

## INTEROCEPTOR INFLUENCE OF THE URINARY SYSTEM ON LYMPH FLOW DURING DEVELOPMENT

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(Received June 26, 1958. Presented by Active Member of the AMN SSSR V.V. Parin)

In the present article, we report results of a study of interoceptor effects from the renal arteries, renal pelvis, and urinary bladder on lymph flow, arterial pressure, and respiration rate in puppies of different ages.

### METHOD

The experiments were carried out under ether anesthesia. Lymph flow was studied by using an electromagnetic device to record the flow of drops from a fistula established in the thoracic duct. After the fistula had been set up, the anesthetic was discontinued. The blood pressure in the carotid artery and the respiration rate were recorded in the usual way, and time markings were made at 3-5 second intervals.

To study reflexes from the renal vessels, the pressure in them was increased by blocking the outflow of blood (by clamping the renal vein).

To study effects from receptors of the renal pelvis and urinary bladder on lymph flow through the cavities of these organs, physiological saline was introduced at a temperature of 37° and at a pressure controlled by a mercury manometer.

### RESULTS

Stimulation of the baroreceptors of the renal vessels in puppies by increasing the pressure (blocking the outflow) may have various effects on lymph flow. Out of 50 observations, an increase in lymph flow was obtained in 20, and a reduction in 23; there was no change in 7 cases.

In 1-4-day-old puppies, pressor arterial effects were obtained, together with an increased depth of respiration, but there was no change in lymph flow (Fig. 1, a). Increased flow was observed in animals of 1-day-old and more, together with an increase in arterial pressure and an increased depth and frequency of respiration, though the extent of these changes was small. In 1-month-old puppies, increase in lymph flow occurred without a change of arterial pressure, and the depth of respiration was actually reduced (Fig. 1, b).

The reduction in lymph flow was found to be independent of the age of the animal, though various changes in arterial pressure and respiration rate, including no change, were found (Fig. 1, c).

After the first few days of life, stimulation of the baroreceptors of the renal pelvis by increase of pressure led (in 36 out of 55 cases) to a not very marked reduction of lymph flow, which sometimes continued after the pressure had been removed. In these cases, the reduction occurred either with no change or with an insignificant increase in arterial pressure, while the depth of the respiration actually increased (Fig. 2, a).

With this form of stimulation, lymph flow increased in 13 out of the 55 experiments, while in 6 cases there was no change.

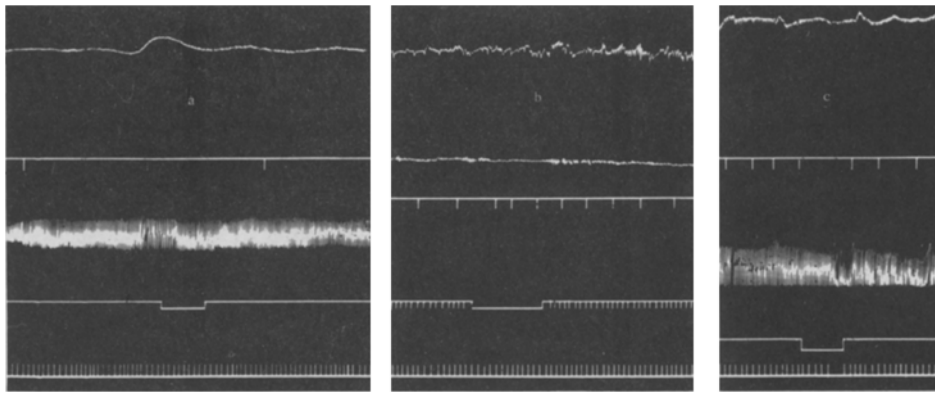


Fig. 1. Lymph flow rate change on compressing renal vein. a) In 2-day old puppy. Curves, from above downwards: blood pressure, number of drops of lymph, respiration rate, stimulus marker (3 seconds); in 40-day-old puppy. Curves, from above downward: blood pressure, respiration rate, number of drops of lymph, stimulus marker, time marked (3 seconds); c) in 3-day-old puppy. Curves, from above downward: blood pressure, number of drops of lymph, respiration rate, stimulus marker, time marker (3 seconds).

