THE EFFECT OF REFLEXES FROM RECEPTORS IN THE PERICARDIUM ON BLOOD FILLING IN THE SPLEEN

I. P. Krichevskaya

Department of Normal Physiology (Head – Academician of the Akad. Nauk of the Kazakh SSR A. P. Polosukhin) of the Kazakh Medical Institute, Alma-Ata
(Presented by Active Member of the Akad. Med. Nauk SSSR V. V. Parin)
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For a long time the question of pericardial sensitivity has interested both physiologists and surgeons. Based on the work of our [Russian] morphologists [9, 11, 15], it is known that the pericardium is richly supplied with sensory endings.

There are a number of experimental works demonstrating the presence of mechano-, as well as chemoreceptors in the pericardium [3, 7, 8, 13, 14, 16, 17]. Mechanical stimulation of the pericardium, as a rule, causes reflex cessation of the heart beat and lowering of the arterial pressure, as well as changes in the lymph flow and the venous pressure [1, 4].

Analogous reflex reactions have also been observed in studying "cardiac tamponade" (the injection of fluid into the pericardial cavity) [2, 3, 13].

As can be seen from the above, there is evidence in the literature of significant functional changes in the circulatory system resulting from stimulation of pericardial receptors. It would be natural to expect a reaction in the spleen as well, an "organ taking an active part in the adjustment of hemodynamic balances within the organism, both normally and in pathological states" [13]. Interoceptive regulation of the spleen's reservoir function has been poorly studied. Investigations have only covered the reflexes from receptors in the sinocarotid zone, the pulmonary vessels, and the urinary system [5, 6, 10, 12, 18].

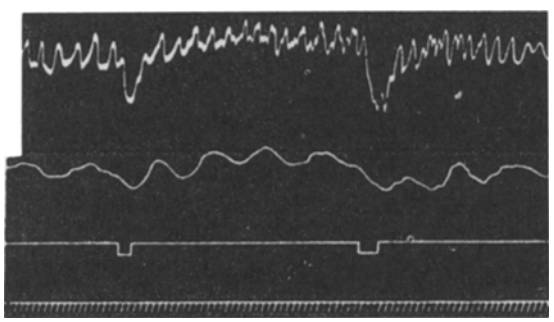


Fig. 1. Change in the volume of the spleen due to electrical stimulation of the pericardium. Meaning of the curves (from above downward) : pressure in the carotid artery (scale in millimeters of mercury); oncogram of the spleen; stimulus marking (distance between the induction coils : 1) 15 cm, 2) 12 cm); time markings (5 seconds).

The purpose of this work was to study the effect of impulses from the pericardial receptors on the blood filling level of the spleen.

EXPERIMENTAL METHOD

The experiments were performed on 18 dogs, using artificial respiration. The pressure in the carotid artery and the volume of the spleen were recorded, the latter being done by the use of an oncograph.

To gain access to the heart, an area of the skin on the anterior surface of the thoracic cavity, in the form of a semicircle, was incised and reflected back. Then, using blunt dissection, the thoracic muscles were separated from the ribs, following which small portions (4-5 cm) were cut from two ribs.

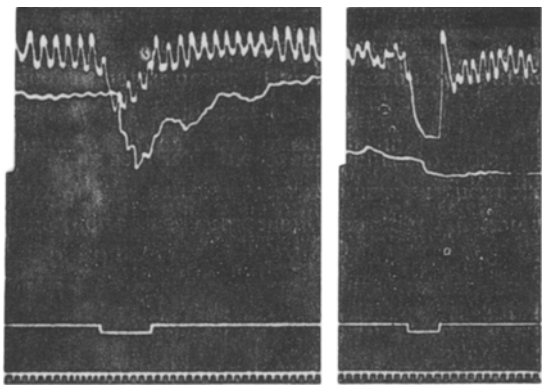
We performed mechanical stimulation of the pericardium ("dotted line" movements of a glass rod, pricking, cutting), electrical stimulation, and tamponade, i.e., the injection of physiological saline, using a 200 ml syringe connected by a rubber tube to a canula which was inserted into the pericardial cavity through an incision in the parietal layer. A glass T-joint was inserted into the rubber tube and connected to a water manometer, in order to determine the pressure in the pericardial cavity. To

eliminate the tamponade, the solution was either withdrawn into the syringe, or the syringe was disconnected and the solution permitted to run out through the tube. The temperature of the solution injected was 37° C, except for certain trials in which it was 8-10° C. No difference was noted in the reaction, which obviously speaks against the presence of specific thermoreceptors in the pericardium.

