

Silicone Tubing Used as Fixation of Epidural Catheters

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A safe fixation of epidural catheters is essential for patients who have epidural catheters in place on a long-term basis. Occasionally, such catheters are removed accidentally during the daily life of the patient. The usual methods for fixation use adhesive tape or surgical knots. The adhesive methods have only fixation properties for 8-10 days. The surgical knot has longer-lasting fixation properties to the skin, but has a tendency to strangle the catheter or to slip. To obtain a reliable and strong fixation, we made a simple device, as described below.

METHODS

The components of the fixation are: 1) a Rüsck 8 F Silkotex urethral catheter (cat. no 20 000 3, Rusch Inc., New York, NY). The silicone urethral catheter is cut into lengths of 3 cm and re-sterilized; 2) an Accu-block CE 18 T polyamide epidural catheter with an outer diameter of 0.85 mm (B. Braun of America/Burron Medical, Bethlehem, PA); 3) a surgical 2-0 silk suture; and 4) a surgical 2-0 monofil nylon suture with needle.

The epidural catheter is inserted and then tunneled subcutaneously for a convenient length. Subsequently, the silicone tubing is threaded over the epidural catheter. The tubing is placed just next to the perforation point of the catheter in the skin. Half a centimeter from the end of the tubing nearest the skin, a clove hitch or equivalent knot is made with a 2-0 silk suture. The free ends of this suture are tied to a monofil 2-0 nylon cutane fixation. Half a centimeter from the peripheral end of the tubing, another clove hitch is made. This knot must be fairly tight to get a good contact between the tubing and the catheter. The method is shown in figure 1.

The silicone tubing works as a dynamic lock. The silicone material is considerably more elastic than the polyamide catheter. When the epidural catheter is pulled, the peripheral end of the tubing follows the catheter while the other end of the tubing is firmly attached to the skin.

When traction is applied to the tubing, the tubing is stretched proportionally, and the inner lumen is longer and narrower, which increases friction against the epidural catheter. If traction is applied to the epidural catheter and the fixation device, the traction will be transmitted to the skin, and pain will warn the patient. The tensile strength was measured by tying the object to a force transducer (Schaevitz MFTA-OU-50 linear variable differential transducer). The signal from the transducer was amplified in a Schaevitz GPM-101 module (Schaevitz Ltd., Camden, NJ). The measurements were recorded. The tensile strength was a series of slow tractions lasting 2 s, and series of fast tractions lasting 0.2 s. The tensile load was increased until slipping of the device was seen. The point of slipping of the device was determined on the force curves as the point, where the force curve deviates from a near linear function.

RESULTS

A total of six devices were tested. In the series of slow tractions, 23 tests were performed, and the tensile strength was measured to a median value of 1.25 kp (range 0.77-1.70 kp). In the series of fast tractions, 45 tests showed a median value of 1.23 (range 0.94-1.92 kp).

Additionally, the tensile strength of the epidural catheters was tested in five cases. The median value of the breaking point was 2.8 kp (range 2.7-2.9). The system has, until now, been used on 25 patients. The longest observation time has been 5 months. None of the catheters have accidentally been removed, and no hazards been found. The first of the patients equipped with this fixation device had a history of three displaced catheters within 3 weeks.

DISCUSSION

The dynamic lock for fixation of an epidural catheter allows a long-term use of such catheters. An expansion of the surgical knot may be an outer plastic tubing tied or glued to the catheter, as proposed by Carl *et al.*¹ Gluing of catheters seem worrisome, since chemical compounds may alter the structure of the epidural catheter or, perhaps, release noxious compounds. Pais‡ has recommended a plastic device with a compression washer. However, such a device compresses the catheter on a few mil-

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‡ Pais SO: Simple method for skin fixation of percutaneous perfusion catheters. *Am J Radiol* 139:1021, 1982

limeters, and, therefore, strangling of the catheter seems probable. Such a device is made by nonelastic plastics, and is, therefore, uncomfortable to wear near to the skin. Totally subcutaneous indwelling injection ports are now commercially available. However, positioning such a device requires a proper surgical procedure.²

Our system is easily made from the materials proposed or similar materials at hand. The measured tensile strength of the system is considered suitable when compared with the slightly larger tensile strength of the epidural catheters. This difference will, in all cases, avoid breakage of the epidural catheter centrally to the fixation device. The tensile strength of the sutures is within the same range as the fixation device, as the USP standard specifies 1.59 kp for a 2-0 suture of the applied type.

