Pain Management: Invasive Procedures

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Purpose:

The purpose of this course is to familiarize the nurse with invasive procedures used to treat pain, and to provide information about the purpose of the procedure, the methods used, the risks and benefits, and the possible complications.

Goals:

Upon completion of this course, the nurse should be able to:

- Discuss the history and uses for acupuncture.
- Discuss at least 2 benefits of balloon kyphoplasty.
- Describe at least 4 complications of radiofrequency ablation/rhizotomy.
- Explain the difference between radiofrequency ablation and direct visual rhizotomy.
- List at least 4 criteria for spinal cord stimulation.
- Describe 4 different types of stimulators.
- Describe the procedure for refilling an implantable intrathecal infusion pump
- List at least 3 ganglion that are targets for sympathetic nerve blocks.
- Discuss the purpose and procedure for trigger point injections.
- Discuss issues regarding deep brain stimulation for pain control.
- Discuss the purpose of platelet-rich plasma therapy.
- List at least 6 joints that may benefit from joint injections.
- Explain the two types of medications used for joint injections.
- List at least 4 reasons an epidural block is performed.

Introduction:

There are many options for pain control, whether acute or chronic. Invasive procedures, for the most part, are intended for those with chronic pain when noninvasive therapies have been ineffective and the patient's quality of life or ability to function is impacted by pain. No one method of pain control can meet the needs of all patients.

Some patients may have better results than others with the same procedure. Before deciding on an invasive procedure, the patient must give informed consent and should be aware of all of the risks and benefits associated with the procedure. Some invasive therapies are well-supported by evidence-based research, but others are more controversial.

Acupuncture

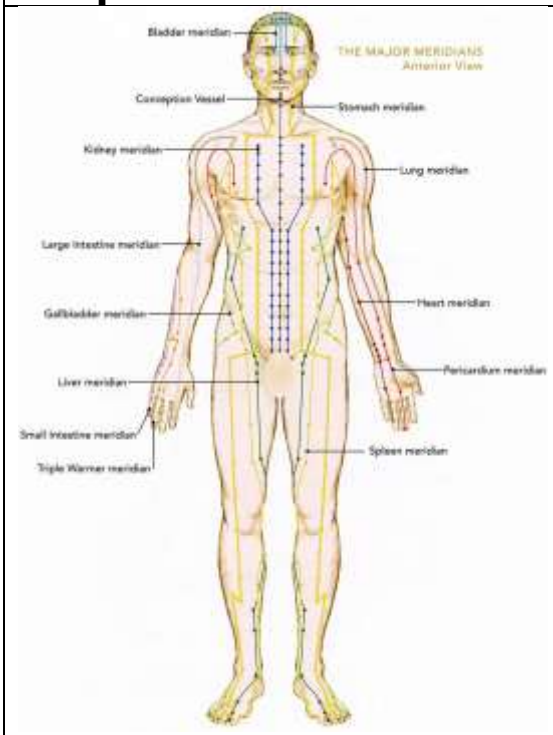
Acupuncture is considered an invasive procedure because needles are inserted through the skin. Very thin needles are inserted at specific meridian points in order to balance the body's life force energy (Qi or Chi) and bring about healing. Meridian points are connected to different areas of the body. Acupuncture is an ancient practice developed in China at least 2200 years ago.

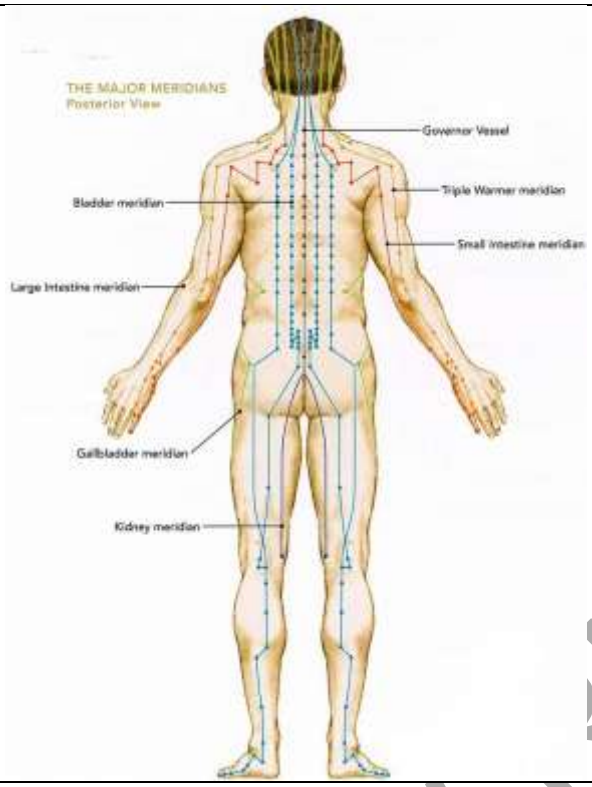
It was first practiced with sharpened stones and bone fragments, but modern practice has evolved and sterile single-use needles are now commonly used. According to a National Health Interview Study, approximately 14 million people in the United States had acupuncture treatments over a 5-year period, and many physicians now practice acupuncture.

