



## Epidural Steroid Injections for the Management of Back Pain and Sciatica

Low back pain and sciatica are important causes of chronic pain and suffering in the U.S. population. Despite multiple treatments, both conservative and surgical, many patients continue to suffer from chronic pain. Epidural steroid injections have an important role in the treatment of many of these patients and should be offered early in the course of the condition. Patients with signs and symptoms of nerve root irritation and radiculopathy generally respond better than patients with primarily low back pain alone.

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● According to the National Institute of Neurological Disorders and Stroke, chronic pain is the most expensive health problem in the U.S. today, costing up to \$50 billion annually.<sup>1</sup> As recently highlighted, pain management is big business.<sup>1</sup> Over the last decade, a new specialty has formed that continues to grow dramatically.<sup>2</sup> Currently, there are an estimated 1,200 pain management centers in the U.S., with an

estimated 3,000 physicians who focus their practices on pain management.<sup>1</sup> At the core of many of these pain clinics are procedures such as epidural steroid injections, which are commonly performed for the treatment of back pain and sciatica (lumbosacral radiculopathy). An ideal pain management center is multidisciplinary; namely, it has the ability to manage a diverse group of disorders with a wide range of modalities, including physical therapy, biofeedback, and psychology.<sup>3</sup>

A major component of chronic pain sufferers is low back pain

with or without lumbosacral radiculopathy, with 80% of all workers losing some time from work because of back pain.<sup>4</sup> Low back problems are the second most common reason expressed by patients for office visits to primary care physicians.<sup>5,6</sup> They are the most common reason for office visits to orthopedic surgeons, neurosurgeons, and occupational medicine physicians.<sup>7</sup> National statistics indicate a yearly prevalence of back problems in the U.S. of 15% to 20% of the population.<sup>7</sup> The total costs to society are difficult to calculate, but annual costs in the U.S. are estimated to range from \$20 to \$50 billion.<sup>8</sup>

Unfortunately, there is a lack of consensus among physicians on the treatment of acute and chronic low back pain as well as lumbosacral radiculopathy.<sup>9</sup> The Quebec Task Force on Spinal Disorders recommends referring a patient with back pain of three months' or greater duration to a multidisciplinary pain management facility.<sup>10</sup> Although back pain and lumbosacral radiculopathy



## Commonly Involved Lumbosacral Nerve Roots with Disc Herniation

Level of Herniation	Disc Involved	Muscle Groups	Reflex	Sensation
L <sub>3-4</sub>	L <sub>4</sub>	quadriceps	knee jerk	anterior thigh
L <sub>4-5</sub>	L <sub>5</sub>	dorsiflexors	no reflex	lateral calf
L <sub>5-S<sub>1</sub></sub>	S <sub>1</sub>	plantarflexors	ankle jerk	lateral foot

Table 1

are distinct entities, epidural steroid injections are commonly performed for both and, hence, they will be discussed together.

### Causes of Low Back Pain and Lumbosacral Radiculopathy

Low back pain can originate from multiple areas both within and outside the back.<sup>11</sup> Various diseases outside the back, including duodenal ulcer, renal calculi, dissecting aortic aneurysm, and pancreatic disease, may result in low back pain.<sup>11</sup> Sources of primary low back pain include bones, ligaments, muscles, intervertebral discs, and sacroiliac and zygapophysial joints.<sup>12</sup>

Radicular pain generally results from nerve root pathology, which may be the result of mechanical compression or irritation from inflamed structures. Lumbosacral radiculopathy should not be confused with muscular deconditioning or facet arthropathy, which generally do not cause radiation of pain below the knee on straight leg raising. Table 1 reviews the commonly affected nerve roots and corresponding symptomatology of lumbosacral radiculopathy.

The natural history of the aging spine includes structural, biochemical, and mechanical

changes. The nucleus pulposus contains mucopolysaccharides, such as chondroitin sulfate, keratin sulfate, and hyaluronic acid. With aging, the proportion of chondroitin sulfate that helps retain the water content of the nucleus pulposus decreases. There is progressive loss of disc water content and, hence, disc space height.<sup>13</sup>

With disc space height loss, abnormal shear stresses are placed on the facet joints, resulting in hypertrophy. Osteophytes develop in an effort to increase the load-bearing surface of the joints.<sup>13,14</sup> These changes contribute to spinal stenosis or narrowing of the spinal canal, which may result in low back pain and neurogenic claudication due to nerve root irritation.

