

Knot Formation at Removal of an Epidural Catheter Placed Against Insertion Resistance Encountered at the Entrance of the Epidural Space

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Knottting of an epidural catheter occurs very rarely with an estimated incidence of 0.0015%. We present a case of an epidural catheter knot formed at removal of an epidural catheter following a forceful insertion of the catheter against resistance met at the entrance of the epidural space during threading of the catheter through Tuohy needle placed uneventfully in a 65 year-old male patient undergoing epidural anesthesia. During removal of the epidural catheter, significant resistance was encountered on traction and it was found that approximately 1.5 cm portion of the catheter had been retained within the patient's subcutaneous tissue. Firm traction was employed to withdraw the catheter against the resistance. The catheter was pulled out uneventfully from the patient. A knot estimated to be formed during removal of the catheter was observed at 0.6 cm proximal to the catheter tip. No complications and side effects were noted until the patient's discharge.

Key Words: Catheters, Epidural anesthesia, Postoperative complications, Traction

Knots formed when inserting a catheter for epidural anesthesia have an incidence rate of 0.0015%, which is extremely rare.¹ In most cases, knots are formed when the epidural catheter is twisted and not inserted straight into the epidural space.²⁻⁷ The case reported here represents a clinical experience in which the epidural catheter – which could not be easily removed due to knot formation in the subcutaneous tissue, particularly when removing the catheter after insertion by force despite resistance at the entrance of the epidural space with a Tuohy needle – was successfully removed without side effects or complications.

CASE

A 65-year-old male patient (height: 167 cm; weight: 79 kg) visited the hospital due to pain in the left hip joint after falling from a 3 m height a week before surgery. At the time, he was diagnosed with left intertrochanteric fractures of the femur, and open reduction under epidural anesthesia was scheduled. With respect to his medical history, he had hypertension, congestive heart failure, and diabetes, and was taking 100 mg/day of aspirin and 75 mg/day of clopidogrel after receiving percutaneous coronary intervention for

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myocardial infarction 3 years ago. The results of the complete blood count performed when the patient visited the hospital were as follows: leukocytes, 12,000 cells/ μ L; hemoglobin, 12 g/dL; hematocrit, 37.1%; and blood platelets, 211,000 cells/ μ L. The results of the coagulation test were as follows: prothrombin time, 14.7 seconds; International Normalized Ratio, 1.17; and activated partial thromboplastin time, 35.4 seconds. Aspirin and clopidogrel were discontinued 5 days before surgery. There was nothing unusual found in the preoperative plain frontal-posterior and lateral lumbar radiography. When electrocardiogram, noninvasive blood pressure, and peripheral oxygen saturation monitoring began after arriving at the operating room, the patient's blood pressure (systolic blood pressure/diastolic blood pressure) and heart rate were 119/50 mmHg and 98 times/minute, respectively. After injecting 200 mL of plasmalyte for 10 minutes, epidural anesthesia was given. The patient was then placed in a left lateral recumbent position and he bent his waist as much as possible; the surgical site was sterilized with povidon. A total of 3 mL of 1% lidocaine was injected in the subcutaneous tissue between the third and fourth lumbar vertebrae for local anesthesia, and an 18-gauge Tuohy needle (Epina®; Ace Medical, Seoul, Korea) was inserted straight into the skin using the midline approach. After mounting the Tuohy needle in the epidural space 5 cm deep inside the skin with loss of resistance using 2.5 mL of saline solution, 15 mL of 0.75% ropivacaine was injected without other resistance. A

22-gauge epidural catheter was about to be inserted in the epidural space via the Tuohy needle, but it did not go in easily due to resistance at the entrance of the epidural space. The tilt angle of the needle was adjusted, as was the needle depth, by 5 mm (deeper or shallower); however, the insertion resistance did not disappear. Despite this resistance, the catheter was pushed in by force by about 5 cm into the epidural space, and the Tuohy needle was removed with the catheter inserted. Following this, 1 mL of saline solution was injected in the catheter, which went in without resistance. After inserting the blood vessel catheter in the right aorta radialis and internal jugular vein (20 minutes after injecting the local anesthetic), the patient's blood pressure and heart rate became 98/57 mmHg and 96 beats/minute, respectively; thus, 10 mg of ephedrine was injected and 100 mL of plasmalyte was administered for 5 minutes. Five minutes later, it was confirmed that the patient's blood pressure and heart rate had increased to 139/49 mmHg and 104 beats/minute, respectively, and the blocked dermatome reached the tenth thoracic vertebra; the patient was then placed in a supine position on the fracture table for surgery. During the surgery, which took 1 hour and 16 minutes to complete, the patient's systolic blood pressure and heart rate were maintained at 120-145 mmHg and 95-105 beats/minute, respectively, with no other notable incidents. A total of 950 mL of plasmalyte and 200 mL of 6% hydroxyethyl starch (Volulyte® 6%, 130/0.4; Fresenius Kabi AG, Bad Homburg, Germany) were



