the fiberoptic device inside can be positioned *via* the contralateral nostril.[7] Postoperative close monitoring that includes neurologic evaluation is mandatory.

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Illicit Substance Abuse *via* an Implanted Intrathecal Pump

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IMPLANTABLE pumps with intrathecal delivery catheters are increasingly used for management of chronic pain conditions.[1–4] Originally, these devices were used mostly in patients with cancer-related pain.[5,6] Now, because of implantation in patients with nonmalignant pain and a longer life expectancy, new complications are seen. These include catheter or pump problems, infections, intrathecal granuloma, lower extremity paralysis, accidental overdose, postdural puncture headache, amenorrhea, arthralgia, decreased libido, chronic headache, and others.[7] We report a case of self-administration of illicit substances into an implanted intrathecal pump.

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Key words: Chronic pain; complications; illicit substance abuse; intrathecal pump.

Case Report

A 43-yr-old man had a history of lower back pain since age 30 when he underwent the first instance of back surgery—a one-level discectomy and fusion. He underwent a total of five lumbar operations, including decompression with intertransverse process fusions at L5 and S1, pedicle screws with fixation plates, and ultimately hardware removal at age 38. At age 40, he underwent implantation of a Medtronic (Medtronic Neurological, Minneapolis, MN) intrathecal pump for the delivery of morphine to treat chronic back pain. This was implanted at an outside institution, and according to records we obtained, he was psychologically evaluated and thought to be an appropriate candidate for an intrathecal pump device.

The patient was incarcerated in the Texas Criminal Justice System at age 42 and was cared for in the Texas Department of Criminal Justice Hospital System. Our decision was to maintain intrathecal morphine because the pump was already in place. The patient complained of marginal pain relief at every visit, and over the course of 6 months his dose was increased from 2.5 mg/day to 5.0 mg/day. On at least two occasions before the incident described herein, the aspirated amount from the patient's pump was 2 to 4 ml more than the anticipated amount. This led to a suspicion of catheter blockage or pump dysfunction. The patency of the catheter into the intrathecal space was confirmed during fluoroscopy approximately 6 months before this incident. At that same time, pump function was confirmed by filling the pump with saline and using a code supplied by the manufacturer to run the pump at a rapid rate while visually inspecting the pump mechanism during fluoroscopy.

The patient was seen in the pain clinic for a pump refill. A cloudy liquid (8 ml) was aspirated from the pump. The expected volume was less than 2 ml, according to data from the pump-programming com-

puter. The fluid was sent for analysis, and the results were positive for the presence of opiates (as expected), phencyclidine, methamphetamine, and propoxyphene.

The patient was confronted with the results, but denied self-administration of medication through the pump. During the ensuing conversation, the patient stated the only drug available in his prison unit was heroin; therefore, he could not possibly have injected this medication into his pump. A detailed neurologic examination of the patient revealed no abnormalities. The patient denied having a history of drug or alcohol abuse. He consented to a psychologic evaluation at this time, including a Minnesota Multiphasic Personality Inventory evaluation. It revealed a significant affective component to his pain.

For the patient's safety, he consented to and underwent pump and catheter removal. The pump appeared quite scored near the refill aperture, presumably because of the patient's access attempts. We sent the pump to Medtronic for analysis; it was noted to be undamaged and functioning normally. The manufacturer has seen other cases of suspected patient tampering in which the pump was not functioning because of septum damage (personal communication, Andrea Hutton-Lau, March 3, 1998). We are maintaining propoxyphene treatment dispensed daily and have referred the patient for substance abuse counseling.

Discussion

Intrathecal drug administration by infusion is used increasingly as an option in the treatment of nonmalignant chronic pain.[1-4] New complications are being seen, especially in this patient population with chronic pain.[7]

Schuchard *et al.*[7] reported that early complications often were catheter related, with 5 of 50 patients requiring reoperation because of a kink in the intrathecal catheter. The same authors reported pump flipping in 2 of 50 patients. Medical device adverse events reported to the Food and Drug Administration regarding implantable pumps (of all types, including intrathecal) have increased from 28 reports during 1984–1989 to 537 during 1992–1994. Of those 537 reports during the 1992–1994 interval, 11% were high-output errors, 11% were no-output errors, 9% were caused by leakage, and 9% were other malfunctions. In this report, chemotherapy pumps and intrathecal pumps were classified in the same category; therefore, it is difficult to interpret these data.[8] Schuchard *et al.*[7] also reported a 4% incidence of superficial infection and a 6% incidence of deep infection necessitating pump removal. A case of meningitis has also been reported.[9]

