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Care and Management of Intrathecal and Epidural Catheters

Abstract



Epidural and intrathecal catheters have increasingly become a part of acute and chronic pain management over the past 25 years. Externalized systems include temporary, permanent exteriorized, and permanent port systems for use over weeks to months of expected therapy. Implanted, completely internalized systems are available for conditions expected to require many months or years of therapy. Expert care includes routine management as well as

advanced troubleshooting. Prevention of infection is a key priority for nurses managing these devices.

The technology associated with intraspinal analgesia has developed over the past 25 years.¹⁻¹⁰ Epidural percutaneous catheters were used initially for surgical and obstetric anesthesia, and later for epidural opioid postoperative analgesia. Short tunnel tracks were used to extend the durability of temporary epidural catheters for prolonged postoperative analgesia.⁴ Zenz et al¹¹ reported a technique of catheter securement for extending the use of a temporary epidural catheter. In 1981, Poletti et al¹² reported the successful placement of 6 silicone-rubber Broviac catheters using a laminectomy to gain access to the epidural canal. The required laminectomy and the duration of postoperative recovery limited the use of this technique. Racz et al⁸

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introduced a silicone-coated, wire-reinforced epidural catheter in 1982. In 1986, a silicone-rubber epidural catheter, modeled after the Hickman catheter, was introduced by Du Pen et al⁶ for long-term use in the epidural space. The Du Pen catheter featured a Dacron cuff for securement, and later a Vita cuff for antimicrobial protection. Development of new catheters, ports, and implanted pumps for intrathecal delivery took on a much faster pace throughout the 1990s. In 1991, Yue et al¹³ reported their experience with a new epidural catheter that combined a Racz-type epidural catheter and a silicone-rubber segment for subcutaneous tunneling.

• TEMPORARY CATHETERS

Temporary catheters for use in the periobstetric and perioperative period are designed for short-term use with materials that easily pass into the epidural and intrathecal spaces. Teflon catheters allow visualization of aspirated fluid, but can become stiff and potentially migrate out of their original placement. Nylon, polyurethane, and polyamide catheters reportedly have had some tissue reaction problems.¹⁴ An ongoing clinical problem associated with prolonged use of temporary catheters is failure of the catheter adapter/connector. The connector may become completely or partially dislodged, or the catheter may break near the connector. Tunneling a temporary catheter may add stability and reduce the rate of bacterial colonization,^{15,16} but the durability of both the catheter and connector is a major issue in maintaining the catheter for long-term use.

Generally, prolonged use of temporary spinal catheters currently occurs for two distinct clinical purposes: as a means of obtaining pain relief for the terminally ill or as part of a screening trial for a totally implanted intrathecal system. For the patient with increased pain at the end of life, temporary catheters have the advantage of being very inexpensive and easy to place. They should be considered for those patients with days to weeks of life expectancy. The choice of either the epidural or intrathecal route for the control of terminal pain is largely determined by whether any spinal tumor is present and the preference of the pain specialist. In general, infection in the intrathecal space (meningitis) is considered to be a more serious sequela than epidural abscess, although both are serious complications.

Many pain specialists believe that the use of a temporary catheter with continuous infusion as a trial for an implanted device is a better screen for success with the implanted spinal pumps than a one-time dose of spinal morphine, which used to be the standard predictor for success. Again, some pain specialists prefer using the intrathecal route for these trials, whereas others believe an epidural trial is sufficient for predicting success or failure.

These trials may run for 3 to 10 days or longer, depending on the individual protocol.

The most significant disadvantages of the temporary systems are the lack of an infection barrier and the potential for displacement or mechanical failure of the system. It is important that the clinician stabilize the catheter with a large transparent dressing and double-check to ensure that the connector is tightly secured. If the connection is too loose, the catheter will leak around the connector or the connector will fall off. If the connector is too tight, it will occlude the catheter. Should the catheter migrate from the epidural space into the intrathecal space, the patient will exhibit signs of a sudden overdose. If the catheter migrates from the intrathecal space to the epidural or subcutaneous space, the patient will lose pain control. Routine care involves monitoring the exit site for erythema or exudate and using a filter on all infused solutions. Suspicion of infection should always prompt a culture of a fluid sample withdrawn from the catheter. In most situations, the dressing will not be changed more frequently than once a week and will involve 2 people to avoid dislodgement and maintain asepsis.

