A NEW DEVICE FOR EXCLUSION OF THE CIRCULATION OF THE INTERNAL ORGANS IN CHRONIC EXPERIMENTS

E. I. Khomchenovskii

From the Laboratory of Experimental Chemotherapy of Cancer (Head – Corresponding Member of the AMN SSSR L. F. Larionov) of the Institute of Experimental Pathology and Therapy of Cancer (Director – Corresponding Member of the AMN SSSR N. N. Blokhin) of the AMN SSSR, Moscow

(Received July 5, 1957. Presented by Active Member of the AMN SSSR V. N. Chernigovskii)

The development of methods of temporary exclusion of the blood supply to internal organs and of various vascular regions in chronic experimental conditions is of great interest to the study of physiology, pharmacology and biochemistry in the intact animal. In contrast to the acute experiment, when the circulation can easily be interrupted by clamping the vessels operatively, using the usual hemostats, the temporary exclusion of the circulation in chronic experiments demands special devices.

In order to produce experimental hypertension Goldblatt and his co-workers [8] used a special clamp by means of which it was possible to achieve prolonged and constant constriction of the renal vessels in chronic experiments on dogs (Fig. 1, 1). This method has been developed further by many workers, but the apparatus suggested was suitable only for constant constriction of the lumen of vessels in chronic experiments.

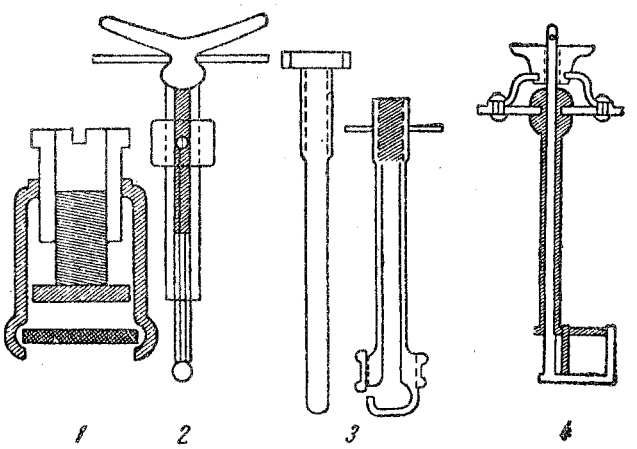

Fig. 1. Devices for excluding the circulation of internal organs. 1) Clamp described by Goldblatt and co-workers; 2) the loop-constrictor used by I. Smirnov; 3) the cannula devised by I. S. Kanfor; 4) vascular clamp (first variant).

I. Smirnov [3] used a special device – the loop-constrictor – for the temporary occlusion of vessels in the rabbit in acute experiments. This consists of a tubular body in the interior thread of which revolves a rod connected to a string; tightening the string constricts the vessel. The apparatus is equipped with a scale which permits graded constriction of the lumen of the vessel to be carried out.

