

METHOD OF ISOLATING THE CAROTID SINUS AND FURTHER PROOF OF THE REFLEX PRODUCTION OF ANTIBODIES

A. N. Gordienko, V. I. Kiseleva, B. A. Saakov, I. M. Bondarev,
and E. I. Nekrashev

From the Department of Pathophysiology (Chairman: Professor A. N. Gordienko)
of the Rostov Medical Institute (Director: G. A. Ivakhnenko)

(Received April 21, 1956. Presented by Acting Member of the Academy
of Medical Sciences of the USSR V. N. Chernigovsky)

The method of isolating the carotid sinus used to prove the reflex mechanism of antibody production is imperfect. Some investigators (L. M. Ishimova, A. I. Oivin, P. F. Zdrodovsky, and A. D. Ado) state that it is impossible to isolate the carotid sinus. Isolation of the carotid sinus by previously described methods was an art which was acquired by experience and the operator was never certain that he had carried it out completely.

With the goal of unifying experiments of this nature we considered it essential to work out a method which would be available to all and which would guarantee complete isolation of the carotid sinus.

EXPERIMENTAL METHODS

A linear cut is made in the skin 10-12 cm in length, so that the corner of the lower jaw would project from the middle of the cut. The muscles are separated and the carotid body is found. The common carotid artery is picked up on a ligature. The venous plexus above the carotid sinus is moved aside and fixed by a retractor. The common carotid artery is pulled toward the outside and a spatula with which the sinus is raised is brought up from the outside. On the internal side of the carotid sinus, the sinus nerve is dissected out and picked up on a ligature (Fig. 1).

A U-shaped probe, lying under the common carotid proximally and between the external and internal carotid arteries distally, is brought under the carotid sinus. Lifting the sinus nerve, a ligature is brought by a needle along the trough of the probe under the external carotid artery and the vessels and tissues adjoining it, and all are ligated. Then a ligature is also brought under the internal carotid artery and the vessels and tissues adjoining it in the same way and they are tied. The intact sinus nerve remains above the ligated vessels (Fig. 2).

Into the carotid sinus isolated in this way, 0.4 ml of radioactive vaccine is administered, after 5 minutes of contact second ligatures are placed distally and the blood vessels and nerve are cut between them and the previously placed ligatures, after which the sinus is removed. The wound after the removal of the sinus remains dry, hemorrhage is absent. The removed sinus remains filled with vaccine, does not diminish under pressure and drops do not appear at the ligated points. The wound is sewn in layers and treated in the usual way.

EXPERIMENTAL RESULTS

A total of 21 experiments were set up on dogs. Before the administration of 0.2 ml of radioactive vaccine, blood was drawn from the femoral vein for agglutination and for the determination of the radioactivity of the blood (determined with type B apparatus). From 100-400 microcuries of radioactive phosphorus (P^{32}) and 4 billion microbial bodies were contained in 1 ml of the administered radioactive vaccine. The radioactivity of the blood for the presence of P^{32} was determined before the administration of the vaccine, 5 minutes after administration and 2-3 minutes after extirpation of the sinus. The operation was carried out aseptically.

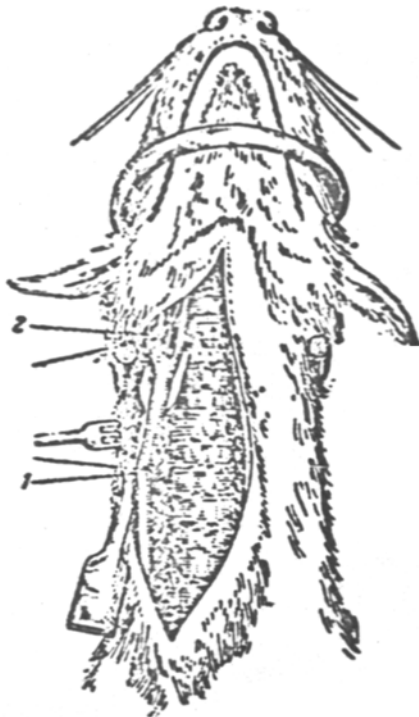


Fig. 1. First stage of the operation to isolate the carotid sinus.
1) Ligature on the common carotid artery;
2) ligature on the sinus nerve.

