# THE EFFECT OF STIMULATION OF THE HYPOTHALAMIC REGION ON THE HEART DURING RESTRICTION OF THE CORONARY BLOOD FLOW

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Myocardial infarcts may develop in the absence of visible morphological changes in the coronary vessels. The zone of infarction is usually much more extensive than the area of the muscle supplied by the blood vessel undergoing obstruction. An essential and frequently decisive role in the genesis of acute coronary insufficiency belongs to the reflex reactions effected through the system of the vagus nerve [4, 5, 6]. It is evident that in practice any stimulation of a reflexogenic zone, in association with restriction of the coronary blood flow, may produce additional spasm of the coronary vessels and disturbances of the cardiac rhythm.

The present investigation was undertaken at A. V. Lebedinskii's suggestion with the object of elucidating the possible role of central autonomic influences in the development of acute coronary insufficiency.

## EXPERIMENTAL METHOD

The investigation was carried out on 16 rabbits. From 1 to 2 weeks before the experiment electrodes were inserted into the hypothalamus of the animals. For the duration of the experiments the animals were immobilized with diplacin (2% diplacin dihydrochloride in a dose of 0.5-0.7 ml intravenously) and maintained on artificial respiration, but not anesthetized. Acute coronary insufficiency was reproduced by ligation of the descending branch of the left coronary artery at the junction of its upper and middle thirds. In all the rabbits ligation of the vessel was accompanied by the formation of a clearly visible focus of stasis in the myocardium of the left ventricle. The electrocardiogram was recorded in the standard leads before and after ligation of the vessel for periods of 30-60 min (5 rabbits), 2-3.5 h (4 rabbits), 4-5 h (7 rabbits). Three rabbits took part in the experiment twice, from 1-2 and 4-5 days after ligation.

The effects of stimulation of the hypothalamus were judged by the changes in the ECG directly after the cessation of stimulation. Stimulation of the hypothalamus was carried out through bipolar nichrome electrodes, using a sinusoidal current from a type ZG-10 sound generator at a frequency of 100 cps and duration 30 sec. Stimuli were applied at intervals of 3-4 min from the time of ligation until the establishment of the threshold effect, after which the superthreshold effects were recorded and the application of the stimuli was suspended for 30-40 min.

## EXPERIMENTAL RESULTS

After ligation of the branch of the coronary artery, all the animals developed changes in the cardiac activity as a result of the artificial disturbance of the coronary circulation. The changes in the ECG took the form of a transient slowing of the rate, a displacement of the S-T interval, and changes in the T wave. Changes of the monophasia type, shown by a direct transition from a negative S wave to a high, dome-shaped T, usually appeared 4-8 min after ligation, and then gradually disappeared in the course of 1-2 h, sometimes later. In some animals these early signs of development of anoxia of the heart muscle did not appear at any time during the experiment. Changes in the T wave, however, could be seen in all the rabbits, in some cases with the appearance of a deep negative (coronary) T.

With these changes in the ECG as a background, stimulation of the hypothalamus led to both usual and special effects, the latter never observed when the experiments were carried out on intact rabbits (more than 40 animals). The usual effects of stimulation of the hypothalamus included the development of sinus bradycardia, the appearance of ventricular extrasystoles, and sometimes an increased T wave [8, 10, 11].

After artificial restriction of the coronary blood flow, and in the presence of a dome-shaped T wave on the ECG, stimulation of the hypothalamus sometimes led to intensification of these changes resembling monophasia (Fig. 1, A). In other cases stimulation of the hypothalamus played the role of a developing factor. The dome-shaped deformation of the T wave appeared as the effect of stimulation, disappearing at the end of the reaction or persisting for a long time (Fig. 1, B). Stimulation of the hypothalamus may also lead to a more marked depression of the S-T interval (Fig. 1, C). The usual effect of stimulation of the hypothalamus—sinus bradycardia—was also recorded on the ECG (see Fig. 1, B and C).

