A METHOD OF STUDYING THE CONDITION OF THE TONUS IN THE PERIPHERAL PORTIONS OF THE VASCULAR BED ON THE WHOLE ANIMAL

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The study of the dynamics of the change in vascular tonus, which is urgently needed for the solution of a number of questions in the physiology of blood circulation, has so far met with serious methodological difficulties.

Changes in the Resistance of the Peripheral Bed of the Femoral Artery

Time	Manipulation	Amount of fluid running out in 15 sec (in ml)
10 hr 05 min	Equipment connected	7.0
10 hr 07 min	–	8.0
10 hr 09 min	–	7.5
10 hr 27 min	Both pleural cavities opened. Ligatures placed under innominate artery, aorta, superior and inferior venae cavae, and vena azygos	9.0
10 hr 29 min	200 ml of blood let out of central end of femoral artery	7.0
10 hr 31 min	Innominate artery is pinched	4.0
10 hr 33 min	Aorta is pinched	2.0
10 hr 34 min		3.0
10 hr 35 min		3.0
10 hr 36 min		3.0
10 hr 37 min		4.0
10 hr 38 min		5.0
10 hr 39 min		6.0
10 hr 40 min		11.0
10 hr 41 min		12.0
10 hr 42 min		13.0
10 hr 43 min		13.0
10 hr 44 min		13.0

*Deceased.

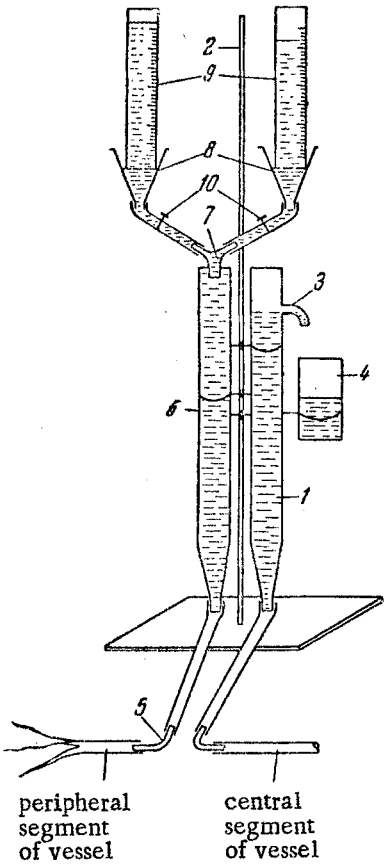

Diagram of device: 1) burette connected with central end of femoral artery; 2) stand; 3) tube for leading off blood when arterial pressure rises; 4) glass for collecting outflowing blood; 5) standard cannula inserted in peripheral segment of femoral artery; 6) burette; 7) T-tube; 8) funnels with constant level of blood; 9) measuring cylinders; 10) ground-glass stopcocks.

The dynamics of the change in vascular tonus can be judged either by measuring the volume of blood running through the portion of the vascular bed under investigation under constant pressure per unit of time, or by the change in pressure in the bed as constant volumes of blood pass through. In both cases, the tonus, which determines the resistance of the bed, alters the character of the variable value at a given constant.

As a rule, the first method is used when studying the condition of the bed of isolated organs. It is simple, since the volume of the flow of liquid through an organ can be judged by the number of drops or by the total volume of liquid flowing out per unit of time. On the whole animal, however, this method does not always ensure adequate accuracy, since even when the amount of blood flowing out along the main venous trunk is taken into account, the amount of blood flowing out along the collaterals remains unknown.

The use of the second method – the supply of constant volumes of blood, proposed by Richards and Dünker [2] and used in our laboratory by V. M. Khayutin [1] – provides for the opportunity of continuous measurement of resistance to the flow of blood, but at the same time presents considerable difficulties, since it requires a special apparatus to guarantee the uniformity of the blood volumes supplied.

The proposed method uses the first principle – the registration of the volume of blood flowing through the vascular bed; however, instead of the outflowing fluid, the fluid flowing in under constant pressure per unit of time is registered. The scheme for the proposed perfusion device is simple, and differs little from conventional devices for perfusing isolated organs.

The central end of the artery is connected with a narrow burette 1 set up on a stand 2 in such a manner that when it is moved along the stand the upper edge is at a level 50-150 cm higher than the level of the animal's body. At the start of the experiment, the blood fills the burette and becomes established at a level corresponding to the blood pressure. A tube 3 is fused to the upper edge of the burette through which, when pressure is raised, the excess blood entering the burette runs off into a special vessel 4. In case of necessity, the burette can be lowered somewhat and the amount of blood running out is increased.

Into the peripheral segment of the same artery, a cannula 5 is inserted which is connected by a rubber tube to the other burette 6, set up at a constant level above the body of the animal. The burette ends in a T-tube 7 connected with two funnels 8, over which two measuring cylinders 9 are attached.

In the work, first one, and then the other funnel is used alternately, which is accomplished by means of stopcocks 10. The total volume of the cylinder, funnel, and burette (to the entrance to the cannula) constitutes 60-110 ml. Before the start of the experiment, the cylinder is filled with blood or perfusion fluid.

After the first cylinder is emptied, the intake to the second funnel is opened; at the same time, the first is closed, and blood from the vessel 4 is poured into its cylinder.

The volume of liquid running out of the graduated cylinder per unit of time depends on the resistance of the bed.

We used this method for determining changes in the resistance of the peripheral portions of the vascular bed with the production of complete anemia of the central nervous system.

The protocol of an experiment performed September 24, 1958 is given as an illustration. Heparin (500 units per 1 kg of weight) was administered to a dog weighing 16 kg. Blood (200 ml) was taken in order to fill the system from the cylinder connected with the central end of the femoral artery. The delivery vessel was set at a height of 120 cm above the level of the table.

The volume of blood running out of the cylinder into the peripheral segment of the femoral artery was recorded.

It is seen from the protocol that during the course of the experiment 123 ml of blood entered into the peripheral segment of the femoral artery. At the same time, 36 ml of blood ran out into the vessel connected with the central end of the femoral artery. Thus, a reserve of 200 ml of blood, replenished as the blood enters from the central end of the femoral artery, was found to be sufficient to carry out experiments on dogs weighing 10 to 25 kg. In work on dogs weighing less, as well as on rabbits and cats, the small volume of the tubes and cylinders used makes it possible to limit oneself to 50-75 ml of previously taken donor blood or blood-replacing fluid.

The results of this experiment also show that, by using this simple method, it is possible to obtain adequate data on the change in the resistance of the peripheral bed throughout the entire experiment.

SUMMARY

The author suggests a simple method of determining the vascular resistance in the peripheral areas of the vascular bed in experimental animals. This method is based upon recording of the blood volume flowing under constant pressure into the peripheral part of the artery.

LITERATURE CITED

1. V. M. Khayutin, Fiziol. Zhur. 44, 7, 645 (1958).
2. A. N. Richards and C. K. Dünker, Pharmacol. and Exper. Therap. 70, 467 (1915).