Intrathecal Pumps for Managing Cancer Pain

What every nurse should know about these programmable medication delivery systems.

ABSTRACT: It is estimated that more than 1.6 million new cases of cancer were diagnosed in the United States in 2014. Among patients with cancer, moderate to severe pain is prevalent and can be refractory, even with the use of systemic opioids, which may cause adverse effects that are difficult to manage at the doses required to control pain. When delivered intrathecally, however, opioids and adjuvant analgesics may provide greater pain relief at dramatically lower doses and with fewer adverse effects. Although the use of intrathecal drug delivery systems for cancer pain management has increased dramatically over the past several years and is expected to continue growing, patients with intrathecal pumps often report interactions with nurses unfamiliar with the technology. This article provides an overview of intrathecal pump therapy and explains how it prolongs duration of action and improves the efficacy of certain analgesics while reducing their adverse effects. The author discusses the costs involved, the patients most likely to derive benefit, the types of pumps currently used in the United States, the medications that can be delivered intrathecally, the potential risks and complications associated with intrathecal therapy, and the nursing care required by patients who use an intrathecal pump.

Keywords: analgesic therapy, cancer pain management, intrathecal drug delivery systems, intrathecal therapy, opioids

According to the American Cancer Society, more than 1.6 million new cases of cancer were diagnosed in the United States in 2014.[1] Among patients with a cancer diagnosis, pain is one of the most commonly reported symptoms, though prevalence and quality of pain varies with type of treatment and stage of disease. A multinational survey of nearly 5,100 adult patients with cancer found that the overall prevalence of reported pain was 84%, and among those who experienced pain several times a month, the quality of pain was characterized as moderate to severe by 94%, severe by 43%, and "worst pain imaginable" by 2%.[2]

The effect of cancer pain on quality of life is substantial and multidimensional. It frequently results in high levels of depression, poor general health, poor physical and social functioning, and impaired ability to perform activities of daily living.[2-4] It may engender feelings of being a burden to others and of wanting to die.[2] Cancer pain can also be refractory to analgesic medications, and many of the medications used to alleviate it can produce adverse effects that are difficult to manage. With intrathecal delivery, however, some of these same analgesics can provide greater pain relief at dramatically lower doses and thus with fewer adverse effects.

The first known use of intrathecal drug administration for pain occurred in 1898 when the German surgeon August Bier successfully eliminated surgical pain by injecting intrathecal cocaine into a young man before resecting an infected ankle joint.[5] In the late 1970s, U.S. physicians published the first report of intrathecal morphine administration for cancer pain.[6] By the late 1980s two systems had been developed for delivering intrathecal drugs.[7]

This article provides an overview of intrathecal analgesia, explaining how and why intrathecal administration may prolong the duration of action and

improve the efficacy of certain analgesics. It also identifies which drugs can be delivered intrathecally. It discusses the costs of intrathecal drug delivery systems (IDDSs), describes the patients most likely to derive benefit from intrathecal administration, and outlines the nursing care required by patients who use intrathecal pumps, highlighting potential risks and complications associated with intrathecal drug therapy.

BENEFITS OF INTRATHECAL ANALGESIA

Pain can be modulated downward in the central nervous system via connections within the dorsal horn of the spinal cord.[8] Located within the dural sheath, the intrathecal space, also known as the subarachnoid space, contains cerebrospinal fluid (CSF) and the spinal cord (see Figure 1). In the intrathecal space, opioids and other adjuvant analgesics encounter no anatomic barriers and vascular absorption of drugs is slow. Therefore, intrathecal administration of very small quantities of opioids, either alone or in combination with adjuvant agents, introduces a highly concentrated reservoir of analgesic medication close to the site of action, where it diffuses passively into the dorsal horn, providing superior pain relief with minimal

