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Device for Injecting or Withdrawing
Fluid from the Third Ventricle of
Conscious Cats*

by


THOMAS J. CROWLEY

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Neuroendocrine studies on the relationships of environmental stress and gastric secretion have led the author's interest to the constituents of cerebral spinal fluid near the hypothalamus. Carmichael¹ showed that a catheter acutely implanted antero-inferiorly to the massa intermedia bathed those areas of the hypothalamus facing on the third ventricle. Using the equipment described here and Carmichael's surgical technique, the author has chronically implanted exchange flow catheters in the third ventricle near the hypothalamus of several cats.

Figure 1 shows the device. A machined 16 mm. diameter cylinder of clear plastic forms each part. The screw base is about 13 mm. high and has a large, threaded axial hole. A piece of PE90 polyethylene tubing cemented into a much smaller axial hole at the bottom of the screw base with silicone rubber cement protrudes about 40 mm. below the screw base (up to 45 mm. for large cats suspected of having a thick calvarium). A circumferential ring and several vertical notches in the bottom of the screw base prevent it from pulling free of the position into which it will later be cemented. The tubing head, inserter, and plug interchangeably turn into the screw base. The inserter is similar to the plug except for an axial hole which admits a No. 22 spinal needle held in place by a set screw. The tubing head has an axial hole and a para-axial hole, both passing through the bottom of the tubing head but not through its top. These both meet at right angles with threaded holes holding hollow 6 X 32 nylon screws without heads and free of thread at the protruding tip. Silicone rubber cement holds a PE10 polyethylene tube in the axial hole of the tubing head. When the tubing head is in

the screw base its shaft does not quite reach the bottom of the large threaded hold in the screw base; thus a small chamber forms, communicating with the para-axial hole of the tubing head and the PE90 tubing of the screw base. The PE10 tubing fits loosely through the inside of the PE90 tubing; accordingly, fluid flows into one hollow 6 X 32 screw, down the PE10 tubing, back up the PE90 tubing, through the small chamber, into the para-axial hole of the tubing head, and out the second 6 X 32 screw. With the tubing head tightly in the screw base, the tips of the two tubes are flush.

The cats used in these operations have weighed from 6-1/2 to 12 pounds. After a 4 to 12-hour fast intravenous pentobarbital sodium, 50 mgm. per cc., 2 to 6 cc., anesthetizes the animal enough to inhibit the foreleg withdrawal reflex following a pinch of the web between the toes. With a stereotactic instrument firmly holding the animal's head, a soap and water scrub, a shave, and a rinse with tincture of benzalkonium chloride precede draping with sterile towels. A subcutaneous injection in the scalp midline of one percent solution of epinephrine in lidocaine (xylocaine) adds to the anesthesia and prevents bleeding. The calvarial midline appears through a two-inch midline scalp incision. A blunt instrument scrapes the bone clean and a goiter retractor separates the wound edges.

The stereotactic instrument determines a point in the midline 12.5 mm. anterior to the ear bars. Each of three small holes around this point in triangular fashion accepts a small stainless steel wood screw, the head of which protrudes several mm. above the bone. Trephining a hole about 3 mm. lateral to the midline point 12.5 mm. anterior to the ear bars, and enlarging this hole with a rongeur into a saddle-shaped defect, exposes 1 cm. of sagittal sinus and 5 mm. of dura on either side of it.

An incision 4 or 5 mm. long paralleling the sagittal sinus and 2 or 3 mm. lateral to it opens the dura. With the part of the needle above the inserter in the needle clasp of the stereotactic instrument, and the inserter turned into the screw base, the spinal needle extends about 1 mm. beyond the tip of the PE90 tubing. A retractor slipped through the dural incision and down the lateral surface of the falx draws the sagittal sinus and the subjacent falx out of the midline. When lowered in the midline to a point 12.5 mm. anterior to the ear bars and 8 mm. superior to them, the tip of the PE90 tubing lies in the antero-inferior part of the third ventricle, according to Jasper².

Acrylic plastic cement, consisting of a powder and a liquid to drip on the powder from a syringe, fills the cranial defect and engulfs the screws which, anchored in the cranium, hold the cement in place. The cement, filled in layers around the polyethylene tubing, forms a column up to and including the bottom of the screw base, anchoring it firmly in place.

When the cement is dry, the plug replaces the inserter in the assembly. A gasket formed around the lip of the plug with a small amount of silicone rubber cement makes an airtight seal. From 100 to 150 cc. of subcutaneous of saline maintains the animal until he eats, drinks, and carries on normal activities, usually 12 to 24 hours post-operatively.

