CHANGES IN THE VENOUS PRESSURE AND VENOUS TONE DURING NOCICEPTIVE STIMULATION

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It is generally accepted that nociceptive stimulation evokes dyspnea and a rise in the arterial and venous pressures [5, 7, 8, 10]. The object of the present investigation was to compare the changes taking place in the femoral vein of one limb and the tone of the corresponding vein in the opposite limb during application of a nociceptive stimulus.

EXPERIMENTAL METHOD

The right iliac and femoral veins were dissected in 47 mongrel dogs as far as the knee joint, and all their branches were carefully ligated. The nerves running along the vessel were preserved. The vein was perfused in the direction of the blood flow with oxygenated Ringer-Locke solution, the temperature of which was maintained constant (37-38°) by means of an ultrathermostat. A 3-way cock in the path of the outflowing solution was connected to a water manometer and a small Marey's tambour for making a graphic recording (Fig. 1). When the inflow and outflow of solution were kept relatively constant, a regular tracing was obtained, characterizing the tone of the vessel. In some experiments respiratory waves could be seen distinctly on the curve. During dilatation of the vein the resistance to the blood flow through it fell, the pressure at the outlet rose, and the pen moved upward; conversely, during vasoconstriction the pressure in the manometer fell and the curve was depressed.

Simultaneously with the recording of the tone of the perfused vessel in the right hind limb, the lateral venous pressure in the left femoral vein was recorded by means of a linear water manometer, and the arterial pressure in the carotid artery and respiration were also recorded. Nociceptive stimulation was applied to the central cut end of the radial nerve by means of an induction current.

EXPERIMENTAL RESULTS

Nociceptive stimulation was applied 79 times. In 45 cases an increase in the arterial pressure was observed, in 16 cases a decrease, and in 10—a biphasic reaction (a rise, followed by a fall), while in 8 cases the pressure remained unchanged. In 65 experiments the venous pressure rose, in 4 it fell, and in 10 it remained unchanged.

Comparison of the dynamics of the venous pressure and of the tone of the perfused vein during nociceptive stimulation yielded the following results. In 46 experiments both indices rose simultaneously, in 16 the venous pressure rose and its tone was lowered, in 3 the pressure rose while no change took place in the tone, in 4 the pressure fell and the tone increased, in 4 the pressure was unchanged and the tone was lowered, and in 6 experiments the pressure was unchanged and the tone increased. Hence, the tone of the perfused vein rose (the vein was constricted) in 56 experiments.

It is clear from the kymogram shown in Fig. 2 that nociceptive stimulation caused a fall in the arterial pressure (from 112-120 to 80-86 mm Hg) and considerable dyspnea, which gave place to holding the breath after cessation of stimulation. The tone of the perfused vein fell very slightly at the beginning of stimulation, and this was followed by a sharp rise in tone (vasoconstriction), as manifested by a depression of the curve. At the end of stimulation the venous tone quickly returned to its original level.