Intrathecal granuloma formation around the tip of the catheter has been reported in six patients.[9-12] This granuloma is a mass of inflammatory tissue that develops around the catheter tip. Cultures for four of six patients cases were negative. These patients had an insidious increase in back pain and varying degrees of neurologic deficits. The time of granuloma development varied from 2 months after catheter implantation to 26 months (mean, 17 months). Five of six patients were administered morphine (10–19 mg/day), whereas one was administered hydromorphone (10 mg/day). A high index of suspicion for intrathecal granuloma must be maintained when a patient with an intrathecal catheter reports a change in the severity of back pain unrelated to injury, especially if accompanied by new neurologic deficit. The optimal imaging to rule out intrathecal granuloma is gadolinium-enhanced magnetic resonance imaging, because in one patient, the mass did not show up during magnetic resonance imaging without gadolinium.[7]

One case of permanent paraplegia has been reported.[13] The patient had an intrathecal catheter and a spinal cord stimulator (epidural space) in place and had acute myelopathy at the level of the intrathecal catheter. At the time of emergent exploration, the spinal cord near the catheter tip appeared to be necrotic and liquefied. During pathologic evaluation, arachnoidal fibrosis and meningothelial hyperplasia was seen. All cultures were negative. The paraplegia persisted after exploratory open laminectomy and removal of both the catheter and the spinal cord stimulator. The cause of the paraplegia is unclear.

Accidental massive intrathecal morphine overdose has been reported in two patients.[14,15] In one patient the dose administered was 250 mg, whereas in the other a 450-mg bolus of intrathecal morphine was administered. In one patient, the catheter port was injected directly instead of in the pump refill port. The possibility of this error occurring again has been minimized by a manufacturer modification to the newer intrathecal pumps. Newer intrathecal pumps have a screen over the direct intrathecal catheter access port that limits needle size to 25 gauge or smaller. Both of these patients had severe seizures that were difficult to treat and hemodynamic instability, including hypotension and hypertension.

Postdural puncture headache has been reported after intrathecal catheter placement. Crul and Delhaas[16] reported an incidence of 7% of postdural puncture headache necessitating blood patch after intrathecal catheter placement.

Illicit substance abuse *via* an implanted intrathecal pump is a previously unreported complication. Although it has not been reported in the literature, Medtronic has seen other cases in which pump tampering has been suspected (personal communication, Andrea Hutton-Lau, March 3, 1998). Various histopathologic and neuro-

