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THE STUDY OF BIOELECTRIC INDICATORS OF BRAIN FUNCTION AND CARDIOVASCULAR ACTIVITY IN ANIMALS WITH NATURAL HYPOTHERMIA UNDER THE EXPERIMENT CONDITIONS IN YAKUTIA

ABSTRACT

Some aspects of studying of bioelectric indicators of function of a brain and cardiovascular activity at a natural hypothermia of a pig organism at temperature -40 °C and below in the experimental conditions are presented in article.

Keywords: EEG, ECG, pigs, hypothermia.

Introduction

The hypothermia (frigorism) – a condition of an organism or its certain area at which its temperature is lower than is required for maintenance of a normal metabolism and functioning. On a cooling parentage source the condition of a hypothermia happens natural and artificial. Researches in the field cover the directions bound to functioning of an organism in the conditions of a life-threatening thermolysis to the environment, the general cooling of an organism in a condition of the general narcosis etc [3].

In modern conditions of development of the Arctic the problem of a frigorism and hypothermia of an organism gains fundamental and applied character from the person and animals [1]. In the republic during the winter about 200 people with a freezing injury of extremities and in a condition of a deep hypothermia come to hospitals of the Sakha (Yakutia) Republic. Studying of organism restoration after a deep hypothermia on experimental models is relevant for Yakutia. The correct well-timed delivery of health care in the region of the Far North is in many respects provided with high-quality preliminary clinical and technical researches by results of which versatile researches of an organism are conducted and their main clinical and physical properties, such as impulses of a brain and cardiovascular activity are defined [1].

In medicine the problems of hypothermia and «resuscitation» of an organism remains open. For the last 15 - 20 years in many countries researches are conducted on a large scale and the works confirming thoughts of a possibility of «resuscitation» of an organism are published. With cold physical solution with bringing body temperature to +10 °C and further gradual replacement with a blood with slow temperature increase I led the method developed by Tisherman and Peter Rhee from Arizona State University since 2000 about full replacement of a blood after a cardiac standstill to heartbeat restoration though it is sometimes artificial. At the same time no negative impact of process of introduction to an anabiosis and the subsequent resuscitation on physical and cognitive functions of animals was taped [3]. Preceding from it is possible to claim that the hypothermal state has neuroprotectiveeffect at various hypoxemic pathologies. Protective properties of a hypothermia were investigated by coryphaeuses of domestic resuscitation V.A. Negovsky, A.I. Treshchinsky and L.P. Chepky. Mechanisms of neuroprotective action of hypothermia aren't quite clear [4].

Objective of research – to studybioelectric activity of a brain and cardiovascular system of a pig at natural deep hypothermia at temperatures -40 ° C and below in the conditions of Yakutia.

We make the following tasks:

1. To set changes of brain EEG and heart ECG indicators of a pig at natural deep hypothermia.
2. To develop methods of body revitalization at a deep hypothermia.

To perform the tasks, we modeled the conditions for obtaining natural deep hypothermia of animals at temperatures of -40 ° C and lower, at which the mechanisms of introducing animals into the state of anabiosis were studied and data on the bioelectrical activity of the brain and heart were obtained.

In the present work we undertook an investigation of the brain EEG and ECG of the cardiovascular system of a pig in a state of deep hypothermia in order to detect the features of the change in the EEG power spectrum and ECG with a decrease in body temperature that could shed light on the mechanisms underlying the temperature dependence of the function of the brain and heart. It was also proposed to develop methods for restoring the function of the brain at deep hypothermia.

Materials and methods of a research

Work is performed in 2018 from January to March on the basis of faculty of veterinary medicine of Yakut State Agricultural Academy, Yakutsk.

Experiments were made on clinically healthy pigs at the age of 2-3 months with a body weight from 15 to 20 kg,received from Hatassky pig farm. For the purpose of restriction of mobility and bracing of animals at the beginning of the experiment carried out a neuroplegia (a neuroleptic – XylaVet of 0,2% 0,5ml and Droperidolum of 0,5 ml.). Further for modeling of alcohol intoxication - ethyl alcohol inside in a dose of 5-6 ml/kg of live weightwas applied. Animals were fixed and placed on the street at ambient temperature –40 °C…–43 °C.

Experimental work was carried out according to the ethical standards regulating experiments on animals according to the European convention on protection of the vertebrate animals used for experiments or in other scientific purposes No. 123 of March 18, 1986, Strasbourg and the order of the Russian Ministry of Health of 01.04.2016 No. 199n «About the approval of Rules of appropriate laboratory practice». The permission of the Local bioethical commission of the YSC CMP for the research was obtained.

For a research of bioelectric activity of a brain we used the computer complex «Neyron-Spektr — 1» which is executed on base «Neyron-Spektr-4P» and is intended for registration of an EEG, the

long-latent of the caused potentials (CP) of a brain in any unscreened room. The recording electrodes connected to the amplifier of biological potentials. Further «Neyron-Spektr- 1» was connected to the computer.All the data were registered on the hard drive. The EEG was recorded during experience to a stopping of signals and emergence of isoelectric amplitude. An ECG carried out by means of the device Poly-range 8/B.

