

# THE EFFECT OF NOVOCAIN ON THE BIOELECTRIC ACTIVITY OF THE BLADDER RECEPTORS

N. F. Glebova

Department of Physiology (Head—Prof. G. N. Sorokhtin) of the Khabarovsk Medical Institute

(Presented by Active Member AMN SSSR V. N. Chernigovskii.

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There have been many works studying the action mechanism of Novocain injected into the general blood stream. Novocain's effect on the function of the interoceptors has also interested researchers. The majority of these investigations concern the changes in reflex reactions in response to various stimulations of receptors under the influence of Novocain. Only recently have works appeared which are directly concerned with the effect of Novocain on the receptors. These investigations used the electrophysiological method to record the bioelectric activity of vascular receptors from humorally isolated veins [6, 7] or of organic interoceptors after the direct application of Novocain to the receptors [5]. We know of only one work [10], in which the electrophysiological method was used to study the effect of Novocain on the lungs and heart after the introduction of the preparation into the general blood stream.

Our purpose was to study the change in the bioelectric activity of the bladder interoceptors caused by the introduction of Novocain into the general blood stream.

The bioelectric activity of the bladder receptors has been thoroughly studied. It has been established that there are no afferent impulses from the bladder receptors when the bladder is empty. Impulsation is increased at the time of the introduction into the bladder or the excretion from the bladder of a physiological solution, i.e., when there is a rapid rise or fall of the intravesical pressure. Periodic changes in impulsation can also occur as a result of changes in the condition of the vesical musculature. Continuous maintenance of a specific intravesical pressure is attended by adaptation of the receptors and by the disappearance of impulsation. The higher the pressure, the slower the adaptation of the receptors. Adaptation to low pressure develops more rapidly [1, 2, 11, 12].

## EXPERIMENTAL METHOD

The experiments were performed on cats under ether-urethan anesthesia. Initial ether-urethan anesthesia was deepened by an intramuscular injection of a 20% urethan solution in a dose of 1 g per 1 kg of animal weight.

The abdominal cavity was opened along the linea alba of the abdomen, and the bladder was brought out.

The afferent ramulus of the pelvic nerve on the lateral surface of the bladder was ligated and sectioned, after which the peripheral end was placed upon an electrode. The impulses from the nerve were recorded on a two-channel OB-2 cathode-ray oscillograph. By means of a catheter inserted into the urethral canal, the bladder was evacuated of urine and filled with 10-20 ml of a warmed Ringer's solution in order to distend the bladder walls to a uniform and constant degree. During the experiment, the bladder was kept covered with a cloth moistened with warm Ringer's solution. A 1% solution of Novocain was introduced into the femoral vein in a dose of 10 mg/kg.

## EXPERIMENTAL RESULTS

The results produced by the 14 experiments performed were uniform in type. We noted a lack of definite rhythmicity in the impulses recorded from the vesical interoceptors.

Impulses of varying amplitude developed non-rhythmically; as other authors also have observed, the original activity of the bladder receptors depended on the degree to which the bladder was filled. The degree of the original activity usually did not affect the reaction of the receptors to the Novocain injection. Using the Ringer's solution to fill the bladder to a uniform degree, we could record the distinct changes caused by the intravenous injection of Novocain.

In 9 out of 14 experiments, Novocain was observed to have a phasic effect on the bladder receptors; the activity first became intensified, then depressed, and subsequently, restored. The phasic effect of Novocain on the receptors was well expressed in the experiment described in Fig. 1. In this experiment, the initial activity (a) was recorded after introduction of 10 ml of Ringer's solution into the bladder. The Novocain was administered over a period of 1 min 35 sec. Forty seconds after the injection ceased (b), the activity increased. The impulsation decreased after 1 min 50 sec (c), and, after 6 min 13 sec (d), the impulses became less frequent. After 7 min 20 sec (e), however, acceleration occurred, and towards the end of this segment of the recorded oscillogram, the impulsation had returned to the original level. Ten minutes after

