Catheter Migration After Implantation of an Intrathecal Baclofen Infusion Pump for Severe Spasticity: A Case Report

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We report a case of intrathecal baclofen infusion pump implantation complicated by migration of the catheter tip. A 55-year-old man required an intrathecal baclofen infusion for severe spasticity 4 years after a cervical spinal cord injury with incomplete tetraparesis. Twelve months after initial implantation of the device, the patient began to experience a recurrence of trunk tightness and spasticity. Subsequent X-ray and computed tomography evaluations of the catheter system revealed pooling of contrast medium outside of the intrathecal distribution in the lumbar subcutaneous region of the back and therefore migration of the pump catheter tip. At surgical revision, emphasis was placed on minimizing the length of catheter outside of the spine and securing the catheter in the supraspinous fascia with a right-angled anchor. The distance between the anchors and the entry point of the catheter into the supraspinous fascia was also reduced to prevent slipping when the patient bends forward. After surgery, the patient's spasticity improved and, 1 year later, he has experienced no further complications during follow-up, requiring an average baclofen dose of 150 μg/day. Here, we describe several surgical methods intended to secure the intrathecal catheter and prevent catheter migration. Other complications related to catheter failure are also highlighted.

Key Words: baclofen, infusion pump, intrathecal, spasticity, spinal cord injury, baclofen withdrawal syndrome
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Patients with cerebral palsy, spinal cord injuries, traumatic brain injuries and multiple sclerosis may suffer from intractable spasticity and rigidity that can lead to significant disability. Muscle tightness and involuntary movements of the limbs and body owing to spasticity in such patients can greatly impact their mobility, care, sleep and ability to transfer. Baclofen is an effective oral antispasmodic therapy for most patients [1–3], but treatment may not be successful in a significant number of patients owing to the severity of their symptoms or the presence of unacceptable side effects. In such situations, intrathecal delivery of baclofen via an implanted infusion pump allows for a more potent antispasmodic effect and fewer side effects. Promising results in the control of spasticity and rigidity have been reported in the medical literature [4–12], but a variety of mechanical and surgical complications have been recognized. The catheter sits in the lumbar subarachnoid space and is the most vulnerable part of the electromechanical infusion system [13]. Previous studies have noted that these catheters are prone to dislodgment, kinking, tearing and disconnection in as many as 40% of the patients who have used these systems [7–9,14,15]. It may be difficult to detect if and when the catheter tip migrates

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from its original position. Here, we describe a patient who suffered increasingly severe spasticity owing to migration of the catheter tip outside of the intrathecal space 12 months after the initially successful implantation and intrathecal therapy.

Case Presentation

A 55-year-old man had previously suffered a traumatic cervical spinal injury resulting in incomplete tetraparesis and was originally treated with anterior discectomy and fusion followed by decompressive cervical laminoplasty. The patient initially recovered with improvements in muscle power in both the upper and lower limbs and was able to walk again a few weeks after the surgical intervention. However, he gradually developed increasing spasticity of the trunk and extremities (especially the lower limbs) despite titration of his oral baclofen dose from 15 mg/day to 60 mg/day. He suffered from severe spasms and trunk tightness that limited his daily activities and induced intolerable pain. For these reasons, some 4 years after his initial injury, it was deemed that oral therapy was insufficient and he agreed to a test dose of intrathecal baclofen. This proved to be very effective at a dose of 75 μg, and his Ashworth score was reduced from 4/5 to 2/5. An intrathecal infusion pump was surgically implanted (SynchroMed; Medtronic, Minneapolis, MN, USA) with the patient in a lateral position, allowing access to the abdomen for the placement of the pump and to the spine for catheter placement. A paramedian skin incision was made over the lumbar spine down to the supraspinous fascia. A 15-gauge needle was advanced in a cephalad direction until free flow of the cerebrospinal fluid was obtained, and the catheter was then passed meticulously through the needle. The catheter tip was positioned at the level of T12, and this was confirmed with fluoroscopy. A tunnel rod was used to tunnel the catheter to the abdomen where it was connected to the pump that was placed in a subcutaneous location.

During the first 3 months after surgery, spasticity was controlled with an average daily dose of 180 μg of intrathecal baclofen and his Ashworth score remained at 2/5. However, 12 months after surgery, the patient experienced increasing trunk tightness and spasticity, and his rehabilitation physician increased the baclofen dose from 180 μg/day to 300 μg/day. Although withdrawal symptoms were not evident, the patient found that transfers and sitting were becoming increasingly difficult.

