# SIMULTANEOUS COMPUTERIZED ASSESSMENT OF BIOELECTRICAL ACTIVITY AND HEMODYNAMIC PARAMETERS

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The basic essentials of research in neurophysiology are the fullest possible analysis of the electrical activity of nerve structures and discovery of their functional importance. Existing methods and equipment for automated data analysis (systems of ATAS, AI Neiron type, and the like) increase the objectivity of measurement and integrate values of spike activity [1]. However, they can assess not more than two parameters of a process simultaneously without documentation of intermediate experimental data.

The computerized system (CS) which we suggest can be used to record and analyze the amplitude, duration, and following frequency of every spike simultaneously with three parameters of the systemic hemodynamics; the systolic and diastolic blood pressure (BP) and momentary values of intersystolic intervals, and can undertake their statistical analysis and record intermediate and final results of the investigation. In particular, the CS has been used to analyze sympathetic mechanisms of regulation of the circulation during exposure to pain.

The CS is based on the Élektronika D3-28 microcomputer and consists of the computer, the 15 IÉ-00-013 display unit of the 15 VVP 80-002 heat-sensitive printer, and the ATsSKS interface, in a special modification (Fig. 1). The spike derived from bipolar recording electrodes is led to a UBP2-04 biopotentials amplifier. To transform the pulsed signal, a specialized analog-to-digital converter (SADC) was used, whereby the amplitude of spikes of random shape, their duration, and the interspike intervals could be determined and these values converted into digital form. The signal is then led to a preliminary information co-processor of our own design, which calculates the parameters of spike activity and enters them into the computer. The use of the co-processor made it possible to use an operative memory of smaller capacity and a less powerful computer.

BP was recorded in the femoral artery by means of a small strain-gauge transducer. The signal from the transducer was recorded directly by a BP meter of our own design. This device picks out the pulse wave of each heart beat and determines the momentary values of the systolic and diastolic pressure, after which the measured values are led to digital voltmeters for display and for conversion to digital form. By means of the ATsSKS-1024 interface the transformed pressure signals are led into the computer. The isolated pulse wave signal is led to the device for measuring intersystolic intervals, from which it is entered into the computer for subsequent analysis.

The algorithm of the program for entering and processing the parameters of spike activity and of the systemic hemodynamics was produced and written in Assembler language (Fig. 2). Collection and processing of the experimental data is controlled from the control panel of the terminal. After operation of the program has begun control is transferred to the initial dialog subprogram, whereby additional information about the experimental conditions (species of animal, its weight, its initial state, and so on) can be introduced and the total data input time assigned. The subprogram also normalizes the amplitude of the electrical signal, thereby eliminating errors of measurement connected with the anatomical and physiological features of electrically excitable structures (diameter of the nerve trunk, etc.). The initial dialog subprogram also enables time intervals (the discreteness of analysis) to be

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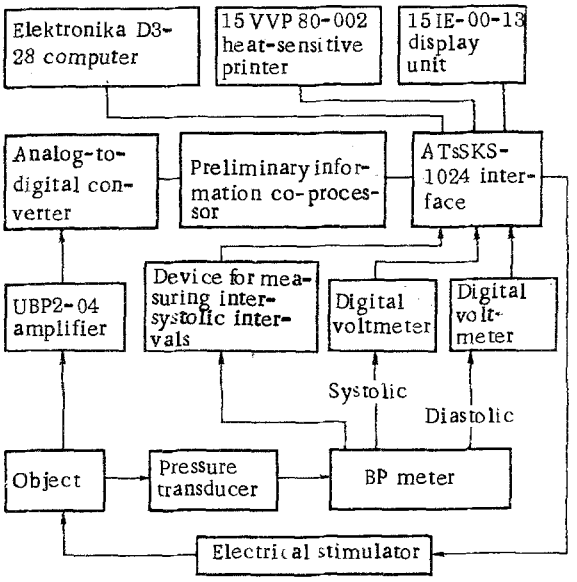


Fig. 1. Block diagram of computer system.

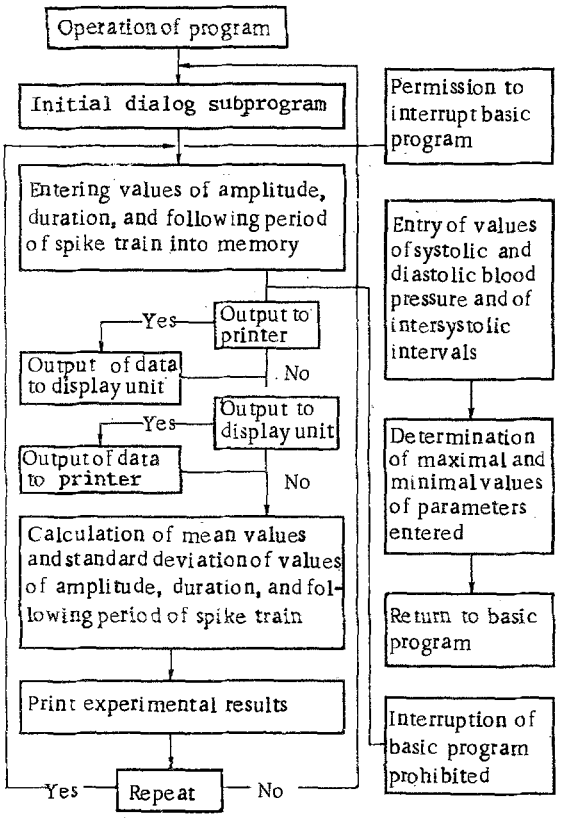


Fig. 2. Block diagram of program for entering and processing information.

assigned for this isolation and separate processing of discharges of sympathetic activity synchronized with the pulse wave.