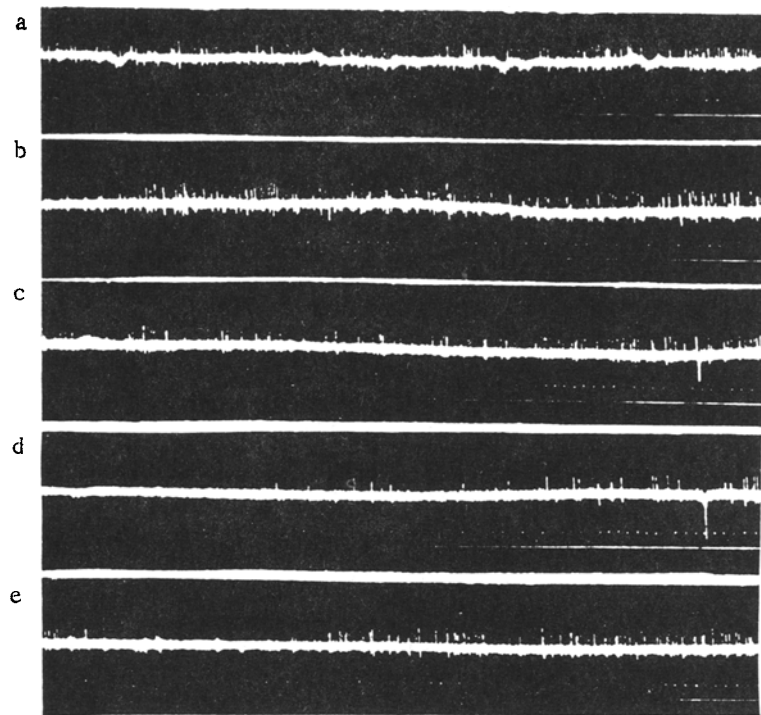


Fig. 1. Effect of novocain on impulsion from the bladder receptors. a) Before novocain injection; b) 40 seconds after novocain injection (10 mg/kg) ceased; c) 1 min 50 sec after injection; d) after 6 min 13 sec; e) 10 min 10 sec after novocain injection.

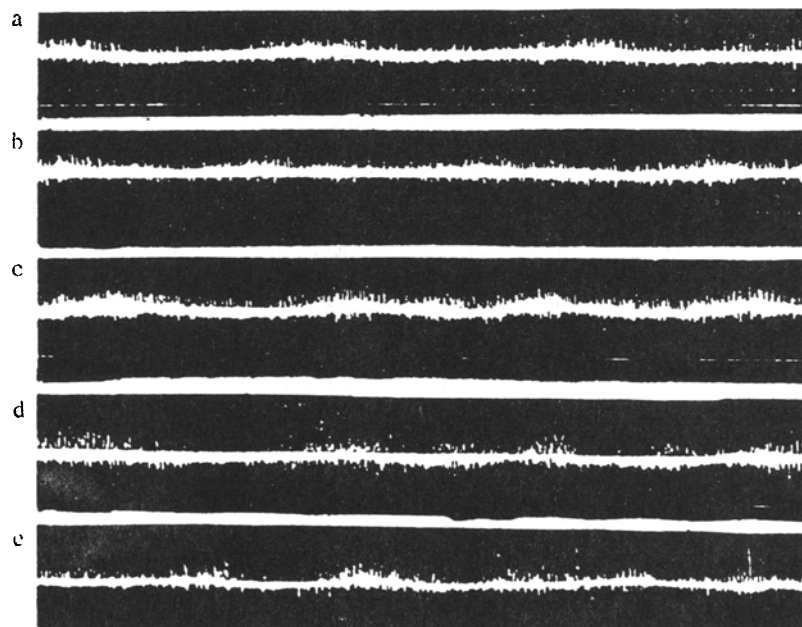


Fig. 2. Effect of novocain on impulsion from the bladder receptors. a) Before novocain injection; b) immediately after injection of 10 mg/kg novocain; c) 2 min 30 sec after novocain injection ceased; d) after 15 min; e) 18 min after injection.

the Novocain injection ceased, the impulses from the bladder interoceptors were stabilized at the original level.

Several other works [5, 7, 8, 9] mention the phasic effect of Novocain. In our previous investigations studying Novocain's effect on the bioelectric activity of the venous receptors, the tactile receptors of the skin, and the pressoreceptors of the arch of the aorta [3, 4], we also observed a biphasic change in the impulsion.