Acupuncture is covered by some insurance policies but not by Medicare, so patients whose treatments were covered before age 65 may find that the treatments are no longer covered by Medicare or their supplementary insurance when they reach 65.

The exact mechanism by which acupuncture relieves pain is not yet clear, but it is believed that acupuncture stimulates the release of endorphins. Some believe, as with all treatments, expectations may play a role in beneficial effects.

Acupuncture meridians





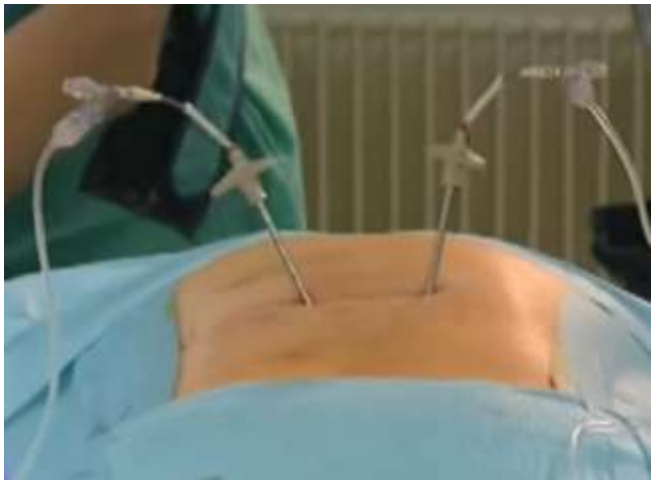
While many claims have been made about the benefits of acupuncture, few of the claims have been validated by research. However, studies have shown that acupuncture can provide pain relief.

A meta-analysis of almost 18,000 patients from randomized trials determined that acupuncture was effective for treatment of chronic pain. Another large study involving about 455,000 patients receiving acupuncture for headache, low back pain, and/or osteoarthritis found 76% of patients had marked or moderate pain relief.

According to the NCCIH, acupuncture may also reduce the frequency of tension headaches and prevent migraines. The NCCIH is currently funding research to determine if acupuncture can reduce pain and discomfort associated with chemotherapy.

While treatment frequency and duration vary, one to two treatments a week for five or six weeks is the average. Treatment time is usually 30 to 60 minutes. Most people are unable to feel the needles, so there is little discomfort. The number of needles may vary from 5 or 6 to 30 or more. The acupuncturist may stimulate the needles by twisting them back and forth or may apply low frequency electrical stimulation or heat (moxibustion) through burning an herb near the needle.

Risks of complication are quite low because the needles are tiny and flexible. However, bleeding, bruising, and soreness may occur at insertion sites and infection may also occur, especially if unsterile needles are used. It is also possible (but rare) that a needle may break off and migrate, causing internal damage.



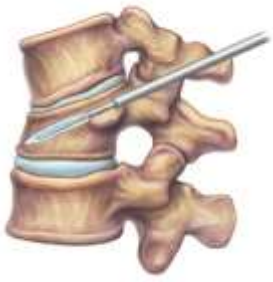
Balloon kyphoplasty

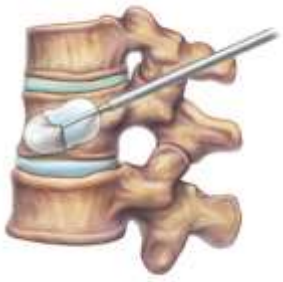
Balloon kyphoplasty is a surgical procedure that is utilized to correct compression and deformity of the vertebral body resulting from spinal fractures caused by osteoporosis, cancer, or other lesions. Compression fractures most commonly occur in the thoracic area, (T1-T12) but may also occur in the lumbar area (L1-L5).

The minimally-invasive procedure is done to relieve pain as well as to restore vertebral body height. Balloon kyphoplasty may be done on an outpatient or inpatient basis, depending on the patient's condition and usually takes about an hour.

