

ASSESSMENT OF THE MYOCARDIAL HEMODYNAMICS BY THE RADIOISOTOPE CLEARANCE TEST IN CORONARY INSUFFICIENCY BEFORE AND AFTER SURGICAL TREATMENT

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The radioisotope clearance test detected a sharp decrease in the local blood flow in the myocardium after ligation of the coronary artery and in experimental atherosclerosis. Pericardio-cardiopexy in these cases increases the vascularization of the myocardium.

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Experimental and clinical investigations aimed at providing the heart with an additional blood supply by suturing richly vascularized tissues to the heart muscle (organopexy) play an important role in the problem of coronary insufficiency. The effectiveness of these operative procedures, however, is not accepted by all investigators, and the surgical treatment of coronary insufficiency is still applied on only a limited scale in clinical practice.

To determine the state of the myocardial hemodynamics before and after surgical treatment of coronary insufficiency, Kety's method [3, 4] was used in experiments on dogs.

EXPERIMENTAL METHOD

Because it has been shown that compounds of low molecular weight are removed from the tissues via the capillaries and those of high molecular weight via the lymphatics [1, 2, 5, 6], the tissue blood flow was studied by means of NaI^{131} in physiological saline, while the lymphatic flow was studied by the use of albumin- I^{125} . The labeled substances were injected into the thickness of the myocardium by means of a thin needle fitted with a special guard in a dose of 0.2 ml solution containing $2 \mu\text{Ci}$ radioiodine. A collimated scintillation counter was used to make the radiometric measurements; the distance from detector to source being 15 cm, thus considerably diminishing the influence of rhythmic oscillations of the area of myocardium studied on the radiometric results. The results were recorded on tape by a self-writing instrument.

Experiments were carried out on dogs under morphine-ether anesthesia with controlled respiration. The animals were divided into two groups: control (without experimental atherosclerosis) and experimental (with atherosclerosis). Atherosclerosis was produced in the dogs (8) by the method of Steiner and Kendall, using courses of dicoumarin as a factor stimulating the development of atherosclerosis (A. A. Sukhanov, S. I. Serov). A considerable increase in the blood cholesterol level (up to 1000-1200 mg%), a decrease in the lecithin-cholesterol ratio, and an increase in the content of β -lipoproteins were observed in the animals of this group. The heart was exposed in the usual manner and, depending on the aim of the experiment, ligation of the anterior descending branch of the left coronary artery or pericardio-cardiopexy was performed.

EXPERIMENTAL RESULTS

The mean time taken for half the electrolyte to be absorbed from the myocardium in the 7 dogs without experimental atherosclerosis was 103 ± 8.4 sec. Ligation of the coronary artery in these dogs produced a sharp disturbance of the local blood flow. The time for absorption of half the electrolyte was considerably increased, with a mean value of 399 ± 77 sec ($P < 0.05$). Tests with labeled albumin showed that the velocity of the lymph flow after ligation of the coronary artery was about doubled. The results demonstrate the compensatory role of the lymphatic system in the case of ischemia caused by ligation of the coronary artery.

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In the next stage of the investigation the effect of atherosclerosis on changes in the local blood flow in the myocardium was studied.

Some 6 or 7 months after the beginning of administration of atherogenic agents the experimental animals began to show signs of marked disturbance of their coronary circulation and this was confirmed by electrocardiographic changes consisting of a lowering of the voltage of the ECG waves, inversion of the T wave, and the appearance of conduction blocks and extrasystoles. The velocity of the local blood flow in these dogs was reduced by 33-50% compared with healthy animals. The mean time of absorption of half the NaI^{131} was 191 ± 25 sec (control 103 ± 8.4 sec; $P < 0.05$).

Thompson's operation was next carried out on the dogs with experimental coronary atherosclerosis with the object of forming adhesive pericarditis and vascular anastomoses between the pericardium and epicardium. Two months after the operation the radioisotope was administered to these same dogs, giving results (mean time for absorption of half the NaI^{131} 132 ± 24.5 sec) indicating an increase in vascularization of the myocardium.

Ligation of the left coronary artery followed by injection of NaI^{131} into the ischemic zone of the myocardium was performed on 8 dogs with experimental coronary atherosclerosis two months after pericardiocardiopexy. The mean half-absorption time was 377 ± 35.9 sec, i.e., compared with the situation before pericardio-cardiopexy (191 ± 25 sec) the capillary blood flow was reduced by about half.

Four months after pericardio-cardiopexy and two months after ligation of the coronary artery, an increase in the intensity of the capillary blood flow in the ischemic zone (almost to the normal level) was observed in the dogs of this group.

The final stage of the investigation was to test the function of the anastomoses formed in the region of the ischemic myocardium. Complete detachment of the pericardium was carried out in this zone, with rupture of all the adhesions present. The labeled electrolyte was then injected into the zone of myocardium treated in this manner. The half-absorption time of the electrolyte was found to be increased to 900 sec, i.e., the velocity of the capillary blood flow had fallen by about 60% (377 and 900 sec). This points to the effectiveness of the vascular anastomoses formed in the pericardial adhesions.

As the results of this investigation show, the radioisotope clearance test can be used to advantage to assess the myocardial hemodynamics. Not only can the existence of coronary insufficiency be established, but the degree of revascularization of the heart muscle can be determined after operative intervention in cases of acute and chronic disturbance of the coronary circulation.

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