Upon hospitalization, the intrathecal infusion pump function and programming appeared satisfactory. When radio-opaque solution was injected into the side port of the pump, X-ray evaluation demonstrated that the contrast medium was accumulating within the lumbar paraspinal region and not in the subarachnoid space (Figure 1A). Computed tomography further revealed the accumulation of the contrast

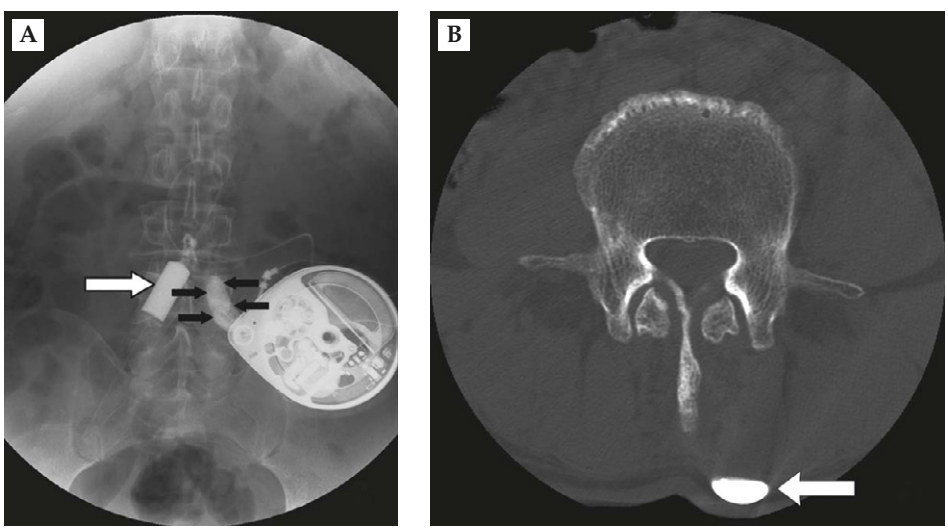

Figure 1. *(A) X-ray evaluation of the catheter system with contrast medium accumulating outside of the intrathecal distribution in the lumbar paraspinal region (black arrows). The syringe used to introduce the contrast via the side port of the pump is indicated (white arrow). (B) Computed tomography further demonstrates the accumulation of contrast medium in the subcutaneous layers (white arrow).*

medium in the subcutaneous layers (Figure 1B) and, as a result, surgery was planned to adjust the positioning of the catheter tip.

During the operation, the catheter was found to be coiled in a subcutaneous pocket outside of its initial intradural position and was removed (Figure 2B). A new catheter was inserted into the intrathecal position. The new catheter was trimmed to an optimal length to prevent collecting in the lumbar paraspinal region and emphasis was placed on minimizing the length of catheter outside of the spine. The catheter was secured in the supraspinous fascia with an additional right-angled anchor (Figures 2C and 2D). The distance between these anchors and the point of entry of the catheter into the supraspinous fascia was also minimized to prevent the catheter from slipping when the patient bends over (Figure 2D). The new catheter was connected to the infusion pump and the wound was closed in layers in the normal way.

After surgery, the dose of intrathecal baclofen was resumed at 195 μg/day and his symptoms gradually improved. Postoperative X-ray confirmed that the catheter tip was in a good position at the lower thoracic level. At 1 year after surgical revision, there have been no further complications and he remains on an average baclofen dose of 150 μg/day.

Discussion

The intrathecal baclofen pump is a device designed to deliver small doses of baclofen into the subarachnoid space. Although this treatment modality can be very effective in the relief of intractable spasticity and pain, it is not without complications. In broad terms, complications can be divided into those related to the surgical implantation or mechanical functioning of the infusion device and those related to the drug itself.