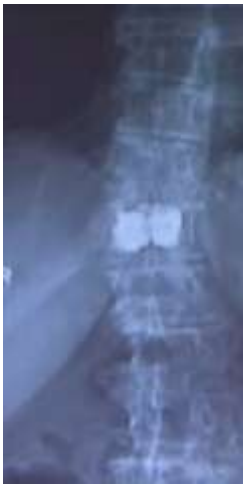
Balloon kyphoplasty may be done under a general or local anesthetic. The patient is placed in prone position and the entry points located through fluoroscopy. Procedures may vary somewhat. One-centimeter incisions are made where the cannulae will be inserted.

Typically, two 11-guage bone access needles are inserted and a guide pin inserted through those needles and then the needles removed, leaving the guide pins in place. Two cannulae (introducers) are inserted over the guide pins and then the guide pins are removed.



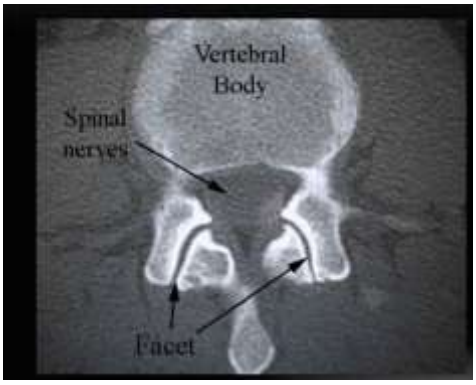


Balloons are inserted through the cannulae and both inflated under equal pressure at the same time to create cavities. Then, the balloons are removed and cement (PMMA) injected into the cavities with a bone filler device and confirmed with fluoroscopy. The cannulae are then removed and the wounds closed.



Most patients experience little discomfort and have almost immediate relief of pain and are able to go home the same day as the procedure. However, complications are similar to those of other surgical procedures and may include heart attack, cardiac arrest, stroke, infection, and embolism. Bone cement may leak into the surrounding tissue and can, in rare instances, cause paralysis. If cement enters the bloodstream, it may cause damage to the vessels, lungs, and/or heart.

Radiofrequency ablation/rhizotomy



Radiofrequency ablation (AKA radiofrequency neurotomy, medial branch thermocoagulation, radiofrequency denervation or lesioning) is done to relieve pain, such as neck or back pain associated with arthritis or disc disease/injury. The pain is often associated with facet joint pain.

The procedure takes about an hour or less. Prior to the procedure, a medial branch block or facet block is performed to ensure that destroying the nerve will relieve the pain. The nerve blocks are both diagnostic and therapeutic as they may provide relief for up to 3 months. A test block may also be of shorter duration, lasting only 2 to 3 hours.

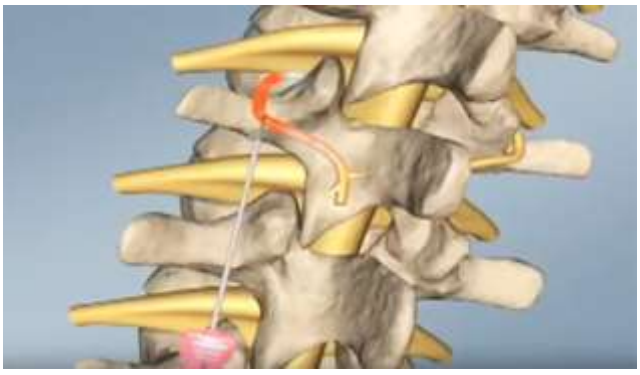
A positive diagnostic result for a block is usually a 50% reduction in pain although some insurance companies require an 80% relief of pain with 2

separate blocks before they will approve payment for radiofrequency ablation.

Radiofrequency ablation is done with the patient awake so that the patient can respond when the stimulation is applied. The procedure is done under fluoroscopic guidance so that the cannulas can be properly positioned. Local anesthetic is applied to the area in which the cannulas will be inserted.

Special radiofrequency cannulas are inserted into the area by the target nerve, and the nerve is stimulated to ensure that the needles are placed properly and not too close to the nerve root. The patient must respond when feeling the stimulation and the nerve response, and this stimulation can be somewhat painful.

Once it is determined that the needles are appropriately positioned, anesthetic, such as lidocaine, is applied through the cannulas to make the procedure more tolerable, and the electrodes are attached to the cannulas and an electrical current applied.



