Riassunto. L'esposizione di giovani ratti e di ratti anziani ad uno stress cronico «ambientale» (stimolazione ottica, acustica e meccanica) ha provocato una diminuzione dell'attività monoamino ossidasica (MAO) cerebrale ed epatica. L'attività MAO si è rinormalizzata entro 7 giorni dall'ultima stimolazione, sia nei ratti giovani che nei vecchi. Viene pertanto suggerita l'assenza di differenze legate all'età, nella sensibilità delle MAO a questo tipo di stress.

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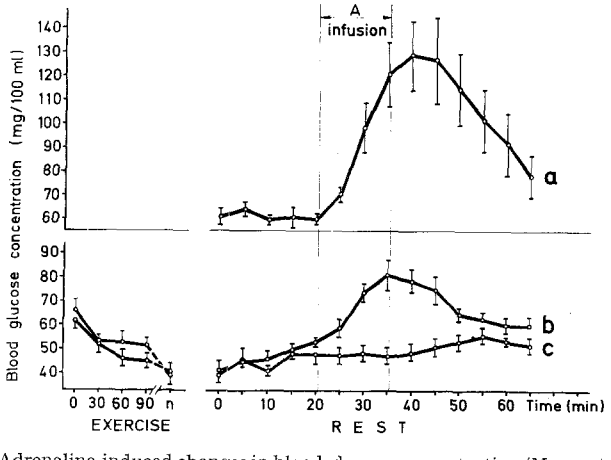
The Hyperglycemic Effect of Adrenaline Infused After Exhausting, Prolonged Physical Exercise in Dogs

During prolonged exercise, a decrease in the muscle glycogen content and blood glucose concentration have been found in dogs. Both the changes were considered as a main factor limiting physical working capacity[1]. On the other hand, a decrease in the plasma adrenaline concentration at the end of prolonged exercise was described[2]. It has not been established yet whether the exercise-induced fall in blood glucose is caused by a lower blood adrenaline concentration, an inhibition of the liver responsiveness to glycogenolytic factors, or exhaustion of the liver glycogen. In the present work, the effects of adrenaline given under control conditions, and after exhausting exercise were compared in dogs.

Materials and methods. Experiments were performed on 7 male, mongrel dogs weighing 16–19 kg, maintained on a standard, mixed diet. Before experiments the dogs were deprived of food for 18–20 h, but had free access to water. 2 main series of experiments were carried out on each dog: 1. i.v. infusion of adrenaline (adrenaline, BDH) at the rate of 2 µg/kg/min given during 15 min at rest. 2. i.v. infusion of adrenaline given at the same rate and time but 20 min after treadmill exercise performed until total exhaustion. The mean time of the run was 165 ± /SE/22 min.

Venous blood samples for glucose determinations[3] were taken at 5 min intervals for 20 min of pre-infusion rest, during the infusion and then for 25 min after its termination. Blood lactate (LA)[4], plasma free fatty acid (FFA)[5], and adrenaline (A) concentrations[6] were measured before adrenaline infusion, immediately after the infusion and 15 min later. During exercise blood glucose, LA and plasma FFA concentrations were determined every 30 min of the run. Before exercise, after its termination, and 25 min following A infusion glycogen content in the muscle samples taken from m. quadriceps femoris was measured[7]. In addition, in control experiments performed on the same dogs changes in blood glucose, plasma FFA and the muscle glycogen content were followed during 65 min after termination of exercise without A infusion.



Adrenaline-induced changes in blood glucose concentration (Means ± SE). a) A infusion without previous exercise; b) A infusion after exercise; c) controls without A infusion.

Results. During exercise blood glucose level decreased by 20.3 ±/SE/2.6 mg/100 ml ($p < 0.001$). The hyperglycemic effect of A infused under control resting conditions was markedly higher than that after the exhausting exercise (Figure). The maximal increase of blood glucose in resting dogs was 75.6 ± 13.8 mg/100 ml, while after exercise it amounted only to 30.7 ± 5.2 mg/100 ml. In most cases the peak values of blood glucose concentrations were attained in 5 min after the end of infusion in the 1st series, and at the end of infusion in the 2nd series. The differences between adrenaline-induced increases in blood glucose concentration in the 1st and 2nd series were statistically significant from the 10th min of infusion to the 15th min after its termination ($p < 0.001$). Without A infusion, blood glucose concentration slowly increased during 65 min of the psot-exercise period (lower part of the Figure).

The muscle glycogen content decreased during exercise from 1.012 ± 0.033 to 0.168 ± 0.061 g/100 g of the tissue ($p < 0.001$) and was maintained at the low level at 65 min of the post-exercise period both with and without A infusion. Adrenaline infused in resting dogs (series 1) caused higher increases in the plasma FFA (from 466 ± 15.9 to 707 ± 42.2 µEq/l) than after exercise (series 2) when it rose from 781 ± 60.0 to 911.6 ± 78.1 µEq/l, but the difference between the two series was not statistically significant ($p > 0.05$). The exercise by itself caused a marked increase in the plasma FFA level from 499.0 ± 15.0 to 816.0 ± 35.0 µEq/l ($p < 0.001$). Without A infusion, the plasma FFA was maintained at the post-exercise level during 65 min of the recovery period.

