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BRIEF COMMUNICATION

A Mild Restraint and Chronic Venous Catherization System for Cats[1]

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SMITH, J. M., P. F. RENAULT AND C. R. SCHUSTER. *A mild restraint and chronic venous catheterization system for cats.* PHARMAC. BIOCHEM. BEHAV. 3(4) 713–715, 1975. – An inexpensive and minimally restrictive restraint system for cats is described which protects any temporary connections to chronic physiological implants during recording sessions and permits free movement of the head and extremities for behavioral studies. Procedures for constructing and implanting a chronic indwelling venous catheter device are also described which allows, directly with a syringe or via a connector system, for intravenous drug infusions in cats. These catheters have remained intact and relatively free of infection for a period of months before tissue rejection begins at the site of the subcutaneous implant.

Chronic indwelling venous catheter Cat Stress-free restraint Intermittent intravenous infusions

THE cat has proven to be an excellent laboratory subject; it is a convenient size, and requires minimal care and space. In addition, a wealth of information has been gathered about the physiological and behavioral characteristics of this species. However, two major obstacles have blocked the use of these animals in investigations which require intravenous administration of drugs: (1) the inaccessibility of large veins near the skin surface, and (2) the absence of a system allowing repeated intravenous (IV) injections in a relatively calm, unanesthetized cat. Since we were interested in taking physiological and behavioral recordings during and following IV drug infusions, we needed a restraint that would prevent the cats twisting and breaking the electrical connections, but would allow relatively free leg and head movements. Although suspended slings have been reported as adequate restraint when taking physiological recording in dogs or larger mammals [2] we found that cats would easily escape a similar device. An alternative was a cat restraint box, which we used for many sessions, but rejected as equally unacceptable since excessive kicking and twisting continued to occur. We have designed a modified sling for the cat. It restrains the animal and, at the same time, allows free movement of the extremities while protecting both the venous catheter and the electrical connections which are attached during behavioral training or testing sesions.

We approached the problem of intravenous administration by modifying a previously devised skin implantation technique [1]. This modification allows access to the venous system of the cat for at least three or four months. The essence of the technique is the construction of a subcutaneous disc on which a Luer-Lok needle can be mounted and which will remain in place without the danger of becoming disconnected from the intravenous catheter or of being dislodged by the animal. Both the catheter and restraint devices have the added benefit of being inexpensive to construct.

INDWELLING INTRAVENOUS CATHETER SYSTEM

Construction of the Catheter Assembly

The fabrication of the catheter assembly begins with a disc made of lucite approximately 3 cm in dia. and 0.2 cm thick which serves as the prototype for the construction of a mold. The prototype is placed in the bottom of a small paper cup and surgical adhesive (RTV-632), prepared according to directions, is poured over it. Once the RTV-632 has cured, the paper cup and prototype are removed. A 20 g beaded needle is shortened and the end filed smooth and dull. The shaft of the needle is bent to 90°, preferably with a wire trochar in place to prevent occlusion of the lumen. The trochar is then removed and

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medical grade silastic tubing (0.030 in. internal dia. by 0.065 in. outside dia.; Dow Corning) is fitted onto the shaft and tied proximal to the bead with silk suture.

The disc is made by filling the RTV-632 mold with E-712 epoxy adhesive (John L. Dore Company, Houston, Texas). Other materials such as dental acrylic can also be used. The Luer-Lok-catheter assembly is then placed in the liquid epoxy and held in place with adhesive tape until the epoxy cures. At this point, care should be taken that the plug is centered in the disc and that epoxy completely covers the base of the Luer-Lok plus a length of the catheter sufficient to prevent movement of the catheter over the end of the needle. Constant movement at this point would eventually wear through the catheter and cause leakage. It is frequently necessary to apply a second coat of epoxy to the base of the Luer-Lok and over the catheter, both to reinforce and to insure complete immobility. When the epoxy hardens (24 hours), the assembly is removed from the mold and the epoxy surface is completely covered with RTV-632. This substance provides a soft covering for the surface and edges of the disc. A 5 cm dia. circular disc of teflon mesh (Harrison's Interlock Mesh Teflon; C. R. Bard, Inc., Glen Falls, NY) with a 1 cm radial cut from the edge is then prepared. A purse-string suture at the circumferential edge, beginning and ending at the radial cut is drawn around the disc tightly to the base of the Luer-Lok, the catheter protruding through the radial cut. Any edges of excess mesh are trimmed. The entire assembly is then washed in mild detergent, rinsed in distilled water and sterilized for implantation either by autoclaving or in dry heat at 105°C for 3 hr.

