Diagnostic and therapeutic spinal interventions

Epidural injections

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Summary

Epidural injections of local anesthetic or a corticosteroid are frequently given to diagnose and treat patients with radicular pain originating from any spinal level. The best-quality evidence supports a transforaminal approach in the lumbar spine. Many patients experience substantial benefit from a single therapeutic injection. Depending upon the benefit obtained, additional injections may be administered. Selective nerve blocks with local anesthetic alone can identify the spinal nerve mediating the patient's pain. Serious short-term risks are rare but occur; long-term risks are infrequent and can be due to systemic effects of multiple corticosteroid injections. Patients who have failed conservative therapy or are not candidates for surgical intervention can be considered for epidural steroid injections to relieve their radicular pain temporarily.

Radicular pain, with or without radiculopathy, is a common clinical condition most frequently due to disk herniation or fixed lateral recess or foraminal stenosis. In the lumbar region, lifetime prevalence estimates range from 12% to 43% with annual prevalence estimates of 2%–34%.¹ Cervical radicular pain is less common, and more likely due to fixed stenosis than disk herniation.² Clinical and experimental studies of the pathophysiology of radicular pain suggest that both mechanical compression and an inflammatory response are needed for pain production.³ The inflammatory process supports the targeted injection of corticosteroids as a therapy for radicular pain. Local anesthetics alone may be used diagnostically to identify the spinal nerve mediating the patient's pain.

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Corticosteroids can be delivered to the dorsal epidural space using an interlaminar approach, or via the sacral hiatus with a caudal approach. However, these midline techniques place the injected drug some distance from the site of inflammation. The transforaminal approach delivers the corticosteroid directly to a symptomatic spinal nerve in the intervertebral foramen where pharmaceuticals are much more likely to reach the site of inflammation in the ventral epidural space. While some neurologists perform epidural injections, more often they are done by interventionalists (usually anesthesiologists, physiatrists, or radiologists) who work in specialized pain center or hospital settings. This article covers 1) indications for epidural injections, 2) how epidural injections are performed and interpreted, and 3) risks and benefits.

Indications and contraindications for epidural injections

These injections are indicated for the diagnosis and especially treatment of significant radicular pain with or without radiculopathy in patients who have failed a trial of conservative therapy.^{4,5} Epidural steroid injections as a therapeutic procedure are much better supported in the lumbar spine than in the cervical or thoracic spine. Although epidural injections are sometimes given to patients with axial spine pain and neurogenic claudication, there is no high-quality evidence supporting their use in these conditions. The spinal nerve to be targeted is selected based on a synthesis of imaging, clinical, and neurophysiologic findings. Advanced spinal imaging with MRI, plain CT, or CT myelography is considered a prerequisite for epidural injections by most interventionalists. Preprocedure imaging allows the injection route to be planned to optimize medication delivery to the epidural space and minimize risk to neural or vascular structures.⁶ Such imaging also excludes underlying tumor and infection. Local anesthetics alone are injected for diagnostic purposes; this is properly termed a selective spinal nerve block. The response to a selective spinal nerve block can aid in diagnosis and localization. Injections of a corticosteroid with or without a local anesthetic are given for therapeutic purposes. Contraindications include systemic or local infection at the injection site, allergies to the medications used, pregnancy, or significant coagulopathy. Anticoagulant use is currently being reevaluated; the risk of hemorrhagic complications must be weighted against the real risk of systemic thrombotic complications from withholding anticoagulants. Aspirin and nonsteroidal anti-inflammatories are not contraindications.⁷ Anticoagulants (warfarin, antiplatelet, and antithrombin agents) should be stopped for interlaminar injections; the issue is less clear for transforaminal injections and the reader is referred to published guidelines for specific recommendations.^{5,7}

How epidural injections are performed and interpreted

Interlaminar epidural steroid injections can be given in the lower cervical, thoracic, and lumbar spine; caudal epidural injections are administered via the sacral hiatus.^{4,5} There is less evidence of benefit from lumbar interlaminar and caudal epidural steroid injections, and they are being supplanted by transforaminal injections. Lumbar interlaminar and caudal injections may be used if the transforaminal route is not feasible (due to postoperative changes or anatomic limitations) or with multilevel, bilateral radicular symptoms and findings. Interlaminar injections are appropriate in the low cervical region, as the literature support for cervical transforaminal injections is much less robust than for lumbar transforaminal injections. Interlaminar procedures are performed on prone patients, without sedation, and with fluoroscopic guidance, using 18- to 22-gauge needles. The dorsal epidural space is entered by a loss of resistance technique, but exclusion of vascular or intrathecal flow via contrast injection

Figure Left L5 radicular pain due to an L4-5 disk extrusion with caudal migration into the lateral recess in a 32-year-old man

Left L5 transforaminal epidural steroid injection; final needle position (A, C) is immediately superior and lateral to the exiting L5 nerve. Contrast injection (B, D) confirms that medication will reach the interface of the disk and L5 nerve in the lateral recess (arrows).

is mandatory. Typically only corticosteroids are administered with interlaminar and caudal injections, which are not target-specific and have no immediate diagnostic value.

