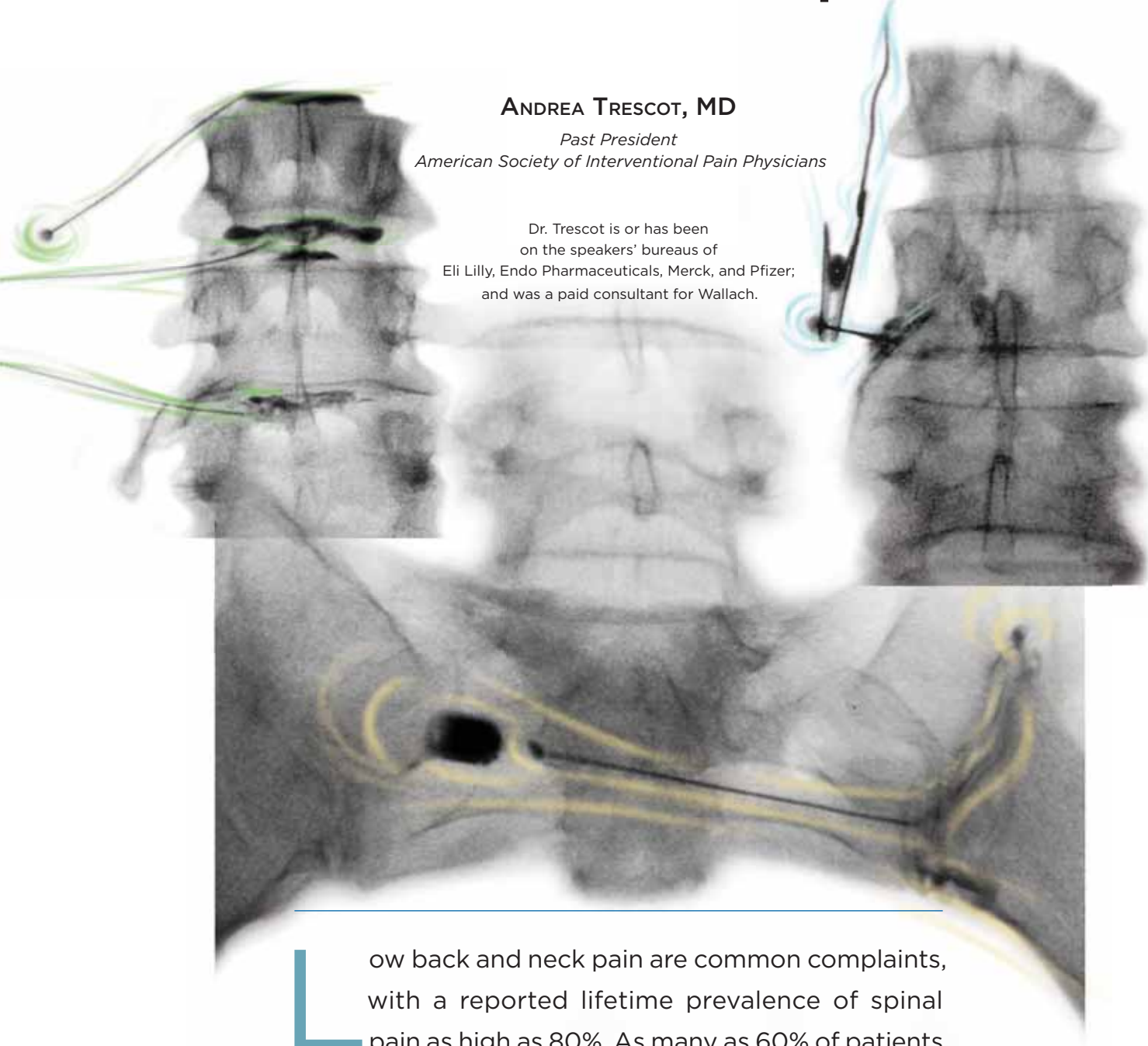


Overview of Injections for the Treatment of Spinal Pain

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Low back and neck pain are common complaints, with a reported lifetime prevalence of spinal pain as high as 80%. As many as 60% of patients continue to have chronic pain 5 years or longer after their initial episodes.¹

Fifty million Americans are partially or totally disabled as a result of episodes of pain.² The annual cost of pain is estimated in the billions of dollars.³

Interventional pain medicine is a specialized approach to pain in which medication is injected directly into a specific structure to both diagnose and treat painful conditions, rather than having patients ingest oral medications that then travel unspecifically throughout the body.

When spinal pain is not resolving on its own or is not responding to simple measures such as ice, heat, physical therapy, and anti-inflammatory medicines, it may be necessary to consider injection therapy. These injections, often done under x-ray or ultrasound guidance, can help diagnose the specific cause of pain, which then leads to more appropriate therapy.