### History

Epidural injections have been performed for almost 100 years.<sup>15</sup> Viner injected 20 mL 1% procaine in 50 to 100 mL normal saline, Ringer's solution, or petrolatum.<sup>16</sup> He believed that congestion or counterirritation in the area of the affected structures stimulated the resolution of pain.<sup>16</sup> Evans reported a cure rate of 61% in patients with sciatica treated with 60 to 145 mL procaine and saline.<sup>17</sup> He believed that stretching the sciatic

nerve trunk or nerve roots was responsible.

It wasn't until the early 1950s that steroids were described for epidural injections in the management of low back pain and sciatica.<sup>18,19</sup> Despite more than 40 years of use, however, definitive outcome studies are lacking and the treatment remains controversial.<sup>11</sup> Of the controlled studies reported,<sup>20-32</sup> seven reported that epidural steroids were more effective than reference treatment, whereas six reported it to be no better or worse than reference treatment.<sup>33</sup> The most recent randomized double-blind trial of epidural steroids for sciatica due to herniated nucleus pulposus found that the steroid group had less leg pain at six weeks, with no significant differences noted at three months.<sup>31</sup>

### Indications

Unfortunately, most of the studies involving epidural steroid treatment for either low back or sciatic pain lack adequate control groups.<sup>31</sup> However, of the controlled studies that are available, epidural steroid injections have been found helpful in the short and intermediate term, but significantly less effective in the long term.<sup>20,34,35,39,30,32</sup> Table 2 lists the indications and effectiveness of epidural steroid injections. As reviewed by Benzon, nerve root irritation is the main indication for epidural steroid injections.<sup>11,35</sup>

Phospholipase A<sub>2</sub>, an enzyme necessary for prostaglandin synthesis, is found in high concentration in the nucleus pulposus and may be responsible for chemical nerve root irritation and inflammation with disc disease.<sup>36</sup> Epidural steroids may act to decrease



inflammation by inducing the formation of a phospholipase A<sub>2</sub> inhibitor, thereby inhibiting prostaglandin synthesis.<sup>37,38</sup> Mechanical nerve root compression, as in the case of a herniated nucleus pulposus with neurologic deficit, has been shown to be less responsive to epidural steroid injection by some,<sup>22,24,29</sup> although a therapeutic benefit has been found by others.<sup>21,23,26,39,41</sup>

Spinal stenosis is also an area of controversy with regard to the efficacy of epidural steroid administration.<sup>22,42-44</sup> Although prolonged relief has been attained by some, this is rare, and relief is often transient.<sup>35</sup> Epidural steroids are an alternative in patients who have not responded to other drug therapy or are unacceptably high surgical risks.<sup>44</sup> The rationale for epidural steroid injections in patients with spinal stenosis is that with bony narrowing and mechanical compression of the nerve roots, edema may result in microvascular injury inside the nerve roots.<sup>24,32</sup> There is thus a theoretical possibility that epidural steroids may inhibit nerve root edema.<sup>42</sup> Corticosteroids are not believed to have direct antinociceptive or analgesic properties but have been shown to suppress chronic pain formation in animal models.<sup>45</sup>

#### Medications Used

The steroids used most frequently are methylprednisolone acetate (Depo-Medrol®) or triamcinolone diacetate (Aristocort®). Although most published reports use methylprednisolone acetate, some clinicians favor triamcinolone because of its lower potential for sodium retention and ability to remain in suspension

Indication	Effectiveness
HNP without mechanical compression (irritation)	++++
HNP with mechanical compression of nerve roots (neuro deficit)	+++
Spinal stenosis/neurogenic claudication	++
Facet arthropathy	+
Degenerative disc disease	+
Postlaminectomy	+
Scoliosis	0
Ankylosing spondylitis	0
Ligamentous/muscular strain or sprain	0

*HNP = herniated nucleus pulposus; 0 = ineffective; + = transient relief in some; ++ = transient relief in many; +++ = hastens recovery and effective in some; ++++ = effective in most.*

Table 2

longer.<sup>46</sup> There have been no studies comparing the efficacy of one over the other. The typical doses range from 40 to 120 mg methylprednisolone acetate or 50 to 75 mg triamcinolone.

