CHANGES IN PHASE STRUCTURE OF THE CARDIAC IMPULSE IN HYPOTHERMIA

I. I. Golitsyna

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Changes in the apical impulse were studied during hypothermia. Cerebral hypothermia increases the duration of the phase of thrust, the phase of the apical impulse proper, and the phase of decline, but has practically no effect on the duration of the atrial impulse phase. The most marked increase in duration of the phase of decline is observed at the end of cooling. During warming of the animal these changes in the cardiac impulse return to normal.

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The contractile activity of the heart is accompanied by biophysical phenomena [5] which have been studied in some detail in craniocerebral hypothermia [1-4].

The object of the present investigation was to study the phase structure of the apical impulse of the heart in hypothermia.

EXPERIMENTAL METHOD AND RESULTS

Experiments were carried out on 9 dogs under craniocerebral hypothermia. The apical impulse was studied by means of a cardiograph of membrane type, connected to an electromanometer. Recordings were made on a type 068 physiograph. The EKG in standard lead II and the phonocardiogram were recorded synchronously with the cardiogram.

The experimental results showed that craniocerebral hypothermia differs in its effect on the duration of the various phases of the cardiac impulse.

Phase of Thrust (Fig. 1a). Beginning of cooling causes complex changes in duration of this phase, the curves reflecting changes in individual cases shifting in different directions. However, as a rule, deepening of hypothermia increased the time (from 0.19±0.03 sec at normal temperature to 0.25±0.04 sec in hypothermia) during which the heart exerts its thrust on the chest wall on the average by 60%, presumably due to prolongation of the phase of isometric contraction.

The Phase of the Apical Impulse Proper (Fig. 1b) is shortened by cooling to 34° (brain temperature 31.9°). However, deeper hypothermia was usually accompanied by a marked increase in this index (to 0.21±0.01 sec; at normal temperature 0.11±0.03 sec), which was directly dependent on the duration of the ejection phase of the cardiac cycle.

The Phase of Decline (Fig. 1c) normally lasts 0.07±0.04 sec. This phase, characterizing movements of the heart in diastole, varies in a distinctive manner during cooling: a fall of rectal temperature to 32° (brain temperature 28.7°) increased the duration of this phase, while cooling to 32-31° (brain temperature 28.7-27.1°) reduced it. However, it was still longer than initially. Further cooling gave an increase in duration of the decline phase, which reached 0.34±0.04 sec at 29° (brain temperature 24.0°), i.e., almost 5 times longer than initially.

The Phase of the Atrial Impulse (Fig. 1d). The duration of this phase is short and shows little variation under different physiological conditions.

Department of Human and Animal Physiology, P. I. Lebedev-Polyanskii Vladimir Pedagogic Institute.
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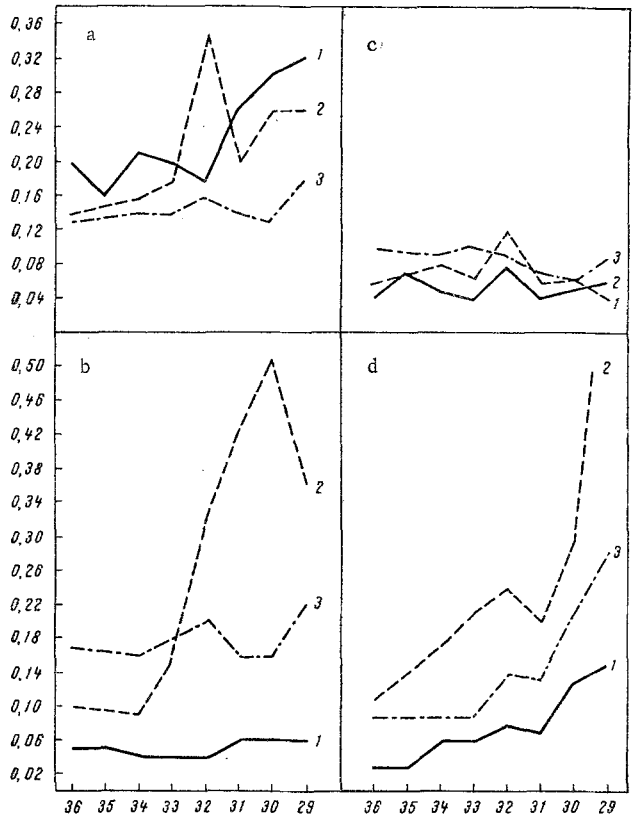

Fig. 1. Changes in phases of cardiac cycle during deepening hypothermia. a) Phase of thrust; b) phase of apical impulse proper; c) phase of decline; d) phase of atrial impulse; 1) experiment No. 634 on April 9, 1968; 2) experiment No. 640 on April 17, 1968; 3) experiment No. 645 on April 23, 1968. Abscissa, rectal temperature (in deg.); ordinate, duration of intervals (in sec).

Craniocerebral hypothermia thus increases the duration of the phases of thrust, of the apical impulse proper, and of the decline phase. The phase of decline is increased most near the end of cooling. The most marked changes in duration of the phases were observed within the range of rectal temperature from 36 to 31° (brain temperature 35.1-27.1°).

Warming the animal restores the normal phases of the cardiac impulse.

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