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## Mishap with an Epidural Catheter

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In 1949, Curbello introduced continuous epidural anesthesia.<sup>1</sup> For a decade in our hospital we have practiced this technique by inserting a radiopaque Teflon catheter through a Tuohy needle. Although 202 broken central venous and cardiac catheters have been documented,<sup>2</sup> we can find only two reports in the medical literature of broken epidural catheters.<sup>3,4</sup>

## REPORT OF A CASE

An 18-year-old white woman, 57.1 kg, gravida 1, para 0, was scheduled for delivery with the use of continuous epidural anesthesia. The patient was in Stage I labor with the cervix 6 cm dilated when epidural anesthesia was started. By use of the Tuohy needle, the epidural space was identified at L2–3 and 2 ml 0.5 per cent bupivacaine were given as a test dose. Next, a 20-gauge radiopaque Teflon catheter, 91.4 cm long, was inserted through the Tuohy needle in the following manner. First, the stylet was withdrawn about 7.5 cm from the catheter end. The catheter was advanced through the needle until slight resistance was met. The needle was then gently angled cephalad and the catheter pushed inwards without difficulty as the needle was removed. An additional 6 ml 0.5 per cent bupivacaine were added through the catheter. The patient had analgesia to pinprick to T8 bilaterally, and she was comfortable for an hour and 30 minutes.

For vaginal delivery we injected 18 ml 2 per cent chlorprocaine through the epidural catheter to achieve perineal analgesia. The patient did not obtain relief of pain. Subsequently, delivery proceeded with use of nitrous oxide, oxygen, and local infiltration of the perineum. The epidural catheter was removed with ease at the end of delivery, but was incomplete. The end was ragged and the removed catheter segment measured 83.4 cm, leaving 8 cm in the patient.

## DISCUSSION

Why this particular catheter broke is not clear. Although it was inserted with minimal difficulty, the

most likely explanation for the breakage seemed to be shredding by the Tuohy needle at the time of insertion. However, good analgesia was obtained with the initial dose of 6 ml 0.5 per cent bupivacaine but no pain relief was provided by the second dose. This discrepancy suggests that the catheter was initially intact but broke during the first stage of labor.

Because the patient was very restless on arrival to the delivery room, the catheter might have been pinched between two vertebral processes. The distal end of the removed catheter segment was frayed. A different edge results when the catheter is sheared off by being pulled back and across the needle tip.

Another possible way for the catheter to break is at the time of removal. The patient's position on insertion is one of back flexion. In this case the longer section of catheter was removed with ease.

Although the catheter was radiopaque according to the package, it was impossible for our radiology department to locate the broken end in the epidural space due to the density of the surrounding vertebral processes. Unfortunately, we were not able to see or feel the end of the broken material under the lumbar skin. According to the manufacturer, the epidural catheter is inert and should not produce any foreign-body reaction. Detection of the lost catheter might be possible by xeroradiography; nevertheless, we prefer not to expose the patient to a large dose of radiation if not indicated. The scan with ultrasonography used for detection of ophthalmic foreign bodies has not been used to locate foreign bodies in the epidural space.<sup>5–7</sup> Although it is also not likely that the catheter in the epidural space will dissolve, attempted surgical removal could provide more complications than leaving it alone, keeping in mind that possible migration of the broken catheter cannot be excluded.<sup>8</sup> Follow-up examinations for neurologic complications during the last 12 months have shown no abnormality.

Plastic materials for use in man are subjected to three testing methods: systemic injection and intracutaneous and implantation tests.<sup>9</sup> Extracts of catheter

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material are given by the intravenous and intra-peritoneal routes to mice and rabbits. The animals are sacrificed at 72 hours. Comparisons are made with the injection of a similarly prepared nonreactive substance. Implantation tests are designed to evaluate the reactions of living tissue to plastics. Eight strips of the sample and four strips of the USP-negative control plastic reference standard measuring at least  $10 \times 1$  mm are implanted into the back muscles of healthy adult rabbits weighing not less than 2.5 kg. The animals are sacrificed at 72 hours. Longer implantation tests are not required by law, and only the reaction of muscle can be assessed. What happens over longer periods?

In 1957, a comparison of tissue reactions to plastic materials, nylon, Dacron, Ivalon sponge, Orlon and Teflon was performed in dogs. A 4<sup>+</sup> acute and chronic tissue reaction to nylon and a 1<sup>+</sup> acute and chronic tissue reaction to Teflon were recorded when the animals were sacrificed after various intervals in a ten-month period.<sup>10</sup>

Resorption of polyvinyl alcohol sponge (Ivalon) implanted into rabbits had commenced by the seventh month, and the sponge had completely disappeared in one rabbit after 18 months.<sup>11</sup> Absorption of Teflon has not been reported. Whereas it is known that the acute reactions to polyvinyl sponge are similar in the rat, the rabbit, and man, the reaction to polyethylene in rats differs from that in rabbits. Teflon, however, is the most benign substance that does not allow adherence of protein to its surface. In some implants a thin capsule forms about the implant segment. Polymorphonuclear cells infiltrate about the implant and are replaced by a thin layer of fibroblasts.<sup>11</sup>