No studies have compared the different volumes of injected steroid; however, for caudal approaches to the epidural space, a higher volume is required.<sup>35</sup> Most practitioners will use 20 to 25 mL via the caudal approach and 5 to 10 mL via the lumbar approach. In the past, very large volumes of 60 to 145 mL have been used when it was felt that "stretching" the sciatic nerve roots was therapeutic.<sup>17</sup>

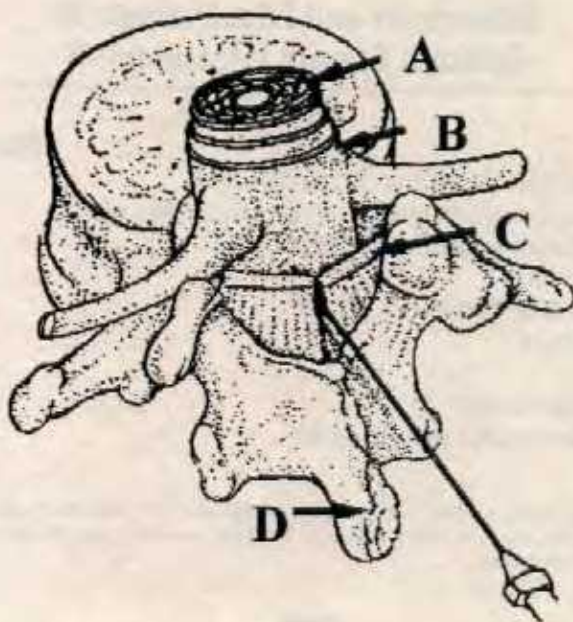
Polyethylene glycol is the vehicle used for both methylprednisolone acetate and for triamcinolone diacetate depot steroid preparations and has been postulated to cause neurologic dysfunction<sup>47</sup>; however, at clinically relevant concentrations, no neurotoxicity has been demonstrated.<sup>46,48</sup>

#### Technique

Figure 1 demonstrates a standard midline lumbar approach through the supraspinous ligament, interspinous ligament (not shown), and, finally, the ligamentum flavum. The epidural space itself is a fat-containing region surrounding the dura mater, with a venous plexus more pronounced laterally (not shown). Both caudal and lumbar approaches to the epidural space are commonly performed, with no studies comparing the two techniques. As mentioned previously, caudal injections require higher volumes to attain adequate cephalad spread than do lumbar-placed injections.

In general, lumbar injections are technically easier because of less anatomic variation. They are also closer to the site of pathology, require less volume, and are thus preferred. Caudal approaches carry a decreased risk of inadvertent dural puncture, since the dural sac terminates at approxi-





**Figure 1—Midline approach to lumbar epidural space: A = cauda equina; B = dura mater; C = ligamentum flavum; and D = spinous process. (Reproduced with permission from Carron H, Korbon GA, Rowlingson JC: Subarachnoid block. In: *Regional Anesthesia: Techniques and Clinical Applications*, Carron H, Korbon GA, Rowlingson JC [Editors], p 35. Orlando: Grunc & Stratton, Inc., 1984.)**

mately the second sacral neural foramen. Caudal approaches may also be necessary in postlaminectomy patients with extensive cicatrization and loss of bony landmarks.

The needle depth is determined using a loss-of-resistance technique. As the needle is advanced through surrounding ligaments, air or saline cannot be easily injected.

Once the fatty epidural space is entered, a sudden loss of resistance to injection of air or saline occurs prior to puncturing the dura mater. Nonfluoroscopically guided epidural steroid injections may miss the epidural space 30% of the time with lumbar approaches and 25% of the time with the caudal approach-

es<sup>30</sup>; thus, many centers routinely use fluoroscopy.

