# EFFECT OF A LOW-FREQUENCY MAGNETIC FIELD ON THE SYSTEMIC ARTERIAL PRESSURE OF SPONTANEOUSLY HYPERTENSIVE RATS

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Investigations into the use of a magnetic field (MF) as a therapeutic physical factor in essential hypertension have been published, in which, in particular, the hypotensive effect of MF on the systemic arterial pressure (BP) has been demonstrated [1, 4, 5, 10]. However, the study of the effect of a low-frequency MF (LMF) on the systemic BP under clinical conditions meets with certain difficulties, for high arterial hypertension requires constant correction of BP by drugs. The study of the effect of LMF on BP in conjunction with pharmacotherapy makes interpretation of the results difficult and does not allow the true hypotensive effect of LMF to be determined.

It was accordingly decided to undertake an experimental investigation on spontaneously hypertensive rats (SHR). This model has much in common pathogenetically with human essential hypertension [6] and is widely used experimentally [7, 13].

The experiments were carried out in the Laboratory of Experimental Pharmacology, Institute of Experimental Cardiology, All-Union Cardiologic Scientific Center, Academy of Medical Sciences of the USSR.

## EXPERIMENTAL METHOD

Experiments were carried out on 11 male Okamoto-Aoki rats with spontaneous hypertension, aged 6 months, weighing 200-300 g, and with a systolic BP of 242 ± 6.3 mm Hg. The comparison group consisted of 10 SHR of the same line, the same age and sex, and with a systolic BP of 243 ± 2.7 mm Hg, subjected to a sham procedure (placebo).

The MF, generated by the mass-produced Soviet Polyus-1 apparatus, was aimed at the kidney region of the SHR. An inductor with surface area of its end of 3 $cm^2$ and with maximal induction of 30 mT on its end surface was used. The inductor was placed in contact with the skin of the SHR in the region of projection of the kidneys. The parameters of exposure were: induction of MF 30 mT, direction of the lines of force vertical, frequency 50 ± 0.5 Hz, sinusoidal wave form, interrupted action (duration of volleys and pauses 2 ± 0.4 sec), duration of exposure 20 min, number of procedures 12. Exposure to the LMF was given daily at the same time, from 10 a.m. to 2 p.m. The SHR were fixed in a Kogan's chamber in which there were special holes for the inductor. To rule out any effect of LMF on the animal's head, it was screened with V-1 tissue, which has concealed metallization and gives attenuation of MF of more than 100 times. Monitoring MF in the region of the animal's head with the F-4356 milliteslameter confirmed the absence of magnetic induction in that region.

BP was measured by the direct method by preliminary catheterization of the femoral artery. The free end of the catheter was brought out beneath the skin on the animal's back and fixed in the interscapular region by means of ligatures. After the operation the catheter was filled with a 50% solution of polyvinylpyrrolidone in heparin (5000 U/ml). The free end of the catheter was closed by a stopper. The operation was performed under pentobarbital anesthesia.

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By the use of the method of preparing the SHR for chronic measurement of BP described above, it was possible to record the systemic BP of the animals for 3-4 weeks under close to natural conditions. A Bentey Trantec model 800 pressure transducer (Italy) was used. The systolic, diastolic, and mean dynamic BP and the heart rate (HR) were recorded on a Linear Corder Mark VII WR 3101 apparatus (Hugo Sachs Elektronik, West Germany).

The experimental results were subjected to statistical analysis on a type 3015 computer (Labtam, West Germany), using a Statmak program, with determination of the significance of differences between mean values within and between groups.

## EXPERIMENTAL RESULTS

Analysis of the experimental results showed that a single exposure of SHR to LMF in the region of the kidneys caused a very small decrease of the systemic BP. It began to fall significantly after the third procedure. The hypotensive action of LMF gradually increased. The "gradualness" of the increase in the hypotensive action of LMF, revealed by these experiments, agrees with observations by other workers. Slow activation of biological systems developing under the influence of MF has been observed in another study [9].

The hypotensive effect obtained as a result of a course of LMF continued for 6-7 days, after which BP gradually rose, to reach its initial level on the 13th-15th day after the end of the course. Under the influence of LMF a marked decrease in HR was observed. It was considered worthwhile to direct the magnetic flux to the region of the kidneys of the SHR, on the grounds that they play an important role in the formation of arterial hypertension in both animals and man [11, 8]. Positive correlation exists between the functional state of the regional renal circulation and the systemic BP [12]. We know that an increase in vascular resistance of the kidneys, leading to their ischemia, is one of the main factors in the mechanism of the raised BP [3].

We also considered that a magnetic flux, which has a vasotropic action with a marked vasodilator effect, if aimed at the kidneys, would reduce the vascular resistance of the kidneys, which would lower the systemic BP of the SHR. This working hypothesis was confirmed by the results of a clinical investigation [2], which showed that a course of LMF aimed at the kidneys of patients with stable forms of arterial hypertension, conducted by the method developed experimentally, led to a marked decrease in the vascular resistance of the kidneys and improvement of the renal blood flow.

A course of LMF applied to the region of the kidneys of SHR thus caused the systemic BP of these rats to fall. The hypotensive action lasted 6-7 days, after which BP returned to its original values.

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