Results of researches

During the «cooling-warming» experiment, the temperature of the pig's internal organs gradually decreases (Fig. 1).V- amplitude beta-diffuse activity is dominant. As the temperature of the body decreases, the EEG parameters of the pigs brain naturally change - the frequency of oscillations and their amplitude gradually decrease, and finally, at a body temperature of about + 18 ... + 20 ° C, the EEG becomes practically an isoelectric (flat) line (Fig. 2-3) .

We have produced selective antegrade cerebral perfusion with an artificial blood circulation apparatus with perfusion rate 8ml/min/body mass with gradual warming the perfusate to obtain bioelectric indicators. For perfusion after sternotomy, aortic cannula in the aortic root and the venous cannula in the cranial vena cavawere established. Heparinizationwas performed at a rate of 3 mg/kg. Warming the perfusate through the AIC performed by maintaining a temperature gradient of less than 5 °C. In the experiment №1 perfusion event began an hour after stopping the heartbeat, in an experiment №1 12 hours. Against the background of perfusion and gradual warming, we did not notice electric brain activity.

When the animal warms after deep hypothermia, the EEG undergoes reverse minor changes, but the appearance of reliable indicators of the recovery of electrical activity is not revealed.Based

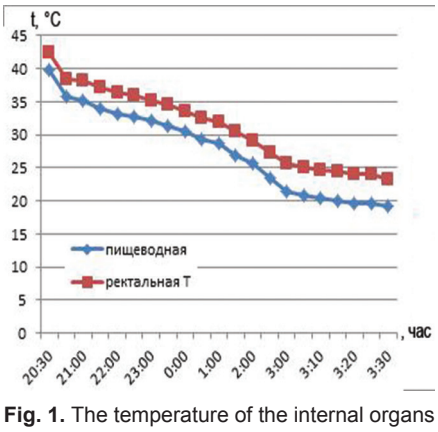

Fig. 1. The temperature of the internal organs of the pig in the period of hypothermia

