**Open Science Journal of Clinical Medicine**
2019; 7(2): 45-47
http://www.openscienceonline.com/journal/osjcm
ISSN: 2381-4748 (Print); ISSN: 2381-4756 (Online)

# Breakage During Removal of an Entrapped Wire Reinforced Epidural Catheter

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## To cite this article

Suzana França Claro, Paula Cristina Leitão de Assunção, Lucas Ferreira Gomes Pereira, José Eduardo Guimarães Pereira, Carlos Darcy Alves Bersot. Breakage During Removal of an Entrapped Wire Reinforced Epidural Catheter. *Open Science Journal of Clinical Medicine*. Vol. 7, No. 2, 2019, pp. 45-57.

**Received**: April 18, 2019; **Accepted**: June 5, 2019; **Published**: June 19, 2019

## Abstract

*Wire-reinforced epidural* catheters exhibit certain advantages, such as greater *resistance and flexibility*, since they are made of a metal spiral shaped structure coated with a polyurethane layer. Due to the flexibility of its tip, epidural catheters reinforced with wire, lead to reduced risk of complications, such as intravenous and intrathecal catheters, epidural hematoma, systemic absorption of the local anesthetic, and transient paresthesia. The lower incidence of paresthesia would be related to the catheter's reduced stiffness. Despite the various benefits observed, there are numerous reports in the literature showing difficulty in wire-reinforced epidural catheters. We report a case of wire-reinforced epidural catheter removal difficulty and discuss possible measures to be adopted in these circumstances.

## Keywords

Anesthesia, Epidural Catheter, Difficult Removal, Complication

## 1. Case Report

A 43-year-old female patient, ASA II PS for controlled hypertension, was admitted for an abdominoplasty. She was 1.65 m tall and weighed 69 kg (body mass index 25.3 Kg/m$^2$). The anesthesia plan was a combined epidural and general anesthesia.

The patient was monitored with standard monitors (5-lead electrocardiogram, non-invasive blood pressure, pulse oximetry, and expiratory capnography), bispectral index (BIS; A-2000 BIS Monitoring System, Aspect Medical Systems, Newton, USA), and neuromuscular transmission monitor (TOF-Watch SX, Organon Ireland, Dublin, Ireland).

After administration of midazolam 1 mg IV, the epidural catheter (EC) placement was performed on right lateral decubitus, under strict sterile technique, after 2 attempts, at T12-L1 interspace, with Tuohy needle 17G, median approach, bevel facing cranially, and loss of resistance (LOR) to air at 5,5 cm. A wire-reinforced epidural catheter (Arrow FlexTip Plus®, 19-gauge) was introduced 14.5 cm into the epidural space. A test dose with lidocaine 2% and epinephrine 1:200,000 in a total volume of 3ml was negative for intravascular or intrathecal catheter placement.

Of note, after needle removal, resistance was noted when pulling the EC back in order to decrease the amount inserted into the epidural space. It was, then, kept in place at 20cm mark at the skin level (14,5 cm introduced) and dressed with sterile tape.

After uneventful general anesthesia induction, EC was successfully used with ropivacaine 0,5% 10 ml and repeated during the case. Surgery was performed and the patient transferred to post-anesthesia care unit and later, discharge to surgical ward.

On post-operative day-1, due to pain at surgical site, the acute pain team administered 10ml of ropivacaine 0.2% via EC without apparent resistance to injection. There were no gross sensitive or motor neurologic deficits. The patient was

positioned on left lateral position with lower limbs flexed and EC removal failed, with just 5 cm being pulled out. There was still 9.5 cm remaining into the epidural space. The catheter removal was unsuccessful even repositioning the patient on sitting position, right lateral decubitus, with both lower limbs extended and flexed. Another attempt to pull the catheter out, this time with continuous traction while injecting saline, was performed, but again, it failed.

A thoracolumbar Computerized Tomography (CT) scan was performed and showed that the catheter was partially located in the anterior epidural space (Figure 1).

After request, the neurosurgery team evaluated the case and decided to remove the catheter using hemostatic forceps. During manipulation, the EC was ruptured and split into two parts. The inner one was grabbed using the forceps and pulled out with the distal tip intact. The patient had no pain or neurological complaints during EC manipulation. A new image exam (CT scan) was performed afterwards showing no evidence of catheter fragments in the epidural space.