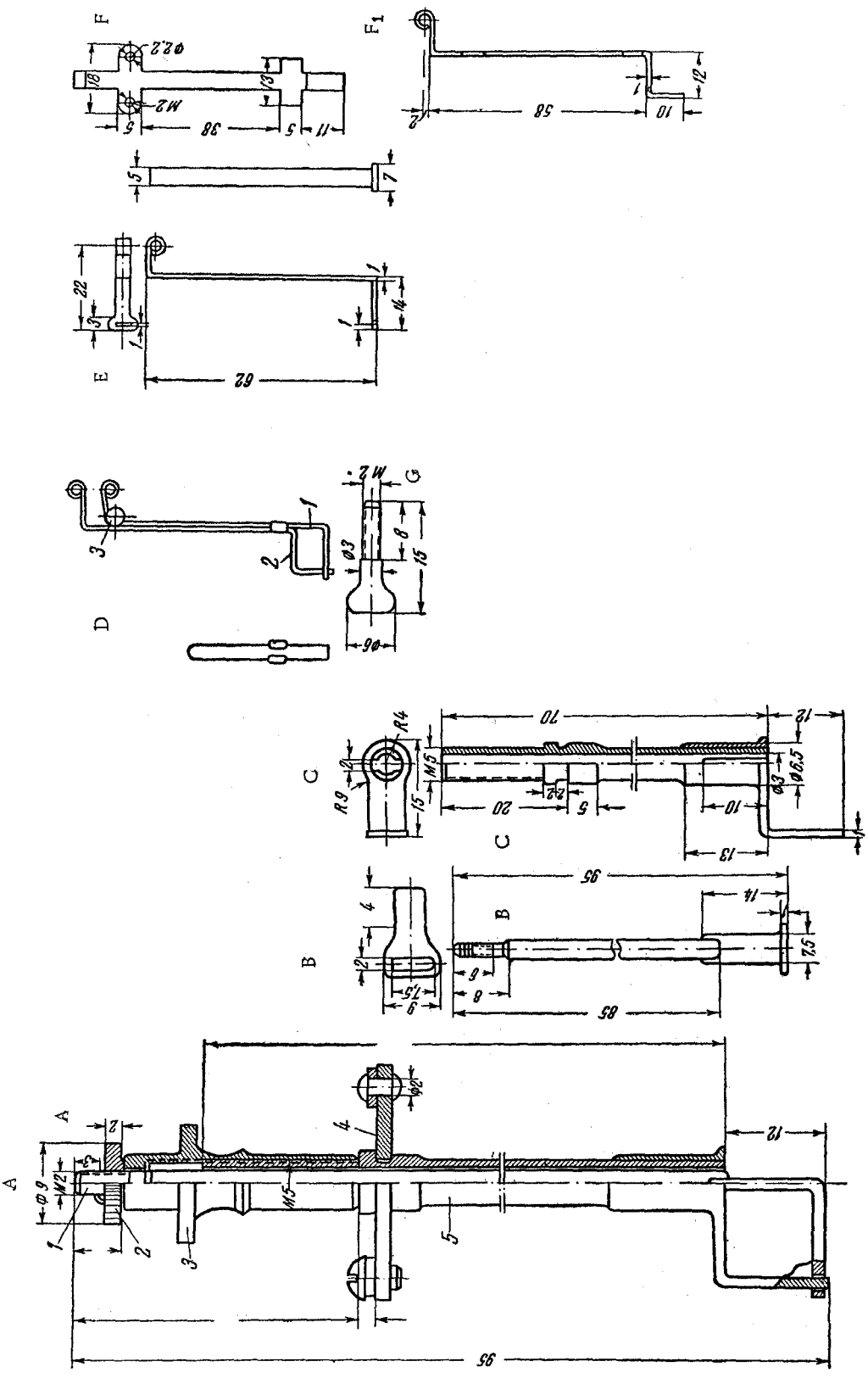

Fig. 2. The vascular clamps SZ-2 and SZ-3. A) The SZ-2 apparatus in assembled form; B) detail 1 of the apparatus SZ-2; C) detail 5 of the apparatus SZ-2; D) the SZ-3 apparatus in assembled form; E) detail 1 of the apparatus SZ-3; F) detail 2 of the apparatus SZ-3; G) detail 3 (screw) of the apparatus SZ-3.

I. S. Kanfor [1] devised a metal cannula which, like the previous author, he used in acute experiments [2]. This cannula consists of a tubular body in the interior thread of which revolves a rod which compresses the vessel against the base of the cannula. Thus, the vessel is compressed in the cannula between two flat surfaces – the immovable bed of the apparatus designed to take the vessels and the revolving butt end of the bolt; hence conditions are created for twisting and severe trauma to the wall of the vessel during its constriction. This can easily be proved by compressing an ordinary rubber tube between the revolving and immovable surfaces. These technical defects combined with the great weight of the cannula restrict its use to acute experiments only [2]. In this respect the cannula has no advantage over that previously suggested by I. Smirnov; there has never yet appeared any report of its successful use in a chronic experiment.

For temporary occlusion of the circulation of the gastrointestinal tract in chronic experiments we introduced in 1952 a new type of apparatus – a vascular clamp, differing in its construction from all the devices enumerated.

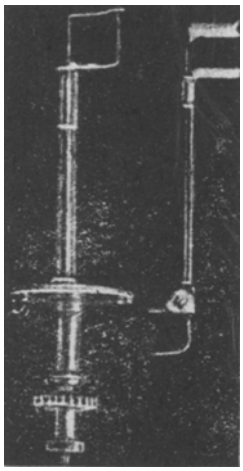

Fig. 3. Vascular clamps (SZ-3 apparatus without handles).

In this clamp which we developed the vessels are included in the lumen of a rectangle and are compressed by the approximation of parallel plates lined with rubber. Thus in the construction of its working parts the vascular clamp is closer to that described by Goldblatt than to Kanfor's cannula (see Fig. 1). By means of the vascular clamp it was possible for the first time in chronic experiments to carry out temporary occlusion of the circulation of almost the whole of the gastrointestinal tract in dogs [4-7]; the possibility of using this method on a wider scale was thus shown.

However, the vascular clamp was not faultless and called for further improvement. With this in view we constructed two new clamps SZ-2 and SZ-3 which are described below.

The newer models have a number of advantages over the first apparatus: simpler construction, lighter weight and safer constriction of the vessels.

