

# Epidural or Subarachnoid Catheter Shear

## ABSTRACT

*Epidural or subarachnoid catheters (sometimes called lumbar drainage catheters) are very small hollow tubes inserted into the epidural or subarachnoid space to administer medications or drain body fluids, respectively. Under certain conditions they can shear, leaving a fragment in the patient. Between June 2004 and December 2008, the Pennsylvania Patient Safety Authority received 13 reports related to epidural or subarachnoid catheter shear. However, most catheter procedures occur without complications. The predominant causes of catheter shear are applying excessive force while removing the catheter, withdrawing the catheter back through the needle, withdrawing the catheter over a deformed or damaged needle bevel, or damaging the catheter during or after placement in the patient. Defects in the catheter occurring during the manufacturing process can also be a cause of catheter shear. The position of the patient during insertion and withdrawal of the catheter can play an important part in reducing the likelihood of fracturing the catheter. For difficult-to-remove catheters, allowing the patient's back muscles to relax for a few days may facilitate the removal in some cases. Unless complications arise, surgery is unnecessary in most cases since catheters are constructed from inert materials. (Pa Patient Saf Advis 2009 Sep;6[3]:84-6.)*

At the request of a Patient Safety Officer at a Pennsylvania healthcare facility, Pennsylvania Patient Safety Authority analysts examined events of sheared spinal and epidural catheters reported between June 2004 and December 2008. During that time, 13 events were reported to the Authority relevant to spinal and epidural catheter shear, which corroborate reports in current literature. The following are examples of reports of spinal and epidural catheter shear submitted to the Authority:

*A lumbar puncture was attempted to rule out meningitis. Noted 1.5 mm puncture or possible sheared area on soft catheter withdrawn from vertebral space. Apparently, reentering the trocar into the soft catheter while attempting entry in the cerebrospinal column punctured/sheared the catheter.*

*While doing a lumbar drain, the moulding portion of the [brand omitted] lumbar drain was sheared off. According to the physician, it could not be retrieved as it is not radiopaque.*

*The anesthesiologist inserted a spinal drain to maintain cerebrospinal pressure at <10 mm Hg. The catheter was placed at the lumbar area without trauma. The patient moved during removal of the needle introducer, severing the catheter. . . . Unable*

*to remove the distal portion. Neurosurgery was consulted on whether or not to remove the severed catheter via laminectomy.*

*A catheter insertion was attempted in the preoperative PACU [postanesthesia care unit]. . . While the catheter placement was checked by pulling back on the catheter, the catheter tip sheared off. A CT [computed tomography] scan confirmed that there was a piece of catheter present in the paraspinal musculature at the level of a lumbar facet. It is posterior to the spinal canal. No catheter fragments were identified in the spinal canal.*

## Reasons for Catheter Shear

An epidural or subarachnoid catheter\* is a very small flexible hollow tube that can be inserted into epidural space to administer fluids (e.g., pain medication) or into the subarachnoid space to drain body fluids (e.g., cerebral spinal fluid). On occasion, spinal catheters are placed in the subarachnoid space to administer medications as well. Depending on a patient's medical condition, a catheter may be placed on a short- or long-term basis. Under certain circumstances, catheters can break. The majority of catheter procedures occur without complications; however, catheters have been sheared in some cases.<sup>1</sup> Shearing typically occurs during insertion or removal of the catheter from patients.<sup>1</sup> Catheter fragments remaining in patients can result in serious complications due to the location or migration of the fragment or inflammation at the fragment site.<sup>1</sup> Reasons for catheter shearing include the following:<sup>†</sup>

- Applying excessive force while removing the catheter
- Withdrawing the catheter back through the insertion needle
- Withdrawing the catheter over a deformed or damaged needle bevel
- A flaw in the catheter from defects during the manufacturing process
- Damaging the catheter during or after placement in the patient

## Applying Excessive Force

A user may use excessive force if he or she encounters resistance during catheter removal. Patient position during insertion or removal of the catheter may increase the resistance. For example, excessive

\* For the remainder of this discussion, the term "catheter" will be used with the understanding that the discussion pertains to epidural and subarachnoid catheters.

† This list and the accompanying discussion represent some causes of catheter shear based on documented evidence, but neither the list nor discussion is comprehensive.

force might be applied if the catheter is placed while the patient's back is arched but is removed with the patient in a different position (e.g., sitting position).<sup>2</sup> Boey et al. observed that the force required to remove an epidural catheter was 2.5 times more with a patient in the sitting position than in the lateral decubitus position.<sup>3</sup> Morris et al. recommend that the patient be placed in the same position for insertion and withdrawal of the catheter.<sup>4</sup>

### Withdrawing through the Insertion Needle

A very sharp needle bevel may shear the catheter with minimal retraction or manipulation of the catheter during insertion. According to Olivar et al., when difficulty in advancing the catheter is encountered, users tend to partially withdraw (back through the needle) then reinsert the catheter.<sup>2</sup> The authors suggest that the catheter never be withdrawn from the needle once the catheter tip has passed through the needle;<sup>2</sup> rather, the needle and catheter should be withdrawn as a unit, or the needle should be withdrawn first.