The electrical current generates heat in the distal centimeter of the cannulas to ablate (burn away) dysfunctional tissue, creating a thermal lesion. The temperature and time are specified, usually 80 degrees C for 90 seconds. Multiple cannulas may be inserted at the same time or cannulas may be inserted one at a time but in different positions, depending on the nerve being treated. When the nerve is being ablated, the patient may feel discomfort.

Following the procedure, the patient may have considerable pain for the first few days, requiring analgesia, but this pain should begin to recede. It may take 3 to 7 days for the nerve to die and 3 to 4 weeks to achieve optimal benefit after the procedure.

Studies show that patients have considerably more relief of pain than from steroid injections, greater range of motion, and lower use of analgesia. However, some complications are possible:

- Potential for increased pain for a week or so after the procedure.

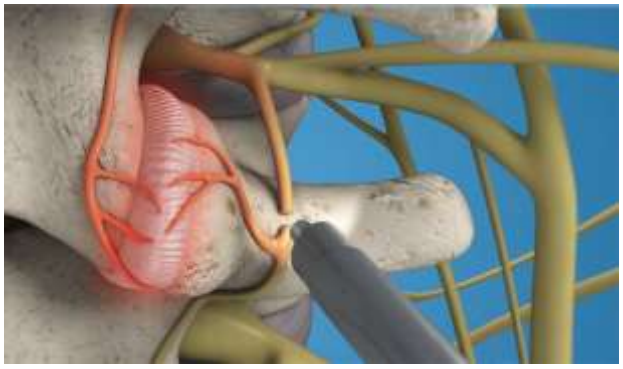
- Increased pain for months if the nerve was not completely coagulated (<5%).
- Spinal cord trauma (rare).
- Numbness over procedure site.

While the procedure destroys the nerve, the sheath remains and over time the nerve regenerate. Patients usually have relief for 6 months and sometimes even up to 2 years (average 15 months) before they need another procedure. Some patients, however, find the pain relief lasts for only 3 to 6 months and have to have repeated procedures. In those cases, a direct visual rhizotomy, which severs the nerve, may be considered.

Direct Visual Rhizotomy (Endoscopic)

DVR (AKA facet joint denervation and endoscopic rhizotomy) is a minimally-invasive procedure used to treat chronic pain, such as neck and back pain due to facet joint arthritis of the spine, and is an alternative procedure to spinal fusion or RFA. DVR is similar to radiofrequency ablation except that instead of destroying the nerve by burning, a part of the nerve is cut away in order to provide long-lasting pain relief. The duration of pain relief may vary from 3 to 5 years or longer.

An injection test to deaden the nerve is carried out before the procedure to ensure that the pain decreases by at least 50% when the nerve is blocked.



The patient is placed in prone position under conscious sedation (most common) or general anesthesia. Procedures may vary somewhat. Typically, a small guidewire is inserted through a 0.5 cm incision down to the nerve under x-ray control, and then a dilator is inserted over the guidewire and then a small tube is inserted over the dilator in

order to provide a portal for the endoscope.

The endoscope is inserted down to the nerve fiber and the medial branch of the spinal nerve root is cut by a laser or a radiofrequency device. One or more nerves may be cut during the procedure, depending on the number of nerves involved.

The procedure takes about 30 to 60 minutes. Recovery is usually rapid and pain relief immediate with a success rate of 90% or greater. Complication rates are low but can include infection. It is possible but very rare that the wrong nerve could be cut. If the patient requires general anesthesia, then complications associated with anesthesia may occur.

Spinal cord stimulation

Spinal cord stimulators are devices that are implanted in minimally-invasive procedures into the spine to deliver a low-voltage electrical current continuously to block the sensation of chronic debilitating pain. SCSs are FDA-approved for the treatment of pain in the back, legs, and arms.

Criteria for SCS include pain not associated with malignancy, poor response to more conservative treatment for at least 6 months, revision surgery not an option or unlikely to resolve pain, no pacemaker or other medical contraindications, no major psychiatric problems, and willingness to wean from inappropriate drug use before the procedure. Conditions for which the SCS is implanted include arachnoiditis, complex regional pain syndrome, failed back-surgery syndrome or post-laminectomy syndrome, neuropathy, and neuritis.

Before permanent implantation, a temporary device is placed at the level of the spine where the nerves generate pain. The trial simulator is programmed with one or more stimulation programs to determine which type works most effectively. If the temporary device is effective in reducing pain, then a permanent device is placed. The SCS may not eliminate all pain, but it should provide adequate relief so that the patient can carry out activities of daily living.

The implantation procedure is carried out with minimal sedation and local anesthesia as the patient must respond during the procedure to ensure the

electrode wires are in the right place. If successful, the pain should transform into a nonpainful buzzing sensation.