Surgical Implant

An area of skin approximately 5 cm in dia. just posterior to the scapulae is surgically prepared on the animal's back. A small amount of skin is grasped with hemostat points and scissors are used to cut a small circular hole around the hemostat points. This hole should be the size of the base of the Luer-Lok. Two 1 cm transverse incisions are cut perpendicular to the circumference of the excised hole and extended with blunt dissection to allow the disc to be slipped in subcutaneously. Prior to final implantation of the disc, the end of the catheter is attached to a surgical trochar and passed subcutaneously from the site of implantation to that of the vein, either jugular or femoral. The skin over the catheter tract and at the site of implantation should have also been surgically prepared prior to beginning surgery. An incision is made in the skin over the vein to permit exit of the trochar and catheter. The disc can then be implanted and transverse incisions closed with silk suture. After removing the surgical trochar, the catheter is filled with saline and implanted in the vein. When tying off the catheter, a small loop of excess catheter should be left outside of the vein to permit movement without placing tension on the site of insertion. The skin is then closed with silk suture. A dilute solution of heparinized saline should routinely be used once or twice a week to maintain patency of the catheter if drugs are not being injected frequently. When not in use, the catheter is protected with a stainless steel Luer-Lok cap.

This implant is remarkably durable and well tolerated by the animal. We have found that in the cat the femoral vein is the most accessible and the most durable site of implantation. The chief limitation of its longevity is eventual breakdown of the skin around the disc, but this takes several months to occur. Infection will accelerate this process and every care should be taken at the time of surgery to implant the entire assembly under sterile conditions. A certain amount of serous drainage will dry around the base of the Luer-Lok. This should be removed and the area cleaned once or twice a week.

RESTRAINT SYSTEM

Figure 1 illustrates the restraint system we have developed. Implants and wire leads to the connectors in the back or on the head of the subject are undisturbed by the animal's movements. The height of the bar or the sling can be adjusted so that the cat is sitting, lying, standing, or suspended in the experimental chamber. The basic materials for the sling are inexpensive and are available at large department stores in the notions and fabric departments.

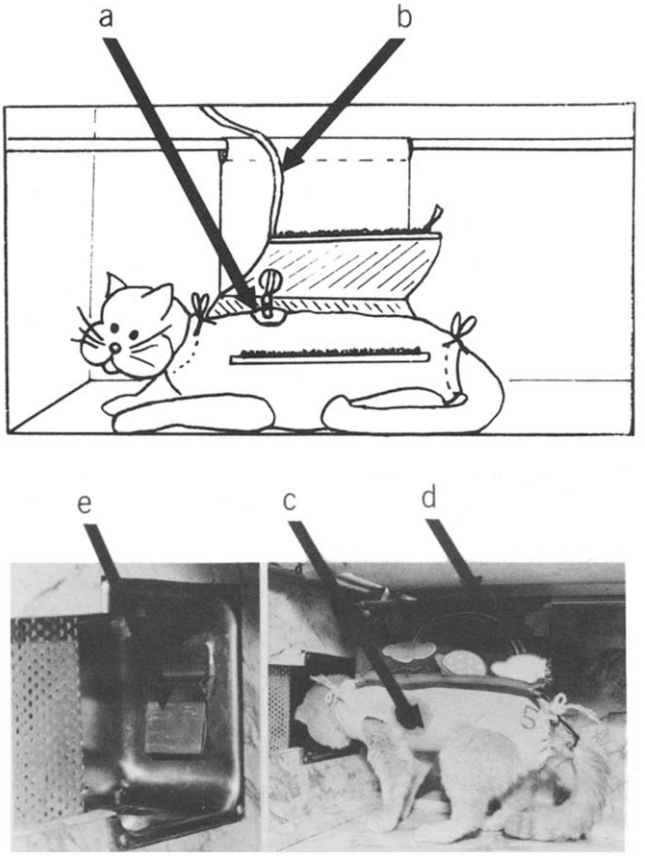

FIG. 1. Restraint system for delivering drugs intravenously to a cat that is either standing or lying. (a) catheter implant and connector to external catheter system, (b) exiting catheter tubing connected to a syringe or pump, (c) lycra jacket, (d) cotton sling suspended from a metal bar in the chamber, (e) modified lever manipulandum in food aperture.

Construction.

