

# Invasive Techniques In Pain-management: From Infiltration To Pump-implantation

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## Abstract

Invasive techniques in pain-management are an important addition to conservative treatment. Only if pain is localized, invasive techniques, which are applied to certain parts of the body, can be successful. The success-rate depends on careful selection of patients and the knowledge of possible complications and side-effects. Patients should be thoroughly informed about special complications and limited duration of treatment. For techniques like implantation of pumps or stimulators prognosis and progression of the illness need to be considered, also in view of economic aspects.

## INVASIVE THERAPIES AND FREQUENT LOCALISATION

### 1. INFILTRATION OF

- muscles
- skin
- subcutaneous nerves
- trigger-points

### 2. INJECTIONS OF JOINTS

- sacro-iliac joint
- facette-joint
- knee
- shoulder

### 3. NERVE BLOCKADE

- occipital nerve
- trigeminal nerve
- stellate ganglion
- superior cervical ganglion
- other autonomic ganglia
- celiac plexus

- lumbar sympathetic

- brachial plexus

- intercostal

- paravertebral nerves

### 4. CENTRAL NEAR VERTEBRAL SPINE BLOCKADES

- intrathecal

- epidural as single shot or with catheter with pump implanted or external

### 5. SPINAL CORD STIMULATION INFILTRATION

Infiltration techniques are used for painful distension of muscles and for painful limitation of movement. Local anesthetics ( LA ) are used with different pharmacodynamics. For achievement of lasting pain-relief , Bupivacaine or Ropivacaine, two long-acting LA's can be used. Infiltration could be repeated to facilitate physiotherapy during the pain-free interval. This should not be performed as permanent repeated injections, because patients could get very dependent on the doctor. Independence for the patient with e.g. oral pain-relief is sometimes more useful.

### **INJECTIONS INTO JOINTS**

Local anesthetics as well as steroids are frequently injected into joints in aseptic inflammation of knee-or shoulder, to increase mobility and allow physiotherapy. This combination could also be used for pain and distension in the sacro-iliac joint with a series of injections. LA's without steroids are used for blocks of the facette-joints. Indication should be worked out thoroughly and patients need to know about limitations of therapy. For chronic pain in the sacro-iliac joint neurolytic injection is an option.

### **NERVE AND GANGLION BLOCKADE**

These blocks could be used therapeutically and also diagnostically. A nerve could be blocked with local anaesthetic to differentiate dermatomes of certain nerves and divide central from peripheral originated pain. Therapeutic blocks in isolated nerves are rarely applied, because the duration of action is , depending on the substance, limited. Therapy of acute pain is an exception. Examples would be intercostal nerve block for fractured ribs, brachial plexus block for mobilisation of the upper extremity and treatment of phantom pain. Continuous application with a catheter technique would be more effective in that case (Lierz 1998).

For blockade of the celiac plexus, the lumbar sympathetic nerves, the stellate and the superior cervical ganglion LA's are traditionally used to produce sympathicolysis. It is not necessary to block nociceptive nerves. This would be indicated for pain-syndromes where the sympathetic nerve is involved, like in peripheral neuropathy, CRPS I and II , peripheral vascular disease (PVD) and others. If the transient blockade is successful, a neurolytic technique can be applied. This could be performed either with 50% ethanol or by thermocoagulation. Unfortunately there is evidence that after effective sympathicolysis the duration of actual pain-relief is limited to four to twelve months. Because of the risks indication should be considered carefully.

Sympathicolysis is a very useful method for pain management in cancer patients, whose life expectancy is not longer then 3 to 12 months. The belt-like abdominal pain in patients with carcinoma of the pancreas can virtually always be relieved by celiac plexus blockade. Results for this technique in selected cancer-patients are good. In 70-90% of patients with cancer of the pancreas or upper abdomen sufficient long-lasting pain-relief, sometimes up to death, can be expected.

Besides most studies report a significant reduction of

additional oral analgesics with a subsequent reduction of analgesia-induced side-effects.

According to a survey and meta-analysis of Eisenberg (1995) 96% of patients have short-term localized pain, 38% have transient hypotension, 44% have mostly reversible diarrhea, triggered by sympathicolysis. Severe other, especially neurologic complications are described in only 1% of cases.

This meta-analysis showed that similar success-rates could be achieved either with or without radiograph, computed tomography ( CT ) and ultrasound. None of these had been used in one third of the cases without changing the success-rate much. Nowadays invasive techniques like celiac plexus blocks should not be done without radiological diagnostics.