A transforaminal procedure is performed without sedation and with the patient supine or on his or her side (cervical) or prone (thoracic and lumbar). Under fluoroscopic guidance, a 22- to 25-gauge needle is advanced into the targeted epidural space. Contrast medium is injected to make certain that the injection is not intrathecal or intravascular, and to ensure that the injectate spreads appropriately along the targeted neural sleeve (figure). If the injection of contrast medium is intrathecal or intra-arterial, the procedure should be terminated and postponed until the dura or artery has healed. In transforaminal epidural steroid injections, patients are usually given both local anesthetic and a corticosteroid, administered sequentially. The patient's vital signs, neurologic status, and pain level are monitored. The patient may obtain immediate benefit if a local anesthetic was administered, or it may take several days for the injected corticosteroid to provide pain relief. Due to potential spread of the agents to adjacent spinal nerves, transforaminal epidural injections have limited diagnostic utility. Improvement 2 weeks after the injection when the corticosteroid anti-inflammatory effect is engaged predicts long-term benefit.

There is a historical practice of providing a series of epidural injections (e.g., weekly for 3 weeks), but this is unsupported by the literature and has no place in current practice.⁵ A decision to repeat an injection should be based on the response to previous injections. If benefit was substantial (e.g., >50% pain reduction) but incomplete, or has waned after a considerable period of relief (e.g., >1 month), then it is reasonable to perform additional

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injections in hopes of obtaining greater benefit, or recovery of prior benefit. Most patients do not require repeated injections. In a systematic literature review of lumbar transforaminal injections, 94% of patients achieving 50% or greater reduction in pain did so with a single injection.⁸ Although there is insufficient evidence to identify an absolute maximum number of injections in a year, a consensus statement by the North American Spine Society (NASS) suggests that a potential need for more than 4 injections in 1 year should prompt consideration of alternative treatment, including possible surgical intervention.⁹

Risks and benefits

Very rare catastrophic spinal cord and vertebrobasilar infarction can occur with transforaminal epidural injections, presumably due to injection into or damage to an artery supplying the spinal cord in the thoracolumbar region (artery of Adamkiewicz or another large radiculo-medullary artery) or the vertebral artery in the cervical spine.^{4,5} The risk of catastrophic spinal cord and vertebrobasilar infarction may be mitigated by meticulous technique including contrast injection, minimal or no patient sedation, use of a test dose of local anesthetic, and use of a nonparticulate steroid (e.g., dexamethasone). Interlaminar epidural injections risk injury to the cervical or thoracic spinal cord by direct needle trauma or epidural hematoma formation. Risks of all epidural injections are greater in the cervical spine. There are also risks inherent in any spine-related interventional procedure that include allergy to medications, radiation exposure, dural puncture, needle injury to neural or vascular structures, and infection (e.g., epidural abscess and recently reported iatrogenic fungal meningitis and spinal and paraspinal infections).^{4,5,10} Multiple corticosteroid injections can cause systemic side effects including suppression of the hypothalamic-pituitary-adrenal axis and worsening of osteoporosis.

Benefits of epidural steroid injections include pain relief, functional recovery, avoidance of surgical intervention, and identification of the patient's pain generator. There is more evidence of temporary symptomatic benefit than avoidance of surgery. While there is support for their use in the cervical spine,^{11,12} there is much stronger evidence of benefit in the lumbar spine.^{5,8,9} Epidural injections in the thoracic spine are poorly studied. In 2007, the American Academy of Neurology Therapeutics and Technology Assessment Subcommittee concluded that "epidural steroid injections may result in some improvement in radicular lumbosacral pain when assessed between 2 and 6 weeks following the injection, compared to control treatments (Level C, Class I–III evidence). The average magnitude of effect is small and ... in general ... does not impact average impairment of function, need for surgery, or provide long-term pain relief beyond 3 months."¹³ A 2009 review found "fair evidence that epidural steroid injection is moderately effective for short-term (but not long-term) symptom relief" for sciatica.¹⁴

Recent reviews provide stronger support for major benefit from lumbar transforaminal epidural steroid injections.^{8,9} The systematic analysis by MacVicar et al.⁸ suggests that for radicular pain from lumbar disk herniations, "60% of patients seem to achieve at least 50% relief of pain at between 1 and 2 months, but only about 40% maintain this outcome for 12 months." The NASS position statement reports that >50% of patients experience pain relief for >1 month, with half still benefitting after 1 year.⁹ A recent comparative effectiveness study in disk herniations demonstrated that 70% of patients achieved 50% pain relief and

50% functional restoration 6 months after lumbar transforaminal injections.¹⁵ In disk herniation patients, temporary pain relief from the anti-inflammatory effect of the injected corticosteroid may last until the disk herniation and its associated pain have improved or resolved. There is evidence that patients with more recent onset of pain,¹⁶ with lesser degrees of neural compression,¹⁷ and with optimal delivery of corticosteroid to the ventral epidural space¹⁸ have better outcomes. The pain relief provided by epidural injections should enable some patients to avoid discectomy. A surgical sparing effect has been demonstrated with lumbar transforaminal injections in some studies,¹⁹ but not in others; this issue is unresolved. For radicular pain with lumbar spinal stenosis, uncontrolled studies report benefit, but NASS states that there is insufficient evidence to make a recommendation regarding the use of epidural injections in this setting.⁹

Epidural steroid injections are popular and will continue to be recommended by providers to patients for relief of radicular pain. They should be used judiciously and in the context of proper indications.

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