Diagnostic Versus Therapeutic Injections

A precision diagnostic injection, done with small volumes of local anesthetic, can help to diagnose the precise cause of pain, resulting in pain relief that occurs immediately after the procedure. However, the local anesthetic by itself is not usually expected to give much in the way of long-term relief. Therefore, medications such as steroids are often injected at the same time or immediately following the local anesthetic. Although this may be very useful for a wide variety of patients, other patients may get temporary relief from the local anesthetic but no sustained pain relief from the steroids. Those patients may be candidates for nerve-killing injections such as alcohol or phenol or neuroablative procedures such as radio-frequency lesioning or cryoneuroablation.

Medications

As described above, pain injections usually are done with local anesthetic and steroids. The local anesthetics usually used include lidocaine, which has a relatively fast onset but is short acting, or bupivacaine, which has a somewhat slower onset but usually is longer lasting. This difference in duration of effect can be used to help prove the efficacy of the injection; a “dual local anesthetic” technique may be used to decrease the potential for a placebo effect. The patient is given 2 sets of injections, each on a different day. One set of injections is done with lidocaine and is expected to provide only a short period of relief; another set of injections is done with bupivacaine, which is expected to give longer relief. The patient is not told which local anesthetic is being used, so if the lidocaine injection gives short-term relief and the bupivacaine injection gives longer-term relief, the result is unlikely caused by a placebo effect.

Another medicine usually injected would be a steroid anti-inflammatory agent, usually one formulated to be time-released (a deposteroid). Several are available, including methylprednisolone, triamcinolone, and betamethasone. These are milky-looking solutions consisting of particles suspended in liquid. Recently, we have recognized that these particles can, if injected

into a small blood vessel, block off the blood supply to structures such as the spinal cord and lead to paralysis. Therefore, many people are advocating the use of particulate-free steroids, especially around nerve roots, to decrease the risk for infarcts.

Types of Injections

The epidural space is the potential space between the bone of the spinal canal and the dura surrounding the spinal fluid. The epidural space extends from the foramen magnum at the base of the brain down to the sacral hiatus, the opening at the end of the sacrum. Local anesthetic and anti-inflammatory medicines can be placed anywhere along that path.

Caudal epidurals (Figure 1) were the first approach to the epidural space, described in 1901. There are several advantages to this technique:

- Even in the heaviest patient, the sacral hiatus usually can be identified, by palpation, anatomic landmarks, or x-ray observation.
- The intrathecal sac does not extend below S3; therefore, as long as relatively short needles are used, there is virtually no risk for dural puncture.
- Because the entry site is distal to the site of pathology, especially in postlaminectomy patients, access to the epidural space can be obtained safely, without the influence of epidural adhesions.
- Because the lumbar epidural space is obliterated by lumbar surgery, lumbar epidurals (see below) usually are performed above the level of pathology, but this medicine normally goes to place of least resistance, which usually is away from the site of pathology. By introducing medicines from below, the epidural space can be distended, like blowing up a balloon, and volume can be used to create a lysis of adhesions.
- Its relatively straight-line access to the lumbar epidural space makes it a convenient entry site for catheters and endoscopic cameras.

Systematic reviews have confirmed effectiveness superior to that of interlaminar epidural injections.⁴

However, there are several limitations to caudal epidural steroid injections, which include the need for large volumes, the difficulty in reaching higher lumbar levels, and the relatively high failure rate (prior to the routine use of fluoroscopy). These limitations can be overcome by the use of a catheter technique and fluoroscopic confirmation of needle placement.

Interlaminar Epidural Steroid Injections

Interlaminar epidurals (Figure 2) for many years were the mainstay of anesthesia-trained interventional pain doctors. The advent of routine fluoroscopic imaging allowed for more precise placement, and small volumes allowed relatively localized effect. However, there are significant limitations to the interlaminar approach.

The posterior epidural space is a potential area for injection; however, there is not always a clear end point and occasionally (1%-3% of the time in some studies⁵) the needle passes through the epidural space into the



Figure 1. Caudal epidural injection.

intrathecal space, causing a “wet tap.” This can result in a postdural puncture headache as well as an unrecognized intrathecal injection, which can result in a “total spinal.”

Medicine is placed in the posterior epidural space, but pathology from disc herniations occurs in the anterior epidural space, and the medication rarely migrates anteriorly.

As stated above, most practitioners avoid injecting the epidural space at the level of prior surgery because of expected obliteration of the epidural space. Medication placed above the level of pathology will be expected to migrate cephalad, away from the pathology.

