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BRIEF COMMUNICATION

Cannula for Intracerebral Administration of Experimental Substances[1]

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REZEK, M. AND V. HAVLICEK. *Cannula for intracerebral administration of experimental substances.* PHARMAC. BIOCHEM. BEHAV. 3(6) 1125–1128, 1975. – Two reliable intracerebral cannulas, with a protective cap and a locking arrangement of the extension tube can be made from inexpensive regular and dental disposable needles and syringes. The preparation and use of these alternative cannula systems which enable the prolonged intracerebral infusion of experimental substances in unrestrained, freely moving animals is described.

Intracerebral cannula Prolonged infusions Unrestrained animals

A convenient and dependable system for intracerebral cannulation is a prerequisite for the successful repeated administration of experimental substances into various parts of the central nervous system [2]. Since intracerebral infusions are generally performed at very slow rates, it is necessary for the cannula system to have a convenient locking arrangement which holds the end of the extension tube securely in the cannula guide for the duration of infusions. This aspect is of special importance when prolonged, intracerebral infusions are performed in unrestrained, freely moving animals.

The present report describes the preparation and use of two types of chronic intracerebral cannulas which have been shown to be suitable for such experiments. Both types of cannula systems consist of three basic components which include a cannula guide with exteriorized well, an inner cannula and a terminal assembly of the extension tube which locks into the well of the cannula guide during the infusions, and a removable cap with fixed cleaning wire to protect the cannula guide between infusions. The preparation of both cannulas is simple and economical as all parts can be obtained from regular or dental disposable needles and syringes.

DESIGN AND CONSTRUCTION

Cannula System A

The parts necessary for the construction of this cannula system are one 25 ga disposable needle (Monoject or Yale), two 30 ga dental disposable needles (Monoject – 401 metal hub), one 18 ga disposable needle (Monoject or Yale), and two 5 ml disposable syringes. The first component of this system, a cannula guide, is made from a 23 ga disposable needle whose plastic well is modified to reduce the height of the exteriorized part of the cannula above the surface of the skull. To do this, the well is first cut approximately at the middle as indicated by the dotted line in Fig. 1a, b. The plastic of the lower cut part b which fixes the needle is then slightly reduced in length and diameter by filing until it fits tightly into the upper cut part a. The mechanical connection between parts a and b is strengthened by applying epoxy between connecting surfaces. For this, part b is temporarily loosened and epoxy is applied from the bottom of part a. An attempt should be made to keep the upper inner wall of part a smooth and clean. Part b is then rotated to assure its concentric position within part a and proper adhesion of the epoxy.

The removable cap with its fixed cleaning wire is made from the lower threaded section of a 5 ml (or 10 ml) plastic disposable syringe. This part is prepared by making two cuts just below and above the Luer-lok section as indicated by Fig. 1e. The fixed cleaning wire, made from a 30 ga dental needle (1d), is then inserted through middle opening of part 1e. The tight mechanical contact is achieved by filing and reducing the diameter of the lower solid part of the hub of the needle and is strengthened by the application of epoxy. The locking arrangement of the removable cap utilizes the principle of a Luer-lok connection between the needle and syringe. The completed cap is shown inserted into the cannula guide (Fig. 1f).

The locking arrangement for the terminal part of the extension tube is also based on the Luer-lok principle. The preparation of the terminal assembly begins with the separation of the lower threaded Luer-lok section from the