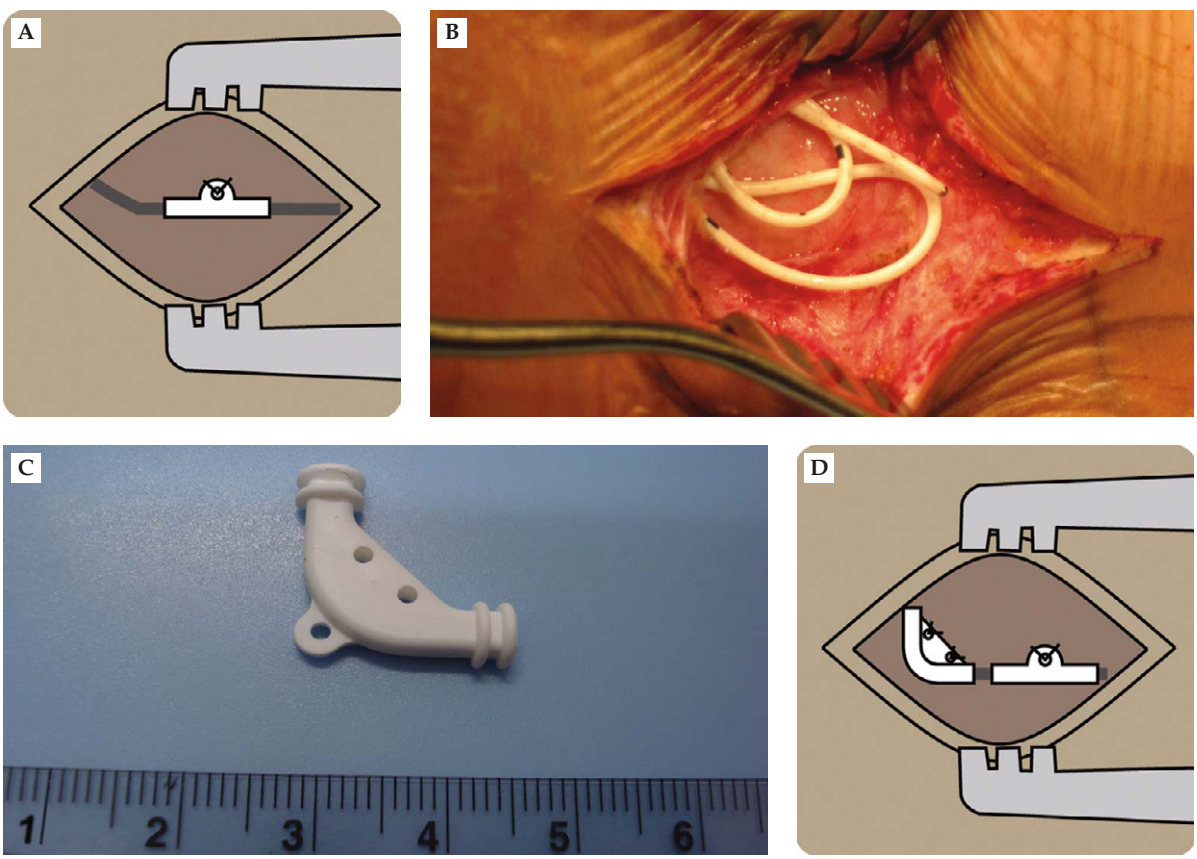

Figure 2. *(A) During the first operation, a single straight anchor was used to secure the catheter in the subcutaneous layer. (B) At surgical revision, the catheter was found to be coiled outside of the intradural position in a subcutaneous pocket. (C) A right-angled anchor was subsequently used to secure the catheter in the supraspinous fascia. (D) The right-angled and straight anchors were positioned to minimize catheter migration.*