In a typical procedure, trial wires (if still in place) are removed and needles are inserted under fluoroscopy and guided to the correct epidural space and then electrode wires are passed through the needles to the site of the successful trial.

Once the electrode wires are in place, they are attached to a cable and the device, and the device is tested with the patient responding to ensure correct placement and relief of pain.

If the test is successful, the patient's sedation is increased and small incisions are made between the needles and at the implantation site.

The needles are removed and the electrode wires are tunneled under the skin from the insertion sites to the device implantation site and anchored to the muscle. The battery is anchored about 2 cm below the skin. The device is checked to ensure proper functioning before the incisions are closed.

There are different types of stimulators.

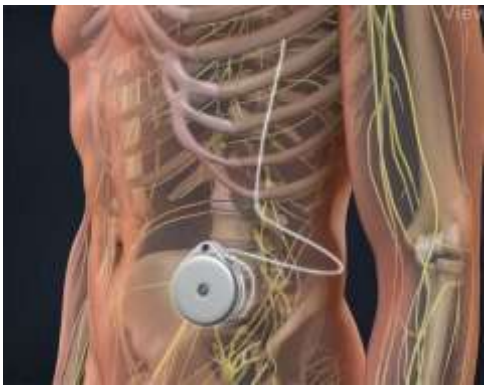
- Conventional systems require little on the part of the patient, but the battery must be replaced periodically through a minor surgical procedure.
- Radiofrequency systems allow for higher output levels (needed with severe of multi-extremity pain) but require an external power source.
- Rechargeable systems require the patient to recharge the device when the power runs low, but when the time between recharging shortens, the battery may need to be replaced through a minor surgical procedure.

Patients usually tolerate the procedure well and can be discharged the same day. However, complication may include allergic reaction, bleeding, infection, headache, paralysis or weakness, spinal fluid leakage, and increased pain. Complications may be directly related to the device itself.

For example, the stimulation may stop. work intermittently, or overstimulate. An electrode wire may move or become damaged.

Patient's should be advised that the SCS may set off metal detectors, and anti-theft devices in stores may increase stimulation. The magnet on the stimulator control device can erase information on magnetic strips and impair watches and clocks. MRIs, ultrasounds, defibrillators, electrocautery, diathermy and cardiac pacemakers may damage the SCS or result in adverse effects.

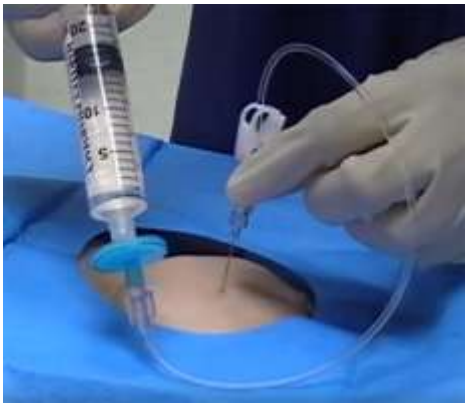
Implantable intrathecal infusion pumps



An intrathecal infusion pumps (AKA pain pumps) is a round metal device that is surgically implanted in a pocket in the lower abdomen. An incision is made in the back and the vertebra exposed so the catheter can be placed in the subarachnoid (intrathecal) space and secured with sutures.

A temporary catheter is inserted for a trial period to determine if the pump may provide relief. If so, the temporary catheter is removed and the permanent pump implanted.

The catheter is tunneled under the skin around the torso and connected to the pump. The abdominal and spinal incisions are closed (usually with staples). The reservoir inside of the device contains medication, and the device is filled and programmed.



Because the medication (most often morphine or baclofen) delivers medicine directly to the spine and the central nervous system, the dose of medication to bring about pain relief is typically about 1/300 of the dose required for oral medications.

The pump is programmed to deliver a set dosage of medication over a specified period of time or the same or different dosages at

specific times. For example, the pump may be set to deliver an increased dose during times of activity.

The pump is refilled by inserting a needle through the skin into the reservoir. Before refilling, the pump is checked electronically to ensure it is functioning properly, the skin cleansed, and a special needle inserted into the pump. Any remaining medication is aspirated prior to refilling the pump. Then the pump is refilled, a bandage applied, and the pump reprogrammed.

The criteria for implantation of an intrathecal infusion pump includes trials of conservative therapies that have failed, dependency on pain mediation, absence of psychological problems, and inability to benefit from further surgery.

