Influence of Exercise at High Temperature on Blood Biochemical Indexes and HSP72 Expression in Adult Males

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Summary: The influence of exercise at high temperature on adult males’ routine blood indexes and biochemical indexes and the expression of HSP72 in peripheral blood lymphocytes (PBLs) was studied in order to provide theoretical ground for health supervision of adults receiving exercise at high temperature. 180 adult males were selected and divided into exercise group and control group, in which the exercise group was subdivided into subgroup 1 and subgroup 2 receiving exercise at high temperature in the afternoon and in the morning, respectively. Peripheral venous blood was phlebotomized before and after the exercise to examine routine blood indexes and blood biochemical indexes. The expression levels of HSP72 in PBLs were detected by flow cytometry. The results showed that the routine blood indexes and biochemical indexes in each group were within the range of normal values of male adults. There was no significant difference between each exercise group and control group before exercise. After exercise, the expression levels of HSP72 in PBLs in exercise groups were higher than those before exercise, and HSP72 expression levels in subgroup 1 were obviously higher than those in subgroup 2 and control group. The contents of ALT, urea, Na+, Cl-, Ca2+ and K+ in subgroups 1 and 2 were lower than those in control group, but CK level was higher than in control group (P<0.05). The contents of Na+ and Cl- in subgroup 1 were relatively lower than those in subgroup 2 (P<0.05). It was concluded that while receiving exercise at high temperature, adult males’ HSP72 levels in PBLs could be increased and the biochemical indexes changed. Attention should be paid to health supervision to avoid obvious body injuries at high temperature.

Key words: high temperature; exercise; blood routine indexes; biochemical indexes; HSP72

During exercise, human body experiences high-strength physical activities and will perspire a lot to reduce their body heat. Their body temperature regulation, humoral regulation and hormonal regulation will change to adapt themselves to the exercise environment, and corresponding changes will also occur in biochemical indexes and routine blood indexes[1]. At the same time, due to the effect of heat stress, the heat shock protein (HSP), i.e. a group of highly conservative cell protective proteins, will be increased remarkably. The HSP70 family is closely connected with cell protection and HSP72, which is one of the two subtypes of the family is most closely related to heat stress. This study intends to provide theoretical ground for health supervision and protection of adult males receiving exercise at high temperature by comparing the differences in routine blood indexes, blood biochemical indexes and expression characteristics of HSP72 in peripheral blood lymphocytes (PBLs) at different temperatures between exercise groups and control group.

1 OBJECTES AND METHODS

1.1 Research Objects

120 adult males (having not received similar exercise at high temperature for 4 weeks) from some training base were selected and divided into subgroup 1 and subgroup 2 (n=60 in each group). The adult males in subgroup 1 undertook exercise at medium intensity, such as running, for 2 h in the afternoon (the maximum temperature exceeded 36ºC) and those in subgroup 2 received exercise of the same strength in the morning (at 30ºC–36ºC), and blood sampling was conducted before and after exercise. Sixty healthy adult males from the same training base who had no exercise tasks and were similar to adult males in exercise groups in age and length of service served as control group. Blood sampling was carried out at room temperature (20ºC–26ºC). Questionnaire survey among the subjects was conducted by professional personnel, mainly covering basic individual information, smoking, drinking and diet situation, occupational history, health status, individual medical history and history of family-inherited diseases, etc.

1.2 Main Reagents and Instruments

Lymphocytes separation medium (Shanghai No. 2 Chemical Reagent Factory, Chian), Triton X-100 (Sigma, USA), rabbit anti-human HSP70 (Institute of Occupa-
1. Detection of Routine Blood Indexes and Biochemical Indexes

For exercise groups, 10 mL venous blood was phlebotomized before and after exercise, respectively. For control group, 10 mL venous blood was taken at one time. The blood was put into 2 anti-coagulation tubes containing EDTA-Na and quickly mixed evenly. One tube was for routine blood test and biochemical index detection, and with the other tube, centrifugal separation was conducted by density gradient method to obtain lymphocytes[2]. Routine blood indexes included the total number of leucocytes and leucocyte count, red corpuscles, hemoglobins and blood platelets. Blood biochemical indexes included alanine transaminase and aspartate transaminase.

1.1 General Situations

All the subjects were male, with good health conditions and without smoking and drinking habit or family inherited diseases. The average age in subgroup 1, subgroup 2 and control was 21.60±2.02, 21.88±2.19 and 23.18±3.15 respectively.

2 RESULTS

2.1 General Situations

The mean value in each group was within the normal range of male adult[3]. There was no significant difference in serum creatinine among the groups (P>0.05). Before exercise, the differences in indexes among groups showed no significance. After exercise, the levels of ALT, urea, Na+, Cl-, Ca²⁺ and K⁺ in subgroups 1 and 2 were lower than those in control group, and CK was higher than that in control (P<0.05). The levels of Na⁺ and Cl⁻ in subgroup 1 were lower than those in subgroup 2 (P<0.05). The results were shown in Table 1.

2.2 Statistical Results of Routine Blood Test

The lymphocytes obtained by centrifugation were added with 500 µL of 4% paraformaldehyde fixative, mixed evenly, centrifugated at 600 g for 4 min and the supernatant was discarded. After addition of 1 mL of PBS-1% BSA (the percentage of BSA in PBS was 1%, w/v), the tubes were evenly shaken and centrifugated, and the supernatant was discarded. The cell deposit was suspended into 100 µL rabbit-anti human HSPs diluted in the proportion of 1:100 (with PBS-1% BSA, including 0.05% Triton X-100, v/v), evenly shaken and centrifugated, and put at room temperature for 20 min. The tubes were added with 1 mL PBS-1% BSA for termination, evenly shaken and centrifugated at 600 g for 4 min, and the supernatant was discarded. The cell deposit was suspended into 100 µL FITC- conjugated goat-anti rabbit IgG diluted in the proportion of 1:100 (with PBS-1% BSA, including 0.05% Triton X-100), shaken evenly and put at room temperature for 20 min. The tubes were added with 1 mL PBS for termination, evenly shaken and centrifugated at 600 g for 4 min, and the supernatant was discarded. The cell deposit was suspended in 0.4 mL ice-cold PBS solution (PI concentration: 100 µg/mL), shaken evenly. The flow cytometer was used to count 5000 PBLs and the expression levels of HSP72 were detected.

1.2 Statistical Analysis

Results were expressed as \(\bar{x}\pm s\). Data were evaluated statistically by one-way analysis of variance (ANOVA). Comparison of two means was made using Student’s t-test. \(P<0.05\) was considered significant.

2.2.1 Statistical Results of Blood Biochemical Test

The average values of Mon, Rbc, Hb, Hct and MCHC in subgroup 1 were less than those in control group (P<0.05). For the rest indexes, there were no significant differences (P>0.05). The average values of WBC, Lym, Mon, Rbc, Hb, Hct and MCHC in subgroup 2 were less than those in control group (P<0.05). For the rest indexes, there were no significant differences (P>0.05). The average values of WBC, Lym, MCHC and RBC in subgroup 1 were greater than those in subgroup 2 (P<0.05). For the rest indexes, there were no significant differences (P>0.05). The results were shown in Table 2.