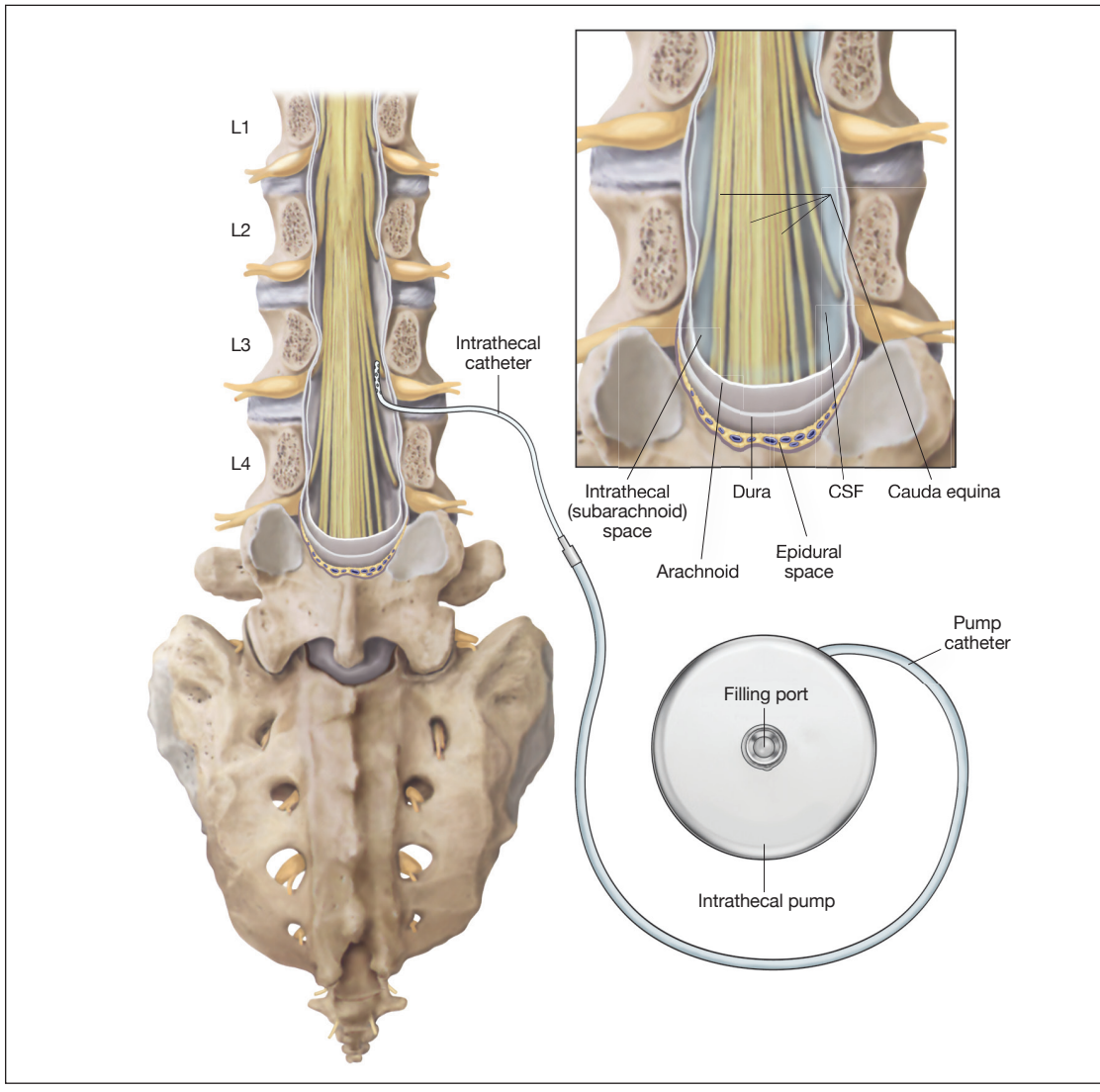


Figure 1. The catheter from an intrathecal pump is inserted in the lumbar region of the spinal cord at the L3 level. The insert highlights the cauda equina and surrounding structures. CSF = cerebrospinal fluid. Illustration by Anne Rains.

adverse effects.[9, 10] Bioavailability of an opioid depends on how hydrophilic (water soluble) or lipophilic (fat soluble) it is, with the more hydrophilic opioids (such as hydromorphone [Dilaudid] and morphine) having greater bioavailability than the more lipophilic opioids (such as alfentanil, fentanyl [Sublimaze], and sufentanil [Sufenta]).[11, 12]