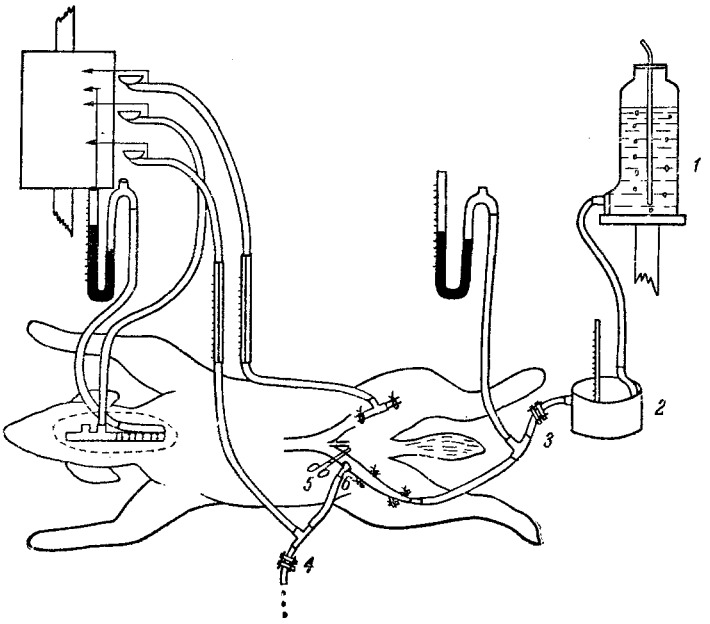
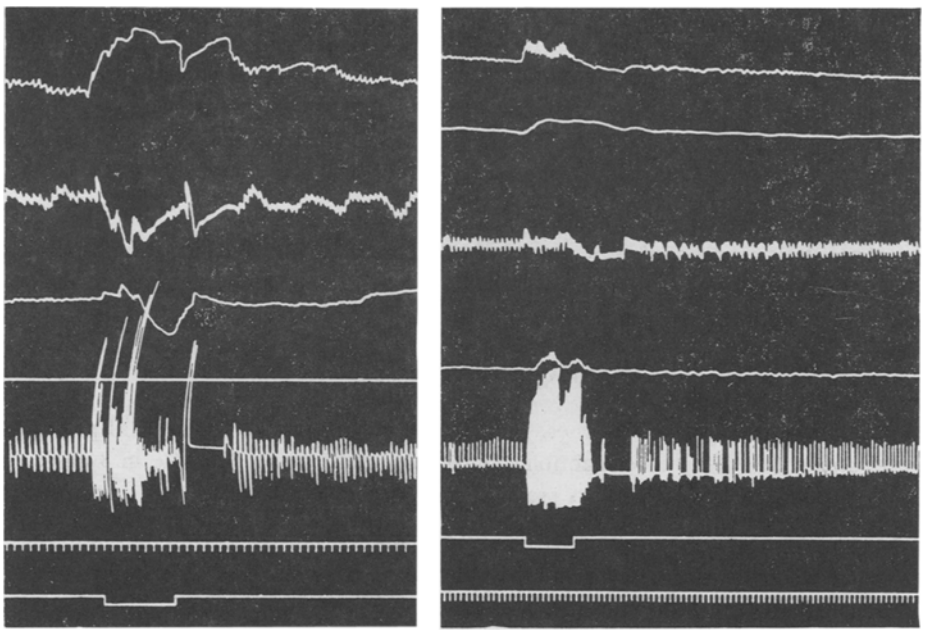


Fig. 1. Scheme of experimental perfusion of vein. 1) Reservoir with Ringer-Locke solution; 2) ultrathermostat; 3 and 4) screw clips regulating inflow; 5) soft clamp applied to iliac vein; 6) Bartyzel's lateral cannula.



A B

Fig. 2. Changes in arterial and venous pressure and venous tone during nociceptive stimulation. Significance of curves (from top to bottom): A) pressure in femoral vein, arterial pressure, venous tone, zero line of arterial pressure, respiration, time marker (5 sec), marker of stimulation (distance between coils 25 cm); B) limb volume, venous tone, arterial pressure, pressure in femoral vein, respiration, marker of stimulation (distance between coils 20 cm), time marker (5 sec).

In 20 experiments nociceptive stimulation caused a distinct reflex lowering of the tone of the perfused vein. Stimulation of the radial nerve caused an increase in the venous pressure in the femoral vein (by 10 mm H_2O) and dilatation of the perfused vessel (Fig.2B).

To exclude the influence of muscle tone,experiments were carried out on 14 dogs in which muscle relaxants (tubocurarine, delsemine, diplacin) were used in conjunction with artificial respiration. The results of these experiments were indistinguishable from those obtained in the main experiments. Consequently, the tone of the skeletal muscles and changes in respiration played no part in the changes in tone of the veins.

The experiments described above showed that after application of a nociceptive stimulus in most cases a simultaneous increase in the venous pressure and in the tone of the femoral vein occurred. In a considerable proportion of the experiments (in 31 of 79), however, the changes in the tone of the vessel and in the venous pressure were not in the same direction, and in some cases they were actually opposite.

Having observed that the venous pressure is not always an indicator of the tone of the veins, several investigators [3, 4] consider that in the course of extensive vascular reactions reflex changes in the tone of arteries, veins, and lymphatics develop in the same direction. Nevertheless, recent work has demonstrated that the vascular reflexes are local in nature [9, 11]. The possibility that reactions in different links of the vascular system may develop in different directions has also been suggested [1, 2, 6]. The results of the present experiments show that varied reflex changes in the tone of the veins may take place in association with relatively uniform changes, most often pressor in character, in the arterial and venous pressure.

SUMMARY

A study was made of the relationship between the venous pressure and the tone of the corresponding veins during nociceptive stimulation. It was shown by 47 acute experiments that in the majority of cases stimulation produced a simultaneous rise in the venous pressure and in the venous tone. However, in many cases (in 31 of 79) changes in venous tone and pressure were not uniform and in a number of cases they were even diametrically opposite.

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