The apparatus SZ-2 consists of 5 components (Fig. 2, A-C and Fig. 3). Detail 1 is ⌐ -shaped; at the end of its flat plate a slot is made to accommodate the vertical plate of detail 5, and at the opposite end there is a thread for the fixing nut 2 and an opening for the splint. On the internal surface of the cylindrical nut 3 there is a thread for engaging with the detail 5. A separating disc 4 is inserted in a cut-out area of the detail 5; it is designed for fixing the apparatus to the surface of the body and for engaging with the cylindrical nut. Inside the detail 5 a hole is drilled for the rod and directing slot for the plate of detail 1, while on the outer part there is a thread for engaging with the cylindrical nut and a cut-out area for fixing the separating disc.

During application to a vessel the rod of detail 1 is inserted in the hole in detail 5 and the vessel is inserted between the ⌐ -shaped plates of these details. Next the tubular part is brought out to the surface of the body through a trocar puncture. The cylindrical nut 3 and the fixing nut 2 are screwed on the thread of detail 5. In the hole in detail 1 is inserted the wire splint to prevent the nut 2 from unscrewing and releasing the clamp. Next the separating disc is inserted in the hollow in detail 5 and fixed by screwing tight the fixing screw of the disc. Compression of the vessel is effected by tightening the cylindrical nut 3 as far as possible (or until the required degree of constriction of the vessel has been attained) in an anti-clockwise direction. In order to restore the original situation the cylindrical nut is turned clockwise as far as possible.

The SZ-3 apparatus is of "periscopic type" and is very simple in construction and easily made from ordinary stainless steel plate. It consists of 3 components (Fig. 2, D-G). Its two flat plates, connected to each other, form a rectangle in which is inserted the vessel to be constricted. For this purpose the screw 3 is unscrewed, the detail 1 is displaced downwards (see 2 and 3) and the vessel is inserted between the ⌐ -shaped parts of details 1 and 2, forming the rectangle; these components are fixed by the screw 3 which prevents the clamp from opening and the vessel from slipping out. In preparing the apparatus for use, the plates which compress the vessel are coated with rubber. In order to minimize trauma, the long part of the apparatus may also be enclosed in a rubber tube. The

end of the clamp is brought out onto the surface of the body through an incision. When necessary the clamp may be fixed by a separating disc similar to that in the SZ-2 apparatus.

The vessel is compressed by a clamp of the Kocher type, for which purpose its ends are inserted into the handles of the details 1 and 2 (see Fig. 2, D). Restoration of the original position is achieved by separating the blades of the Kocher forceps which are then removed from the handles of the clamp.

The method of work with the SZ-2 and SZ-3 apparatus is similar to that described by us previously for the SZ-1 apparatus [4, 6]. We tested the two newer models of the vascular clamp in experimental occlusion of the circulation of internal organs in 2 dogs.

The vascular clamps described may be used for occlusion of the aorta and of its immediate branches. The measurements shown on the diagrams of the clamps are calculated for constriction of the abdominal aorta or of its immediate branches in large dogs. Depending on the dimensions of the vessels and on the regional topographical anatomical relationships the dimensions of the apparatus or of its component part may be modified.

We consider that the development and perfection of metal clamps does not finally solve the problem of creating a satisfactory device and method of occlusion of the circulation of internal organs in chronic experiments. The pneumatic method, in the development of which we are engaged at the present time, presumably offers greater promise.

SUMMARY

2 new variants of vascular clamps for temporary exclusion of the blood supply to internal organs in chronic experiments are described. The technique of application of vascular clamps was described formerly (the Bulletin of Experimental Biology and Medicine, No. I, 1955, pages 72-74).

LITERATURE CITED

[1] I. S. Kanfor, Biull. Eksptl. Biol. i Med. No. 9, 78-79 (1955).

[2] I. S. Kanfor, Ibid., No. 2, 22-23 (1957).*

[3] I. Smirnov, Changes in the Function of Some Bulbar Centers During Incomplete Anemia of the Brain,** Dissertation, Leningrad, 1941.

[4] E. I. Khomchenovskii, The Action of Embiquine on the Function of the Gastrointestinal Tract,** Dissertation, Leningrad, 1953.

[5] E. I. Khomchenovskii, Proceedings of the 2nd Conference on Chemotherapy of Tumors,** pp. 10-11, Moscow, 1953.

[6] E. I. Khomchenovskii, Biull. Eksptl. Biol. i Med. No. 1, 72-74 (1955).

[7] E. I. Khomchanovskii, Farmakol. i Toksikol. No. 4, 45-48 (1956).

[8] Goldblatt, Lynch, Hanzal and Summerville, J. Experim. Med. 1934, v. 59, p. 347-380.

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

**In Russian.