There is strong evidence to support use of an IDDS to manage cancer pain.[7, 10, 13-16] When compared with comprehensive medical management of cancer pain that excluded spinally administered drugs, intrathecal analgesia has been shown to significantly reduce pain and medication toxicity[7, 14, 16]; improve mood[10]; enhance mental and physical function[10, 14]; improve quality of life[10, 14]; increase survival[16]; and demonstrate efficacy against neuropathic, mixed visceral, and somatic pain.[10, 13] Long-term intrathecal analgesia is effective against chronic pain, including cancer pain, in up to 77% of patients, with some patients reporting pain relief within one month that was sustained over three years.[17]

When administered intrathecally, morphine and hydromorphone have been shown to have more than 400 times the potency they have when delivered subcutaneously.[18] Though the relative potency of oral morphine to intrathecal morphine has not been definitively established, an oral to intrathecal ratio of 300 mg to 1 mg is commonly accepted in clinical practice (see Table 1[12, 19]).[19] The intrathecal route also makes it possible to target multiple pain receptors using a wide variety of medications,[9, 20] including medications that cannot be administered by any other route.

When compared with epidural or systemic administration, the intrathecal route has the lowest potential for adverse effects. This is because most of the medication delivered remains concentrated within one centimeter of the catheter tip, having bypassed peripheral receptors responsible for many of the adverse effects associated with opioids.[21, 22] When compared with comprehensive medical management, intrathecal administration has been shown to reduce opioid toxicity by 51%.[23]

It's easy to make dose changes with an IDDS using wireless telemetry communication with the help of a remotely controlled programming device provided by the manufacturer. Refilling a pump requires only a brief in-office procedure. Using aseptic technique and a refill kit provided by the manufacturer, the pump can be accessed, and medication remaining in the reservoir can be aspirated and replaced with new medication. Refill intervals can be as long as three months, depending on the concentration and amount of drugs required for pain control.

For patients with opioid-refractory cancer pain, unmanageable opioid adverse effects, or the expectation of severe pain with disease progression, the benefits of intrathecal therapy generally outweigh any concerns associated with its use.

Table 1. Approximate Equivalent Doses of Morphine Based on Route of Administration[12, 19]

Morphine Dose	Route of Administration
300 mg	Oral
100–200 mg	Intravenous
10 mg	Epidural
1 mg	Intrathecal

COST CONCERNS

In 2011, the Medicare allowable cost for implanting an intrathecal pump was $35,601, which is a realistic estimate of the total cost, including the cost of the device and catheter, professional fees, facility fees, and initial fill medication.[24] Despite this high initial cost, a 2013 study found that when used to manage intractable cancer pain, intrathecal therapy (including medications, pump implantation, and maintenance) may achieve cost equivalence to that of high-cost, conventional analgesic therapy within 7.4 months.[24] The authors calculated the median monthly cost of cancer pain medication for 36 patients receiving either low cost (n = 24) or high cost (n = 12) conventional analgesic therapy as $400 and $5,246, respectively, before the use of an IDDS and as $487 after IDDS implantation. They concluded that, for patients with refractory cancer pain and a relatively long life expectancy, intrathecal therapy may be cost beneficial within six months. An IDDS is generally indicated for patients with a life expectancy of at least three months.

POTENTIAL RISKS

Intrathecal therapy is not without risk. The catheter can become dislodged, fractured, or occluded.[25-29] A granuloma, which is a noninfectious mass of cellular debris that can form at the tip of the catheter,[19, 28, 30] can potentially cause spinal cord compression. Surgical site infection can occur[31, 32] and, if infection migrates up the catheter, could result in life-threatening meningitis.[19, 25, 28, 33] During refills, medication may inadvertently be instilled into the pocket around the pump, resulting in a potentially fatal drug overdose.[25, 30, 34] Like all mechanical devices, the pump can malfunction, fail, or leak.[19, 25, 33, 35] In addition, programming errors can result in overdose or insufficient dosing.[28, 33]

The incidence of complications is generally considered to be low, with reported rates as follows:

- catheter migration, 5.3%[36]
- catheter fracture, 5.3%[36]
- occlusion, 1.8%[37]

- bacterial meningitis, 2.8%[38]
- surgical wound infection, 2.7%[31] to 8.8%[36]
- granuloma, less than 3%[39] to 3.5%[36]
- mechanical failure of pump or battery, 5%[40]

Actual incidence of complications may be higher, however, owing to underreporting.

