THE EFFECT OF DIRECT CURRENT POLES ON THE CONDUCTIVITY OF CARDIAC MUSCLE ALTERED BY MECROTIC TISSUE

O. D. Kurmaev and I. Sh. Makaleev

From the Laboratory of Physiology (Head – Prof. O. D. Kurmaev)
of the Kazan Pedagogical Institute
(Presented by Active Member of the Akad. Med. Nauk SSSR A. V. Lebedinskii)
Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 56, No. 7,
pp. 44-46, July, 1963
Original article submitted May 16, 1962

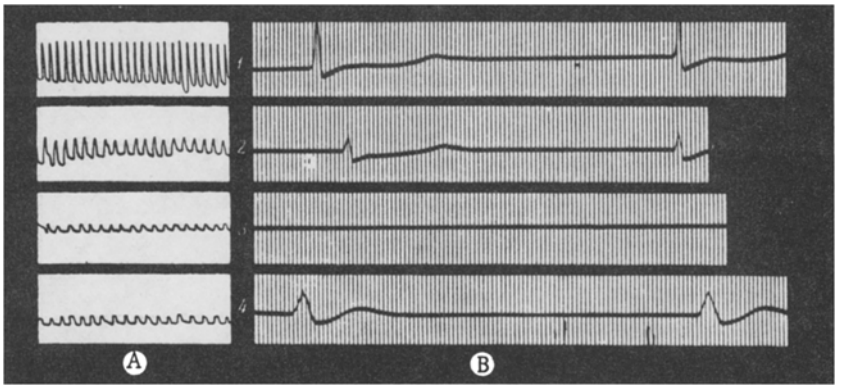
It is known that necrotized tissue, applied to the heart, finally causes major functional changes which are typical for focal diseases of the myocardium [4]. The effect of necrotized tissue, obviously, is not limited to the site of direct injury, but tends to extend into the surrounding portions of the myocardium.

The search for means of eliminating the effect of necrotized tissue on the myocardium and other tissues is of great interest both from a practical and theoretical point of view.

There are data indicating that the effect of necrotized tissue on the myocardium is primarily caused by an outflow of potassium ions from the injured tissues and their entrance into the healthy tissue, causing depolarization of the latter, and, along with this, the loss of excitability and conductivity [6]. If this is actually so, it could be expected that the effect of necrotized tissue could be eliminated to some degree by the anode of a direct current, since the latter restores conductivity in a nerve that has been altered by potassium ions [2], and also restores an EKG that has been deformed by chemical alteration of the heart [3].

A series of experiments, carried out on a neuro-muscular preparation, justified our predictions: with the action of a direct current anode, conductivity was restored to a nerve that was previously disrupted by necrotized tissue [1].

In this work, we attempted to examine the possibility of restoring normal function to the perinecrotic zone in cardiac muscle by the action of direct current.



Changes in the mechanogram (A) and electrogram (B) of the cardiac band with application of necrotized tissue to the middle of the preparation. 1) Starting tracing; 2) at 3 minutes after application of the necrotized tissue; 3) after onset of complete blockade; 4) after the action of a direct current anode on the altered portion of the band.

The experiments were carried out on a band of frog heart ventricle, which is a very convenient subject for studying properties related to the conduction of excitation [5]. To facilitate the analysis, the tissues of the strioventricular node were left on only one end of the band. A mechanogram of the band and an electrogram of its distal end were recorded simultaneously.

It was established that after application of necrotized tissue to the mid-portion of the band, the amplitude of the contractions decreased significantly; the voltage of the electrogram peaks also gradually diminished, and, finally the runner remained on the isoelectric line, although contractions still continued (this was noted on the kymograph drum). In this case, it was even apparent to the eyes that movements of the band continued to register due to contractions limited to its proximal half. Removal of the necrotized tissue, and washing of the band with Ringer's solution, completely restored the contractions of the band, as well as the normal bioelectric activity of the distal section of the myocardium.

The experiments showed that with anodization of the area in which the necrotized tissue acted, the bioelectric activity of the distal end of the band was restored in 81% of the cases, although the character of the electrogram that was recorded in this case did not coincide with the starting tracing. Anelectrotonic restoration of contractility was less pronounced – in many of the trials, the amplitude of the contractions was elevated to a minimal degree (see figure).

Restoration of the bioelectric activity to the distal end of the band could be observed in the course of a certain amount of time, even after the polarizing current was switched off.

At the same time, experiments set up with cathodization of the altered portion did not yield the same results: transient restoration of the cardiac band's conductivity was noted only in 4 trials out of 21.

LITERATURE CITED

1. A. M. Aleksenko and O. D. Kurmaev, in the book: Data from the 2nd Povolga Conference of Physiologists, Biochemists and Pharmacologists [in Russian]. Kazan, (1961) p. 20.
2. D. S. Woronzow, Pflüg. Arch. ges. Physiol., Bd. 203, S 300 (1924).
3. A. G. Gol'tsman, Fiziol. zh. SSSR, No. 8, (1957) p. 753.
4. É. A. Kyandzhuntseva and M. G. Udel'nov, in the book: Questions in the Pathology and Physiology of the Heart [in Russian]. Moscow. (1955) p. 24.
5. É. A. Kyandzhuntseva and M. G. Udel'nov, in the book: Questions in the Pathology and Physiology of the Heart [in Russian]. Moscow, (1955) p. 37.
6. V. S. Sal'manovich, Pat. fiziol., No. 5, (1957) p. 53.