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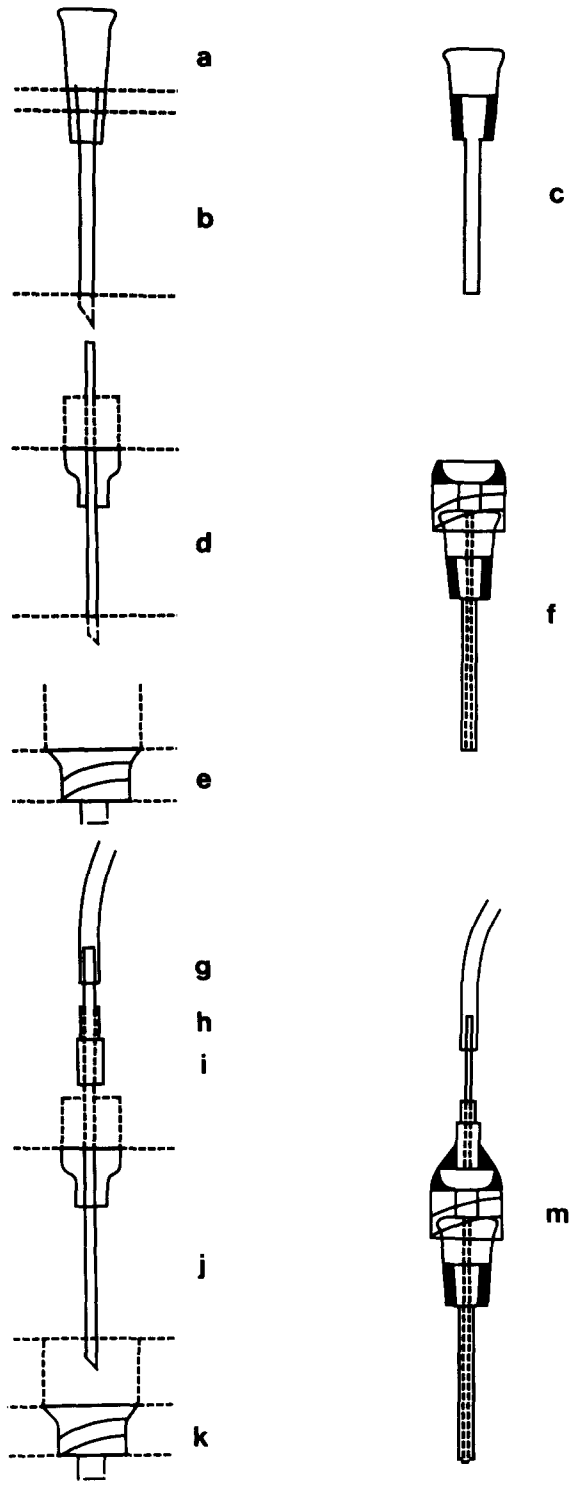

FIG. 1. Parts and assembled components of cannula system A.

plastic disposable syringe. This is accomplished by two cuts indicated on Fig. 1k. Subsequently a 30 ga dental needle with its well cut away (Fig. 1j) and the lower solid part of the needle hub reduced in diameter by gentle filing, is inserted and fitted tightly into the middle opening of part 1k. Application of epoxy at the point of contact makes this connection permanent. To reinforce the extended upper part of the inner cannula just above the assembly, one or two sections of 23 ga and 18 ga tubing from a disposable needle (1h, i) can be inserted concentrically on 30 ga tubing of the inner cannula (1m). Before applying epoxy, it is useful to insert the 30 ga tubing of the extension assembly (inner cannula) into the cannula guide (outer cannula) so that hardening of the connections takes place while all parts are in the proper concentric position (Fig. 1m). Before implanting the cannula, the terminal inner cannula of the extension tube is inserted into the cannula guide and premeasured so that its tip exceeds the tip of the outer guiding cannula by 0.5 mm. While both parts are still locked, the position of the extension tube in relation to the top of part 1a of the implanted cannula guide (the end of the last turn) should be marked on parts 1k and 1a to prevent the possibility of overscrewing the cap home on subsequent insertions. The cannula guide and the extension assembly are also kept in the locked position for implantation. The whole assembly is held in the stereotaxic apparatus by the supporting tubes of the terminal plug of the extension tube (1 h, i).

Cannula System B

The parts necessary for the construction of this cannula system are three 30 ga disposable dental needles, two 23 ga disposable needles, and a convertible tip for a Cook-Waite dental aspirating syringe (Fig. 2k).

The procedure for construction of the cannula guide is basically similar to preparation of the cannula guide for the Type A cannula system with the exception that part 2a is made from the well of a 30 ga dental needle. Part 2b is again made from a 23 ga disposable needle with its plastic holder filed to size and fixed tightly in part 2a in the same way as described for the preceeding cannula system.