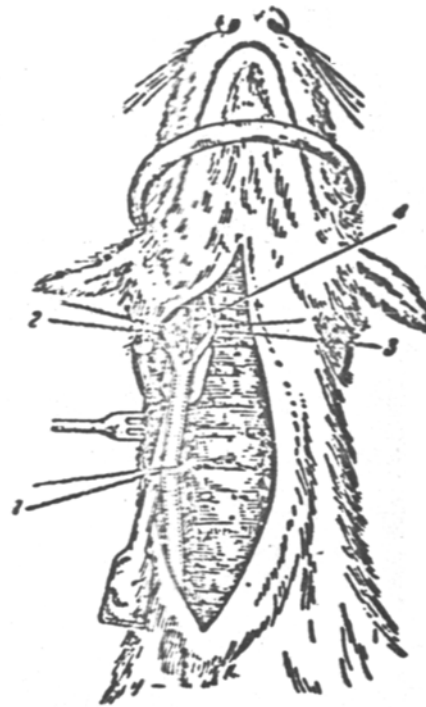


Fig. 2. Second stage of the operation to isolate the carotid sinus.
1) Ligature on the common carotid artery;
2) ligature on the external carotid artery with adjoining blood vessels and tissues; 3) ligature on the internal carotid artery with adjoining blood vessels and tissues; 4) sinus nerve.

The zero reading on the counter varied between 30 and 72 impulses per minute on different days, the radioactivity of the blood before administration, as a rule, corresponded with the zero reading of the counter and consisted of 32-72 impulses per minute. The radioactivity was determined 5 times during each minute. The radioactivity of the blood taken 5 minutes after the administration of the vaccine into the isolated sinus remained within the limits of the zero reading of the counter and the radioactivity of the blood before administration of the vaccine, with the exception of 2 experiments (Nos. 8 and 12). In experiment no. 8 the zero reading on the counter was 62 impulses per minute, the radioactivity of the blood before the administration of vaccine was 60 impulses per minute, after administration 428 impulses per minute, while after extirpation of the carotid sinus it was 148 impulses per minute. In experiment no. 12 the zero reading on the counter was 62 impulses per minute; the original radioactivity of the blood was 64 impulses per minute; after administration of vaccine, it was 259 impulses per minute and after extirpation it was 107 impulses per minute.

Thus, the isolation of the carotid sinus was complete and the radioactive phosphorus did not penetrate into the blood, and consequently neither did the vaccine enter it. Two cases are exceptions, when the inadequacy of the isolation of the carotid sinus was immediately evident by the sharp increase in the radioactivity of the blood.

In all the experiments we used typhoid fever vaccine. Seven days after the contact of the typhoid fever vaccine with the receptors of the carotid reflexogenic zone, blood was taken from all the dogs and another determination of the antibody titer was made.

The original titer was from 1:20 to 1:80, 1:40 on the average. Determination of the titer after 7 days showed a many-fold increase in it. The titer was equivalent to dilutions of from 1:160 to 1:2560, while in most cases the titer was 1:320, 1:640. Thus, in experiment No. 7 the original titer was equal to 1:40, after 7 days it was 1:2560. In experiment No. 11, the original titer was 1:20, while in 7 days it rose to 1:160. In the experiments in which phosphorus was drawn into the blood stream, an increase in the antibody titer was also observed (In experiment No. 8 from 1:40 to 1:640, in experiment No. 12 from 1:80 to 1:160).

At the same time the agglutination reaction for specificity was set up with the colon bacillus, and 7 days after the contact of the typhoid fever antigen with the receptors of the carotid reflexogenic zone the titer usually rose to 1:40 or 1:80.

It should be emphasized that the increase of the antibody titer in the experiments in which the antigen did not reach the general bloodstream and in experiments in which it reached the bloodstream was the same.

Having established antibody production when the antigen acted on the isolated carotid sinus, we attempted to study the effect of preliminary section of the sinus nerve on this process. With this goal, after isolating the carotid sinus in the manner described above, we cut the sinus nerve, then administered the vaccine. The resorption control was carried out in the same way as in the previous series of experiments. The antibodies in the blood of these animals were determined after 7 days also. The section decreased antibody production considerably, and completely excluded it in one case. It is important to note that the insignificant rise in titer (1:160-1:640) which was observed in 2 experiments was the same with respect to typhoid bacteria and to colon bacilli. The dissection of the nerve may be difficult so we attempted to study the effect of tying the nerve with the blood vessels on the production of antibodies. Experiments showed that the inclusion of the nerve in the ligated bundle sharply decreased the production of antibodies, but did not completely eliminate it.

SUMMARY

The method we suggest allows the complete isolation of the carotid sinus without injury to the sinus nerve. The administration of radioactive vaccine containing 100-400 μ C per 1 ml of radioactive phosphorus into the sinus isolated by the method described above and the subsequent determination of the radioactivity of the blood testified to the complete absence of resorption from the isolated sinus. Preliminary section of the sinus nerve eliminated the production of specific agglutinins during the administration of typhoid fever vaccine into the isolated carotid sinus. Preliminary inclusion of the sinus nerve in the ligated bundle sharply decreased the production of antibodies. The data obtained testify to the presence of a reflex mechanism in the production of antibodies.