Although the technique is relatively effective for acute radiculopathy and radiculitis,⁶ it gives only short-term relief of nonspecific low back pain.⁷

Transforaminal Epidurals

The transforaminal approach to the epidural space (Figure 3) was developed in an effort to overcome the limitations of interlaminar and caudal epidurals: the lack of specificity and the difficulty in getting medicine to the anterior epidural space. Using fluoroscopy and sometimes a peripheral nerve stimulator, the specific nerve involvement in the patient’s pain problem can be identified, and medication can be injected directly in the nerve, the dorsal root ganglion, and the anterior epidural space. Unfortunately, just as these injections were increasing in popularity, a disturbing number of catastrophes (spinal cord infarcts and deaths) started to be reported. The current villain in this tragedy is the particulate steroid, which, after an undiagnosed injection into the radicular artery, travels retrograde into the spinal cord and causes an infarct. Many interventional pain physicians have abandoned the technique altogether or switched to blunt needles (to decrease the



Figure 2. Interlaminar epidural injection.



Figure 3. Transforaminal epidural injection.

risk for cannulating the blood vessel) and/or switched from particulate steroids to clear steroids (which are not depo-formulations and therefore do not have as long an effect).⁸

FACET INJECTIONS

Facets are composed of a superior articular process and an inferior articular process. Innervation of the posterior spinal structures comes from the posterior (dorsal) ramus of the spinal nerve root, whereas the anterior (ventral) ramus makes up the spinal nerves (Figure 4). This dorsal ramus is divided into a lateral branch (which innervates the paravertebral muscles and skin) and a

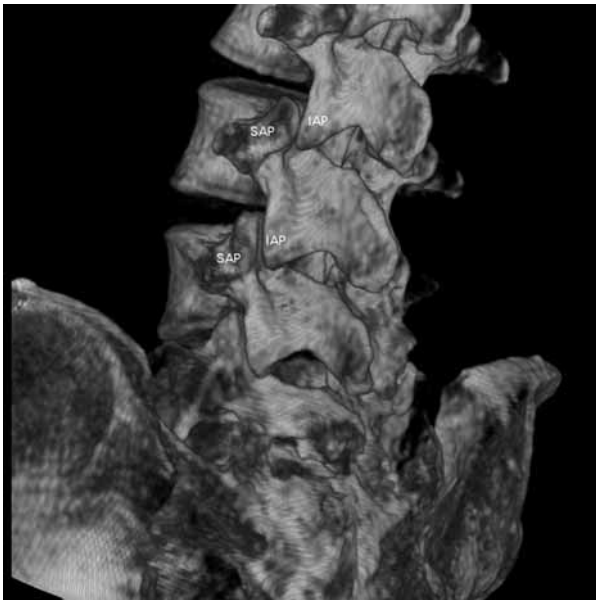


Figure 4. Labeled lumbar facet anatomy.

IAP, inferior articulating process; SAP, superior articulating process

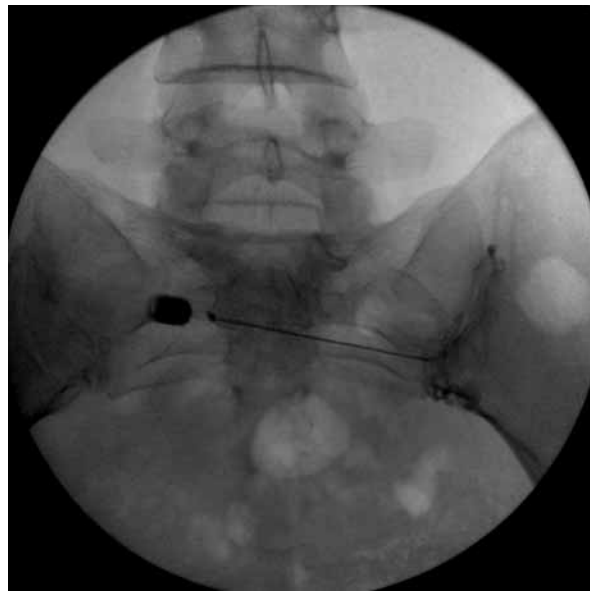


Figure 5. Sacroiliac joint injection.

medial branch, which innervates the joint at that level and the joint at the level below. Each facet joint, therefore, has dual innervation. The facet nerves enter the spinal column at the same level as the arm or leg nerves, so pain from these joints can refer down the arm or leg in a pseudoradicular pattern.