Five artificial resins, polyester (Nylar), polyethylene (Polyten), nylon (Zytel), cellulose acetate, and polytetrafluorethylene (Teflon), were tested in embryonic chicken heart tissue culture or so-called "in-vitro" tests, which can be performed at lower cost. The tissue growth rate was best preserved with Teflon.<sup>12</sup> Five hundred fifty-one segments of human tissue at suture sites from previous operations were graded according to the numbers of neutrophils, lymphocytes, fibroblasts, histiocytes, and giant cells present. Many of the operations had been performed years before, with the longest interval being 33 years. A comparison of catgut, silk, cotton, wire, nylon, and Dacron coated with Teflon demonstrated that nylon caused the least chronic reaction. The Teflon is apparently shed from the Dacron and in a number of specimens each Teflon particle was surrounded by its own histiocytic and giant-cell reaction. The longest interval for Dacron coated with Teflon was six years.<sup>13</sup>

In 1948, LeVeen and Barberio reported that Teflon

instilled as a fine particulate into the peritoneum of the dog caused minimum reaction between 36 hours and six months. After six months, Teflon was not invaded by cells, but a thin layer of mature fibroblasts were evident under the mesothelial lining. The Teflon showed no protein absorption.<sup>14</sup> However, scattered foreign-body giant cells were found adjacent to the nylon particulate after 70 days, and an active fibroplasia was present.

Subcutaneous injection of Teflon into 112 mice examined one hour to 100 days later showed infiltration of polymorphonuclear leukocytes after five hours. During the fourth to tenth days, fibroblasts and mononuclear cells increased and the polymorphonuclear cells decreased significantly. By the thirty-fifth day fibroblasts, mononuclear cells and giant cells predominated in the reaction. On the hundredth day fibroblasts had infiltrated the Teflon fibers. Other mice examined at 217 days showed little change from the thirty-fifth day. Fifty-two implants were cultured, with four positive bacterial growth cultures occurring between the third and tenth days, but not later. In rabbits, degeneration of the eosinophils was the most conspicuous reaction to Teflon. These investigators believed that the electrical charge of the plastic material attracts the leukocytes, but offer no explanation for early degeneration of eosinophils.<sup>15</sup>

A foreign-body reaction to epidurally placed polysaccharide was the cause of laminectomy in one mother following epidural analgesia for pain relief in labor.<sup>16</sup>

An otolaryngologist's report stresses the permanent nature of Teflon-glycerine suspension injected to relieve dysphonia in patients with unilateral recurrent cord paralysis.<sup>17</sup> A misplaced injection necessitated surgical removal when a post-injection mass appeared between the thyroid and cricoid cartilages. One could predict that catheter segments will probably remain intact in the epidural space throughout the patient's life.

Migration of Teflon mesh from the site of abdominal-wall fixation into the abdominal cavity has been reported. The implants caused inflammation of the transverse colon, adjacent loops of bowel and omentum. Although the Teflon mesh was intact, perforation of the antimesenteric border of the transverse colon was regarded as the main factor responsible for the inflammatory mass.<sup>8</sup> We have found no report of migration of Teflon even when embedded in active muscle tissue.

Many reports demonstrate that intravascular fragments become incorporated into the walls of vessels or heart and do not irritate even when they have been in the body for years. Benedict<sup>18</sup> reports that

none of a group of patients with polyethylene catheters left in the pulmonary artery was symptomatic. Attempts to retrieve the fragments were more traumatic and dangerous than leaving harmless segments *in situ*. He claims that the presence of a broken catheter in the vascular system is not harmful. Our epidural catheter was made of Teflon, which is recognized as being the least reactive plastic in implantation tests.

We believe the patient must be informed of such an incident and be reassured that no damage results from the presence of Teflon in the body. Attempted removal is far more traumatic and potentially harmful than a policy of reassurance and noninterference.

We conclude that: 1) epidural needles should be inspected for possible barbs on the bevel; 2) epidural catheters should be inspected for possible defects; 3) an epidural catheter must not be pulled back while the Tuohy needle is in place; 4) epidural catheters made of Teflon labelled radiopaque are not visible roentgenographically when in the epidural space; 5) complications from the broken segment are unlikely to occur unless infection supervenes; attention to sterile technique when performing epidural block cannot be overemphasized; 6) breaking off the catheter is not necessarily malpractice, but the vigorous pursuit of the broken segment into deep recesses of the body certainly could be imprudent.

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## Early Recognition of Renal Insufficiency in Post-anesthetic Trauma Victims

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Acute renal failure continues to be a major complication following trauma. Reported mortality rates for

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acute renal failure in trauma victims range from 50 to 90 per cent.<sup>1-4</sup> Aggressive fluid infusion has been our main thrust in the prevention of ARF; however, respiratory failure is not uncommon in posttraumatic patients, and aggressive fluid therapy in the presence of limited renal functional may aggravate such failure.<sup>3</sup>

Early detection of renal dysfunction is difficult. It has been customary to monitor patients by serial determinations of blood urea nitrogen (BUN), serum