PATIENT SELECTION

Determining which patients might benefit from an IDDS is important. Certain cancers are known to be associated with a high prevalence of pain, including the following[19,41]:

- prostate, 56% to 94%
- head and neck, 67% to 91%
- uterine, 30% to 90%
- urogenital, 58% to 90%
- breast, 40% to 89%
- pancreatic, 72% to 85%
- multiple myeloma, 73%
- lung, 61%

In patients with cancer known to cause refractory pain, early implantation of an IDDS can be considered even before the use of systemic opioids.[42] Postponing implantation until widespread metastatic disease has developed—when the patient may experience extreme pain and demonstrate significant opioid tolerance—often results in suboptimal relief. Patients with cancer pain that has responded poorly to escalating opioid therapy and those with intolerable opioid adverse effects may also be candidates for intrathecal therapy.[19]

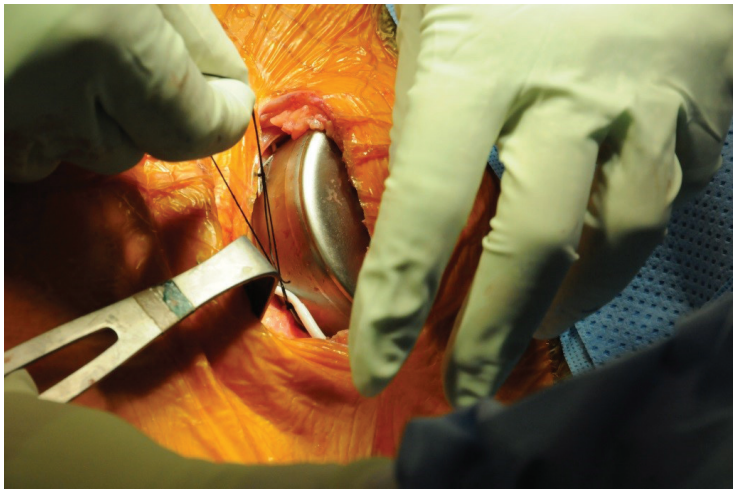
Contraindications include ongoing infection, inability to implant the pump an inch or less from the skin's surface (due to anasarca, for example), insufficient body size to accept the pump's bulk and weight, spinal abnormalities,[43,44] and inability to interrupt anticoagulant therapy.[10] Other factors to consider include

- patient expectations of the device capabilities.[33]
- patient history of adherence to a treatment plan and ability to keep appointments for pump maintenance.[45]
- patient's general medical status, psychological status, social support, and disease prognosis.[10]
- availability of skilled, knowledgeable physicians and nurses able to provide ongoing pump management if hospice is required.

PLACEMENT OF AN INTRATHECAL PUMP

In the past, a prepump psychological evaluation followed by an intrathecal trial was considered critical in determining likelihood of therapy success. As evidence supporting the efficacy of intrathecal therapy for cancer pain has grown, however, many insurance companies have relaxed that requirement. Today—with the exception of Medicare, which still requires an intrathecal trial—it is relatively uncommon for insurance payers to require patients with cancer pain to undergo a trial. Medications used during a trial include morphine, hydromorphone, fentanyl, ziconotide (Prialt), bupivacaine (Marcaine Spinal), clonidine (Duraclon), and sufentanil. The trial medication is injected into the intrathecal space as a one-time dose or administered over several hours or days through an intrathecal catheter connected to an external pump.[17]

Figure 2. Creating the pump pocket. Used with permission from William S. Rosenberg, MD.