Diagnostic and therapeutic interventions of the facets involve either intra-articular injections or medial branch blocks. Most pain physicians focus on medial branch blocks, which are diagnostic and, according to

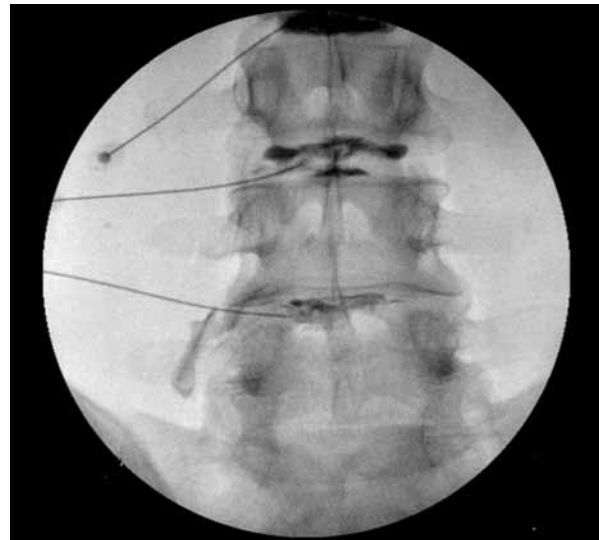


Figure 6. Leaking disc during discogram.

some studies, potentially therapeutic.⁹ If the diagnostic injections gave good relief (especially using the dual local anesthetic technique described previously), then radio-frequency lesioning or cryoneuroablation of those nerves can give long-lasting pain relief.¹⁰ There is strong evidence of the benefits of medial branch blocks and neurolysis of the facets in the cervical and lumbar regions, although there have been very few studies published on thoracic facets.¹¹

SACROILIAC JOINT INTERVENTIONS

The sacroiliac (SI) joint once was considered the most common cause of low back and leg pain. However, after Mixter and Barr identified the herniated disc in 1934,¹² all attention was placed on disc herniations as the cause of radiculopathy. The SI joint is designed to move, but it moves very little; that, coupled with the difficulty in visualizing it radiographically, has made SI-related low back and leg pain almost a diagnosis of exclusion. Confirmation of the diagnosis requires an intra-articular injection under fluoroscopy, with contrast confirming the intra-articular placement of local anesthetic and steroid¹³ (Figure 5). Once the diagnosis has been confirmed by injection of local anesthetic, most of the therapy focuses on rehabilitative stabilization or mobilization of the joint. However, because the SI is analogous to the facet joint, there has been recent interest in neurolysis of the posterior rami to denervate the joint in a manner similar to the techniques used for the medial branches.

DISCOGENIC PAIN

Significant pain can come from discs that may look normal on magnetic resonance imaging (MRI). The nucleus of the disc consists of compounds such as leukotrienes, interleukins, and tumor necrosis factors,

which—if leaked out of the disc through a fissure in the annulus—can create an intense radiculitis and epidural inflammatory response. These annular tears may not show up on MRI, and disc herniations may not be painful, as proven by Jensen’s study of asymptomatic patients.¹⁴ One of the few ways of proving that a disc is painful involves injecting dye under pressure, and looking for replication of symptoms and leaking of disc material (Figure 6). Unfortunately, this test by definition has to replicate the patient’s pain, and it can be quite uncomfortable. Additionally, the disc gets very poor blood flow, so infections introduced into the disc can be very difficult to treat. It also is possible to make any disc hurt with enough pressure, so it has been difficult standardizing the amount of pressure used to provoke pain. The use of meticulous sterile technique, IV antibiotics, intradiscal antibiotics, and pressure monitors has helped to reduce infection and to standardize results. Although the discogram itself is not therapeutic, there are now several percutaneous disc techniques available to the interventional pain physician.

PERIPHERAL INJECTIONS

A significant number of peripheral nerve entrapments, myofascial trigger points, or ligamentous injuries can mimic herniated discs. For example, in the lumbar region, the cluneal and superior gluteal nerves, the gluteus medius and piriformis muscles, and the iliolumbar and sacrotuberous ligaments all can cause pain in the buttocks radiating down the leg to the foot. Knowledge of these alternative causes of pain can save the patient from unnecessary, expensive, and potentially misleading diagnostic studies as well as ineffective surgeries. If diagnostic and therapeutic injections provide only temporary relief, the peripheral nerves can be further treated with cryoneuroablation, the trigger points with botulism toxin, and the ligaments with prolotherapy or platelet-rich plasma.

Contraindications/Complications

Injections done inside the spine (epidurals) are at particular risk for bleeding and infections. Use of preservative-free amide local anesthetics and non-ionic contrast will result in fewer allergic reactions. Additional problems may include pneumothorax as well as inadvertent intravascular injections and spinal radicular artery injections, described earlier.

Effective Strategies for Optimal Outcomes

Two tenets guide my approach to the patient with spinal pain. The first is “the diagnosis is made by the history and confirmed by the physical exam.” The pattern of pain helps direct my attention to a particular etiology,

and physical exam helps confirm those suspicions.

The second tenet is “do the simplest or least invasive or least risky procedures first.” Therefore, I tend to do trigger point injections before facets, facets before epidurals, and epidurals before discograms.

Summary

The field of interventional pain management has expanded greatly over the past few years; with each clinical development and improvement comes an incremental increase in our ability to provide quality pain relief to our patients.

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