Conditions for which the pump may be implanted include cancer pain, failed back surgery syndrome, reflex sympathetic dystrophy, causalgia, arachnoiditis, and chronic pancreatitis. Some patients may have the device implanted to reduce spasticity associated with cerebral palsy, multiple sclerosis, stroke, brain injury, and spinal cord injury.

Complication may include fever, nausea and vomiting, bleeding, severe back pain, sudden onset of weakness and spams in the leg with loss of bladder and/or bowel function, and persistent headache. The catheter may move or become obstructed, and the pump may malfunction. Cerebrospinal fluid may leak, causing discharge from the back incision and headache. Overdose or other adverse effects may occur because of the drugs used. The battery of the pump typically must be replaced every 5 to 7 years.

Sympathetic nerve blocks

Unlike RFA and DVR procedures which target the nerve roots, sympathetic nerve blocks (AKA sympathetic nerve blockade, regional block, and sympathetic ganglion block) target peripheral ganglions. Sympathetic nerve blocks are less invasive than RFA and DVR and require no incision.

Sympathetic nerve blocks may be carried out in different areas of the body, depending on the site of the patient's pain, so the procedure may vary. Common sites include the lumbar ganglia and the stellate ganglia in the

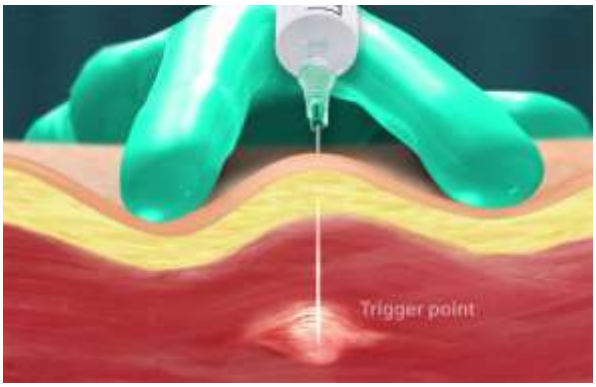
lower part of the anterior neck. The stellate ganglia (right and left) carry signals of pain from the head, neck, upper chest, and arms. Other sites include the trigeminal ganglion (used to treat trigeminal neuralgia).

Nerve blocks are indicated to relieve the pain of complex regional pain syndrome, reflex sympathetic dystrophy, peripheral vascular disease, post-herpetic neuralgia, phantom pain, and diabetic neuropathy.

Nerve blocks are done under mild sedation and local anesthetic as an outpatient procedure. The site is cleansed. A needle is inserted under fluoroscopic or ultrasound guidance and contrast dye is injected to confirm the needle placement before the local anesthetic and sometimes a steroid are injected and the needle removed.

Individual responses may vary. Nerve blocks are done to provide relief of pain for periods of 4 to 6 months. Usually, each time the procedure is done, the results last longer. Side effects depend upon the site of the block but are usually minimal and may depend on whether a steroid was used. As with any invasive procedure, infection may occur and the needle may damage a vessel, causing bleeding.

Trigger point injections



Trigger point injections are used to relieve myofascial pain caused by painful knots that form in muscle or fascia. Myofascial pain results in dysfunction and may occur in conjunction with chronic musculoskeletal disorders, such as fibromyalgia.

Trigger points may respond to physical therapy if caught in the early stages, but chronic trigger points often need trigger point injections to reduce pain.

The patient is positioned comfortably, and the trigger point located by palpation, which often elicits a local twitch response referred to as a "jump sign." The skin cleansed, and a topical anesthetic administered.

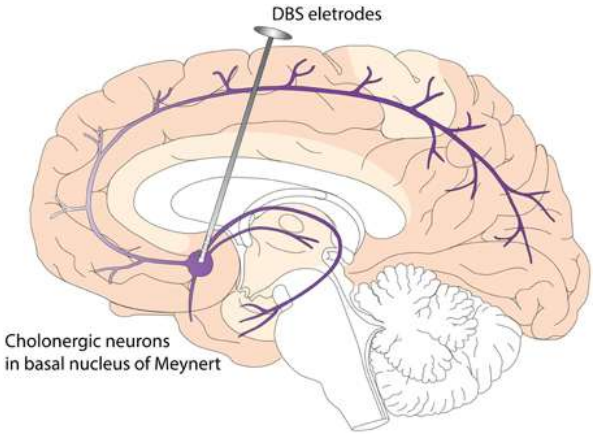
Then, an anesthetic mixture is injected into the trigger point to relax the tissue. The needle is inserted 1 to 2 centimeters away from the trigger point and then advanced to the trigger point with the needle held at a 30-degree angle to the skin. The needle may be slightly withdrawn and redirected into different areas of the knotted tissue. In some cases, dry needling is done with the needle inserted but no medication injected.