Fig. 1. A knot of the epidural catheter is observed at 0.6 cm proximal to the catheter tip (red circle).

injected into the patient, and there was approximately 350 ml of blood loss. Following surgery, when the catheter was removed after placing the patient in a lateral recumbent position without bending his waist, there was resistance about 1.5 cm from the tip of the catheter; thus, the catheter could not be removed. The patient and his caregiver were consulted; they were informed that removing the catheter with too much force may cut the catheter, creating the need for additional surgery. The patient and his caregiver provided informed consent to remove the catheter. The patient was laid sideways with his waist bent as much as possible, through which the catheter was going to be pulled with gradual force and removed. The area in the patient's skin where the catheter was

inserted was pulled due to resistance during removal. The catheter was completely removed without evident skin damage or cutting of the catheter. Upon observing the removed catheter, there was a knot formed in the 0.6 cm proximal area from the tip of the catheter (Fig. 1). The diameter of the proximal area of the knot expanded due to the force that was exerted when removing the catheter; the diameter was smaller than that of the distal area of the knot close to the tip of the catheter (Fig. 2). Moreover, in the proximal area where the knot was located, there was a small amount of blood observed due to the damaged epidural vein caused by pushing the catheter by force despite insertion resistance (Fig. 2). No side effects or complications were observed until the

patient was discharged from the hospital 20 days after surgery.

DISCUSSION

This case highlights a clinical experience in which an epidural catheter – which could not be easily removed due to knots that formed in the subcutaneous tissue when removing it, after it was inserted by force despite resistance at the entrance of the epidural space with a Tuohy needle – was successfully removed with gradual force by making the patient bend his waist as much as possible in a lateral recumbent position. This was

achieved without side effects or complications.

In most cases, knots of the epidural catheter are formed when the catheter is deeply inserted into the epidural space (at least 6 cm), so that it is curved, twisted, bent, or it is turned in the opposite direction^{2,8} of its insertion.^{2-4,9} Generally, knots are formed when deeply inserting a catheter into the epidural space^{5-7,9} or upon its removal after deeply inserting it into the epidural space.²⁻⁴ However, knots are also formed when the catheter is mounted less than 3 cm inside the epidural space.⁶ In this case, unlike previously reported cases, the resistance occurred when inserting the epidural catheter after finding the epidural space with loss of resistance keeps the catheter from

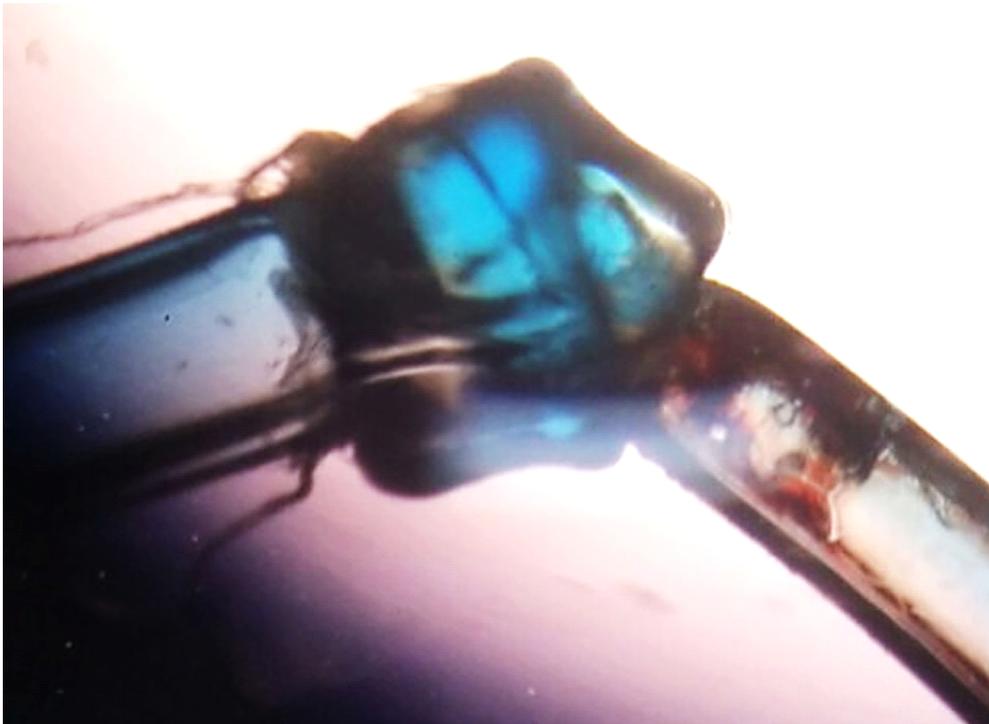


Fig. 2. The magnified view of the knot under a light microscope shows a reduced diameter of the epidural catheter proximal to the knot due to a significant tension against resistance encountered during removal of the catheter and a small amount of blood presumably from an epidural vein injured from forceful placement of the epidural catheter despite resistance upon insertion of the catheter into the epidural space.

going in straight, thereby twisting the catheter significantly in the epidural space. When pulling the catheter to remove it in this state, knots begin to form, even in the subcutaneous tissue, thus making it difficult to remove the catheter.