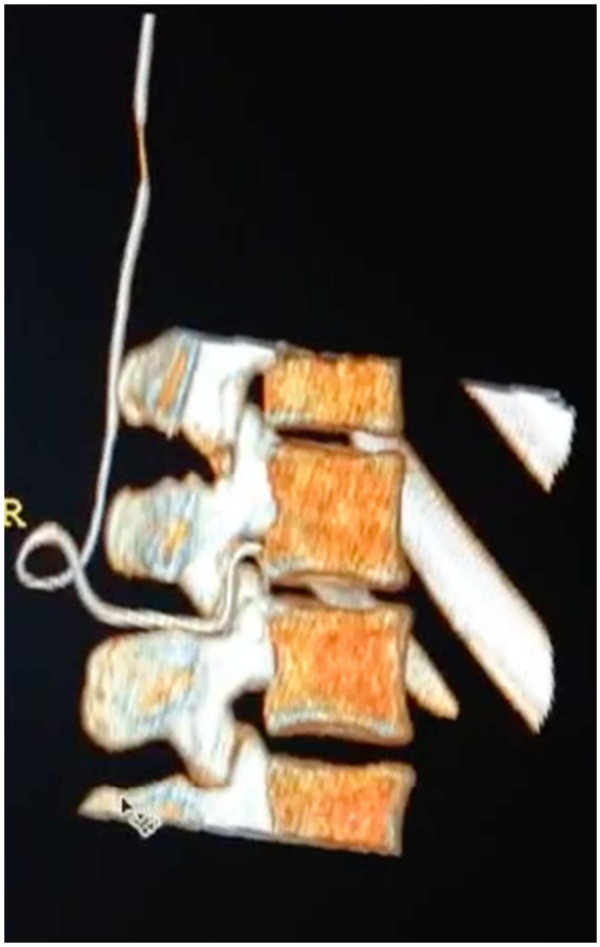

***Figure 1.*** *This picture shows that the catheter was curled and partially inserted into the epidural space.*

## 2. Discussion

The Arrow FlexTip Plus® wire-reinforced epidural catheters present a spring like metal material that provides stiffness, strength, and firmness during its insertion and also lumen patency and kink resistance. [1] At the distal tip, wire-reinforced EC are designed with fewer coils which may provide flexibility enough to minimize paresthesia, dural perforation and intravascular catheter placement. [2-5] The polyurethane outer layer is responsible for the higher elasticity and may be subjected to significant stretching (up to 300% of its original length) before rupturing. [6]

There are numerous reports of difficulty during removal, including the risk of the wired metallic part being lodged within the epidural space after unintentional withdrawal of the polyurethane cover. [7] and catheter knotting [14,15] In general, these complications are related to the catheter being excessively inserted into the epidural space. Ideally, the EC should be inserted an amount enough to provide adequate analgesia and lower complication risks. (The optimum length to be inserted in such space shall be able to provide adequate analgesia and lower complication risks). In cases of epidural catheter entrapment, some maneuvers can be performed to facilitate its removal. The literature emphasizes that the first step is to place the patient in the original position used to insert the catheter. Other options include the performance of extreme bending, as well as soft and continuous traction to be applied in different spine bending or extending positions and intensities. [8] There are also reports saying that force required for removal while in a lateral position is 2.5 times lower to the force required while in a sitting position. it is essential to employ continuous and gentle traction on the catheter and pull it as close as possible to the skin. Some authors further advise to traction it over a few hours, keeping it lightly extended and securing it on the skin or tying a light weight as to provide continuous tension on it. There is also a report of a trapped epidural catheter removal at the knee to chest position under general anesthesia moments before neurosurgery [13].

Five milliliter epidural saline may be administered through the catheter during the continuous motion (increasing turgor) [9], or wait a few hours in order to make a new attempt, or even carry it out on subsequent days as to allow increased muscle relaxation.

Once verified unusual difficulty and expected maneuvers have failed in removing the catheter, the location of the catheter must be to confirmed to evaluate the etiology using imaging tools including computed tomography (CT). [10] Computed tomography is a good option, especially for wire catheters, since they are radiopaque. Arrow's guideline informs that the catheter offers less resistance when motioned with hemostats pliers and warns that arrest instruments should not be used in cases that already present difficulties during the removal, especially due to higher risk of rupture and fragmentation. [11]

As such the opinion of the neurosurgeon shall always be considered. In the reported case, an opinion was asked from the neurosurgery team who inappropriately removed the catheter by applying more force than usual using hemostatic forceps. The patient had no complaints related to pain and had no neurological shortcomings during manipulation of the catheter, which has fragmented into two parts and, in this

case, could be completely removed. A CT scan was performed afterwards showing no evidence of catheter fragments present in the epidural space. It also warns that under no circumstances extreme force should be used to remove the catheter.

In case of unsuccessful catheter removal, the surgical procedure would be indicated: if the patient reports pain while attempting to remove the catheter, which would mean presence of impaired nerve roots; if there are neurological symptoms and when the catheter tip is displaced out of the skin, especially to act as an entry point for neuraxial infections. The catheter should also be removed when located in the subarachnoid space due to the elevated risk of serious neurological complications. Moreover, the laminectomy can be performed if requested by the patient, even in cases that the patient is asymptomatic. [11]

According to the manufacturers, epidural catheters are sterile and inert, and once inserted aseptically should not cause neurological sequelae or infection should a fragment be left in the epidural space. Neurological damage risks or infections are rare. Therefore, surgical removal is not mandatory for asymptomatic patients. Always remember that every neurosurgery has its risks and that neurological damage could occur while trying to remove the catheter fragment. [12].

On the other hand, the fragment could migrate with time and result in symptoms if not removed. There are reports of cases that evolved to root compression syndrome, formation of granuloma or spinal stenosis. Therefore, asymptomatic patients should be properly instructed to immediately seek medical help in case of onset neurological signs and symptoms.

## 3. Conclusion

Epidural catheters may present difficult to remove. Although wire-reinforced catheters are less prone to complications, caution should remain paramount during its insertion. In order to avoid these complications, epidural catheters should not be inserted further than 5 cm beyond the needle's tip. The literature indicates several strategies that should be adopted in cases of epidural catheter entrapment and it also claims that excessive force should never be applied to remove catheters. It is also important that catheter handling should only be performed by qualified personnel. Despite the misconduct of the neurosurgeon in the reported case, the patient presented good clinical improvement and was discharged in the same week.

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