After the injection, a vapocoolant spray may be applied to the muscle and the muscle should be stretched to full length. After this, a hot pack should be applied to injection sites for several minutes and then range of motion exercises carried out.

The patient should be advised to avoid strenuous exercise for 1 to 2 days following the procedure. Adverse effects are minimal although, as with any injection, an infection may occur, and bleeding may occur. Trigger point injections are contraindicated with systemic or local infection.

Deep brain stimulation

Deep brain stimulation, most often used to control tremors, has also been used to treat chronic pain since the 1960s, when it was used to treat cancer pain, generally after more conservative methods had been unsuccessful.



Since the 1980s, DBS has fallen out of favor as other methods of pain control have become available. Currently, DBS is FDA-approved to treat movement disorders, including Parkinson's disease, essential tremor, and dystonia but not pain although relief of pain may be secondary.

Conditions that may respond to DBS include failed back surgery syndrome, phantom limb pain, central post-stroke pain, cluster headaches, atypical facial pain, and brachial plexus injury. Patients for whom spinal cord stimulation has not been successful may also benefit from DBS.

Deep brain stimulation is done with the patient awake. A local anesthetic is administered into the scalp, an incision made, and then electrodes inserted

into the brain and stimulated, and the patient provides feedback as the electrodes are placed.

Research carried out regarding DBS for control of pain over the past decade has shown only modest benefit, but most of the patients involved included those the most difficult to treat because they had failed to respond to other treatments, such as spinal cord stimulation. The use of DBS for chronic pain is still considered investigational in the United States but further research may provide more information about possible uses and benefits.

Platelet-rich plasma therapy

PRPT is a controversial therapy favored by elite athletes and promoted as a method of increasing the rate of healing, but there is little evidence-based research as yet to support its use; and the treatments, which can cost $500 to $2000 each, are not covered by insurance.

However, this therapy is offered by some physicians, especially those in sports medicine, to relieve osteoarthritic pain and stiffness in joints as well as to promote healing of tendons, muscles, and ligaments.

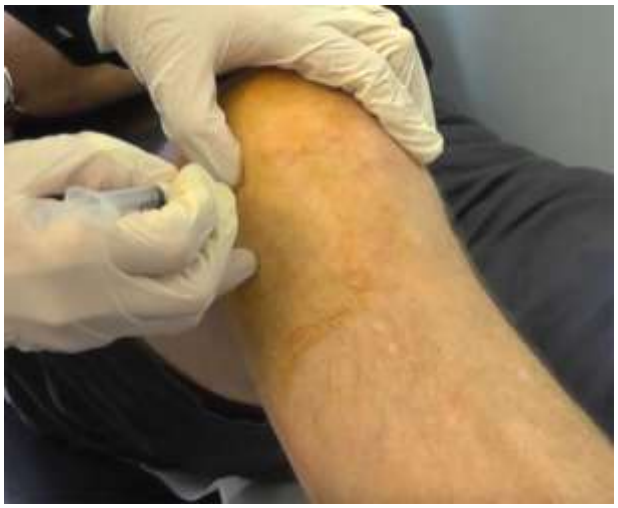
PRPT involves withdrawing blood from the patient and the placing the blood sample in a centrifuge to separate the platelets from the other components of the blood. The platelets are then injected into the area to be treated. The injection may be done under ultrasound guidance, such as when used to promote healing of a torn tendon.

It is believed that PRP reduces inflammation and releases growth factors. A small study of osteoarthritis of the knee found PRPT to be more effective than hyaluronic acid treatment. However, the *JAMA* reported that PRP was no more effective than saline injections for treatment of Achilles tendinosis, so research results have been mixed.

Because the patient's own platelets are used, reactions are minimal although injections always carry a risk of infection and local irritation.

Joint injections

Joint injections are used to relieve pain and swelling of a joint. Commonly injected joints include shoulder, elbow, wrist, base of the thumb, small joints of the hands and feet, hip, knee, ankle.



Joint injections are fairly simple procedures although injections of the hips are generally done with fluoroscopic or ultrasound guidance and those of the small joints of the hand and feet with ultrasound in order to ensure correct placement of the needle.

The area if palpated to determine the injection site and the area is cleansed with antiseptic. A local anesthetic is sometimes administered to reduce discomfort and the anesthetic agent may also be mixed with the other medication in the syringe.

