

THE MECHANISM OF RESPIRATORY AND CIRCULATORY REACTIONS INDUCED BY THE INTRODUCTION OF CHEMICAL AGENTS INTO THE MESENTERIC VESSELS

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In the modern concepts of the reflex effect of intravascular injections of medicinal preparations and chemical agents on the functions of the organism the role of vascular receptors still remains insufficiently clarified.

V. N. Chernigovskii [4] observed reflex respiratory and vascular changes, upon the action of chemical agents on the receptors of a vascularly isolated loop of small intestines. Brown and Gray [9] recorded the impulse activity from mesenteric chemoreceptors. A. G. Bukhtiyarov [1], S. M. Leites, G. T. Pavlov, and T. S. Yakusheva [2] reported on the changes of respiration, arterial pressure, and blood sugar level, upon injection of pharmacological substances into mesenteric vessels. The results of these experiments were regarded as the effect of reflex influences from the receptors of mesenteric vessels. O. P. Minut-Sorokhtina and B. Z. Sirotin [3] observed the reactions of respiration, blood circulation, and fluctuations of the number of leucocytes in the blood, upon chemical action on the anterior mesenteric vein isolated from general circulation.

Analysis of the participation of the vascular receptors in the mechanism of reflex effects is hampered in a number of experiments by the fact that substances injected into mesenteric vessels may exert an irritating effect on the vascular receptors, as well as on the receptors of tissues or capillaries.

In the present work we investigated the role of the mesenteric vascular receptors in the mechanism of reflex reactions of the respiratory and cardiovascular systems, upon injection of pharmacological substances in these vessels.

METHOD OF EXPERIMENTS

Four series of experiments were carried out on 40 cats under urethan intravenous narcosis. Respiration, arterial pressure, and the rhythm of cardiac activity were recorded.

A loop of the small intestine, isolated from general blood circulation, was perfused with a Ringer-Locke solution. The direction of the flow of the nutrient fluid in the intestinal loop vessels alternated. Under a "direct" perfusion of the organ, the Ringer-Locke solution entered the intestinal loop vessels through the artery and flowed out of the organ through the vein. In "reverse" perfusion, the nutrient fluid entered through the vein and flowed out via artery. Chemical agents were introduced into the stream of the Ringer-Locke solution in "direct" perfusion through a cannula inserted into the artery; in "reverse" perfusion—through the cannula inserted into the vein of the intestinal loop.

In the next series of experiments we studied the latent period of reflex reactions of respiration and circulation upon feeding chemical agents to the receptors of the intestinal loop via "direct" or "reverse" perfusion. In both types of perfusion, an equal volume of Ringer-Locke solution passed through the vascular system in a given unit of time. The rate of flow of the nutrient fluid in the loop vessels was regulated according to the rate of drops of the solution flowing out of the organ.

