

EPIDURAL STEROID INJECTIONS A REVIEW

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The management of chronic pain has witnessed marked advancement since the advent of pain management centers from which a practice model based on extensive workup of chronic pain sufferers has evolved. In fact, private practice has led to more aggressive interventional therapies available for a multitude of patients.

Back pain is probably the most common complaint for which patients report to pain clinics.¹ Most episodes of acute back pain resolve on their own in 4 to 6 weeks and extensive therapeutic intervention is not necessary. But assessment of the pain becomes more complex when the symptoms persist and produce attitude, behavior, and lifestyle changes. The resultant neuroplastic consequences in the nervous system perpetuate the pain.^{1,2} The medical history must then encompass aspects of the consequences of activity interference, that is, disruption of activities of daily living, loss of independence, inability to perform one's job, and related psychosocial issues. The physical examination is more likely to reflect the components of pain-related deconditioning being endured by the patients. The workup must be tailored to find answers to rule out any systemic disease causing the pain, any social or psychological distress that might be amplifying or prolonging the pain or any nerve compromise that might dictate surgical evaluation.

Not all patients referred or selected for epidural steroid injections (ESIs) manifest the classic symp-

toms of radiculopathy (see Table 53-1) or, are considered appropriate candidates. The decision to embark upon ESI rests entirely upon the individual pain physician's choice. The correlation of laboratory test findings, as to the efficacy of ESIs, is still not certain, so clinical judgment must be an additional and compelling component in the decision to suggest ESI.^{1,3}

When one is treating just the *symptoms* of pain, and not the cause, a more appropriate, realistic expectations should prevail.

TABLE: Classic signs of Radiculopathy

- * Sharp, sudden, shooting pain
- o Low back source: pain into the extremity below the knee
- o Cervical spine source: pain into the upper extremity
- * Increased pain with coughing, sneezing, or straining
- * Onset often associated with lifting a heavy load while in an awkward position
- * Repetitive spinal motions can be causative in fatigued, anxious, poorly conditioned individuals

In chronic pain, the reasonable goals of treatment include decreasing the frequency and or the intensity of the pain, improving the patient's functional capacity, and enhancing the patient's ability to cope with residual pain.

RATIONALE FOR EPIDURAL STEROID INJECTIONS

A number of studies have shown that radiculopathy may represent a toxic spill of inflammatory mediators from the disc, and it may not merely be a result of mechanical compression of nerve roots by herniated disc.^{2,4-7} Neuromuscular coordination defects are thought to cause inadequate distribution

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of physical forces that create pressures exceeding the visco-elastic characteristics of the annulus.¹ The posterior longitudinal ligament is thinner in the lumbosacral spine areas, and a shift of weight bearing from the anterior elements of the spine to the more delicate posterior elements of the spinal arch, including the pedicles, lamina, and facet joints, leads to either frank herniation of the disc or a leak of nucleus pulposus contents.

The disc contains phospholipase A-2 (PLA-2), interleukins, and proteoglycans. As a result of mechanical irritation or trauma, these potent instigators of inflammation are spilled into the epidural space. It is also suggested that ingrowths of new nerves into the healing annulus may result in subsequent discogenic pain. McCarron et al demonstrated that only small amounts of nucleus pulposus content were necessary to precipitate a marked inflammatory response.^{5,8} Chen et al demonstrated in an animal model that PLA-2 can "cause nerve root and corresponding behavioral and electrophysiological changes consistent with sciatica."⁹ The action of PLA-2 is to release arachidonic acid from cell membranes, so inhibiting this would help decrease the elaboration of inflammatory mediators. Steroids are the most potent inhibitors of arachidonic acid.

Traditionally, the concept impelling the injection of Depo-steroids into the epidural space is that a localized placement of these most potent anti-inflammatory agents will maximize the anti-inflammatory effect and decrease the physical size of the nerve root, thereby decreasing the patient's symptoms.^{6,7} This may lead to resumption of normal activity and participation in focused physical therapy and rehabilitation, thus breaking the cycle of pain-spasm-physical immobility. Some authors have suggested that the steroids provide a moderate block of nociceptive C fibers, stabilize membranes, decrease ectopic discharges from inflamed tissue, and perhaps decrease the CNS sensitization associated with acute and chronic pain.^{4,6} Finally, any anti-inflammatory action of the local anaesthetic frequently used has not been fully characterized.¹⁰

The two most common steroid preparations used are triamcinolone and methylprednisolone, yet there is no study comparing one with the other.⁴ There is lack of sufficient data regarding comparative potency, efficacy or side-effects of these two drugs. These are chemically altered so as to diminish their solubility, resulting in an estimated dwell time of 2-3 weeks.