Placement of an intrathecal pump involves two surgical procedures: one to place the catheter into the intrathecal space and another to place the pump under the skin. A small incision is made over the lumbar spine and, unless anatomy or other circumstances require alternative placement, a needle is inserted at L2–L3 or L3–L4 because lower areas of the spine are more mobile, increasing the risk of catheter displacement or damage.[32] Under fluoroscopic guidance, the catheter is then threaded to the appropriate level of the spinal cord and anchored in place. Next, a shallow pump pocket is created between the skin and the fascia (see Figure 2). Manufacturers recommend that the pump be placed in the lower abdomen,[32] though the flank or posterior buttock can also be used. The pump is placed in the pocket and sutured to the fascia. A special tool provided by the pump manufacturer is used to create a tunnel under the skin from the pump pocket to the catheter. The catheter is then pulled through to the pump pocket, and the pump is filled with medication. The catheter is secured to the pump and the incision is closed. The pump is programmed to deliver the ordered dose of medication.

APPROVED PROGRAMMABLE INTRATHECAL PUMPS

Three implantable intrathecal pumps are approved for patient use by the U.S. Food and Drug Administration (FDA): the SynchroMed II (Medtronic, Minneapolis),[44]

and the Prometra[46] and the Prometra II[47] (Flowonix Medical, Mount Olive, New Jersey). All three pumps are programmable, which eases dosing changes and titration.

These titanium pumps are battery operated. The Prometra pumps have a 20-mL medication reservoir, and the SynchroMed II is available with either a 20-mL or a 40-mL medication reservoir. Pressurized gas beneath the pumps' reservoirs advances the medication through the internal tubing.

The pumps can be programmed to deliver a precise medication dosage at a constant or variable rate. In addition, the Prometra pumps may be programmed to deliver medication periodically at specific intervals, and both the SynchroMed II and the Prometra II allow the patient to administer a prescribed bolus dose for breakthrough pain.

Morphine has a long history of intrathecal effectiveness.

The pumps are compatible with magnetic resonance imaging (MRI). If the patient is using an earlier model of the Prometra, however, all medication must be removed from the reservoir prior to the scan and the drug flow rate must be programmed to 0.0 mg per day; otherwise, the magnetic fields could open the valves, releasing all medication in the reservoir and causing a massive overdose. Prior to MRI, an alternative pain management plan should be implemented. The flow-activated valve of the Prometra II shuts down if a high flow rate occurs (as during MRI), but a small amount of the drug (less than 10 mcg/L) is delivered. The physician should determine whether this would be a safe amount for the patient to receive during the procedure. If the Prometra model in use cannot be determined, the drug reservoir must be emptied. The SynchroMed II will suspend drug infusion during MRI but should be interrogated by a clinician following the procedure to ensure that drug delivery has resumed.

When pumps reach the end of their service life, they must be surgically replaced. Service life depends on flow rate. The SynchroMed II has a service life of approximately 84 months. The Prometra and Prometra II have a minimum life of 10 years at a flow rate of 0.25mL per day.

MEDICATIONS USED FOR INTRATHECAL ANALGESIA

Only morphine and ziconotide are FDA approved for intrathecal pain management, though a variety of other medications, including hydromorphone, fentanyl, sufentanil, bupivacaine, and clonidine, are commonly used off label.[17, 19] Medications are selected based on targeted receptors.[19] Since preservatives are associated with neurotoxicity, all intrathecal medications must be preservative free. Published recommendations are available to guide starting and maximum doses of intrathecal drugs (see Table 2[17]).

Opioids. Used alone, opioids are effective in reducing cancer pain, but opioids plus a local anesthetic provide superior pain relief at lower opioid doses.[12, 17] Hydrophilic opioids are used when there is a large area of pain to cover; lipophilic opioids are best for targeting a small area of pain.[17] Some providers use both a hydrophilic and a lipophilic opioid when there is a need to target a small, intense area of pain but also provide widespread analgesic coverage.

Morphine, a highly hydrophilic opioid that spreads widely within CSF, has a long history of intrathecal effectiveness.[17] Hydromorphone, which is less hydrophilic but more potent than morphine, is also commonly used intrathecally.[17] While fentanyl, a highly potent, highly lipophilic opioid, can provide analgesia to a very small area near the catheter tip, sufentanil, also highly lipophilic, is even more potent, though very expensive compared with other opioids.

