

Intrathecal Drug Delivery System for Chronic Pain Management

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Introduction

Since the beginning of this century, medical science is giving much importance of acute and chronic pain management. Recently, Anesthesiologists have been increasingly involved in development of acute and chronic pain management. "Pain" is derived from Latin word "Poena" that means a penalty or punishment. It may be defined as "suffering, distress, soreness, the sensation one feels hurt". Thus pain is sensory and emotional experience which is a subjective feeling. The international association for the study of pain (IASP, 1979) defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage."

Chronic pain is quite common among the large population. These pains are dull and uncomfortable sensations and are further exaggerated by psychological distress. Chronic pain is treated in pain clinics. These are comprehensive multidisciplinary pain clinics where patients come by referral, where pain specialists evaluate and diagnose the source of pain whether it is peripheral tissue trauma or psychogenic behavioral problems or both and then treat accordingly.

In some patients there is an observable pathology exists, which is associated with persistent long duration of pain, like malignant pain (chronic pain) which is very severe and where most of conservative therapies have failed. In such patients direct administration of opioids to spinal cord receptors is very much useful technique to relieve pain. For this a new technology has evolved which is well practiced in developed countries and termed

as *Intrathecal Drug Delivery System* (IDDS). It means there is a continuous deposition of analgesic drugs in subarachnoid space i.e. continuous spinal analgesia. For this the most commonly used opioid is Morphine because it exhibits slower onset and longer duration of action. Other medications which can also be used are local anesthetics, baclofen, fentanyl, sufentanyl etc.

Historical Background

The administration of narcotics in and around the neural axis arose following the detection of opiate receptors by Pert and Snyder and Yaksh and Rudy in the late 1970s. More than 50,000 patients worldwide have received Medtronic drug infusion system to treat chronic pain or severe spasticity and is in use since the early of 1980s. The first clinical implant of a Medtronic programmable pump for intrathecal morphine was performed in 1982. In the United States it was released in 1991.

Components of IDDS

This Intrathecal drug delivery system (IDDS) is composed of two implantable components.

- a) An infusion metal pump
 - b) An intraspinal catheter
- a) An infusion metal pump is implanted in the lower abdomen, in a subcutaneous pocket which is made surgically under local anesthesia. This pump is programmable and is set to deliver medication by pain specialists and locked by a coding system so changing of dose can be done only by treating Pain Physician who will decode the system and adjust the dose accordingly. This coding and decoding is done exteriorly by a small computer like device which sends signal to this implanted infusion pump. Medication can be delivered at a constant or variable flow rates.

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- b) An intraspinal catheter is inserted into the intrathecal space of spine, tunneled under the skin and connected to the infusion pump.



Picture Showing inserted Intraspinal Catheter

How it Works

Nociceptors are the free nerve ending receptors which gather the sensory information of pain and is transmitted via sensory neurons to the dorsal horn of the spinal cord. In the dorsal horn, sensory neurons release several neurotransmitters especially substance P that act on the dendrites of ascending neurons. Eventually, these ascending neurons carry the signal to the brain where it is perceived as pain.

When we put the opioids in the intrathecal space with the help of this IDDS system, it will inhibit the release of substance P and other neurotransmitters by bonding to opioid receptors (Mu, Kappa, Delta), thus blocking the transmission of message signal to the brain where it would be perceived as pain. The advantage of putting the opioid directly into the cerebrospinal fluid is that a much smaller dose is needed and the frequency of side effects is also quite low. Most frequently used opioid for this purpose is Morphine. Because it is

less lipid soluble than fentanyl and sufentanyl (800 & 1600 times respectively) thus it exhibits slower onset and longer duration of action as it remains in CSF for longer period and also ascends cephalad.

Candidates of IDDS are these patients where;

- More conservative therapies have failed
- An observable pathology exists that is associated with the pain
- Further traditional surgical intervention is not indicated
- No serious untreated drug habituation for pain condition exists
- Psychological evaluation and clearance for implantation have been received
- No medical issues exist that are contraindicated for surgery
- The screening trial is successful

Pain Pump screening Trial

- The objective of the trial is to determine your response to medication delivered into the intrathecal space
- Single injection: small amount of medication is delivered with a needle and syringe into spinal column
- Continuous infusion: a continuous infusion of medication is delivered through a temporarily implanted catheter which is attached with the external pump. This trial goes over several days.

Benefit of this System are that it;

- Reduces the risk of infection compared to long term use of external system.
- No external parts, so does not restrict daily activities.
- Programmable pump allows clinicians to adjust dose non-invasively.
- Pump can be programmed to deliver different doses at various times of the day-meeting patients changing needs during day and night time.

- e. Frequency of side effects of opioids are much reduced as very small dose is used. (pruritis, nausea, vomiting, sedation, constipation, respiratory depression)
- f. Improved physical assessment and increased ability to perform daily activities.

Complication of this System

- a) Pharmacological – Mainly pharmacological side effects reported are brurits, nausea, vomiting, sedation, constipation. And these problems are transient and not so much alarming.
- b) Equipment – there are some reports of catheter disconnection, blockage and leakage of drugs.
- c) Procedural – As this is the surgical procedure, there is always a chance of infection, bleeding, haematoma, pain, and discomfort in the operated site.
- d) Programming errors – Sometimes due to programming errors there could be chance of over dose or under dose. But this is very rare.
- e) Psychological – Some of the patients may have psychological discomfort that there is implanted metal inside of the body.

Conclusion

There are several studies regarding this system and it has been found that IDDS is a very effective and safe device for the chronic pain management where the conservative therapies have been failed. As there is very low dose of opioid used there is less side effect and high grade of pain relief. Thus the quality of life and survival of patient with chronic malignancy and non malignancy pain with this system is significantly improved. In future there is

a hope that this system will be a popular device for pain management in our country as well.

Reference

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