These drugs exert systemic effects so caution should be exercised in their use in patients with congestive heart failure, renal insufficiency, and diabetes secondary to the fluid retention and metabolic effects.⁴ Cluff et al state "the ideal dose and type of steroid have yet to be determined."¹¹ Single-dose injections in animals failed to demonstrate evidence of tissue damage from the toxicity of polyethylene glycol, at the concentrations used clinically.² The potential for inducing adhesive arachnoiditis seems low and any such symptoms would be less common than the potential for procedure-related side effects such as backache, postdural puncture headache, paresthesias, bleeding, and infection, or even anxiety-related symptoms such as lightheadedness and nausea.¹²

It has been advocated that the use of a test dose of local anaesthetic prior to the injection of depo-steroid in any patients in whom the determination of the correct placement of epidural needle is difficult, as in patients with previous back surgery.⁴

Horlocker et al looked at the incidence of hemorrhagic complications related to NSAID use in patients receiving epidural steroid injections. One thousand thirty-five patients underwent 1214 injections, the majority of them in the midline and at lumbosacral spine levels. Thirty-two percent had used NSAIDs within 1 week. Five and two-tenths percent of patients has a minor, hemorrhagic complication defined as blood appearing in the needle or catheter. No spinal hematomas were detected. Four percent of patients had a micro, hemorrhagic complication defined as blood appearing in the needle or catheter. No spinal hematomas were detected. Four percent of patients had worsening of the primary symptoms or a new neurologic deficit. Significant risk factors

identified included increased patient age, needle gauge, the procedural approach used, needles tried at multiple levels, the number of needle passes, the volume of the injectate, and accidental dural puncture. The authors concluded that epidural steroid injections were safe in patients taking NSAIDs.¹³

One might worry about the potential increase in the intensity of symptoms after withholding such drugs. The risks and benefits of continuing steroid use must be carefully weighed in case of each individual patient.

Liu et al reported the benefit of using 20-gauge Tuohy needles.¹⁴ Though effective in increasing patient comfort and lessening the risk of postdural puncture headache, their most successful use might also require confirmation of correct placement using fluoroscopy, adding at least expense if not scheduling issues and demanding greater expertise of the clinician. Parenthetically, the loss of resistance technique with these needles was most inaccurate in males and patients older than 70.

A contemporary point of view holds that clinicians must establish a differential diagnosis for the patient's complaints through the distillation of data from history taking, physical examination, and laboratory tests.¹⁴

Distinguishing internal disc disruption, with which patients complain of referred pain to the thigh and leg but with which there's no associated neurologic change, from obvious radiculopathy, with which there is positive straight leg raising, dermatomal pain, and peripheral sensory and/or motor changes, is important.^{3,15}

Epidural steroid injections are of minimal help in the former, as they would be in patients with neurogenic claudication, but of clearer benefit to patients with the latter diagnosis.¹⁶

Fanciullo et al surveyed 25,479 patients referred to 23 specialty spine care center with spinal and radicular pain as to the application of published guidelines

that qualify patients for (mostly lumbar) epidural steroid injections.¹⁷ Whereas it was felt that younger patients with recent onset of radicular pain and no history of back surgery are the best candidates, these authors reported that epidural steroid injections were recommended for 7.9 % of the studied patients. These patients reported with complaints of radiating pain, a dermatomal distribution of pain, and neurologic signs on examination. In addition, the patients had symptoms of greater than 1 year's duration and a higher incidence of co-existing systemic conditions such as congestive heart failure, hypertension, peripheral vascular disease, and diabetes mellitus. This is particularly significant since most of the reported cases of epidural abscesses related to epidural steroid injections in diabetics.⁴

In his editorial preceding this study, Abram notes that the diagnosis of radiculopathy is the most consistent predictor of outcome with epidural steroid treatment, including patients with the provisional diagnosis of spinal stenosis.³ The application of guidelines, as documented by Fanciullo et al, resulted in a relatively small number of patients being referred and many of those having had protracted symptoms and/or previous surgical treatment – groups less likely to respond to epidural steroid injection.

A short-term response would generate frequent requests for repeated treatment, leading to risks of steroid-related and/or procedure-related complications in groups of patients perhaps already at risk.