Lipophilicity and hydrophilicity determine not only an opioid's spread, but also its duration of action and potential adverse effects. Opioids administered intrathecally move across the CSF into the spinal cord and the epidural space. Hydrophilic opioids move across the CSF more slowly but to a greater extent than lipophilic opioids, bind poorly to epidural fat, and enter the systemic circulation slowly, which results in a slower onset of action but long-lasting pain reduction and late onset of prolonged respiratory depression.[32, 48] The most common adverse effects of opioids, such as nausea, vomiting, pruritus, urinary retention, sweating, peripheral edema, constipation, and hormonal imbalance (particularly affecting the sex hormones), are more frequently seen with hydrophilic opioids.[12] Lipophilic opioids, on the other hand, rapidly cross the dura mater and enter the epidural fat and systemic circulation, which results in rapid-onset, shorter-acting analgesia and early-onset respiratory depression, though with fewer other opioid-associated adverse effects.[48] There is no clear correlation between dosage and incidence of nausea and vomiting in patients receiving intrathecal opioids.[49] Constipation and fatigue are the adverse effects most likely to decrease with intrathecal administration.[16]

Local anesthetics provide analgesia by blocking sodium channels necessary for depolarization of neurons, thereby inhibiting the action potential of nerve tissue in the dorsal horn of the spinal cord and the intrathecal portion of the nerve roots.[12, 33] Commonly used agents include bupivacaine and ropivacaine (Naropin). Bupivacaine can cause sensorimotor changes, including numbness, weakness, and

Table 2. Recommended Starting and Maximum Dosages of Intrathecal Medications[17]

Drug	Starting Dosage Range	Maximum Dosage
Morphine	0.1–0.5 mg/day	15 mg/day
Hydromorphone	0.02–0.5 mg/day	10 mg/day
Ziconotide	0.5–2.4 mcg/day	19.2 mcg/day
Fentanyl	25–75 mcg/day	No known upper limit
Bupivacaine	1–4 mg/day	10 mg/day
Clonidine	40–100 mcg/day	40–600 mcg/day
Sufentanil	10–20 mcg/day	No known upper limit

bowel or bladder incontinence. Ropivacaine is nearly identical to bupivacaine in terms of onset, quality, and duration of block, though the intensity of its motor block tends to be lower.[17] Potential adverse effects include sensory deficits, paresthesia, motor impairment, urinary retention, hypotension, diaphoresis, fatigue, somnolence, autonomic dysfunction, and neurotoxicity, though adverse effects are generally not seen at low doses (less than 15 mg per day).[28, 33]

α_2-adrenergic agonists provide analgesia two ways: by inhibiting spinal cord glial cell activation and by binding to receptors on primary afferent neurons, thus hyperpolarizing the neurons and reducing the release of neurotransmitters involved in pain signaling.[17, 28] One such agent, clonidine, is associated with such adverse effects as nausea, dizziness, confusion, sedation, orthostatic hypotension, bradycardia, and dry mouth.[33] Depression, insomnia, and night terrors have also been reported.[33]

γ-aminobutyric acid (GABA)-A receptors play a critical role in inhibiting the system responsible for implementing and perpetuating pain. Baclofen (Gablofen, Lioresal) is a GABA agonist with antihyperalgesic effects at the spinal level that has been shown to produce analgesia and reduce sensitivity at doses that do not impair motor function.[12] Baclofen may be particularly helpful in reducing pain secondary to underlying muscle spasm, which is commonly associated with bony metastasis.