• PERMANENT CATHETERS

Permanent catheters are used for weeks to months, and most pain specialists agree that in the majority of cases, the epidural route is the appropriate one for these devices. Some specialists, particularly those caring for patients with advanced cancer, will opt for an externalized intrathecal catheter or an intrathecal port system. The advantages of the permanent catheters are that they have a Dacron cuff to aid in the stabilization of the catheter to the tissues, and many have a second Vita cuff impregnated with silver to reduce antimicrobial activity. Another advantage of permanent wire-guided catheters is that the catheter tip can be advanced and positioned more precisely. This is particularly important in situations wherein the catheter tip is critical, as is true with thoracic or cervical dermatomal pain sources. One disadvantage of permanent catheters is that the large-volume drug infusions via externalized pumps can be very costly over time. Once the patient has received therapy longer than 3 months, the intrathecal implanted systems are more cost efficient.¹⁷

There are no studies that identify the optimal infection prevention site care for externalized spinal catheters. At least one laboratory experiment showed almost no contamination of the spinal space, even with the sloppiest of techniques, implying that the povidone-iodine versus alcohol debate probably is a moot point when it comes to exit-site cleansing.¹⁸ The Centers for Disease Control (CDC) Guidelines for Prevention of Intravascular Catheter-Related Infections noted a study performed on approximately 2,000 peripheral vascular devices that showed

essentially no difference between transparent and gauze dressing changes.^{19,20} There have been no recent large studies such as this with a focus on site care for epidural or intrathecal catheters.

The author's protocol for immediate postoperative dressing changes consists of daily gauze dressings with a hydrogen peroxide and povidone-iodine preparation.²¹ Once the surgical sites heal and the sutures are out, patients transition to a weekly transparent dressing change. It has been suggested that clinicians should use an impregnated antimicrobial dressing for patients at high risk for infection (eg, those with concomitant colostomy or open wounds), and that they should also always use an in-line filter for all externalized infusions. Our pain clinic uses a double filter system, in which one filter is changed with the bag and tubing change, and the proximal filter is considered part of the catheter and not changed unless occlusion occurs. In 2000, this procedure resulted in an infection rate lower than 3%.²¹

When troubleshooting an occlusion alarm, a clinician should think first about the possibility of a clogged filter. Other possibilities for the occlusion alarm sounding include an internal kink in the catheter, which often can be detected with plain spine radiographs, or a catheter tip fibrosis (epidural) or granuloma (intrathecal), determined by magnetic resonance imaging (MRI).

Exit-site erythema or exudates should be treated aggressively with daily gauze dressing changes. If exit-site irritation proceeds to infection, it should be treated promptly with systemic antibiotics. Clinicians need to check an exit-site culture to identify the organism. Methicillin-resistant *Staphylococcus aureus* and other resistant organisms can be very difficult to eradicate. Some pain specialists routinely perform nasal cultures before implantation to identify *Staphylococcus* carriers.

Swelling at the spinal insertion site could be a sign that the catheter has migrated out of the spinal canal into the paravertebral subcutaneous tissues and is infusing subcutaneously. It frequently is a more ominous sign of infection in a patient with an epidural catheter. The catheter becomes encapsulated in the epidural space, and exudates track back out along the catheter, sequestering in the subcutaneous space. An aspiration culture from the epidural catheter is mandatory for optimal selection of antimicrobial therapy. If the clinician sees no aspirate when pulling back on a syringe from the Luer-Lok™ of the catheter (the filter must be removed before aspirating), he or she should instill 2 to 3 mL of preservative-free saline and draw that back out to be sent to the lab for a stat gram stain, with culture and sensitivities to follow.²¹ It is important that the clinician not remove the catheter before getting the aspiration culture. Removal of the catheter and cutting off the tip for culture will sample the entire track and exit site as well as the epidural space. When infection is suspected in a patient with an

intrathecal catheter, an aspiration culture will secure a cerebrospinal fluid sample.

