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ANALYSIS OF FACTORS THAT NEGATIVELY AFFECT ON THE RESULTS OF RESEARCH OF PATHOLOGICAL NEUROPHYSIOLOGICAL PROCESSES OF THE BRAIN

Abstract. The article examines the analysis of factors that negatively affect on the results of the study of pathological neurophysiological processes of the brain, and identifies ways to elimination of them. The reasons that distort research results and, as a result, biometric errors are given.

Key words: neurophysiological processes, epileptology, microprocesses, interictal spikes, convulsive readiness, spike activity.

Relevance of research

Despite intensive research conducted in many laboratories around the world, the study of neurophysiological and molecular mechanisms of formation and reorganization of epileptic and antiepileptic brain systems remains one of the urgent issues of experimental epileptology. The need for such works in wartime conditions is obvious, as cases of severe contusions complicated by acquired epilepsy have become more frequent.

The aim of the study

Determination of factors that affect the distortion of the results of the study of pathological neurophysical processes of the brain with their analysis and ways of exclusion.

The main research materials

The research conducted (Odesa National Medical University) on the basis of the laboratory of electrophysiology of the Department of Physiology has always pursued three main goals:

1) elucidation of the fundamental mechanisms of the functioning of neurons and their networks;

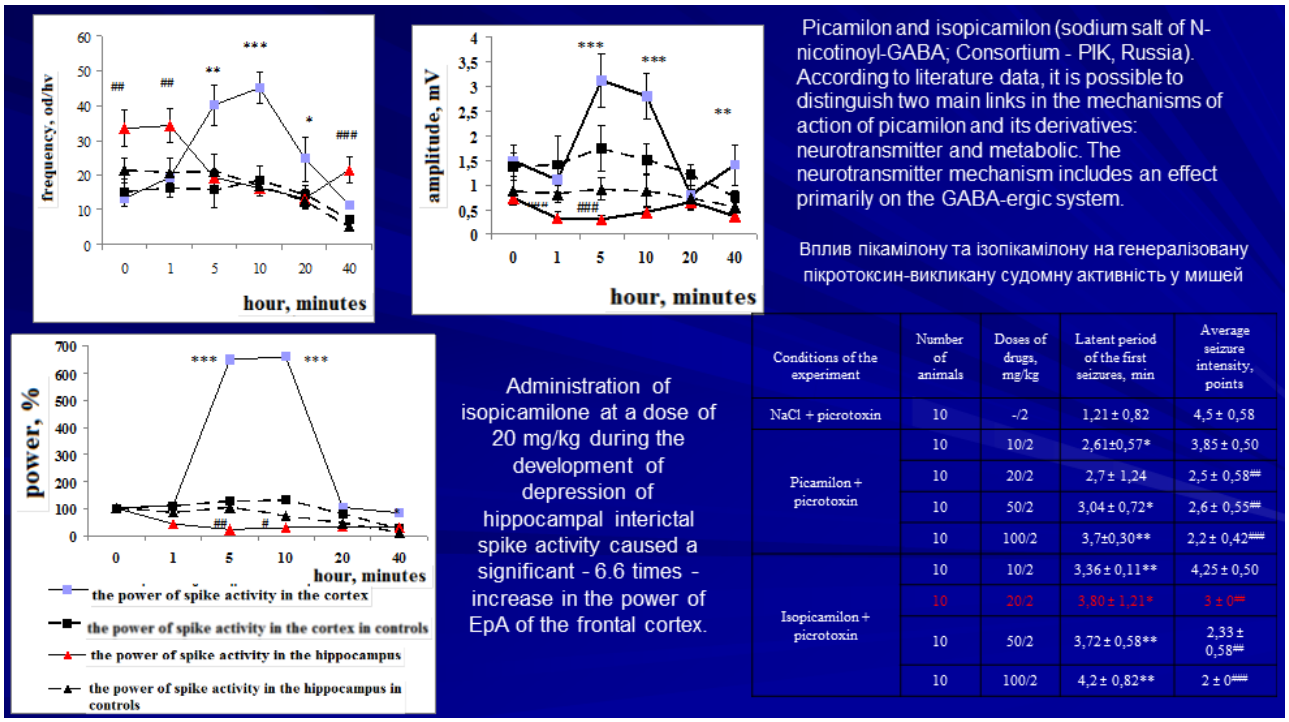
2) understanding the mechanisms of epilepsy development;

3) clarification of the mechanisms of action of new neurotropic drugs [1, 2, 3, 4].

The increase in convulsive readiness is registered on the electroencephalogram (EEG) by generalized synchronization and hypersynchronization of the total activity of neurons, a shift in the spectrum of waveforms towards slower oscillations. Only spikes, sharp waves and peak-wave complexes can be considered truly epileptic phenomena. Spikes are typical positive-negative potentials. It is possible to register them in the distant period after convulsive attack, which is why they were called interictal potentials. In epileptology, it is generally accepted that when convulsions begin, the frequency of interictal paroxysms in the EEG increases, and then the EEG activity turns into the ictal ativity. Recently, works have been published in which it is shown that the generation of interictal and ictal discharges is carried out by different populations of cells, thanks to different cellular and network mechanisms. Previously, during the study of the occurrence and development of interictal and ictal activity in various brain structures in the case of focal epilepsy, it was established that the basis of epileptiform effects is the formation of not only the primary focus in the cortex, but also in the hippocampus, which determines the development of the pathological epileptic system, which causes syndrome of generalization of epileptiptogenic activity. A number of studies on experimental models both *in vitro* and *in vivo*, as well as in the clinic, have shown that stimulation of the hippocampal region with the generation of interictal spikes (IS) reduces the possibility of the development of ictal discharges. But at the same time, the nature of the modulatory effect of ISs on the development of seizures remains not fully elucidated even today. Moreover, in clinical epileptology, the presence of ISs in the EEG remains an important sign of epilepsy, as well as one of the criteria for the effectiveness of antiepileptic therapy.