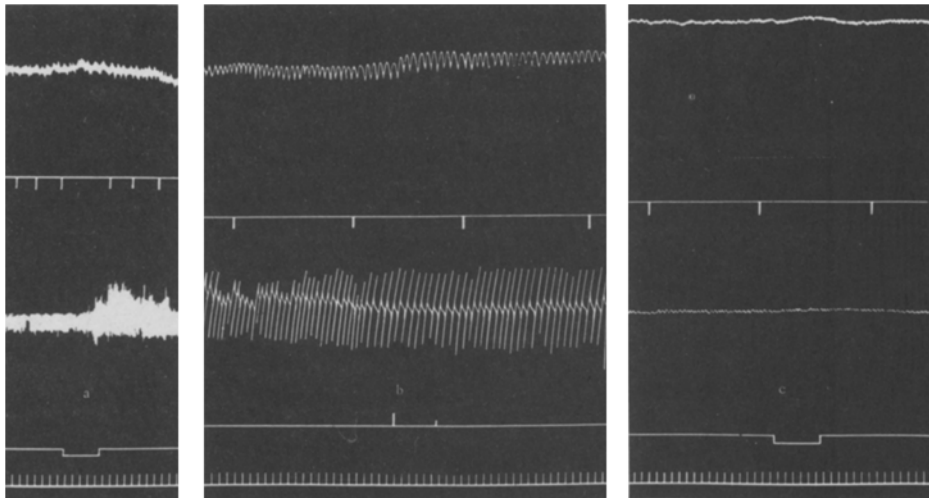


Fig.2. Change in lymph flow due to pressure changes in renal pelvis. a) In 45-day-old puppy; b) in 1-day-old puppy; c) in 10-day-old puppy. Curves, from above downward; blood pressure, number of drops of lymph, respiration rate, stimulus marker, time marker (3 seconds).

In puppies a few days old, in addition to a very small increase in arterial pressure and a scarcely noticeable increase, or even a decrease in the depth of respiration, a small increase in lymph flow was observed, which, as a rule, was not maintained (Fig. 2, b). In puppies more than 2 weeks old, the increase was more marked, while the respiratory and vascular reactions were as before.

In puppies up to 10 days old, no changes in lymph flow were found, while the increase in arterial pressure was insignificant, and there was no alteration in the respiration or blood circulation (Fig. 2, c).

The pressure in the bladder was increased 86 times. In 39 cases, this caused lymph flow to be reduced, in 34, there was an increase, and in 13 cases, no change was recorded.

The absence of lymph flow changes is found only in puppies 1-4 days old, when the change in the arterial pressure and respiration may be in either direction (Fig. 3, a).

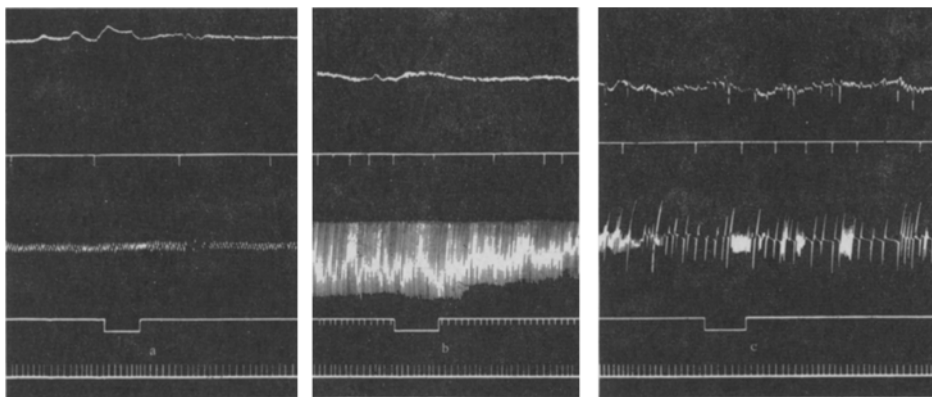


Fig. 3. Change in lymph flow due to increase of pressure in bladder. a) In 2-day-old puppy. Curves, from above downward: blood pressure, number of drops of lymph, stimulus marker, time marker (3 seconds); b) in 45-day-old puppy; c) in 9-day-old puppy.

Increases or decreases in the rate of lymph flow, which are found in most experiments, were also found in puppies during the first few days of life, when there might or might not be changes in the other quantities recorded (Fig. 3, b and c).

In studying reflex effects originating from various blood vessels and acting on the lymphatic vessels in adult animals, it was found that compression of the renal vein leads to a dilatation of the lymphatic duct [4]. When the renal vein was clamped in adult dogs, in every case there was an increase in lymph flow [5, 6]. In our experiments, these changes in lymph flow during the first few days of life in puppies were found in only 2 cases, and then the increase occurred as an aftereffect and coincided with a marked increase in respiration rate; the increase in lymph flow was very small. But besides this effect, in growing, and especially in newborn puppies, the same stimuli brought about a directly opposite reaction in lymph flow, so that a marked reduction was observed. With this kind of stimulation, both the increase and the decrease in lymph flow rate were associated with various changes of arterial pressure and of respiration rate, and sometimes these latter changes did not occur at all. It is interesting to note that similar changes in lymph flow rate in puppies up to 1 week of age have been observed to result from stimulation of the sinocarotid gland [1].

