

CASE REPORTS

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Resistance to Injection May Predict Spinal Catheter Breakage

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BREAKAGE of spinal or epidural catheters beneath the skin, leaving a catheter segment that remains as an intrathecal or epidural foreign body, is relatively rare.¹⁻⁶ Because prediction of catheter breakage is dif-

ficult, Hurley and Lambert recommend removal of the catheter while the patient is in the lateral decubitus position with the spine maximally flexed to reduce possible binding on the catheter and to facilitate its removal.¹ We report two cases in which there was evidence of catheter damage. In both cases resistance to injection was relieved by altering the patient's position. Subsequent inspection of the catheters revealed compression and kinking, which may have increased the likelihood of breakage. We suggest that resistance to injection may be a warning sign of catheter compression or damage that could result in catheter breakage.

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Case Reports

Continuous spinal anesthesia was used for two patients (ages 70 and 73 yr) undergoing infrainguinal vascular operations. In one case

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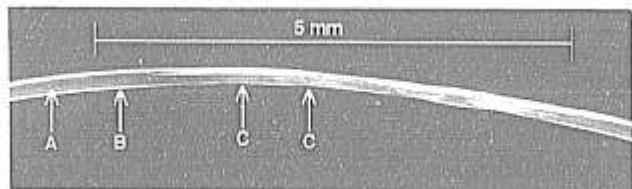


Fig. 1. A 5-mm section approximately 3 cm from the tip of the 24-G polyamide spinal catheter removed from a patient. Normal air contrast of the lumen (A) is reduced above and to the right of C (arrows). Intact catheter wall (B) is deformed and thinned at C.

a 24-G polyamide spinal catheter (Spinocain Continuous Spinal Tray, Burr Medical, Bethlehem, PA) was used, and in the other a 20-G polyamide epidural catheter (Perifix Continuous Epidural Anesthesia Tray, Burr Medical) was used. Procedures were the same in both cases. With the patient in the sitting position, the catheter was easily placed by a midline approach at the L3-L4 interspace without paresthesias. The catheter was advanced approximately 3 cm into the intrathecal space. After aspiration of cerebrospinal fluid and with the patient in the sitting position, the first dose of local anesthetic was injected without any resistance. After the patient was placed supine, however, we were unable to administer a second dose of local anesthetic. The patient was then placed in the sitting position so that the catheter could be examined; no kinks were visible, and the second dose of local anesthetic were easily injected. The patient was again positioned supine for surgery. In both cases subsequent attempts to inject local anesthetic were possible only after moderate flexion of the spine was achieved by lifting the shoulders. At the end of the surgery we gently attempted to remove the catheter while the patient was in lateral decubitus; however, resistance to withdrawal was encountered. After the patient was repositioned with maximal flexion of the spine, the catheter was withdrawn easily.

After removal, both catheters were examined with a magnifying glass. Both had an irregularity, one at 3.5 cm and the other at 6 cm from the tip. Figure 1 is a photomicrograph of a segment of the damaged 24-G catheter. The normal contrast between the lumen and the wall of the catheter was abnormal at several points, perhaps indicating areas of weakening. Figure 2 shows a kink 6 cm from the tip of the 20-G epidural catheter.

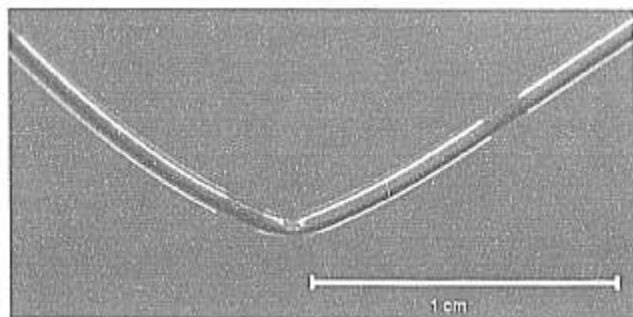


Fig. 2. Section of the 20-G polyamide epidural catheter removed from a patient. A kink approximately 6 cm from the tip is shown.