● IMPLANTED PORTS

Permanent catheters placed either epidurally or intrathecally can be connected to implanted ports. These ports usually are placed over the lower rib cage in the mid-clavicular area for ease of access. Although no studies have compared infection rates for ports versus externalized spinal catheters, some providers presume a lower risk of infection with ports. This argument is strongest when it is considered that there is no external access to the catheter for organisms to track along the tunnel. It could be argued that the continuously accessed ports do allow for contamination via the needle track. In any case, further study to compare infection rates is needed. If in the future, analgesic drugs that can be administered weekly or less frequently are developed, the implanted ports would clearly become the more advantageous choice when medicine is to be administered through episodic chemotherapy-differentiated vascular ports from tunneled central vascular catheters.

Routine care involves initial daily gauze dressing changes with hydrogen peroxide and povidone-iodine. Once the incision is healed, a weekly transparent dressing change is performed over the firmly secured Huber needle. Troubleshooting specific to the port often involves partial or complete deaccessing difficulties. Partial deaccessing generally is identified by an occlusion alarm. Complete deaccessing usually is identified when fluid is found to be leaking under the dressing. When the patient is at home, this accidental deaccessing can result in a prolonged period without analgesia.

● EPIDUROGRAMS

Epidurograms are imaging studies that allow for the position of a catheter to be determined. There are no publications that establish the use of epidurography with a standard study protocol. In a review of epidurograms for more than 600 patients, a pain clinic was able to establish a standard epidurogram protocol in the hospitals associated with the author.²² The test should include anteroposterior and lateral scout radiographs as well as similar radiographs after each of two 5-mL doses of Omnipaque 180 (nonionic dye; GE Healthcare, Chalfonte, St. Giles, UK).²² The resulting radiographs will show the catheter, the catheter tip location, the dye flow after 5- and 10-mL dye injections, the distribution of dye in the epidural space, and the highest and lowest extent of dye flow in

both anteroposterior and lateral views. The following are examples of helpful information that can be reported by the radiologist after a review of the study:

- Epidural catheter tip location (level) and position in the epidural space (anterior or posterior)
- Dye flow after 5 mL of Omnipaque 180, upper extent, and lower spinal level of flow
- Space where Omnipaque 180 is present (intravascular, subarachnoid, subdural, epidural, or outside of the epidural space)
- Dye flow after 10 mL of Omnipaque 180 and comparison with the 5-mL injection
- Abnormalities and/or obstruction of flow and level.

The epidurograms are a valuable resource to review if the character of analgesia changes during therapy. A comparison of dye flow will assist the clinician in determining volume or concentration changes required to overcome problems from tumor spread or vertebral body compression of the epidural space. Obstruction may be overcome by surgical or radiation intervention, or the obstruction may be bypassed by placing a second epidural catheter above or below the obstruction. Epidurograms also are useful in attempts to determine the volume-flow changes within the epidural space. The baseline study after catheter placement is useful for later comparison.

• IMPLANTED INTRATHECAL PUMPS

Several internalized pump systems are available for implantation to deliver analgesic drug therapies to the intrathecal space. There are pumps that can be programmed via a computer wand to deliver simple continuous, variable rates for patients who may have more pain at predictable times of the day. These pumps also have bolus capability for both one-time dosing and daily bolus doses. The pumps are available with 10-, 18-, and 40-mL reservoirs.

Nonprogrammable pumps are available with 16-, 30-, and 50-mL reservoir volumes that infuse at set rates. Dosing adjustments must be made by changing concentrations. One advantage of these devices is that they are completely internalized and therefore presumed to have less chance of infection (at least from organisms accessing the system from outside the body). The infection rates for totally implanted systems vary from 2.5% to 9%.²³ The infrequent need to access the system for refills also is an advantage over the port systems, and the drug costs associated with the highly concentrated infrequent reservoir refills are much less than the costs of frequent bag changes with an exteriorized system.¹⁷ The nonprogrammable pumps also are less expensive. The major disadvantage of these pumps is that clinicians cannot rapidly titrate patients, as they can with an externalized epidural catheter. This is another reason why these sys-

tems are appropriate for chronic, long-term pain management or for cancer patients with relatively controlled long-term disease.