The modified sling has two separate parts. The sling (heavy cotton) itself is open at the bottom, with a zipper at each of the two edges (one 30 cm light weight jacket zipper) which can be connected to matching zippers on the

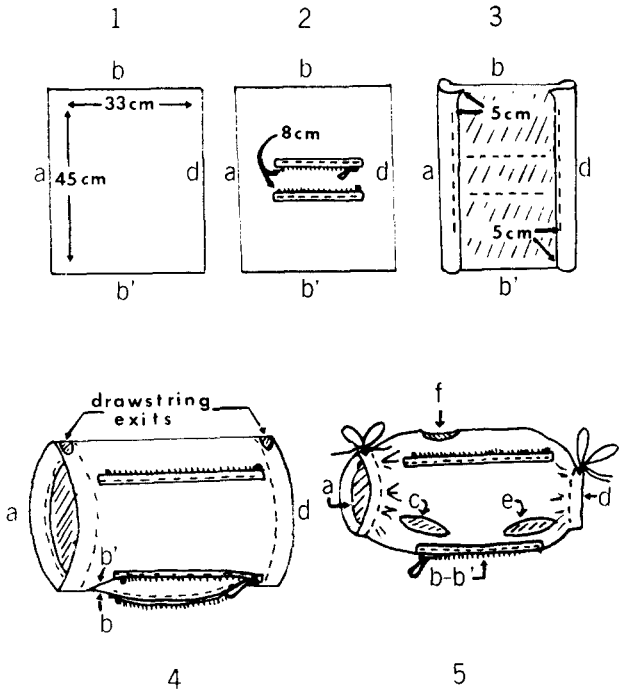

FIG. 2. Steps for constructing a jacket fitting a 2.5 kg cat proceeding from the initial cut piece of lycra material (top left) to the finished product (bottom right). (a) neck opening secured by drawstring, (b-b') underside zipper opening, (c) front leg openings, (d) tail opening secured by drawstring, (e) hind leg openings, (f) openings for connectors to implants.

jackets. The jackets are made of lycra material and can be adjusted to fit any one cat; it is advisable to use a separate jacket for each cat; this allows for cleanliness and individual size differences. They can be readily differentiated by machine embroidering a number on each jacket. The resiliance of the lycra allows for a snug fit around the cat without observable discomfort, lesioning, or restriction of body movement. Holes must be cut in the jacket for leg openings and for any connectors which may be implanted on the body of the cat; lycra is desirable because cuts do not ravel but will expand further to fit active protruding limbs or connector leads. This material can be washed frequently, shrinks very little and is extremely durable.

Figure 2 illustrates the steps in constructing the lycra jacket. The materials needed for one jacket are: one 45 cm X 33 cm rectangle of lycra (fits a 2.5–3 kg cat), nylon or plastic thread, one 30 cm lightweight jacket zipper, one 23 cm skirt or neckline zipper, and cotton cording or heavy twine. Special care should be taken to directionally match all jacket zippers to those on the sling. It is recommended that a seamstress or someone with established sewing skills make the jackets; it takes our seamstress 1/2–1 1/2 hr to make each one.

Application

Using Fig. 2(4&5) as a guide, the easiest way to slip the jacket on the cat is to (1) slide the head through underside opening b out head opening a; (2) pull drawstring a and tie; (3) put front paws through b out leg openings c, one at a time; (4) slide back of underside opening b over haunches of cat, pulling tail through opening d; (5) by bending legs in a lying position, tuck back legs through appropriate openings e; (6) tighten drawstring d and tie; (7) close underside zipper b by pulling zipper and fabric away from the cat (avoid catching hair in the zipper). This procedure takes only a few minutes; the cat need only be zipped into the sling in the experimental chamber, which usually takes less time. The back zippers are connected first, all electrical leads and/or catheters are attached to the cat's implants, and the front zippers are then connected.

A number of cats have maintained stable response rates under several schedules of reinforcement while in this restraint system. The manipulandum used is a vertical lever panel which protrudes at a 20° angle from the right side of the food aperture (see Fig. 1). The response topography is a pushing or rubbing motion using the side of the head. Cats frequently rub against objects, beginning with the head and continuing past the object with the rest of their bodies. Using this manipulandum, food-deprived cats respond at a rate of 20–30 responses per min when reinforced with liquid food available according to a variable interval 60 second reinforcement schedule.

REFERENCES

1. Bass, P. and J. N. Wiley. Contractile force transducer for recording muscle activity in unanesthetized animals. *J. Appl. Physiol.* **32:** 567–570, 1972.

2. Kaplan, M., S. L. Campbell, J. M. Martin, D. G. Wulp and C. E. Lipinski, Jr. A restraining device for psychophysiological experimentation with dogs. *J. exp. Analysis Behav.* **5:** 209–212, 1962.