### Complications

Despite a significant history of relative safety, even in patients at the extremes of age,<sup>49</sup> epidural steroid administration is not without major and minor complications. Obviously, inadvertent dural puncture may result in cerebrospinal fluid leaking out into surrounding tissues, with a resultant onset of postdural puncture or spinal headache. More serious complications include epidural abscess or hematoma, which are severe, life-threatening complications, frequently requiring urgent neurosurgical intervention.

Systemic anticoagulation with

major coagulation abnormalities and localized infection at the site of needle insertion are thus absolute contraindications.<sup>50</sup> Epidural abscess formation has also been associated with diabetes.<sup>51</sup> There have been rare case reports of bacterial meningitis,<sup>52</sup> transient paralysis,<sup>53</sup> steroid-induced myopathy,<sup>54</sup> Cushing's syndrome,<sup>55</sup> congestive heart failure from sodium and water retention,<sup>56</sup> and retinal hemorrhages with occasional permanent visual deficits.<sup>57</sup> The mechanism of retinal hemorrhage is postulated to be from sudden increases in intracranial cerebrospinal fluid pressure, which may increase retinal venous pressure.<sup>57</sup>

The hypothalamic-pituitary-adrenal axis is depressed for up to three weeks after a single dose of epidurally administered steroid.<sup>58</sup> Although no complications related to hypothalamic-pituitary-adrenal axis suppression have been reported, Benzon has suggested that patients who have received epidural steroids within three to five weeks of surgery be given exogenous corticosteroids perioperatively as a "stress dose."<sup>11</sup>

### Summary

Epidural steroid injections most frequently provide the most pain relief in patients with signs or symptoms of nerve root irritation or edema and are generally less effective in relieving low back pain resulting from mechanical etiologies. Since most patients with signs of herniated nucleus pulposus and nerve root irritation resolve spontaneously within one year,<sup>11,59</sup> epidural steroids are probably effective in providing symptomatic relief, thus hastening recovery, espe-



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cially when given early in the treatment plan.<sup>51,60</sup>

Patients with neurogenic claudication and low back pain secondary to spinal stenosis should also be offered epidural steroids

despite the transient pain relief they provide, since such patients are generally elderly and may be high surgical risks.<sup>11</sup>

Patients whose back pain persists for more than six weeks should be referred to a neuromusculoskeletal certified specialist, and pain that persists for more than three months should prompt referral to a multidisciplinary pain management center, as outlined by the Quebec Task Force on Spinal Disorders.<sup>10</sup>

Although generally devoid of complications, epidural steroid injections have been associated with adverse outcomes and should be used in appropriately selected candidates, as already outlined.<sup>51,52,54,55,57</sup> Given the magnitude of chronic pain in the U.S., epidural steroid injections will

continue to have a major role in the armamentarium of pain management physicians. ●

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## Self-Assessment Review Questions for Epidural Steroid Injections in the Management of Back Pain and Sciatica

Choose the best answer to each of the following questions:

1. In which condition are epidural steroid injections most beneficial?

- A. Acute low back pain without radiculopathy
- B. Nerve root irritation with radiculopathy
- C. Degenerative disk disease
- D. Scoliosis

2. How does the administration of epidural steroids in patients with spinal stenosis most likely decrease pain?

- A. Improves regional blood flow to affected spinal

nerves

- B. Decreases sympathetic nervous system activity
- C. Decreases nerve root edema
- D. Partially anesthetizes nerve roots

3. Which are complications of epidural steroid administration?

- A. Headache
- B. Nerve damage
- C. Blindness
- D. All of the above

4. Which medications are commonly administered epidurally?

- A. Methylprednisolone acetate

- B. Triamcinolone diacetate
- C. Both
- D. Neither

5. What may be the results of epidural steroid administration?

- A. Decreased need for surgery in selected patients with spinal stenosis or herniated nucleus pulposus
- B. Hastened functional recovery
- C. Greater participation allowed in physical therapy programs
- D. All of the above

### Answers

1. B; 2. C; 3. D; 4. D; 5. D



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