Materials and Methods

We tested new 20-G catheters from the Burr epidural kit and from a Portex epidural kit (Concord/Portex Continuous Epidural Tray, Concord/Portex, Keene, NH) and 24-G catheters from the Burr continuous spinal kit. Four of each catheter were tested. All catheters were cut into four equal segments. One piece was randomly selected as the control section and the other three sections were damaged by crushing with smooth-jawed pliers or by kinking. We attempted to produce damage that appeared similar to the damage shown in figures 1 and 2. By using a technique similar to that of Ley and Jones,⁷ each segment was tested for break strength.

Each control group was compared to the respective damaged group by Student's *t* test with correction for multiple comparisons. If the probability of a type 1 error was less than 0.05, the difference was considered significant.

Results

The results are shown in table 1. The break strength of the control sections was comparable to Ley and Jones's results.⁷ Of the 36 damaged segments 35 broke at the point of damage. Damaged sections broke, on average, at 65% of the force required to break the undamaged control sections. However, there was considerable variability in the break strength of the damaged segments, as indicated by the standard deviations. Several catheters broke at one-third the force required to break their respective controls. The appearance under magnification of our artificially damaged catheters was remarkably similar to the damage shown in figures 1 and 2.

Table 1. Break Strength of Catheters Comparing Undamaged Control Segments with Artificially Damaged Segments

Manufacturer	Gauge	Break Strength (lb)	
		Control (n = 4)	Damaged* (n = 12)
Burr	20	6.1 ± 0.5	4.0 ± 0.6
Concord/Portex	20	6.9 ± 1.0	4.6 ± 0.8
Burr	24	2.9 ± 0.4	1.8 ± 0.5

Values are mean ± SD.

* Break strength of damaged catheter segments was less than ($P < 0.05$) that for respective control segments in each case.

Discussion

These two cases suggest that spinal catheters, if sufficiently compressed or kinked at some point between the skin and subarachnoid space, can generate enough resistance to prevent the injection of the local anesthetic. The 24-G catheter (fig. 1) was probably compressed somewhere in the region of the ligamentum flavum and the lamina, because we had advanced the catheter 3 cm intrathecally and the damaged section was 3–3.5 cm from the tip. The kink at 6 cm in the larger, 20-G catheter (fig. 2) was more likely related to the interspinous ligament or a dorsal spinous process. Maneuvering the patients to relieve the obstruction allowed us to inject the anesthetic and to use the spinal catheters successfully during prolonged surgery. The finding that the patency of a catheter depends on patient position should suggest catheter compression.

In Hurley and Lambert's study¹ of 58 continuous spinal anesthetics, two 32-G catheters broke during withdrawal. They attributed the breakage to the "catheter's entrapment by the ligamentum flavum" or to the "binding" action of the interspinous ligament.² Because spinal catheters have relatively high tensile strength,⁷ it is difficult to imagine how a nonrigid structure such as the ligamentum flavum could entrap a catheter firmly enough to cause breakage during removal. We believe that without using excessive force, breaking a catheter during removal requires not only entrapment but also previous damage to the catheter. Catheter damage seems most likely to occur when the back is extended (not flexed), reducing the intervertebral spaces posteriorly, especially in older patients who may have ligamentous calcifications and bony spurs. Although Lambert² suggested the possibility of catheter entrapment when he recommended that "if the flexion did not result in easy catheter extraction other positions should be tried," our findings (figs. 1 and 2) further suggest that entrapment may result in physical damage that makes the catheter more prone to breakage. Because in our cases we were very careful when withdrawing the catheters, we do not believe the damage occurred during removal. That our damaged catheters were larger than 32-G may explain why they

did not break when withdrawn.⁷

The results of our study tend to confirm the hypothesis suggested by our two cases. Although we cannot know precisely how the catheters in our cases were damaged or what forces were developed, the magnified appearance of the artificially damaged catheters was remarkably similar to the appearance of the damaged catheters from the cases (figs. 1 and 2). Furthermore, 35 of the 36 test segments broke at the point of artificial damage, and all of those 35 catheter segments broke at a lower break strength than any of the four respective control segments. There was considerable variability in the break strength of the damaged catheter segments. Four of the damaged segments (11%) broke at less than one-third the break strength of their controls.

In summary, difficulty injecting through a spinal catheter may indicate severe compression and damage to the catheter. Although it may still be possible to use the catheter for anesthesia, extra care should be exercised during its removal. The recommendations of Gravenstein and Wissler⁸ may be of value to ensure removal of an intact catheter.

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