SOME PECULIARITIES IN THE REGULATION OF THE RATE OF HEART CONTRACTIONS IN CORONARY INSUFFICIENCY

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It is known how quickly and responsively the rate of the heart contractions changes due to different environmental changes. Emotional influences and the effects of stimuli causing a superficial reaction lead to this or that change in the heart rhythm. Pulse retardation or acceleration is one of the ways in which the body responds to the stimulus in the realization of many reflex acts.

Pathological changes occurring in the organ due to a pathologic process alter both the condition of the organ as such and its reflex responses. A series of authors studying the vegetative cardiac reflexes noted certain peculiarities in their course in patients with diseases of the myocardium. Wenckebach [6] used the Chermak's reflex for diagnosis, as he considered that acute expression of this reflex was typical of serious heart patients. A. Weil [5] proposed that this intensified reaction was connected with pathologic change in the coronary vessels. L. Braun and B. Samet [4] discovered in an experiment that the effect which stimulating the peripheral termination of the vagus nerve has on the heart is intensified when the coronary arteries are impaired.

M. E. Mandelshtam and others [2, 3], studying vegetative cardiac reflexes in patients with inflammatory and degenerative-infiltrative processes in the heart, found that the carotid sinus reflex was often acutely expressed, whereas, in patients with only inflammatory signs in the heart, the reflex was expressed to the same degree as in healthy people.

V. M. Kogan [1], in a psychological study of patients with coronary insufficiency, found that their heart rhythm accelerated less in response to emotional stimulation.

Our study was based on this observation.

EXPERIMENTAL METHODS

The purpose of our work was to study the changes in the rate of the heart contractions in coronary insufficiency patients in response to stimuli normally causing both acceleration and retardation of the heart contractions. The stimuli we used were emotional stimulation, nitroglycerin , pressure on the eyeballs (Aschner's reflex) and pressure in the region of the carotid sinus (carotid sinus reflex). We recorded the pulse continuously during these various influences and also the electric reflex and the vascular reactions (by plethysmography); electrocardiograms were taken in the second lead (Fig. 1).

The emotional stimuli we used were as follows: the patient was questioned briefly about the pains in his heart and the reasons first causing them and a series of problems were successively suggested to him, some of which encouraged the patient as he could easily cope with them, and others which perplexed him, causing the patient either to refuse to solve them or, on the other hand, to become agitated and try to solve them at all costs. The reactions in response to the emotional stimuli were examined in colaboration with V. M. Kogan.

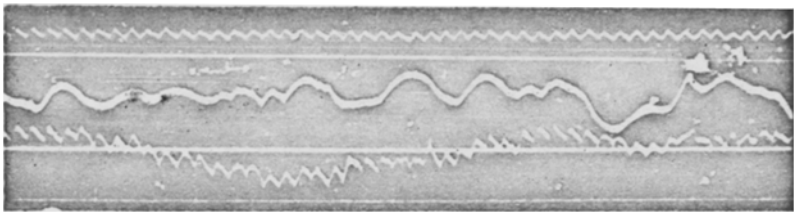

Fig. 1. Simultaneous recording of pulse, electric-skin reflex and plethysmogram (from finger).
Curves signify, from top to bottom: pulse, electric-skin reflex, plethysmogram, zero line, time indication (in 5 second marks).

As the material was developed, the heart contractions were counted every 15 seconds throughout the investigation. The records were analyzed by computing the height and frequency of the waves recorded by the electric-skin reflex, the background oscillation and the degree to which the vascular reactions were expressed in the plethysmograms. The intensity of the electric-skin reflex and the vascular reactions was expressed in conditional marks (according to the triple-mark system).

We observed a total of 112 persons: 106 patients with pains in the region of the heart and 6 healthy people.

The patients were divided into three groups according to the classification of L. I. Fogelson, which has been accepted by TsIETIN: the first contained those persons with pains of coronary origin in the heart (28 persons), the second (control), those with pains of noncoronary origin in the heart (30 persons), and the third, those with pains of mixed origin in the heart (48 persons). In the last group, coronary insufficiency was the main source of the pain in 31 persons (group 3-a), while pains of a noncoronary origin predominated in 17 persons of this group (group 3-b).

The average frequency of the heart contractions, which was first examined daily in the clinic and then under the experimental conditions before our experiments, was about the same in all of the groups.

EXPERIMENTAL RESULTS

At certain moments during the emotional stimulation, the heart rhythm changed considerably by becoming either faster or slower than the original pulse rate.

The maximal acceleration of the heart contractions as compared with the original rate was much smaller in the patients of the 1st group – a total of 6.5 beats, while the total was 19.8 beats in the patients of the 2nd group (Fig. 2). The acceleration of the heart rhythm in the 3rd group was intermediate as compared with the first two groups and consisted of 14 beats.