### Withdrawing the Catheter over a Deformed or Damaged Needle Bevel

Catheters may shear from snagging on imperfections such as barbs or nicks on the bevel of an unsharpened needle.<sup>1</sup>

### Manufacturing Defects

Catheter fractures are rarely related to manufacturing defects.<sup>5</sup> However, defects such as a bubble or foreign material in the catheter wall can cause the catheter to break under less force than that required to break an intact catheter (i.e., without a defect).<sup>5</sup>

### Damaging the Catheter during or after Placement

Manipulating the catheter within the patient can cause the catheter to become trapped.<sup>1</sup> A catheter can become looped or knotted from curling back on itself when deflected by anatomical structures.<sup>1</sup> Epidural catheters can also become entrapped in nerve roots, blood vessels, lumbar fascia, posterior vertebral arches, and facet joints.<sup>1</sup> The use of clamps or hemostats to remove catheters can result in fractures. In a 2001 study, Nishio et al. observed that the tensile strength of catheters decreased with the use of a stainless steel hemostat at the site grasped by the hemostat.<sup>6</sup>

## Avoiding Catheter Shear during Removal

When encountering a catheter that is difficult to remove, the following methods are available to clinicians to reduce the risk of catheter shear:<sup>1</sup>

- Place the patient in a position that will exert the least amount of pressure during insertion and withdrawal of the catheter, such as the lateral decubitus position.
- To help identify any knots or entanglements, consider injecting sterile saline into the catheter. If a knot is encountered, gentle, firm traction may tighten the knot, making it smaller. Decreasing the size of the knot may ease catheter removal.
- Do not use metal forceps, hemostats, or clamps to remove catheters; their use may increase the likelihood of fracturing the catheter.
- Allow the patient's back muscles to relax for a few days to facilitate catheter removal.
- If pain or paresthesia develops during catheter removal in the intrathecal space, stop removal and consider performing a neurosurgical consultation with radiographic evaluation to help in determining the location of the retained catheter.
- Consider surgical removal of the catheter for patients who are symptomatic. Unless complications develop, surgery may be unwarranted since the catheter is inert.

### Notes

1. Fischer R. Epidural conduction device fractures and complications of retained fragments. *AANA J* 2008 Feb;76(1):37-40.
2. Olivar H, Bramhall J, Rozet I, et al. Subarachnoid lumbar drains: a case series of fractured catheters and a near miss. *Can J Anesth* 2007 Oct;54(10):829-34.
3. Boey S, Carrie LE. Withdrawal forces during removal of lumbar extradural catheters. *Br J Anaesth* 1994 Dec; 73(6):833-5.
4. Morris GN, Warren BB, Hanson EW, et al. Influence of patient position on withdrawal forces during removal of lumbar extradural catheters. *Br J Anaesth* 1996 Sep; 77(3):419-20.
5. ECRI Institute. Epidural catheter breakages [from the accident investigation archives]. *Risk Manag Reporter* 2009 Apr;28(2):19.
6. Nishio I, Sekiguchi M, Aoyama Y, et al. Decreased tensile strength of an epidural catheter during its removal by grasping with a hemostat. *Anesth Analg* 2001 Jul;93(1):210-2.

(See Self-Assessment Questions on next page.)

## Self-Assessment Questions

The following questions about this article may be useful for internal education and assessment. You may use the following examples or come up with your own.

1. Which of the following factors is NOT a reason for catheter shear?
  - a. Application of excessive force while removing the catheter
  - b. Withdrawal of the catheter back through the insertion needle
  - c. A flaw in the catheter caused by defects during the manufacturing process
  - d. Placement of the patient in the lateral decubitus position during insertion and withdrawal of the catheter
  - e. Withdrawal of the catheter over a deformed or damaged needle bevel
2. All of the following are methods for avoiding catheter shear EXCEPT:
  - a. Using metal forceps, hemostats, or clamps to remove catheters
  - b. Allowing the patient's back muscles to relax for a few days to facilitate catheter removal
  - c. Injecting saline into the catheter to help identify any knots or entanglements
  - d. Surgically removing the catheter from patients who are symptomatic
3. The following methods are likely to minimize resistance during withdrawal of the catheter EXCEPT:
  - a. Placing the patient in the lateral decubitus position
  - b. Placing the patient in the sitting position
  - c. Placing the patient in the same position for insertion and withdrawal of the catheter
  - d. Allowing the patient's back muscles to relax for a few days
4. A patient experiences pain and paresthesia during catheter removal in the intrathecal space.  
Select what to do when encountering this situation.
  - a. Allow the patient's back muscles to relax for a few days to facilitate catheter removal.
  - b. Stop the removal and consider performing a neurosurgical consultation with radiographic evaluation to help in determining the location of the retained catheter.
  - c. Apply firm, steady traction when removing the retained catheter.
  - d. Pull sharply on the retained catheter to facilitate withdrawal.
5. An obstetric patient underwent epidural anesthesia during labor. During removal, the catheter began to stretch. Injection of saline through the catheter showed that the catheter was obstructed, most likely due to a knot.  
Select the appropriate method to remove the knotted catheter.
  - a. Pull on the catheter with gentle, firm traction to reduce the size of the knot.
  - b. Surgically remove the catheter.
  - c. Place the patient in the sitting position.
  - d. Grasp the catheter with forceps and pull sharply to remove the catheter.

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