The infusion of A induced similar increase of blood LA in both series of experiments (by 0.9 ± 0.26 mM/l in the 1st and by 0.9 ± 0.43 mM/l in the 2nd series). At the end of exercise, blood LA reached the level of 2.61 ± 0.22 mM/l, which was by 0.68 ± 0.20 mM/l higher than that before the exercise.

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Blood A levels attained during the hormone infusion in the 1st and 2nd series did not differ significantly ($p > 0.05$). The concentration of A at the end of infusion was 1.65 ± 0.28 µg/l (1st series) and 1.56 ± 0.29 µg/l (2nd series).

Discussion. The results obtained show that the hyperglycemic effect of A is much smaller in the dogs previously exercizing until exhaustion than in the same dogs infused at rest without preceding physical effort. This phenomenon cannot be attributed to the increased uptake of glucose by the muscles depleted of glycogen, since there was no significant increase in the muscle glycogen content following A infusion. The weaker effect of adrenaline after exercise may be caused by an exhaustion of the liver glycogen, insufficient gluconeogenesis, or by a decreased reactivity of the liver enzymatic systems to adrenaline. A decrease of the liver glycogen content after exhausting physical work has been found in human subjects; however some amount of the liver glycogen seemed to be not available for glycogenolytic factors acting during exercise[8]. In the present investigation, FFA response to A in the dogs infused under resting conditions did not differ significantly from that found after exhausting exercise. On the contrary, an increased adipose tissue responsiveness to NA after preceding physical activity was described in humans[9]. Adrenaline-induced increase of LA after exercise in spite of glycogen depletion from the working muscles suggests that it originated from non-working muscles.

Summarizing, the data obtained in the present study demonstrate that the hyperglycemic effect of A is markedly reduced after prolonged exercise. However, it is still possible to increase blood glucose concentration by adrenaline in this situation. Thus, a decrease in blood A level may be partly responsible for the hypoglycemia found at the end of prolonged exhausting exercise in dogs.

Résumé. Les changements de concentration de glucose, FFA et LA résultant d'une infusion intravénale d'adrénaline ont été étudiés chez des chiens ayant été soumis à un exercice physique prolongé. On a constaté un abaissement de l'effet hyperglycémique de l'adrénaline. Les autres paramètres changeaient semblablement, comme dans les conditions de contrôle, sans effort physique préalable.

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Catecholamines in Fetal and Neonatal Rabbit Heart

It is well known that important physiological changes occur at birth[1]. The fetal suffering conditions which exist at parturition, and the sudden adaptation of the new-born to atmospheric life, are probably accompanied by modifications of neuro-endocrine system activity. The adrenal catecholamines store has been found to decline immediately after birth, in rats[2] and rabbits[2,3], while in rabbits the level of plasma norepinephrine increased at parturition[4]. This study was undertaken to determine whether or not the cardiac catecholamine store changes in the fetus near term and within the first few hours after parturition.

Materials and methods. The experiments were carried out on fetuses and new-born rabbits of the white New Zealand strain. In the last 2 days of pregnancy (term = 31 days), the female rabbits were killed by air embolism, laparotomy was performed and the fetuses were taken out immediately and decapitated. The hearts were quickly removed, washed with ice-cold 0.9% NaCl, blotted on filter paper and frozen at once. It was necessary to pool 4 to 5 of the hearts from fetal animals (from the same litter) to provide sufficient tissue for one single norepinephrine and epinephrine determination. The new-born rabbits were decapitated either just at birth or later on, and the samples were prepared as with the fetuses. The tissue was homogenized in ice-cold 0.4 *M* perchloric acid by using a Tri-R tissue homogenizer (Genelab International) provided with a glass pestle. Homogenates were kept on ice until centrifuged at 9,000 × *g* at 0 °C for 30 min. The residues were re-extracted twice more and all 3 supernatants were pooled[5]. The pH was adjusted to 8.5 with 0.5 *M Tris* buffer[6] and the samples were adsorbed onto alumina[7] (Merck Aluminium oxide active, acidic activity I), prepared by the method of ANTON and SAYRE[8]. The alumina containing the adsorbed catecholamines was washed with bi-distilled water. After centrifugation, the supernatant was carefully aspirated off. Elution was performed with 3 × 2 ml of 0.3 *N* acetic acid which was thoroughly mixed with the alumina by using a magnetic stirrer. All 3 eluates were pooled, centrifuged, adjusted to pH 6.5 and used for fluorometric assay[9]. For fluorometric measurement, an Aminco-Bowman Spectrofluorimeter with ellipsoidal mirror was used. Readings were made at activation wave lengths of 380 and 430 nm and at fluorescence wave lengths of 490 and 540 nm. The mean values ± SEM are given in ng/g and ng/single heart. The *t*-test was computed.

Results. In the 30- and 31-day-old fetal rabbit heart (gestational age), the norepinephrine level is low. As no change was observed from one day to another, we have pooled the values. Their mean value is 85 ± 12 ng/g, as can

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