The fixational force of the device is considered sufficient to withstand accidental traction in the epidural catheter, if the catheter is tangled in clothing. If a portable pump is connected to the catheter,³ the device is able to carry the weight of the pump. The typical weight of a pump is 250 grams. Pain provoked by traction in the device will cause a rapid reaction in order to relieve the traction in the catheter. The system may be applied in the fixation of other types of tubings and drains.

We conclude that the described dynamic lock for fixation of epidural catheters is found able to withstand an accidental pull in the epidural catheter. The lock can resist a tensile force of at least 1 kp. Preliminary clinical experience with the device seems to show that the intended fixation of subcutaneously tunneled epidural catheters is obtained.

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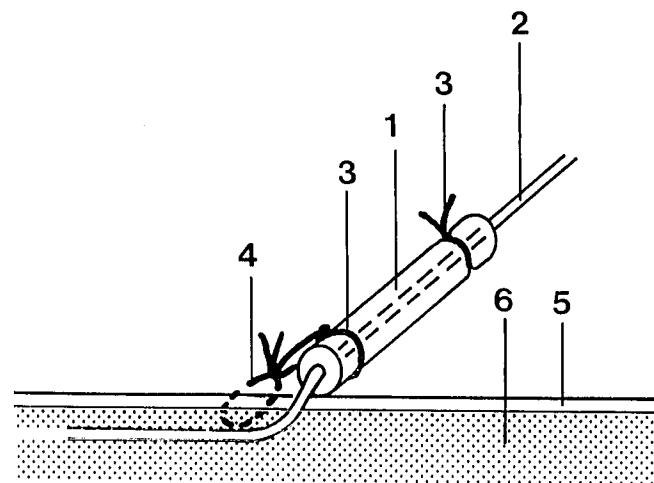


FIG. 1. A dynamic lock for fixation of subcutaneously tunneled epidural catheters. 1 = silicone tubing; 2 = polyamide epidural catheter; 3 = surgical 2-0 silk suture; 4 = surgical 2-0 monofil nylon; 5 = skin; 6 = subcutaneous tissue.

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An Unusual Cause of Postoperative Respiratory Failure

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Postoperative respiratory failure can be attributed to multiple causes. An infrequent cause is bilateral phrenic nerve paralysis, usually following open-heart surgery¹ and radical neck surgery.² Bilateral phrenic nerve paralysis resulting in postoperative respiratory failure is described.

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REPORT OF A CASE

The patient is a 34-yr-old, 104 kg male admitted for bilateral thoracic outlet syndrome. He was scheduled for bilateral supraclavicular first rib excision, to be performed on separate occasions. His medical history was unremarkable, with the exception of his admitting diagnosis. He was taking no medications and had no drug allergies, and he had had no prior anesthetics. Laboratory values and preoperative chest radiograph were within normal limits.

A left-sided supraclavicular first rib excision was performed under general anesthesia as the initial procedure. Induction of anesthesia consisted of d-tubocurarine 6 mg, thiopental 500 mg, succinylcholine 140 mg, and fentanyl 100 µg iv. The trachea was intubated without difficulty. Maintenance of anesthesia consisted of isoflurane, N₂O, O₂, and iv pancuronium 4 mg. The procedure lasted 2 h, and, prior to tracheal extubation, neostigmine 3 mg and glycopyrolate 0.4 mg were