The removable cap is prepared from a 30 ga dental needle. Its well is first flattened in a vise from sides and then filed around to the shape indicated in Fig. 2d. The part which actually holds the cap in the well of the guiding cannula is, however, made from the lower part of the well of a 23 ga disposable needle (Fig. 2e). It is then inserted on the lower narrow portion of part 2d and sealed with epoxy. Although this part is not threaded, thread can be easily produced on this component by gently pressing and screwing the assembled cap into the threaded well of the cannula guide. Several repetitions of this procedure will produce a good thread which securely holds the cap in place and prevents the animal from removing it between infusions. The completed cap inserted into the well of the cannula guide is shown in Fig. 2f.

The extension tube assembly is made from a 30 ga dental needle whose well is gently cut off so that only the protruding 30 ga tubing and solid metal block fixing the needle remain intact. The other part is the threaded, stainless steel connecting part for the dental syringe and the needle (2k). Its upper part (above the dashed line) is cut or filed off to make the assembly lighter. The remaining parts are the same as those used in the previous cannula system; they consist of protective tubes cut from 23 ga and/or 18 ga disposable needles and the polyethylene extension tube. To assemble these parts, a 30 ga needle is first inserted through the center opening of part 2k up to the solid metal holder through which it will not pass. Subsequently, one or two supporting protective tubes are inserted concentrically

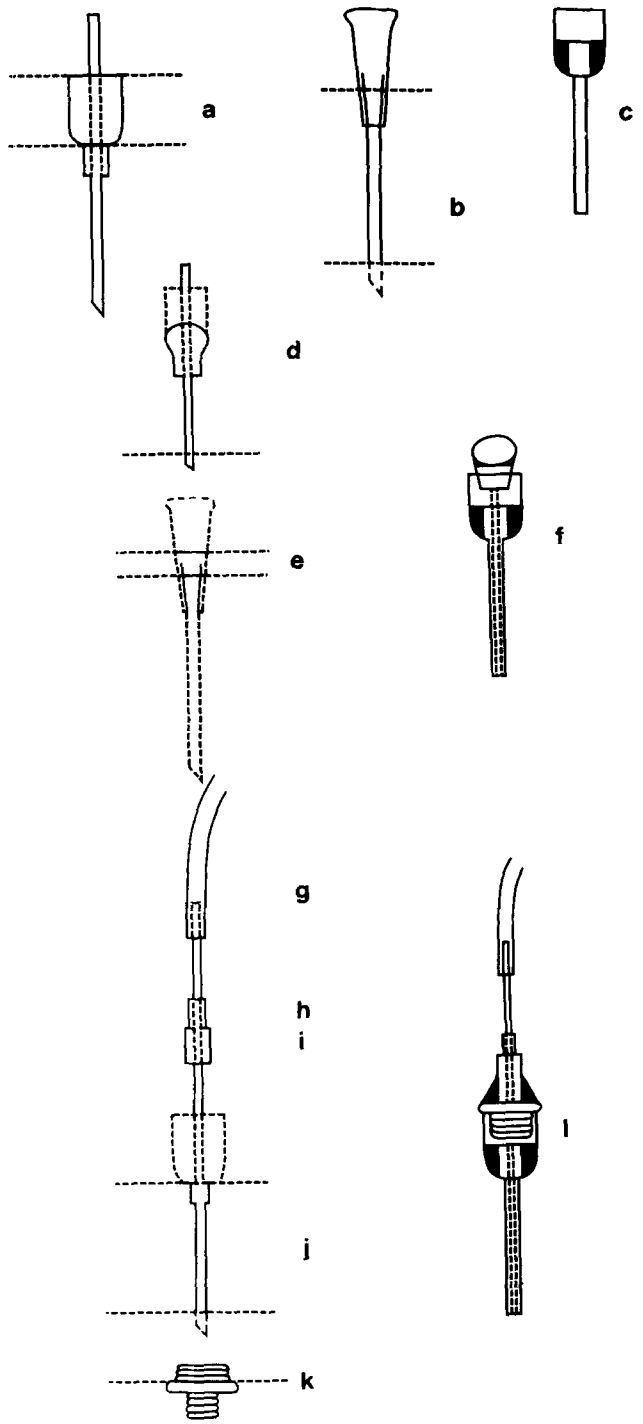

FIG. 2. Parts and assembled components of cannula system B.