A needle is inserted into the joint and a steroid (such as methylprednisolone) or hyaluronic acid is injected. Steroids have anti-inflammatory properties and hyaluronic acid lubricates the joint.

Steroids may be most effective for inflammatory arthritis conditions, such as rheumatoid arthritis, plantar fascitis, bursitis, tendinitis, and gout. Hyaluronic acid injections have been FDA-approved only for osteoarthritis of the knee, but it is sometimes administered to other joints as well.

Hyaluronic acid injections may be administered once or weekly for 3 to 5 weeks. Steroids, on the other hand, should not be administered to a joint more than 3 to 4 times a year because of the possibility that the steroid could cause cartilage to deteriorate.

Most hyaluronic acid used is derived from the combs of roosters. There are several different versions of hyaluronic acid injections available:

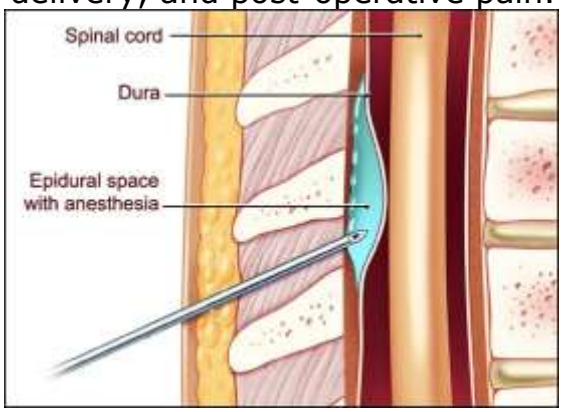
- 1% Sodium hyaluronate (Euflexxa®)
- Sodium hyaluronate (Hyalgan®))
- High-molecular-weight hyaluronan (Orthovisc®))

- Sodium hyaluronate (Supartz)
- Hylan-G-F20 (Synvisc®)
- 1% Sodium hyaluronate (Nuflexxa®

Complications of steroid injections may include infection, nerve damage, lightening of skin about injection site, osteonecrosis, osteoporosis, and increased pain. Complications of hyaluronic acid are usually mild but may include allergic response, bleeding, infection, numbness, and ulceration.

Epidural nerve block

Epidural nerve blocks are corticosteroid injections into the epidural space of the spinal column to reduce the pain and inflammation associated with a herniated disc, sciatic, spinal stenosis, compression fracture, labor and delivery, and post-operative pain.



When an epidural is used for labor and delivery or postoperative pain, usually a combination of analgesics and anesthetics is administered, and a catheter is left in place until the block is no longer needed so that medications can be slowly administered.

When used to control chronic pain, epidural nerve blocks are usually performed on an outpatient basis. The epidural block may be given as a single treatment or in a set of multiple injections, such as 3 corticosteroid injections with one every 2 to 3 weeks.

Conditions for which epidural nerve blocks may provide relief include spinal stenosis, spondylolisthesis, herniated disc, degenerative disc, and sciatica. Epidural nerve blocks are contraindicated in those with infection or bleeding problems.

Different areas of the spine may be used for the injection, depending on the level of pain. Epidural nerve blocks can relieve pain in the neck, arms, mid-back, lower back, and legs.

The patient is placed in prone position and the area of the epidural cleansed with antiseptic. A local anesthetic is applied to relieve discomfort. A thin needle is inserted into or adjacent the epidural space, usually under fluoroscopic guidance.

Contrast dye is injected to ensure that the needle is positioned properly and that the medication will be delivered accurately. The medication is then injected slowly. A local anesthetic may be added to the corticosteroid to provide further relief of pain. Then the needle is removed and a dressing applied.

The patient may experience some weakness and numbness in the arms and legs immediately after the procedure. Patients may apply ice to the injection site to relieve discomfort. Most patients experience initial pain relief in 18 to 48 hours although some feel almost immediate relief, especially if an anesthetic agent is used. Peak pain relief usually occurs within the first 7 days.

Conclusion

Very few things are as debilitating as chronic pain. Patients are often desperate for relief, and many have tried one treatment after another in attempts to find relief. While there are now many options, they can be confusing to the lay person, so the nurse often serves as a resource person to help the patients understand what procedures entail and what outcomes to expect.

While patients usually are treated with noninvasive medications and treatment initially, some patients can benefit from invasive procedures, which can often provide long-lasting relief. These interventional techniques aim to get at the source of the pain and eliminate or decrease the pain rather than simply treating the pain, such as with analgesics.

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