X-ray and CT are mostly used now, whereas ultrasound is reserved for the ventral approach.

The application of opioids to ganglia is a supplement to the classical blockade with LA. Promising results have been published, especially for trigeminal- and postherpetic neuralgia. Series of blocks with Buprenorphine are done mainly for the stellate and the superior cervical ganglia and sometimes for the sphenopalatino ganglion. Every 2 to 3 days injections are repeated up to 8 to 10 times.

Blocks of peripheral nerves can lead to a sympathicolysis in the corresponding dermatome. However, with use of LA the blocking effect will mostly be nociceptive, sensible and motoric depending on dosage. The substance can be injected next to a certain nerve-root to get maximal spread and to reach certain central nerve-branches. This can be achieved via paravertebral injection as well as epidural injection of a single nerve-root. A C-shaped epidural catheter is advanced under X-ray-control towards the desired nerve-root and the substance is injected directly there. The advantage is, that only one segment is blocked and side-effects are decreasing.

### **NEUROLYSIS, CRYOTHERAPY, THERMOCOAGULATION**

Neurolysis is achieved by ethanol- or phenol-injections, cryotherapy or thermocoagulation with a radio-frequency-generator. Every block needs to be tested with LA's first, in certain cases even twice, before proceeding to neurolysis.

This is mandatory for every destructive blockade. Neurolysis should mainly be used in patients with malignant conditions and reduced life-expectancy because a deafference pain, which is very difficult to treat, can occur after nerve-

destruction.

### **EPIDURAL AND SPINAL TECHNIQUES**

Most important for management of chronic pain are probably central blockades. Permanent implantation of pumps and stimulators are also possible.

The spinal cord is not only a pathway for pain-conveyance, it has its role in processing and modulating nociceptive information. There are enhancing and inhibiting mechanisms. The latter are used in central application of analgesia. The choice of technique depends for instance on whether pain is acute or chronic in nature.

The decision should be made pre-operatively, so that the operation can possibly be done with regional anesthesia only, or in combination with general anesthesia. Early application of regional techniques should also be considered for trauma patients. These are getting effective therapy of pain and possible prevention or treatment of phantom-pain.

Epidural as well as spinal application of drugs could be injected as single-shot or catheter-technique. Combined spinal- epidural (CSE) analgesia-anesthesia combines both techniques. The decision which technique is used does not only depend on duration and type of operation, economic aspects need more and more consideration. Catheter techniques are also used postoperatively for analgesia. Single-shot injections are mainly used for short or intermediate procedures. Prompt action and a reliable motor-block are advantages of intrathecal application. For longer duration of action, less motor-block and a lower incidence of post-dural-puncture headache through loss of liquor, epidural injection would be favorable. The CSE-analgesia combines advantages of both techniques. Intrathecal catheters are frequently not indicated for therapy of acute pain because of high cost, more hygienic complications and the danger of loss of liquor.

### **CONSIDERATIONS FOR MANAGEMENT OF CHRONIC PAIN WITH INVASIVE TECHNIQUES**

- Besides sole therapy of pain the underlying illness needs to be treated or investigated further
- Secondary or following symptoms and side effects of therapy need to be treated, if necessary with systemic pharmacotherapy.
- Not to forget physical- and physiotherapy.

Beside intrathecal and epidural drug-application electric stimulation of the spinal cord is used for chronic pain.

For patients with lower back-pain or postherpetic neuralgia single-shot technique would be feasible. Frequently a series of blocks is applied every few days. This is especially useful for outpatients, whereas epidural catheters are mainly applied for in-hospital-patients. The period of treatment with epidural catheters often needs to be shorter compared with intrathecal catheters because a greater amount of drugs with potentially more side-effects are used. The permanent indwelling catheter could cause epidural fibrosis, so that further drug-increments are necessary (Crul 1991).

For longer periods of treatment intrathecal catheters are preferred. Beside malignant disease indications are degenerative illness, vascular disease, systemic reflex-dystrophies and neuropathies.

Catheters can be inserted differently: either direct percutaneously or tunneled subcutaneously to apply the drugs. This shows the greatest hygienic risk but lowest cost. For port-implantation there are several different devices: manually activated, implanted automatic or even programmable pumps with very low hygienic risk but quite high cost.

Opioids and  $\mu$ 2-agonists are also frequently being used for management of chronic pain as well as steroids. However, a direct analgesic action for steroids is still questioned (Koes 1995).