EXPERIMENTAL RESULTS

Even touching the pericardium with the glass rod caused a change in the character of the blood pressure curve in a number of cases. There was usually no splenic reaction. Stronger stimulation (pricking, cutting) caused a contraction of the spleen and a lowering of the arterial pressure in the majority of cases. The intensity of the reaction depended on the depth of anesthesia.

With electrical stimulation of the pericardium (25 trials on 13 dogs) a lowering of the arterial pressure and simultaneous contraction of the spleen was observed in 20 cases. In 3 cases we observed a splenic reaction without any change in the arterial pressure, in which case further increase of the stimulus strength lead to a lowering of the pressure and an intensification of the splenic contraction.



a b

Fig. 2. Change in the volume of the spleen due to experimental cardiac tamponade; a) intact, b) denervated. Designations are the same as in Fig. 1.

In 2 of the dogs, electrical stimulation of the pericardium did not lead to changes in the blood pressure or blood filling of the spleen, despite a high current intensity.

In one of the trials (Fig. 1), using electrical stimulation of the pericardium, there occurred a lowering of the arterial pressure and a mild contraction of the spleen, with subsequent wavelike dilatation. With a second, more intense, stimulation, the decrease in the volume of the spleen lasted longer without subsequent restoration.

The effect of tamponade on splenic blood filling was investigated in 30 trials on 15 dogs. The introduction of 50 – 200 ml. of physiological saline into the pericardial cavity, under a pressure of from 30 to 250 mm of water, caused a reduction of the arterial pressure in all cases. The degree of the reaction depended on the amount of fluid introduced, as well as on the speed of its injection. After removal of the fluid the arterial pressure immediately rose.

The characteristic reaction of the spleen was a contraction, in some cases lagging slightly behind the reaction of the arterial pressure, and lasting some time after its equalization. Following the contraction, the volume of the spleen became greater than its starting level.

Fig. 2a shows that injection of 80 ml of physiological saline into the pericardial cavity caused a lowering of the arterial pressure. When the tamponade was discontinued the pressure quickly returned to the original level. The spleen contracted (after a 10 second latent period) and remained contracted for some time after restoration of the pressure, following which the splenic volume became greater than the original.

There are data [13] on minimal changes in the splenic volume of cats during pericardial tamponade [5 trials]. The author regards this alteration as a basically passive reaction of the spleen, related to the lowering of the blood pressure. Maintenance of the spleen in the contracted state is explained by the entrance of adrenalin into the blood stream when pericardium is freed of the fluid.

We performed cardiac tamponade on five animals, before and after denervation of the spleen, and were convinced that after denervation the reaction level decreased significantly and the latent period was considerably elongated (see Fig. 2b).

The results of the experiments show that with stimulation of the receptors in the pericardium, along with changes in the arterial pressure, there occurs, as a rule, a change in the blood filling of the spleen, manifested in its contraction and subsequent dilatation. The reaction of the spleen is more prolonged than the reaction of the blood pressure.

SUMMARY

Acute experiments were performed on dogs. A study was made of the interoceptive effects from the pericardial receptors on blood storage in the spleen. The results of experiments have demonstrated that, apart from the arterial pressure reduction during various effects upon the pericardium (mechanical and electric stimulation, tamponade) there occur changes in the blood filling of the spleen, manifested in its contraction with a subsequent dilatation. Splenic reaction is more prolonged than is the arterial response.

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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.