Ziconotide is a synthetic form of the toxin produced by the Conus magus snail.[50] This nonopioid, atypical analgesic is FDA approved as a first-line agent for managing cancer pain.[17] Within the dorsal horn of the spinal cord, N-type calcium channel blockers are present in pain pathways. Ziconotide reversibly and selectively blocks the influx of calcium into the cells, reducing the release of multiple neurotransmitters responsible for pain transmission.[50, 51] Ziconotide, which can be given only intrathecally, has no mu activity and is not associated with respiratory depression. However, it has a very narrow therapeutic window and is associated with numerous adverse effects, including suicidal thoughts, worsening mood disorders, cognitive impairment, psychosis (with auditory or visual hallucinations), impaired memory, vertigo, speech disorders, hypotension, diaphoresis, nausea, acute urinary retention, muscle cramps, creatine phosphokinase elevation, nystagmus, abnormal gait, and amblyopia.[9, 17, 50, 51]

In a study of 77 patients with cancer pain who were treated with ziconotide, 44 (57%) reported experiencing adverse events, but discontinuation was required in only seven (9%).[51] The FDA recommends that starting dosages of ziconotide should not exceed 2.4 mcg per day and that dosages should increase in steps no greater than 2.4 mcg per day, titrated upward no more frequently than every 48 hours.[51] Most serious adverse drug effects are associated with too high a starting dose or too rapid titration.[50]

***N*-methyl-D-aspartate (NMDA) antagonists.** Ketamine is an NMDA receptor antagonist that blocks the action of glutamate and facilitates GABA.[17] On the basis of postmortem spinal cord tissue studies, it is considered neurotoxic; but it is unknown which patients will develop neurotoxicity, at what dose, over what duration, and how they will present. Ketamine, however, can be very effective in reducing cancer pain that is unresponsive to other agents and for severe neuropathic pain.[52]

CARING FOR THE PATIENT WITH AN INTRATHECAL PUMP

Admission nursing care. When admitting a patient with an intrathecal pump, ask the patient or family to provide the name of the physician managing the pump. Then contact the managing physician's office and request the following information in printed form:

- the level of the catheter tip
- medications and concentrations administered by basal or continuous dose
- patient-administered dosage, if applicable
- pump reservoir volume
- refill alarm date

The office staff should also provide contact information for manufacturer representatives in the event that an emergency occurs or the nursing staff is unfamiliar with the product.

Postoperative nursing care following pump implantation includes vigilant monitoring of respiratory status, surgical sites, and control of surgical pain. Respiratory depression is a rare but life-threatening event. After initiation of intrathecal opioid therapy, patients should be monitored for respiratory depression (that is, for respiratory rate, oxygenation, and level of consciousness) every one to two hours during the first 12 hours following initiation and every two hours for the next 12 hours.[17] Comorbidities that place patients at greatest risk for respiratory depression include central or obstructive sleep apnea, chronic obstructive pulmonary disease, smoking, obesity, and concurrent use of sedating drugs.[17] Respiratory depression is managed with respiratory and cardiac support, transfer to a high acuity level of care, reducing intrathecal medication to the lowest possible dosage, discontinuation of systemic sedating medications, and ruling out other causes.[25]

In the interest of patient safety, long-acting opioids should not be given.

MONITORING FOR COMPLICATIONS

Patients with intrathecal pumps must be monitored for three types of complications: surgical, pump related, or catheter related.

Surgical complications include infection, meningitis, bleeding, pocket seromas or hematomas, and post–dural puncture headaches. A CSF leak can occur anytime and presents as a raised, swollen, nonred, nonwarm, nontender area under the lumbar incision. It may or may not be accompanied by a postural headache, depending on the extent of the leak. If a CFS leak occurs, the physician who implanted the pump should be notified. It is not considered an emergency, however, and is treated with bed rest.[17]

Pump-related complications include pump malfunction and pump flipping or tilting.[32] Pump malfunction, which is uncommon, tends to cause underdosing or overdosing of medication,[32, 53] and manifests as loss of pain control or sudden somnolence. If there is reason to believe the pump has flipped or tilted, apply an abdominal binder. No attempt should be made to manually return the pump to its normal position. In either case, notify the physician.

Constipation and fatigue are the adverse effects most likely to decrease with intrathecal administration.