The purpose of this part of the research was to clarify the significance of interictal spikes in the frontal cortex and hippocampus of the rat brain in the development, maintenance and inhibition of epileptiform activity. Experiments were performed on 155 male non-linear white rats weighing 200…250 g under conditions of acute and chronic experiments.

In Fig. 1, 2. features of the formation of focal epileptiform activity in the brain of rats in the cortical penicillin focus model are presented.



Conditions of the experiment	Number of animals	Doses of drugs, mg/kg	Latent period of the first seizures, min	Average seizure intensity, points
NaCl + picrotoxin	10	-/2	1,21 ± 0,82	4,5 ± 0,58
Picamilon + picrotoxin	10	10/2	2,61±0,57*	3,85 ± 0,50
	10	20/2	2,7 ± 1,24	2,5 ± 0,58##
	10	50/2	3,04 ± 0,72*	2,6 ± 0,55##
	10	100/2	3,7±0,30**	2,2 ± 0,42###
Isopicamilon + picrotoxin	10	10/2	3,36 ± 0,11**	4,25 ± 0,50
	10	20/2	3,80 ± 1,21*	3 ± 0##
	10	50/2	3,72 ± 0,58**	2,33 ± 0,58##
	10	100/2	4,2 ± 0,82**	2 ± 0###

Fig. 1. Development of interictal spike activity in the frontal cortex during systemic administration of isopicamilone at a dose of 20 mg/kg under conditions of inhibition of hippocampal IS activity.

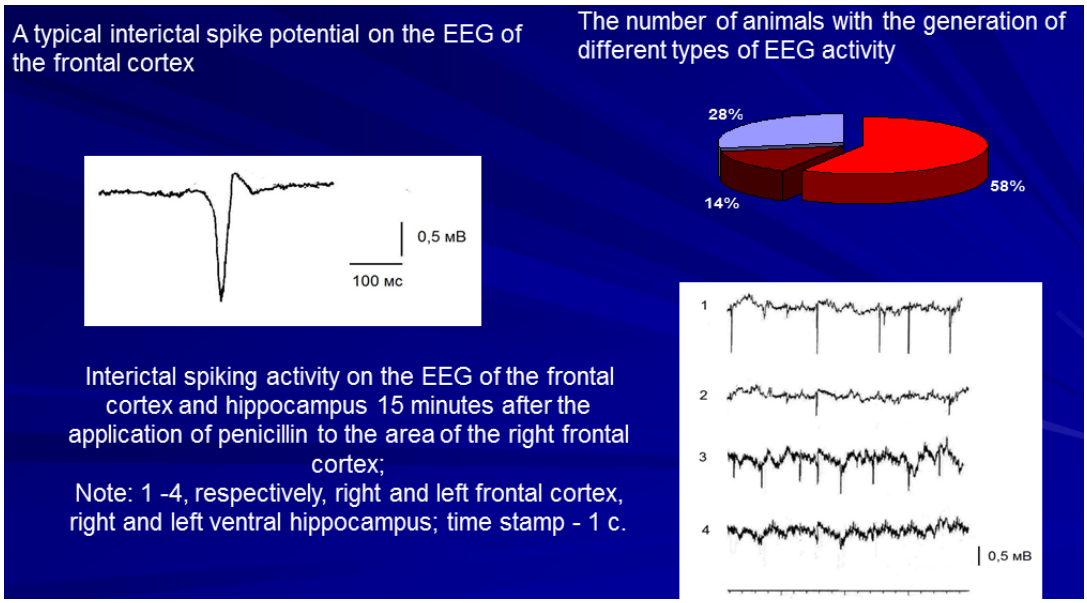


Fig. 2. Interictal adhesions in the frontal cortex and hippocampus of the rat brain

Studying the peculiarities of neurophysiological research, the authors have noted that in the frequency domain, particular issues typically do not arise, as the action potential duration is approximately 1…2 ms, and background potentials fall within the range of 50…250 ms. Problems mostly arise with noise in the amplitude domain. These are inherent amplifier noises of the recording device, potential inductions from the power grid, which may overlay a small recorded signal whose amplitude is around a hundred millivolts or lower. If electroencephalographic signals are recorded from the scalp, the amplitude is approximately 10…150 μV. For microactivity, in the case of intracellular or extracellular recordings from a small number of neurons (from a few to several tens), the amplitude of bio-potentials ranges from 10…130 mV under normal conditions. In the case of pathological neuron activity recordings, bio-potential amplitudes may

increase by 2…3 times. It should be noted that grounding is not always effective (due to excessive surrounding equipment, high electrical network density, and occasional strong spikes). All of this poses significant challenges in conducting research, with a considerable portion of experiment time spent on avoiding biometric inaccuracies.

Difficulties of another nature should also be mentioned, particularly during operations when stabilizing the brain. The issue lies in the fact that the brain itself has certain oscillatory moments that hinder the proper maintenance of electrodes within the targeted zone of the brain.

The study also addresses the analyzed software used by researchers, which, according to the authors, needs refinement according to the thematic specificity to yield sound conclusions. Regarding the capabilities of technical equipment, recent medical technology used in research has significantly reduced noise parameters. However, despite technical advancements, this equipment sometimes fails to provide a clear picture because the processes occurring at the level of these microchips often overshadow the microprocesses recorded in the animal nervous system during examinations or operation

Conclusions

The authors have identified technical factors negatively impacting the results of research on pathological neurophysiological processes of the brain. An analysis of these factors has been conducted, and pathways for their elimination have been outlined.

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