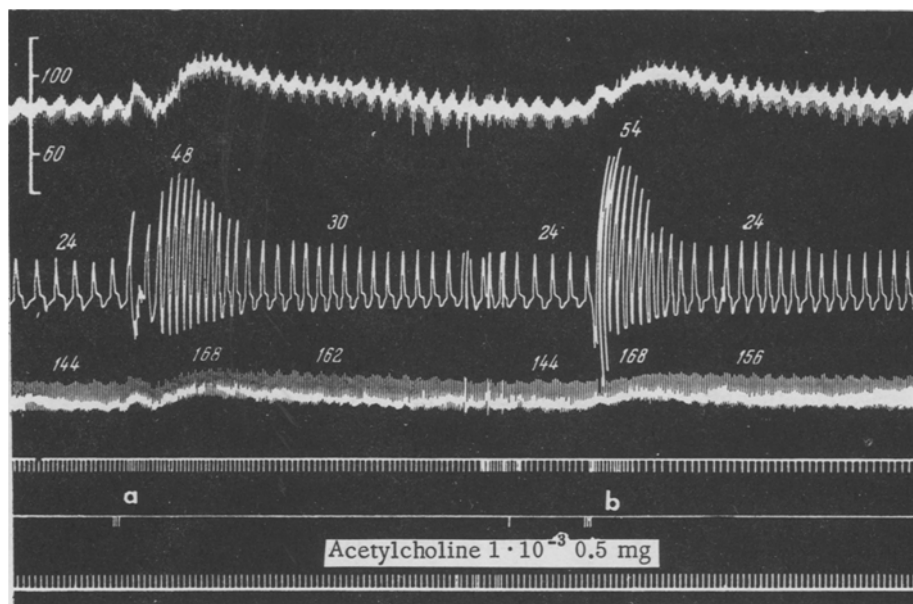


Fig. 1. Character of reflex respiratory and circulatory reactions upon feeding a chemical agent to the receptors of a segment of the small intestine in "direct" and "reverse" perfusion. Designation of curves (top to bottom): arterial pressure; respiration; rate of cardiac contractions; drop-recorder mark; stimulation mark; time mark (one second). Explanation in text.

In our final series of experiments, the chemical agents were introduced into the loop vessels through needles inserted into one of the small branches of the artery and vein. The needle was inserted in the branch of the vessel at the point of the passage of the mesenterium into the intestinal loop. Here, under "direct" perfusion of the organ, the chemical agent was introduced via the needle into a small branch of the vein and, carried by the flow of nutrient fluid, irrigated the venous receptors and moved toward the cannula inserted in the principal vein. In "reverse" perfusion in this case, the chemical agent was introduced via needle into a small arterial branch; it irrigated the arterial receptors and flowed out through the cannula inserted in the principal artery of the loop. Thus, in this series of experiments, the pharmacological substances, injected into the ramifications of the vessels, acted on the vascular walls, but did not enter the capillaries of the loop.

RESULTS OF EXPERIMENTS

Upon feeding 0.5 mg of acetylcholine to the receptors of the intestinal loop in "reverse" perfusion, we observed a pressor reaction, dyspnea, and tachycardia (Fig. 1, a). Feeding of the chemical agent to the loop receptors in "direct" perfusion was accompanied by an analogous reflex effect (Fig. 1, b).

However, feeding of 0.5 mg acetylcholine to the loop receptors in "reverse" perfusion caused dyspnea and hypertension within eight seconds (Fig. 2, a, b), whereas feeding it in "direct" perfusion produced a reflex effect within five seconds (Fig. 2, a', b').

Introduction of 0.5 mg of nicotine through a needle, inserted into a small branch of the vein in the loop, produced no change in respiration and circulation (Fig. 3, a). Introduction of 0.5 mg of nicotine through a

cannula inserted into the loop artery was accompanied by an increase of arterial pressure and dyspnea (Fig. 3, b). Introduction of 0.5 mg of nicotine through a cannula inserted into the vein produced the same effect (Fig. 3, c).

Introduction of 0.5 mg of nicotine through a needle inserted into a small branch of the loop artery caused no change in respiration and arterial pressure (Fig. 3, d). Thus, the action of chemical agents on the blood vessel walls does not lead to reflex reactions of the respiratory and cardiovascular systems.

Thus, the function of chemical irritation shows no reflex reaction on the respiratory and vascular system's centers.

The difference in the duration of the latent period of reflex reactions of respiration and circulation upon chemical action on the receptors of the loop in "direct" and "reverse" perfusion can be explained by the greater rate of the propulsion of the chemical agent to the reflexogenic zone via arterial system, than via venous system.

These experiments demonstrated that the action of chemical agents on the receptors of an organ in "direct" and "reverse" perfusion not infrequently produce entirely analogous reflex effects. The similarity of reflex responses of the receptors of an organ to a chemical stimulation in both types of perfusion has already been pointed out by V. N. Chernigovskii [8].