The total evidence allows us to suppose that, in the renal vessels of the newborn puppies, there is a receptor apparatus whose stimulation leads to reflex contraction of the lumen of the lymphatic duct, and that, in newborn animals, this reflex effect is different from that in adults, where the same stimulation produces a different effect.

At present, there can be no doubt as to the existence of receptors in the ureters and renal pelvis. Evidence is supplied by clinical observations which have shown that a number of autonomic reflexes are associated with the accumulation and passage of gall stones, and numerous morphological and physiological studies have supported this conclusion. In [8], a description is given of reflex effects exerted by the renal pelvis on arterial pressure and respiration rate during development.

In adult dogs, on increasing the pressure in the renal pelvis by clamping the ureter, or by injecting warm physiological saline, an increase in lymph flow was found, but this did not occur in all cases [6]. In our experiments, in the great majority of cases, increased pressure in the renal pelvis in puppies caused a reduction of lymph flow. In the first few days of life, both the reduction and the increase in lymph flow were accompanied by various circulatory and respiratory changes. For instance, the reduction in lymph flow might be observed to occur from the moment of stimulation, and to be associated with an increased depth of respiration and a rise in arterial pressure; in other cases, there would be no change in either of these last two factors. In some cases, the same arterial pressure and respiratory changes might occur, or, on the other hand, the respiration might be reduced, and the lymph flow rate would be increased. Here, it was not possible to establish any relationship between lymph flow rate changes and the pressure applied.

Of all the organs of the urinary system, the one that has been most studied in connection with interoceptors is the urinary bladder [2, 3, 7, 8].

Mechanoreceptors are known to initiate reflexes affecting blood pressure, respiration, lymph flow, and other systems. It has been shown that increased pressure in the bladder in adult dogs caused by the introduction of physiological saline at different pressures causes an increase in lymph flow [5]. In puppies, during the first few days of life, an increase in pressure in the bladder usually causes a reduction in lymph flow, but in some experiments an increase may be observed. It is then not possible to determine the relationship between the lymph flow changes and alterations in arterial pressure and respiration, because the reduction in lymph flow may, for example, be associated with an increase in arterial pressure and amplitude of respiration, or the increase may take place without any changes in these systems. Neither is it possible to establish any relationship between lymph flow rate changes and bladder pressure.

#### SUMMARY

The author studied the development of the interoceptive reflexes from the organs of the urinary system on the lymph flow in acute experiments upon puppies of various ages. The reflex changes of the lymph flow occurring in stimulation of the urinary bladder, renal pelvis and renal vein were revealed from the first days of the puppies' life. The value and the character of the reflex shifts of the lymph flow differed with the age. The changes in the lymph flow were independent of the arterial blood pressure and respiration.

#### LITERATURE CITED

- [1] I.A. Beremzhanova, Byull. éksptl. biol. i med., 1951, volume 32, No. 9, pp. 181-184.
- [2] V.A. Erenkov, Fiziol. zhurn. SSSR, 1955, No.2, pp-92-98.
- [3] G.N. Kotova, Fiziol. zhurn. SSSR, 1957, No.5, pp-428-434.
- [4] M.I. Kokhanina, Izv. AN Kaz. SSR, Ser. fiziol., 1949, No. 73, issue 2, pp. 120-126.
- [5] M.I. Kokhanina, Theses and Reports of the Joint Scientific Session of the Institute of Physiology of the AN Kaz SSR and of the Department of Normal Physiology of the Kaz. Medical Institute at Alma-Ata\*, 1955, pp. 20-23.
- [6] S.G. Kul'kin, Doklady Akad. Nauk SSSR, 1957, volume 113, No. 1, pp. 195-198.\*\*
- [7] T.S. Lagutina, Byull. éksptl. biol. i med., 1957, volume 44, No. 7, pp. 3-7.\*\*\*
- [8] L.E. Pal'gova, Byull. éksptl. biol. i med., 1954, volume 38, No. 12, pp. 3-6.

\* In Russian.

\*\* See English translation.

\*\*\* Original Russian pagination. See C.B. Translation.