on the upper part of the 30 ga needle (2h, i) and sealed with epoxy. The polyethylene tubing is then inserted on the end of the 30 ga needle to close the system (2g). The premeasuring of the tip of the extension tube with respect to the cannula guide is performed in the same manner as was described for cannula system A. The nature of the connection between parts 2a and 2k practically eliminates the possibility of overscrewing the cap home although

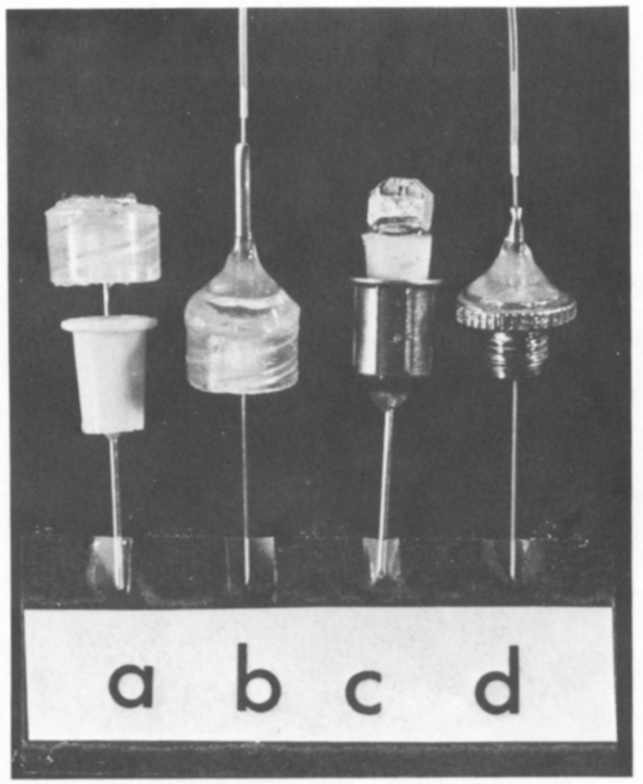

FIG. 3. Cannula system A: (a) cannula guide and protective cap with fixed cleaning wire; (b) terminal plug of the extension tube. Cannula system B: (c) cannula guide and partially inserted protective cap with fixed cleaning wire; (d) terminal arrangement of the extension tube.

marking the position of the last turn should be made as is described in Cannula System A. Fig. 2l shows the completed terminal assembly of the extension tube locked into the well of the cannula guide.

In comparison (Fig. 3), cannula system A is simpler and cheaper although somewhat less accurate than cannula system B and thus probably more suitable for intraventricular infusions. The smaller size and accuracy of cannula system B (Fig. 3) makes this type more versatile and especially convenient for cerebral tissue infusions. A cannula can easily be implanted on the head of an animal in addition to other experimental components such as an electrode connector or another cannula. For prolonged infusions, an extension tube with a swivel located near the infusion pump [1] can be used along with a suitable counterweight or fine spring arrangement to prevent the animal from reaching the tubing. In our laboratory, rats are implanted with one or two cannulas along with multielectrode amphenol connector. The animals are simultaneously connected to an EEG recorder and to the infusion pump which can be turned on by remote control from a separate observation room after the initial excitement caused by handling subsides. The infusions last up to 25 min but the animals remain connected to both EEG machine and infusion pump for another 2 hr to avoid disturbing the animals by handling during the recording and observation period.

RESULTS

Our experience with both cannulas is quite satisfactory as animals do not lose the protective cap between infusions or the terminal plug of the extension assembly during the infusion or subsequent recording period. The principle advantages of the cannula systems described are the availability and low cost of material as well as a reliability of operation. Although their preparation may appear to be somewhat elaborate, only a short practice allows a person to prepare larger quantities of these cannulas in a relatively short period of time. After adoption of the assembly line approach, two dozen of these cannulas can be prepared in 2 to 3 hr. The primary benefit of the cannula systems described is realized in experiments which require the prolonged infusions of experimental substances in unrestrained, freely moving animals.

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