About a week after surgery under anesthesia with thiamylal (Surital) sodium, 25 to 50 mgm. intravenous, and under sterile precautions with the plug removed from the screw base, iophendylate (Pantopaque) will outline the ventricle on x-ray if the catheter tip is in place. The animal is prone for the injection, and in the lateral decubitus position for the x-ray. The PE10 tubing of the tuberculin syringe (Figure 1) passes down the PE90 tubing of the screw base and their tips are flush. As little as 0.05 cc. iophendylate injected from

the syringe disperses in droplets about the ventricular system if the tip of the cannula is in the third ventricle. Amounts of 0.10 to 0.20 cc. of iophendylate extensively fill the ventricle for a detailed ventriculogram as seen in Figure 2. The sterile tubing head can now take its place in the screw base, and a gasket of silicone rubber cement seals the two. A small mass of cement also seals the open tips of the hollow 6 X 32 screws protruding from the tubing head. Holding the animal nose-up for a few seconds encourages the flow of iophendylate back into the cisterna magna.

Whenever the tips of the 6 X 32 screws are free of their rubber cement seals, sterile silicone rubber tubes slip over the ends of the screws. The tubes are protected by plastic wrapping and light, flexible conduit. The animal wears a leather harness and the conduit is tied securely to the harness. An artificial cerebrospinal fluid of the proportions given by Merlis³ primes the tubing.

These are some uses for the system.

(1) Sealing only one of the 6 X 32 screws permits the injection of 0.1 to 0.4 cc. of drug into the other screw from a syringe via a piece of rubber tubing. The animal shows no discomfort if the injection extends over 30 to 60 seconds. Droplets develop at any leaks in the apparatus, but silicone rubber cement seals them. The efflux allowed by unsealing both screws facilitates repeated small injections.

(2) The suction of a syringe will draw a few drops of cerebrospinal fluid from one 6 X 32 screw if the other is unsealed as an air inlet.

(3) Pumping fluid into one screw and out the other qualitatively mixes the perfusate with cerebrospinal fluid. Such a perfusion can go on for minutes or hours if a good filter in the inflow tube prevents the passage of particles that would block the small polyethylene tubes. Connection of the inflow screw of one cat to the outflow screw of another

and vice versa, has allowed cross circulation of cerebrospinal fluid between two cats for as long as two hours.

Assembly of THIRD VENTRICULAR CATHETER

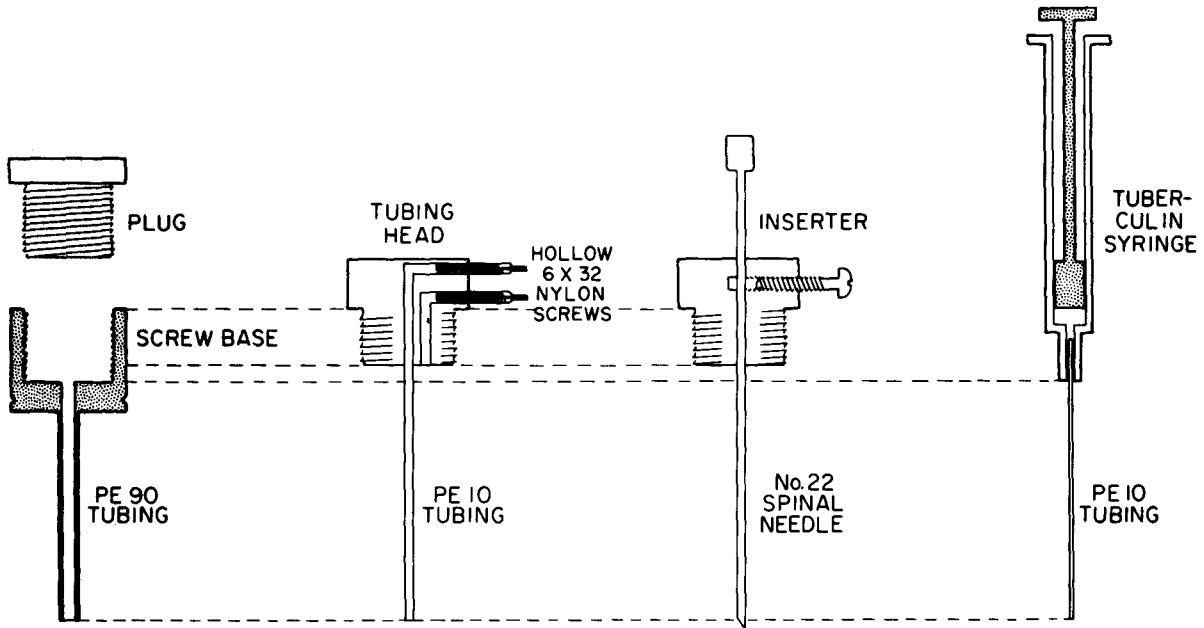


FIGURE 1



FIGURE 2

Ventriculogram showing dye in the lumen of tube, the third ventricle, the fourth ventricle, a portion of the anterior horn of the lateral ventricle, and the cisterna magna.

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