Along with the phasic changes which occurred in the above 9 experiments, in 3 experiments we observed only a brief intensification of the impulsion from the bladder receptors, and in 2 experiments we observed primary depression of the latter. Intensification of impulsion, or exaltation, was well expressed in the experiment described in Fig. 2. Impulsion began to increase immediately after the Novocain injection. It reached its greatest intensity after 2.5 min (c), remained at the high level for a rather long time until, after 18 min, it decreased to the original level without any apparent subsequent depression. In the following experiment (Fig. 3), primary depression of the impulsion from the bladder receptors occurred. Forty seconds after the Novocain injection began (b), the activity started to decrease. It was still depressed after 6 min 17 sec (c), but the impulses returned to the original frequency and amplitude after 11 min 10 sec (d).

A characteristic of all the experiments was the brevity of the reaction of the bladder interoceptors. Both the changes in the activity and its restoration to the original level developed very quickly regardless of the type of reaction—depression or exaltation. The maximal duration of the interoceptor reaction to the Novocain injection was 18 min, but usually the reaction lasted only 5-10 min.

Zipf [10], who studied the action currents of the afferent nerves of the heart and lungs before and after the administration of various anesthetic substances, including Novocain, described similar changes in impulsion from the interoceptors. He administered Novocain once intravenously and also in the form of a prolonged transfusion and observed that the afferent impulses traveling from the lungs and heart only disappeared after the prolonged infusion. This depression, however, was brief, and the number of impulses returned to the original level as early as 10-15 min after the infusion. After the single intravenous injection of Novocain, impulsion from the receptors decreased only slightly and did not disappear altogether.

#### SUMMARY

The author studied the effect of the intravenous injection of Novocain on the impulse activity of the cat's bladder receptors. The impulses were recorded in the peripheral end of the afferent branch of the

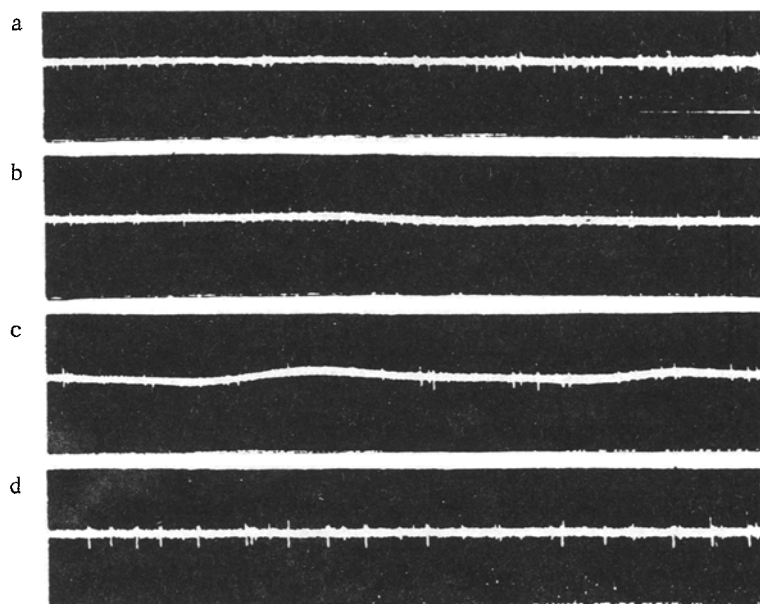


Fig. 3. Effect of novocain on impulsion from the bladder receptors. a) Before novocain injection; b) 40th second of novocain injection (10 mg/kg); c) after 6 min 17 sec; d) 11 min 10 sec after novocain injection.

pelvic nerve. A 1% Novocain solution was injected into the femoral vein in a dose of 10 mg/kg.

The investigations show that a single intravenous injection of Novocain does not block the bladder interoceptors. The brief (5 to 18 minutes) reaction of these receptors to the administration of Novocain was usually manifested by an initial increase in the activity and its subsequent inhibition. Occasionally, however, a brief incomplete inhibition of the intensification of the receptor activity was noted.

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