With respect to the function of the infusion device, the most vulnerable part of the system is the catheter. Albright et al [16] and Tutak and Doleys [17] reported that the incidence of complications relating to the catheter itself may be as high as 31% and 35%, respectively. Of these catheter-related complications, over 50% were attributed to kinking, breakage or tearing of the thin silastic catheter [13], and disconnections and dislodgments of the catheter were far less common problems. It seems simple to make a more solid and, therefore, durable single connection between the catheter and pump to prevent potential disconnections in the catheter system with multiple connection points. However, it is more difficult to prevent dislodgment of the catheter tip from the subarachnoid space, and this migration is exacerbated by repetitive pulling movements on the catheter as the patient moves. It has been suggested that the differential motion generated during spastic ambulation between the pump located in the abdomen and the spine may contribute to the gradual withdrawal of the catheter [18]. Specific steps can be taken during the surgical implantation of the device to limit occurrence of these complications described thus far. First, given that the intrathecal catheter is more prone to kinking and fracture, the length of catheter outside the spine should be minimized. A right-angled anchor should be used to secure the catheter in the correct position and prevent redundant catheter from migrating. The anchor should be secured to the supraspinous fascia so that it prevents gliding of the catheter when the patient bends over. In our case, it should be noted that only one straight anchor was initially used to secure the catheter in the subcutaneous tissue, and the redundant catheter collected between this and the entry point into the spine (Figure 2A). These factors certainly contributed to the unwanted migration of the catheter and, hence, during the second operation, these issues were addressed (Figures 2C and 2D). The distance between the straight and right-angled anchors and the entry point of the catheter into the supraspinous fascia were minimized to prevent the catheter from slipping out when the patient bent over (Figure 2D), but excessive tension should not be applied whilst securing the anchor in this fashion so that the catheter does not snap back under strain. A permanent braided suture was used because it is stronger and easier to place. In addition, excess tubing was coiled around and beneath the pump to provide some slack between the pump and spine during movement.

Baclofen withdrawal syndrome is a potentially life-threatening condition and complication of intrathecal baclofen injection (and a failure thereof). The most common symptoms include hyperthermia, itching and hypertonicity, but multiorgan failure, rhabdomyolysis, severe hyperthermia, neuroleptic malignant syndrome and seizure have also been noted. Acute withdrawal most commonly occurs after pump failure when administering intrathecal doses, and immediate administration of a supplementary oral or intrathecal bolus of baclofen would be needed. Our patient did not present with symptoms of acute baclofen withdrawal, and we suspect that this was because the gradual migration of the catheter created a relatively gradual decrease in intrathecal baclofen concentrations rather than an abrupt change. However, it is important that the drug delivery system is regularly checked by a specialist and/or trained caregiver so that the incidence of life-threatening intrathecal baclofen withdrawal syndrome is kept as low as possible. It can be very difficult to diagnose malfunctions in the pump system, even in specialist centers. The clinician may wrongly assume that baclofen tolerance has occurred and may not appreciate that the catheter or pump is malfunctioning. In our case, systematic analysis of the drug infusion device showed no programming abnormality and it was not until contrast radiography was used that the problem was identified. Pasquier et al recommend the use of computed tomography with contrast to accurately locate the distal tip of the catheter [19].

In conclusion, intrathecal baclofen pump delivery systems provide a vehicle for the management of medically intractable spasticity. However, malfunctions in the intrathecal baclofen pump can be caused by migration of the catheter tip or by other faults in the catheter itself. To minimize the possibility of catheter migration, adequate fixation to the supraspinous fascia with both right-angled and straight anchors is preferred.

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治療嚴重肌肉痙攣之脊膜內 Baclofen 注射幫浦術後併發導管移位 — 病例報告

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我們報告一例脊膜內 **baclofen** 注射幫浦植入後併發導管移位的病案。在本病案中，**55** 歲男性病患在頸部脊髓損傷合併四肢不完全癱瘓四年後，因嚴重的軀體與四肢痙攣及僵直而接受脊膜內 **baclofen** 注射幫浦植入手術。在首次脊膜內注射幫浦植入手術 **12** 個月後，病患又復發軀體緊繃與肌肉痙攣的症狀。以顯影劑注射於幫浦之側孔後，以 **X** 光及電腦斷層照影檢查發現有顯影劑聚積於腰椎皮下區域，顯示導管系統移位進入背部皮下區。因此，病患接受導管系統的重新置放手術。於重新置放導管之手術中，我們特別注意避免留置於脊椎外的導管過長，並且以一個直角之導管固定器將導管固定於脊椎上筋膜 (**supraspinous fascia**)。此外，導管之固定亦盡量使固定器至導管進入脊椎上筋膜的距離縮短以避免因病人彎腰活動時導管外滑。病患於導管重新置換後獲得肌肉痙攣僵直的改善，且於手術一年後的追蹤中接受每天 **150** 微克脊膜內 **baclofen** 注射可獲得病情之穩定控制。因此，在本報告中，我們強調在裝置脊膜內注射幫浦手術中幾項應注意的技術以固定幫浦的導管並防止導管移位及其相關之併發症。

關鍵詞：baclofen，注射幫浦，脊膜內，肌肉痙攣，脊椎損傷，**baclofen** 戒斷症候群

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