The maximal acceleration in the healthy people was 17 beats.

The average maximal retardation was the same in all of the experimental groups (Fig. 2), but it occurred more often in some patients of the 1st group. There was no specificity observed for any particular group of patients in the manifestation of other vegetative reactions (electric-skin reflex and vascular reactions); there was approximately the same number of acute, moderate and weak reactions observed in each group of patients.

Therefore, although the reactions in response to the emotional stimuli were identical as far as the other vegetative functions were concerned, the reaction of heart rhythm change was electively diminished in the coronary insufficiency patients, as was expressed in the lesser acceleration of the heart contractions observed in these patients.

The data described confirm similar phenomena observed earlier by V. M. Kogan.

In the remaining part of the work, we analyzed the effects of other stimuli on the heart rhythm.

When nitroglycerin was used as the stimulus, the heart contractions accelerated one minute after its administration in all of the patients, reaching the maximum acceleration by the third minute (16-44 beats). The blood pressure (maximal, average and minimal), which was measured by arterial oscillograph 3 and 5 minutes after the administration of nitroglycerin to the patients, did not change in most cases.

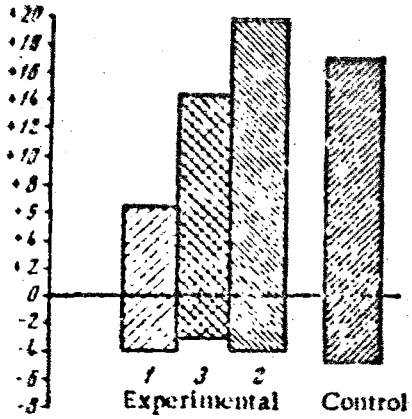

Fig. 2. Maximal acceleration and retardation of pulse as compared with original rate.
1, 2, 3) different groups of patients.

In the patients of the 1st group, the acceleration of the heart contractions observed after the administration of nitroglycerin (an average of 19 beats) was somewhat less than in the control group (an average of 24 beats).

Aschner's reflex caused the heart contractions to become 4-8 beats slower. No great differences as to the extent to which the heart rhythm was retarded were observed between the patients with pains of coronary origin and those with pains of noncoronary origin. In the patients of the 1st group, however, a retardation approximating 8 beats was more frequently observed than in the patients of the 2nd group, in which the retardation was usually 4 beats. Therefore, one could observe a greater tendency to retardation of the heart contractions in the patients with a coronary insufficiency.

With pressure on the carotid sinus region, the heart contractions slowed in 98% of the patients of the first group, in most cases, by 12 beats. The heart contractions were only slowed in 28% of the patients of the 2nd group, and then, only by 4-8 beats. The heart rhythm was either not retarded at all in the healthy persons, as occurred in the majority of cases, or by a total of only 4 beats.

Consequently, the carotid sinus reflex (which slows the heart rhythm) was somewhat stronger in the patients with pain of coronary origin than in the patients of the other groups.

The electrocardiograms, which were taken during the action of both the emotional stimuli and the other stimuli, did not show any changes indicating that dynamic disturbances of coronary circulation had developed in the course of our study.

Therefore, in comparison with the patients with pain of non-coronary origin and with the healthy people, a diminished ability to alter the rhythm of the heart contractions was observed in the patients noncoronary ailments during the action of stimuli causing heart rhythm acceleration (emotional stimuli, nitroglycerin).

There was a more pronounced reaction of heart rhythm retardation observed in these patients with the action of stimuli causing retardation of the heart contractions.

Therefore, peculiarities which were evidently of a compensatory-defense nature could be found in the reflex cardiac activity changes of the coronary insufficiency patients. Due to these peculiarities, the heart rhythm with various external and internal stimuli was slower than in healthy people. The lack of significant heart rhythm acceleration can be regarded as a favorable phenomenon, as acceleration would have made increased demands on an imperfect coronary system and thus cause acute coronary circulation insufficiency.

The lesser acceleration of heart rhythm in the coronary insufficiency patients cannot be explained by a reduction of general reactivity. The absence of any specific changes in the reactions of the other vegetative functions indicates the specificity of extracardial heart rhythm regulation in coronary insufficiency patients.

One can propose either that this is due to the altered reactivity of the heart itself caused by pathological change, or, which we believe is more probable, that it is due to a reconstruction of the reflex mechanisms regulating the heart rhythm, causing a relative predominance of inhibitory effects.

SUMMARY

The rate of heart contractions, electric-skin and vascular reactions to different agents exciting and inhibiting the rate of heart contractions have been studied in patients with coronary insufficiency. A diminished ability to alter the rate of the heart rhythm has been disclosed in such patients. Since no specific peculiarities have been demonstrated in the reactions of other negatative functions, it is assumed that in coronary patients changes of extracardial regulation of heart rhythm are specific.

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