To reduce postoperative bleeding, anticoagulants should be withheld until their administration is approved by the physician who implants the pump. Anticoagulants can usually be resumed two to three days after surgery. An abdominal binder may be used to hold the pump flat within the pocket for two to four weeks following surgery. This will allow time for the pump to become further embedded in the pocket, reducing the chance that it will flip over or that fluid will accumulate in the pocket. Patient education should reinforce the need to adhere vigilantly to postoperative restrictions, which include

- no lifting more than five pounds.
- no raising arms overhead.
- no bending or twisting at the waist for six weeks.

Individual surgeons may further restrict postoperative activity.

A common misperception is that the pump is capable of relieving any pain the patient experiences. Do not expect the pump to provide relief from pain related to surgery, including pain along the tunneling path. Systemic short-acting opioids will be necessary to manage such situations. For pain related to cancer, a patient-managed bolus should be used if available.

Catheter complications, the most common reasons for therapy failure, include microfracture, leaks, disconnection, breakage, kinks, migration, partial occlusion, or granuloma formation.[25, 32, 45] Symptoms are frequently subtle, presenting as a change in pain control or as opioid withdrawal.[32] When such symptoms occur, X-ray or computed tomography to evaluate catheter location is indicated, though a catheter dye study performed under fluoroscopy may be necessary.

Granuloma formation, though uncommon, is a particularly concerning complication that should be considered any time there is evidence of reduced medication efficacy or the patient presents with new neurologic symptoms at or below the level of the catheter tip, including new pain onset, numbness, limb weakness, or bowel or bladder incontinence.[32, 54] A complete patient history and a thorough neurologic examination—including assessment of deep tendon reflexes, sensory changes, and proprioception—is indicated.[32] The physician should be notified immediately. Thin-slice MRI with gadolinium performed

at the level of the catheter tip is most commonly used to determine the presence of a granuloma.[32, 54]

SPECIAL CONSIDERATIONS

A burning sensation over or around the pump has been reported by some patients. This phenomenon is not well understood but may be related to the development of postimplant neuropathic pain or scar tissue formation. Cold packs and lidocaine creams or patches may provide effective relief. Heat (in the form of heating pads or hot tubs, for example) should never be directly applied over a SynchroMed pump, because flow rate on these pumps varies with body temperature, increasing as it rises above or decreasing as it falls below 37°C (98.6°F). While, theoretically, fever would increase the flow rate of the SynchroMed II, a fever of 41°C (105.8°F) would increase the flow rate by only 5%, and the flow rate would return to normal following the febrile episode. The Prometra pumps can tolerate temperatures as high as 57°C (134.6°F) and as low as 2°C (35.6°F).

Baclofen and clonidine should never be discontinued abruptly. Abrupt discontinuation of intrathecal baclofen can result in life-threatening withdrawal that can be severe and prolonged.[17] Signs of baclofen withdrawal include respiratory depression, profound hyperthermia, disseminated intravascular coagulation, multisystem organ failure, and coma. Abrupt discontinuation of high-dose clonidine can result in rebound hypertension, with increased risk of stroke.[33]

External beam radiation. Though pump failure from external beam radiation has not been researched sufficiently to determine safety guidelines, it is theorized that pump battery drain or electronic failure could result from exposure.[55] Intrathecal pumps should thus be shielded with lead during treatment[56] and checked after treatment to verify functionality.[55]

Hyperbaric therapy could damage an intrathecal pump or cause underdosage. If hyperbaric therapy is indicated, the manufacturer should be contacted for guidance.

Postmortem care. When a patient with an intrathecal pump dies, the funeral home should be informed of its presence and brand. Pumps will explode if cremated or incinerated. After use, these devices are considered biohazards. Removed pumps should never be sterilized and reimplanted.

CONCLUSION

Intrathecal therapy is a very effective and increasingly popular modality for managing cancer pain. As use of intrathecal drug delivery continues to increase, more nurses are likely to care for patients with an intrathecal pump. To provide the highest level of patient care, nurses must have a good understanding of the therapy and potential complications. For the majority of patients with cancer pain, the pump dramatically improves quality of life. As one patient told me, "Having a pump opened my eyes to the possibilities—you don't have to suffer." ▼

For 31 additional continuing nursing education activities on pain management, go to www.nursingcenter.com/ce.

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