM

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The aim of this study was to evaluate the usefulness of screening for thyroid disease by performing thyroid function tests and measuring thyroid autoantibodies in 371 children and adolescents with insulin-dependent diabetes mellitus (IDDM). We analyzed clinical data and results of serum thyroxine, triiodothyronine uptake, thyroid-stimulating hormone, and antibodies to thyroid microsomal antigen and thyroglobulin. Goiter was noted in 20% of subjects. Thyroid-specific autoantibody was positive in 19% of subjects. Twenty-seven subjects (7%) had thyroid dysfunction. Autoantibody testing identified subjects with thyroid dysfunction with a sensitivity of 50%, a specificity of 84%, a degree of misclassification of 17%, a positive predictive value of 13%, and a negative predictive value of 97%. We recommend that all children and adolescents be screened shortly after diagnosis of IDDM by determination of thyroid-stimulating hormone (measured by high-sensitivity assay) to identify thyroid dysfunction and by testing for antibody to thyroid microsomal antigen to characterize both risk of future thyroid dysfunction and the need for future testing. *Diabetes Care* 13:801–803, 1990

The association of insulin-dependent diabetes mellitus (IDDM) with thyroid disease, both hypothyroidism and hyperthyroidism, has been known for many years (1–3). Screening for thyroid disease was stressed recently in a position statement from the American Diabetes Association (4). However, a specific approach has not been recommended. The aims of this study were to determine the prevalence of both thyroid dysfunction and thyroid autoantibody positivity in children and adolescents with IDDM, relate biochemical findings to clinical features, evaluate the predictive value of autoantibody test results, and propose a protocol for screening for thyroid disease.

RESEARCH DESIGN AND METHODS

During a 12-mo period, 402 patients with IDDM had at least one admission to the pediatric service of the Diabetes Treatment Unit at New England Deaconess Hospital. All records were reviewed, and data were available on 371 subjects (212 girls, 159 boys). Their mean ± SD age was 13.9 ± 3.7 yr (range 3–22 yr). Duration of IDDM was 4.6 ± 4.2 yr (range 0–17 yr). The distribution of developmental stages (n = 330), based on the Tanner method of assessment, was I, 24%; II, 7%; III, 10%; IV, 22%; and V, 37%. Ten percent had a family history of IDDM among first-degree relatives, and 5% had a family history of autoimmune thyroid disease. Goiter was noted in 20%; most of these were small. Mean glycosylated hemoglobin level was 13 ± 3.0%, with a range of 6.3–22.6% (normal range 5.4–7.4%).

A fasting blood sample was drawn before breakfast on the morning after admission. Serum thyroxine was measured by radioimmunoassay (NML Tetra-Tab, Organon Teknika, Durham, NC), serum triiodothyronine uptake by determining unsaturated binding capacity of serum proteins (NML Tri-Tab, Organon Teknika), and serum thyroid-stimulating hormone (TSH) by radioimmunoassay (MAGIC TSH, Ciba Corning, Medfield, MA). Antibodies to thyroid microsomal antigen and thyroglobulin were determined by hemagglutination (Thymune-M and Thymune-T, Wellcome, Dartford, UK). Categorical variables were compared by the Mantel-