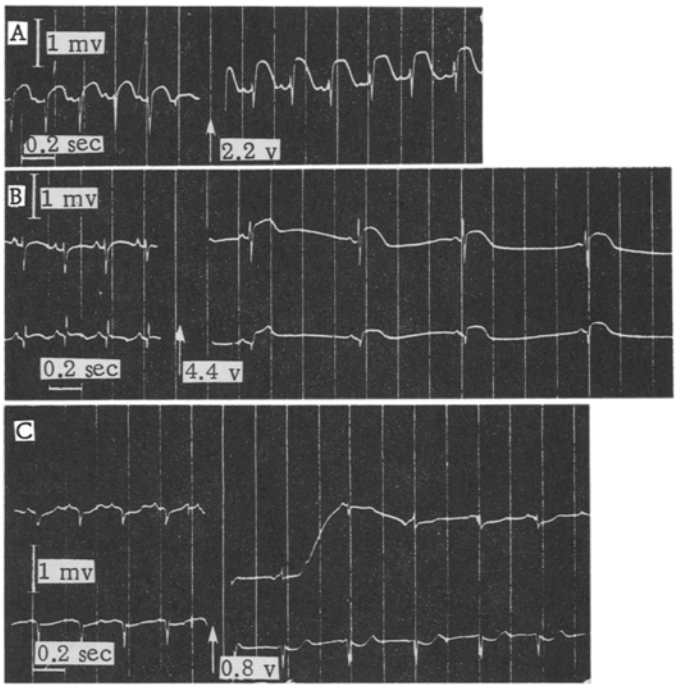


Fig. 1. Changes in the work of the rabbit's heart as a result of stimulation of the hypothalamus after ligation of the coronary artery. A) Intensification of monophasia (20 min after ligation; B) slowing of the rate and appearance of a dome-shaped T wave (2 h 20 min after ligation); C) slowing of the rate and increased depression of the S-T interval (2 h 15 min after ligation).

Sometimes more serious disturbances of the cardiac activity could be observed by means of stimulation of the hypothalamic region. For instance, 1 h 10 min after ligation of the coronary vessel, with moderately marked dome-shaped deformation of the T waves as a background, in response to stimulation of the hypothalamus, contractions appeared with dissociation of the ventricular complex, indicating a disturbance of the conductivity of the bundle of His. These signs of heterochronicity of the ventricles subsequently disappeared, after which ventricular tachysystole developed and complexes with a high dome-shaped T wave returned, with much higher voltages than the R waves (Fig. 2). In this case stimulation led to additional myocardial ischemia, as a result of which the conductivity of the bundle of His was disturbed.

The effects we have described appeared only in the course of the first few hours after ligation of the vessel. In three rabbits which took part in the experiment twice, after 1-2 and 4-5 days, in response to stimulation of the hypothalamus only the usual effects were observed in the form of sinus bradycardia and the appearance of heterotopic impulses.

There is evidence that after injury to the myocardium, and also after ligation of the coronary vessel, the reactions of the heart and coronary vessels to certain stimuli may be modified [1, 2, 7, 9]. In these conditions changes have been found in the excitability of the cardiac endings of the vagus nerves [3]. It is evident that we met with the same phenomenon of increased reactivity of the heart when we studied the hypothalamic influences, which were

different in the presence of restriction of the coronary blood flow from those usually observed, and contributed towards the development of acute coronary insufficiency, causing additional spasm of the vessels and thereby aggravating the disturbance of cardiac activity.