To safely remove the epidural catheter, which is difficult to remove after epidural anesthesia, it is first necessary to provide the patient and caregiver with sufficient explanations about the severity of the clinical condition, the step-by-step procedure, as well as of any side effects and complications. If the patient is under epidural anesthesia, it is better to remove the catheter once the effects of the anesthesia are completely gone. While under epidural anesthesia, the patient cannot describe the neurological symptoms that may occur while removing the catheter, and thus any neurological damage related to catheter removal cannot be prevented. On the other hand, the catheter can be surgically removed when the patient's back is under epidural anesthesia,⁹ or it can be removed by pulling the catheter during a state of muscle relaxation under general anesthesia.⁴ If the patient suffers from dysaesthesia or pain when removing the catheter once he or she has completely recovered from the anesthesia, it is necessary to consider surgical removal instead of pulling on the catheter. In this case, resistance occurred 1.5 cm deep inside the skin when removing the epidural catheter, and the skin was pulled due to knots. This suggested that the nerves located deeper inside are very unlikely to be damaged by the catheter; thus, the catheter was pulled

and removed before the patient was fully recovered from anesthesia. In many cases other than this one, it has been reported that the catheter is easily removed by pulling on it with gradual force without causing side effects or complications, which are caused when part of the catheter remains in the body due to cutting of or damage to the catheter.^{2,3,6} However, there are cases in which the catheter is removed by surgery⁸ or ultrasound guidance¹⁰ when the catheter is not removed by gradual force,^{7,9} or it is broken by pulling on it.

If there is resistance upon removal of the epidural catheter, it is helpful to place the patient in the same position that had been taken when the catheter was first inserted. Moreover, when comparing the force applied when pulling the epidural catheter with the waist bended in a lateral recumbent and sitting position, the force applied in a sitting position is 2.5 times greater than the force applied in a lateral recumbent position.¹¹ This case also showed that the catheter was not properly removed when taking just a lateral recumbent position without bending the waist to remove the epidural catheter; although, it was removed after bending the waist in the same manner as when initially giving epidural anesthesia. However, taking these positions does not make it easy to remove the epidural catheter.⁷⁻⁹ In addition, the catheter can be removed by putting the saline solution into the epidural catheter and applying positive pressure, or by waiting until the tension in the patient's mus-

cles or tissues is relieved.

In this case, clopidogrel and aspirin were discontinued for 5 days, and when there was insertion resistance of the epidural catheter, the catheter was forced into the epidural space without attempting other methods (such as attempts in the space between other vertebrae, the midline approach, or reduction of the angle with the epidural space by laying the needle). There are various guidelines that are currently followed whereby clopidogrel is discontinued for 5 - 7 days when blocking the central axis of patients receiving antiplatelet therapy. However, the idea that there are no troubles faced when blocking the central axis, even when discontinuing clopidogrel for 5 days (as shown in this case), stems from a very small study of only 13 patients.¹² Therefore, there is insufficient scientific evidence to prevent epidural hematoma due to blockage of the central axis. When changing the direction of the needle or inserting a new one in this state, the location of the needle was no longer changed, as an epidural hematoma is likely to occur. Moreover, when clopidogrel and aspirin are discontinued for 7 days to prevent epidural hematoma, there may be major cardiovascular issues such as cardiac death, stent thrombosis, and myocardial infarction.¹³ When only clopidogrel is discontinued and aspirin is sustained, there may be a risk of bleeding during surgery.¹⁴ However, an epidural hematoma may develop, even when the epidural catheter is inserted by force; the incidence rate of this is remarkably low.¹⁵ Thus, in this case,

there was an attempt to insert the epidural catheter despite the resistance, and without changing the direction of the needle or removing the needle to make new attempts at insertion.

Difficulties in removing the catheter due to knots in the epidural catheter rarely occur, but once they do, they may greatly threaten the safety of patients. When mounting the catheter in the epidural space as shown in this report, it is better to give up on inserting the catheter using local anesthetic with long hours of anesthesia if the surgery does not take long, or switch to general anesthesia, rather than trying to insert the catheter by force in case of resistance. In conclusion, the authors hope that anesthesiologists are well aware of the complications related to epidural catheters when performing epidural anesthesia, and that they can apply such knowledge in treatment, thereby providing safer and higher quality anesthesia for patients.

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