In the next stage information on the amplitude, duration, and following period of the spike tran is entered, and next, if the experimenter wishes, intermediate data are displayed

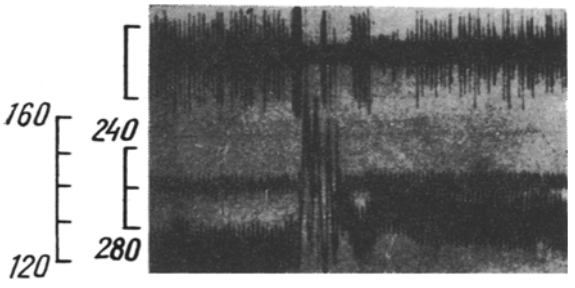


Fig. 3. Example of chymogram and documentation of experimental data. On chymogram, from top to bottom: marker of stimulation, sympathetic activity in renal nerve, intersystolic intervals, BP. Calibration: amplitude of sympathetic activity 100 μV, BP 10 mm Hg, intersystolic intervals 20 msec, time 20 sec. On print-out of experimental data, from top to bottom: data entered by initial dialog subprogram, parameters of systemic hemodynamics (minimal and maximal values), print out of intermediate data (vertical axis: group of numbers 1, 4, 7 denotes amplitudes of spires of positive polarity; group of numbers 2, 5, 8 denotes their duration; group 3, 6, 9 denotes their following periods. Statistical analyzed data, mathematical expectation, and standard deviation. [Figure appears as in Russian original where the portion containing the printout is missing].

on the terminal screen and led out to the printer. The mean values and standard deviations of spike activity are next calculated. Parameters of the systemic hemodynamics are entered from the digital volt meters and devices for measuring intersystolic intervals and are processed when the basic program is interrupted. Analysis of sympathetic bioelectrical activity is thus synchronized in time with evaluation of the parameters of the systemic hemodynamics. After values of the systolic and diastolic BP and the intersystolic intervals have been entered and processed, maximal and minimal values of each parameter for the time of the experiment are calculated and a final record of them is printed. An example of the record of an experiment and of documentation of the data after computer analysis is given in Fig. 3.

The CS is based on USSR-made instruments in large scale production. The design of the SADC is such that spike trains of varied origin can be transformed for entry into the computer whatever their amplitude and frequency characteristics. The pressure transducer can also be used to analyze parameters of venous pressure and volume velocity of the blood flow. Both the hardware and software of the CS are thus suitable for use in the optimization of experiments in many different fields of biology and medicine.

## LITERATURE CITED

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# POSSIBLE ROLE OF POSITIVE REWARD ZONES IN PAIN REGULATION MECHANISMS AND THEIR CONNECTION WITH THE ENDOGENOUS OPIATE SYSTEM

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KEY WORDS: self-stimulation reaction; analgesia; naloxone

Morphine is a classical narcotic analgesic, whose spectrum of pharmocological activity also includes euphoric properties. The question accordingly arises whether this combination of pharmacological properties is essential for manifestation of the analgesic effect. Drugs with a euphoria-inducing action in experiments on animals have a facilitatory effect on the self-stimulation reaction (SSR) if the electrodes are located in the lateral hypothalamus (LH) and septum, i.e., in positive reward structures [1]. In turn, electrical stimulation of positive reward structures may lead to the devlopment of analgesia [3, 11].

In view of these considerations, and also data showing that the regions mentioned above contain large quantities of endogenous opioid peptides [5, 9, 10, 13], which can modulate both SSR and nociceptive sensitivity [3], it was decided to compare the character of involvement of opioidergic processes in SSR from the dorsal nucleus raphe (DNR) and LH, and the changes in nociceptive sensitivity arising under these conditions, with the aid of naloxone, a selective opioid antogonist.

## EXPERIMENTAL METHOD

Experiments were carried out on 36 noninbred male rats weighing 180-250 g, into which chronic unipolar electrodes were introduced under pentobarbital anesthesia (40 mg/kg, intraperitoneally) into LH (AP 1.5, L 1.5, H 8.5) and DNR (AP 7.0, L 0, H 7.0) in accordance with stereotaxic coordinates [8]. One week after the operation the animals were trained in SSR from LH (nine animals) and DNA (nine animals) respectively, until stable parameters of self-stimulation had been established by the method described above [1]. Next, in the experiments of series I, during a 10-min session, levels of the threshold of SSR and the number of

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