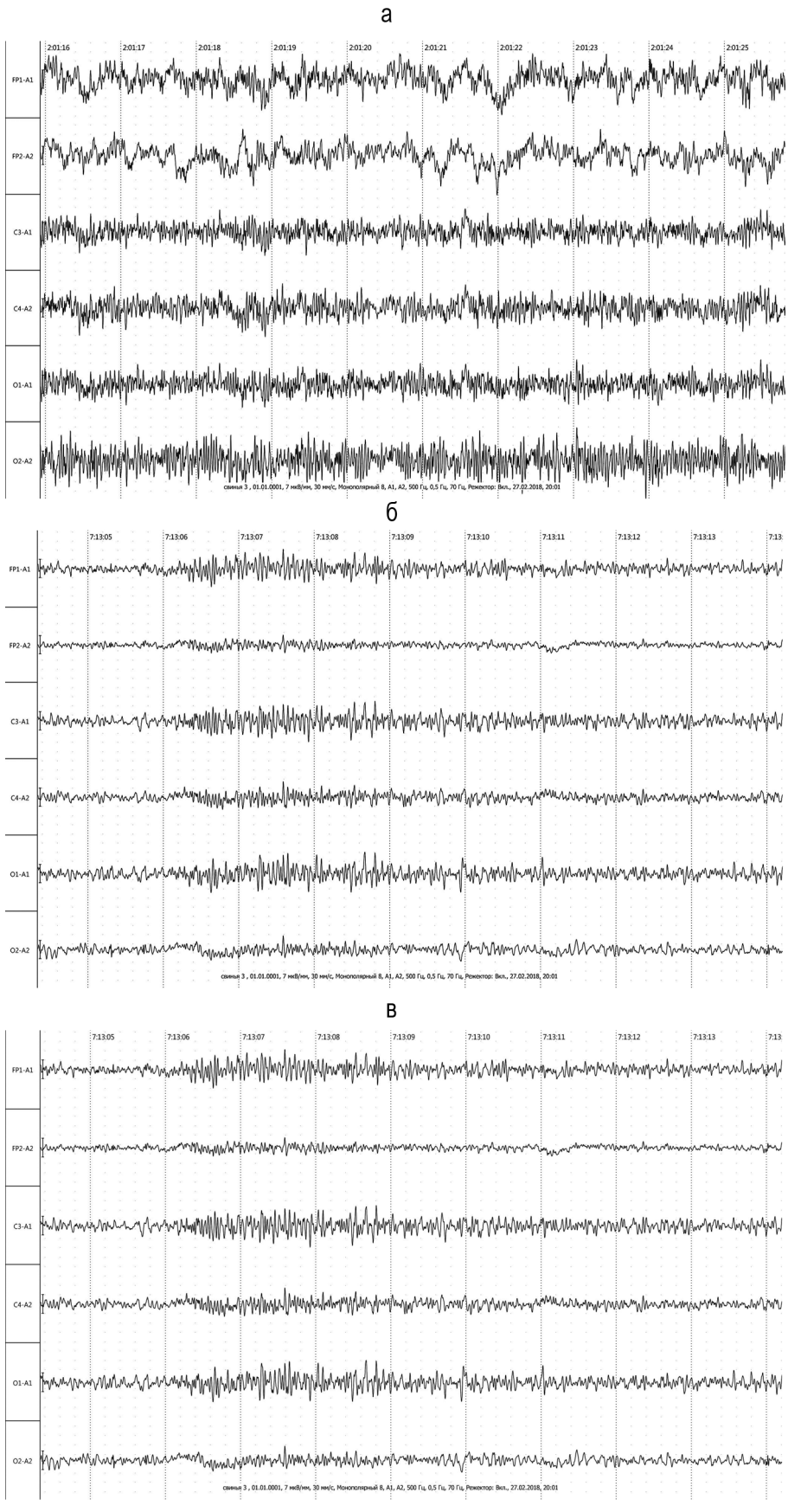

Fig.2. Changes in the EEG of the pig's brain: a - after 2 h of hypothermia (rectal T 35.2 ° C, esophageal 34 ° C); b - after 7-10 h of hypothermia (rectal T 27.3, esophageal - 23.5 ° C); c - after 7-20 h of hypothermia (rectal T 19.2 ° C, esophageal -23.3 ° C)

on the results of our experiments, it can be argued that the decrease in internal temperature depends on the ambient temperature. At the same time, according to ECG indications, gradual slowing of atrioventricular conduction and, accordingly, bradycardia followed by arrhythmia and cardiac arrest. The appearance of the isoelectric line occurred immediately after the cardiac arrest.

Experiments with animals have made it possible to establish a number of factors that make it difficult to restore the vital functions of the brain. These include long-term exposure to low temperature, the impossibility of establishing a time when you can «start» the reverse mechanism of recovery of the brain.

The experimental data presented above show that the mechanisms of the brain functioning in the case of cold trauma have not yet been clarified, and the researchers face still enormous and complex tasks of further studying this problem. We need to search for new technologies for «revitalization», and experimental research on this issue will continue.

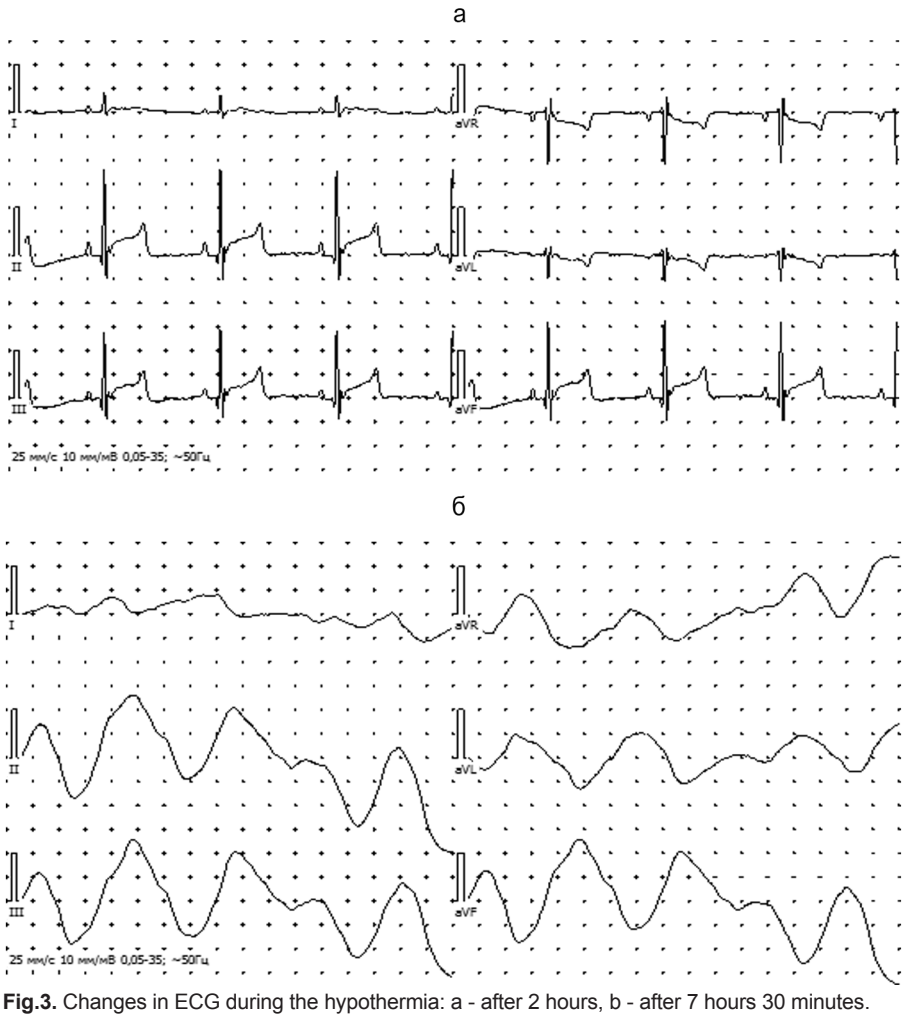

Fig.3. Changes in ECG during the hypothermia: a - after 2 hours, b - after 7 hours 30 minutes.

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