A2- agonist clonidine-hydrochloride has been used with success for pain-management. Sympathetic block is also seen with  $\alpha$ 2-agonists but less marked than with LA 's. Neither a motor block nor a complete sensible block has been seen. These drugs are especially useful for combination with opioids or LA, where they enhance and prolong action.

Cardiovascular side effects need to be taken into account and patients need to be monitored closely in the beginning.

The value of intrathecal or epidural steroids is still in discussion (Koes 1995). Animal-studies showed no direct analgesic effect (Abram 1994), but painful stimuli conveyed via C-fibers are inhibited (Devor 1985). Lower back pain with spinal irritation of nerves or compression is treated with epidural steroids. The anti-inflammatory effect is taken into account rather than the analgesic effect. Epidural steroids also show good results for treatment of postherpetic neuralgia. Further blinded studies need to be done for this

indication. By all means systemic side-effects of epidural steroids need to be thought of.

Opioids are the substances which are used most frequently for chronic pain for epidural or spinal injection. They do not cause sympathetic or motor blockade and are able to be combined with  $\mu$ 2-agonists and LA's. Because of their action profile, they are useful for long-term spinal or epidural application.

Main indication is chronic pain, which cannot be treated sufficiently by oral or parenteral opioids any more or where treatment is limited by extreme side effects.

For changing systemic to epidural or intrathecal opioid therapy, much smaller doses are necessary and the possibility of opioid-withdrawal needs to be thought of.

For chronic pain management Morphine is used most frequently. It is more hydrophilic than fentanyl, buprenorphine and Sufentanil. This explains the different pharmacokinetic properties of epidural and intrathecal opioids. Morphine has the greatest incidence of urine-retention and pruritus, compared with more lipophilic drugs like fentanyl, buprenorphine and sufentanil.

In a literature-survey about side effects in epidural and intrathecal opioid-administration, published by Chaney (1995), the incidence of pruritus was described as 0 to 100%. However, severe pruritus was only seen in 1% of cases. Nausea and vomiting is seen in 30% and a bit more frequently with intrathecal administration. This is similar after intravenous administration. Urine-retention is seen more often after epidural and intrathecal than after intravenous administration. A clinical significant respiratory depression has only been seen in less than 1% of cases. Hyperalgesia after very high doses of Morphine has been described as another side effect.

The following factors increase the risk of respiratory depression after epidural and intrathecal application of opioids:

High and repeated doses of opioids, especially with intrathecal application and more so if more hydrophilic drugs are used. In higher-aged patients, with additional illness and if sedation is used at the same time. If a patient never had opioids before or if the catheter is placed at a thoracic level.

It is still discussed whether position of the patient influences

the risk of respiratory depression.

For intrathecally-administrated morphine early and late side effects need to be differentiated. Maeraert and Kupers (Maeraert 1996) could show, that the relatively frequent incidence of pruritus, nausea and vomiting initially after intrathecal morphine is significantly reduced after a period of treatment whereas other side effects increase with time.

Neurolytic procedures are also possible. The sacral intrathecal neurolysis is one technique, where 60 % of cases are pain-free for more than one month but possible complications are considerable. Sphincter-paresis of the bladder is seen in 3 to 10%, paresis of the anal sphincter in 0.5 to 2% and not infrequently paresis and paralysis of the lower extremity. Therefore this procedure should only be a last resort for patients with quite reduced life expectancy.

### **SPINAL CORD STIMULATION ( SCS )**

Spinal cord stimulation was first described by Shealey 1967. The effectiveness of this technique is seen controversially so far: High success-rates in the beginning seem to decrease after 1 to 2 years. However, new equipment with computer-aided programs and therefore a great number of combinations possible, show longer lasting and better aimed chances of therapy.

Especially the right indication and a very thorough period of testing are essential for success of treatment.

This technique is evaluated best for the post-laminectomy-syndrome. According to a study of North et al, SCS shows a significant advantage over re-operation ( North 1995 ). Above all, segmental, radicular pain is improved more than axial back-pain.

### **SUMMARY**

For management of pain it is important to decide if the invasive technique is an alternative or an addition to systemic administration of analgesia, especially if systemic treatment causes severe side-effects. For a high rate of success it is crucial to choose the patients thoroughly. They should not get too dependent on the invasive technique and need to be informed about the limitations. Conservative treatment should have been preceded and could be complemented with invasive techniques. On the whole, invasive pain management should have its definite role in treatment of acute and especially chronic pain.

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