The identity of reflex reactions, the difference in the length of the latent period when the chemical agents are fed to the receptors of the perfused organ through the arterial and venous bed, as well as the absence of reflex reactions in an isolated action on the mesenteric vessels, permit us to localize the reflexogenic zone of the organ within the limits of capillary and tissue receptors.

There were also no reflex influences observed from the mesenteric vessel receptors in experiments, where chemical agents colored with methylene blue had been injected into the vascular ramifications of an isolated intestinal loop. It was noted in these experiments that the appearance of the colored material on a scarcely noticeable area of the surface of the intestinal loop, from which the blood was washed off with the nutrient solution, was accompanied by fairly well marked reflex effects.

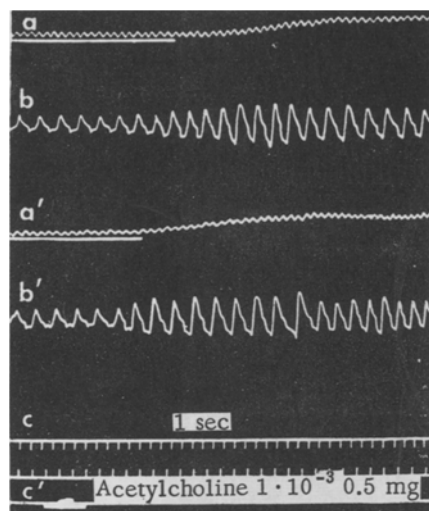


Fig. 2. Latent period of reflex effects upon feeding of chemical agents to the loop receptors in "reverse" and "direct" perfusion. a) Arterial pressure; b) respiration; c) drop-recorder mark; a') arterial pressure; b') respiration; c') drop-recorder mark. Explanation in text.

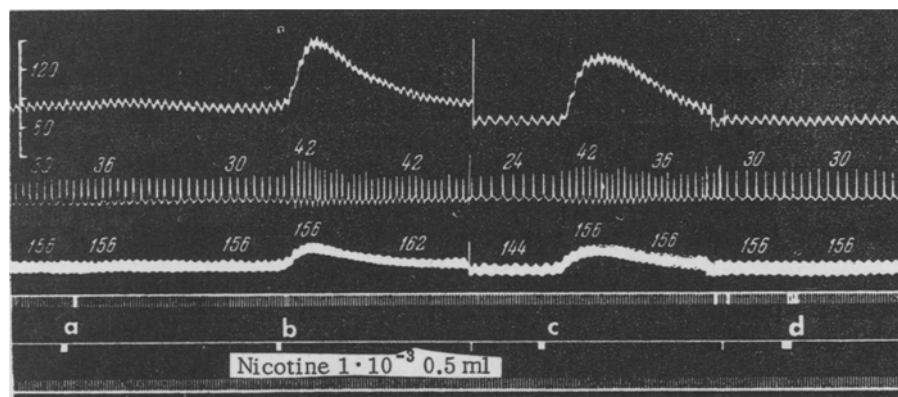


Fig. 3. Absence of reflex effects upon isolated chemical irritation of the artery and vein of the loop of the small intestine. Designations the same as in Fig. 1. Explanation in text.

V. N. Chernigovskii [5, 6] connects the emergence of reflex reactions, upon intravascular injection of chemical agents, with the stimulation of tissue receptors.

It is possible that by prolonged and strong chemical action on the vascular walls one can produce reflex effects similar to those observed by O. P. Minut-Sorokhtina and B. Z. Sirotin [3]. However, the interpretation of these data requires further investigation, since certain substances may stimulate vascular receptors indirectly, as a result of the changed tonus of the vascular wall.

Thus, upon injection of chemical agents into the mesenteric artery, reflex influences on respiration and circulation originate from the receptors of the intestinal tissues. Injection of chemical agents into the mesenteric vein stimulates the hepatic receptors. Chemical irritation of the receptors of these organs is accompanied by stimulation of the respiratory and vasomotor centers.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. Some or all of this periodical literature may well be available in English translation. A complete list of the cover-to-cover English translations appears at the back of this issue.
