44) Effects of Exercise on Hemodynamics in Spontaneously Hypertensive Rats (SHR)

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INTRODUCTION

During a given bout of submaximal exercise, the training effect becomes manifest as a lower heart rate, higher stroke volume and increased left ventricular mass in trained individuals (J Appl Physiol 42:824, 1977). This adaptation might result in a reduced energy demand per unit time on the heart (J Appl Physiol 51:941, 1981). On the other hand, SHR in established hypertensive state have a low cardiac output, increased heart work and increased left ventricular mass weight (LVM) compared with Wistar rats of the Kyoto strain (WKY). In this study, we measured a cardiac function of trained SHR in order to detect if a training is useful for the cardiovascular system of genitic hypertension, or not.

MATERIALS AND METHODS:

Six week-old SHR (male) and WKY were used in this study. Rats were assigned three groups, 6 in each, designated as sedentary controls of WKY and SHR (C-WKY and C-SHR), and trained SHR (E-SHR). Trained SHR run on a rodent treadmill (SHIMAZU SEISAKUSHO SN-460) at a speed of 20-30 m/min for 30 min, 3-4 days/wk from 7 to 20 weeks of age. The incline was 0°. E-SHR started to run at a low running speed, and the speed was gradually increased until 7 weeks of age. After 2-week rest, left ventricular pressure and arterial pressure were measured by a 3F tip transducer (Millar Co.) and a pressure transducer (TP 101T, Nihon Koden Ltd.), respectively. Electrocardiogram was recorded under anesthesia (pentobarbital sodium 30 mg/kg). All data were fed in TEAC R 210 B-data recorder and analysed by a signal processor 7T08 (Nihon Denki Sanei Co.).

RESULTS:

A ratio of the left ventricular weight to body weight and a ratio of the whole heart weight to body weight in E-SHR was higher than in C-SHR and C-WKY. In arterial pressure measured using a tail-cuff method, there was no difference between conscious E-SHR and C-SHR. Under anesthesia, there was no difference in arterial pressure and heart rates (HR) between E-SHR and C-SHR. The index of the ventricular contractility: V_{max} and V_{pm} (Am J Physiol 202:931, 1962) were significantly increased in E-SHR compared with C-SHR. However, there was no significant difference in max dp/dt between E-SHR and C-SHR. The index of the ventricular relaxation: time constant T (J Clin Invest 58:751, 1976) and max negative dp/dt (Am J Physiol 227:613, 1974) in E-SHR were not different from in C-SHR, but significantly decreased compared with WKY.

DISCUSSION:

Left ventricular hypertrophy in SHR was augmented by a series of training exercise on a treadmill. This result suggests that the intensity of the exercise in this study has influenced the cardiac function of SHR at least. V_{max} and V_{pm} were increased in E-SHR compared with C-SHR, so it can be said that the training exercise tend to improve the left ventricular contractility in SHR. On the other hand, time constant T and max negative dp/dt in E-SHR were not different from in C-SHR in spite of increased ventricular hypertrophy due to the exercise. Thus, we can conclude that exercise increases the indices of ventricular contractility (V_{max} , V_{pm}) but has no effect on the indices of ventricular relaxation (time constant T , max neg. dp/dt). These data are suggestive for the usefulness for training exercise in genetic hypertension.