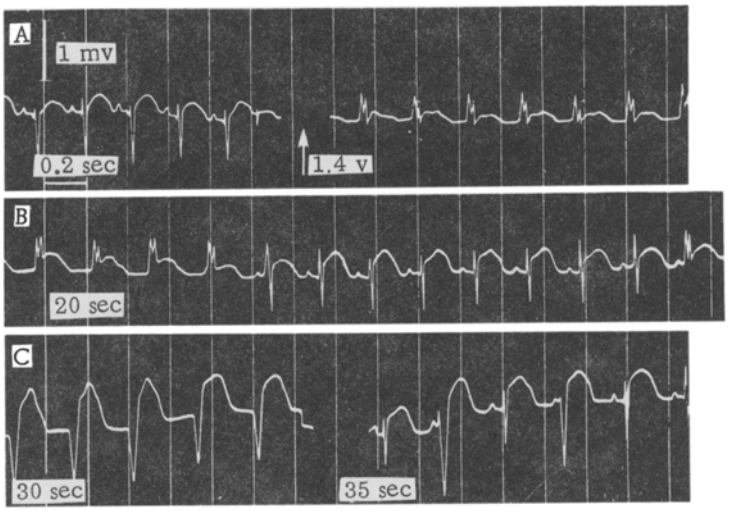


Fig. 2. Signs of heterochronicity of the ventricles (A), intensification of dome-shaped deformation of the T wave (B), ventricular tachysystole (C), and complexes with high dome-shaped T waves in response to stimulation of the hypothalamus (1h 10 min after ligation).

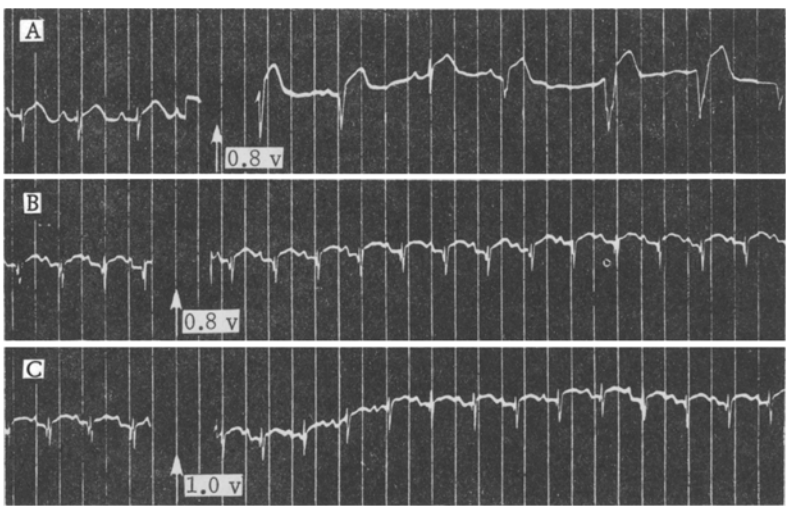


Fig. 3. Effect of hexamethonium on the changes in the work of the heart caused by stimulation of the hypothalamus. A) Slowing of the rhythm, extrasystoles in response to stimulation; B and C) absence of effect 9 min after intravenous injection of hexamethonium.

The hypothalamic influences were transmitted to the heart through vagal parasympathetic pathways, and could be abolished by vagotomy or by administration of atropine or gangliolytics (Fig. 3). Injection of hexamethonium in a dose of 10 mg/kg completely abolished the effect of stimulation of the hypothalamus, hitherto appearing in the form of ventricular extrasystoles.

The involvement of the hypothalamic region after occlusion of a blood vessel evidently takes place through the afferent vagal and posterior-root innervation and the reticular formation of the brain stem [6].

SUMMARY

The work deals with studies of the role played by central vegetative influences in the development of acute coronary insufficiency. For this purpose the descending branch of the left coronary artery was ligated. As demonstrated on rabbits, stimulation of the hypothalamus in such conditions, along with the effects common to intact animals (sinus bradycardia and the appearance of heterotropic impulsation) may cause an intensification or appearance of monophasia-augmented deviation of the S – T interval and other changes of the cardiac activity, aggravating the course of acute coronary insufficiency.

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**All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.**

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