Routine postoperative care of the implanted system includes site care, which generally is consistent with routine postsurgical wounds. According to the pain clinic's protocol, an occlusive dressing should be changed during the first postoperative visit at 2 weeks. Any nonabsorbable sutures are removed at that time. It is recommended that the patient wear an abdominal binder for the first 4 to 6 weeks to encourage optimal pump-pocket healing. Pump refills are conducted after a routine protocol. A 22-gauge Huber needle is used to access the central port. Any fluid in the reservoir is withdrawn and compared with the amount of fluid that should be in the reservoir. Discrepancies in expected versus actual levels of fluid are a signal that something is wrong with the system. The new drug is instilled into the pump, and the pump is reprogrammed to reflect a full reservoir. Any programming changes can then be accomplished through the computer. Often, there is a combination of multiple drugs in the reservoir, and the concentration and dose of these drugs must be tracked manually. The newest programmable pumps will allow for multiple drug concentrations to be programmed into the system, decreasing the chance for dosing errors.

Troubleshooting an implanted pump system can be a challenge. The most frequent problem encountered is difficulty accessing the pump at the time of routine refill. Most often, this is caused by a pump that is "deep" in the subcutaneous tissue or "tilted" in the body, making it difficult to gauge the location of the port. A template is available to help guide the clinician during the accessing procedure, and some of the pumps have a raised area to help guide the clinician to the port. In rare situations, the pumps actually can flip over, moving the port to the "bottom" surface of the pump. This can be detected only by x-ray. The most common technique for managing difficult access is to identify clearly the edges of the pump, to use the template, and then to "walk the needle" across the surface of the pump to identify the port. (The clinician should have a backup to assist with a difficult patient.) In some cases, it is necessary to access the port under fluoroscopy.

Programming errors are another possible problem encountered with implanted pumps. If the patient reports dramatically increased pain or increased side effects after reprogramming, the clinician should consider a programming error as a potential etiology. Furthermore, the clinician should always double-check and print the new program when reprogramming the pump. A beeping or an alarm sounding is indicative of a pump that has passed its "low reservoir alarm" date and is in need of immediate refill. Alarms also occur at the time of battery depletion, indicating a need for pump replacement. Finally, patients who have a discrepancy between the reservoir volume expected and the actual volume removed may be experiencing a mechanical pump failure. In the case of

rotor-drive pumps, a “rotor study” can be performed according to the manufacturer’s instructions to rule out a rotor failure.

Infections in patients with implanted pumps can be divided into pump-pocket infections and meningitis. Pump-pocket infections occur mostly in the postoperative period and, unless treated very aggressively, will result in the need to remove the pump. Pump-pocket exudates should be cultured and treated with antibiotics targeted toward sensitive organisms. Intravenous antibiotics may be necessary. Patients with meningitis often present with fever, stiff neck, pain in the neck and back, and loss of pain control. Culture of the cerebrospinal fluid and treatment with appropriate antibiotics must be initiated immediately. Removal of the system also is necessary.

Another increasingly reported complication of intrathecal catheters is granuloma at the catheter tip. Granulomas are fibrous, inflammatory masses that form around the catheter tip, potentially causing pressure on the juxtaposed spinal cord. Patients generally present with pain, paresthesia, or numbness in the lower extremities that can progress to paresis with or without bowel and bladder symptoms. The clinician should use an MRI to diagnose the problem, and the infusion should be stopped immediately. These granulomas may resolve on their own once the infusion is stopped (which should be followed by serial MRIs), or they may require surgical decompression.²⁴

CONCLUSION

Epidural and intrathecal drug delivery systems have revolutionized the treatment of intractable pain. The technology now includes temporary and permanent exteriorized catheters as well as implanted parts and programmable pumps. Expert nursing care includes mastery of routine management as well as the ability to troubleshoot mechanical and infectious complications associated with these devices.

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