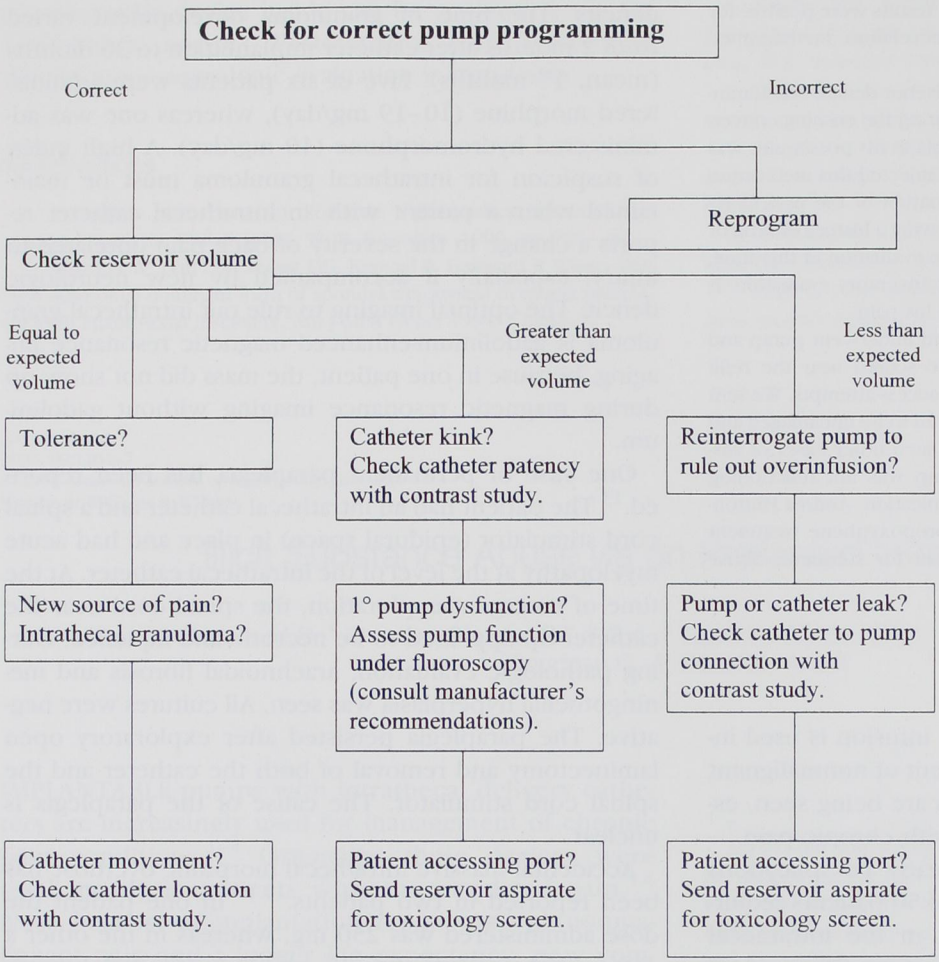

Fig. 1. Recommended algorithm for checking intrathecal pump dysfunction. Modified and reprinted with permission.[19]

toxic side effects can occur with administration of various intrathecal substances. In an animal study, motor weakness and axonal changes associated with neurotoxicity were seen with low- and high-dose butorphanol administration.[17] The same study revealed motor weakness and mild inflammatory histopathologic changes with high-dose sufentanil only, whereas both low- and high-dose nalbuphine were shown to be relatively free of side effects. Karpinsky *et al.*[18] reported administering intrathecal ketamine by infusion to a cancer patient with good control of intractable neuropathic pain. However, motor weakness developed in the patient, and at autopsy there was evidence of neurotoxicity in the lumbosacral nerve roots (subpial vacuolar myelopathy). Amazingly, our patient suffered no apparent neurotoxic or infectious sequelae from grinding up of oral medications and self-administration into the pump reservoir.

This patient was seen 6 months before our discovery of the illicit use of his pump and was misdiagnosed with a pump malfunction. We reviewed an algorithm (fig. 1) for checking apparent pump malfunction.[19] Now added to the list of possibilities is "patient tampering with device" based on this case report. During pump refill, we recommend sending samples for analysis whenever the amount aspirated is significantly higher than expected.

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Total Spinal Anesthesia following Epidural Saline Injection after Prolonged Epidural Anesthesia

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TOTAL spinal anesthesia is a complication that follows inadvertent introduction of local anesthetics into the intracranial subarachnoid space. It has been reported during attempted interscalene,[1] epidural,[2] and spinal[3] blocks. With some cases, the signs of total spinal anesthesia were produced during neuraxial block, but the mechanism of production was obscure.[3–9] We report an unusual case in which total spinal anesthesia developed after injection of epidural saline following a prolonged combined epidural–general anesthetic.

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Key words: Brain stem; local anesthetics; subarachnoid fluid.

Case Report

A 29-yr-old 56 kg woman underwent arthroscopic repair of the anterior cruciate ligament of the left knee. An epidural catheter was atraumatically placed on the first attempt at the L2-L3 interspace using a loss of resistance technique. After a test dose with negative results, 12 ml lidocaine, 2%, produced loss of sensation to T10 on the right and L1 on the left. General anesthesia was induced using a propofol bolus (140 mg) and was maintained by a continuous propofol infusion of 25–30 $\mu g \cdot kg^{-1} \cdot min^{-1}$ while the patient breathed a mixture of nitrous oxide and oxygen (60:40) *via* laryngeal mask. Epidural anesthesia was