The original technique for the deposition of corticosteroids was a caudal approach with a large-volume injectate. There was clearly intent to disrupt adhesions by fluid dissection. Winnie refined the concept by showing that steroids placed at the level of pathology were more effective, and this became the prevalent technique.^{2,4,6}

Since then, many, many studies have been published, but the lack of consistency of research design, type(s) of patients included, therapeutic protocol, and quality and duration of follow-up have been a signifi-

cant problem in comparing the results and unifying the therapeutic approach based on randomized controlled trials.^{2,3,6,7,11,18}

APPROACH

The addition of fluoroscopy to the armamentarium of the pain physicians theoretically limits the complications of this procedure by allowing confirmation of correct needle placement and demonstrating the clinically relevant spread of the injective. The fluoroscopy has allowed us the more liberal practice of a transforaminal/selective nerve root block (SNRB) technique.^{11,19-22} This places Depo-steroids at a site from which flow of the drug is more likely to include the anterior epidural space. Other authors stated (unproven) advantages include a lower likelihood of dural puncture (5% for translaminar, not known for transforaminal) and use of less medication, thus decreasing the potential of drug-related side effects.

Lutz et al advocated the (anatomically) "safe triangle" approach for transforaminal blocks, as enhancing the accuracy of drug deposition, providing a high steroid concentration at the chosen site, and doing so with a smaller dose of steroid.²⁰ Thus, there should be less need to add diluents.

Slipman et al studied 14 of 20 patients who were given cervical SNRBs at the pathologic level identified by clinical findings, such as motor weakness and reflex changes, MRI findings, and EMG, if necessary.¹⁹ Overall, 60% of the patients had a good to excellent result as to pain reduction and functional improvement, after one to two injections over 2 weeks, as recorded during the average 21-month follow-up. Klein et al advocated the same technique for use in patients with cervical spine radiculopathy and published basically the same results.²¹

Cluff et al recently completed a national survey on the technical aspects of ESI practice.¹¹ The mix of 68 academic centers and 28 private practices lends the results applicability. Their overriding summary was that after 50 years of clinical use, there still is no consensus as to the best technique for providing ESI. The

majority of practitioners use the loss of resistance technique to identify the epidural space, with patients in the prone more than the sitting position and with fluoroscopy used more in nonacademic venues. The most frequent injectate was a combination of local anaesthetics and corticosteroids. Clinicians expressed concerns that too much injectate volume would dilute the corticosteroid whereas too little volume might not result in enough spread of the drug, giving the false impression that ESI was not effective.

Private practitioners were more likely to use a transforaminal approach in patients with failed back surgery syndrome in whom the chronicity of the pain and/or scar tissue may interfere with the patient's ability to get better.

In academic centers, the mean maximum number of ESIs in a patient in a year was 4.7, but the range was 0-20. For private practice, the mean maximum number was 6.9 with a range of 3 to 40.

These data raise questions about how to evaluate the effectiveness of ESI most critically, so that only those patients continue to receive it, who are most likely to benefit from it, as well as the safety of repeated doses of Depo-steroids. Closed claim data are beginning to indicate that ESI's are a major source of claims made, leading some insurance companies to apply up to a 25% surcharge for malpractice coverage for pain management physicians (personal communication).

No study yet published can answer the question, Does an epidural steroid injection placed above or below a previous surgical site gain adequate access to the effective nerve roots?¹¹

A thorough, contemporary review comparing the transforaminal to the translaminar to caudal technique is provided in the evidence-based practice guidelines for interventional techniques for chronic spinal pain by Manchikanti et al.²² Based on their critical review, the transforaminal techniques have the best short- and long-term benefit, with caudal ESI and translaminar techniques thereafter.

Straus provides insight about ESIs through the unique view of cost-benefit analysis.²³ No review has been done that identifies the most economical practice setting (hospital, office, ambulatory surgery center) in which to provide ESI treatment. The higher success rate for accurate placement of the epidural needle with fluoroscopy, alone, is not evidence of such benefit. For economic success, there need to be data manifesting improved patient outcome, fewer complications, and actual cost reduction in care. Straus's calculations don't justify the benefits of fluoroscopy, which impacts the decision about in which venue ESI therapy should be provided.

COMPLICATIONS

Botwin et al published data from a retrospective study of complications in 207 patients who received 322 transforaminal lumbar ESIs.²⁴ Non-positional headache was the most common complaint, with short-term increase in back pain and increased leg pain the next most frequent. The overall minor complication rate was 9.6% per injection.

TABLE: Incidence of Complications per Injection

COMPLICATIONS	LSS GROUP (259 INJECTIONS)	HNP GROUP (63 INJECTIONS)	COMBINED (322 INJECTIONS)
Transient non-positional headaches that resolved within 24h	7(2.7)*	3(4.8)	10(3.1)
Increased post procedure back pain at injection site	5(1.9)	3(4.8)	8(2.4)
Facial flushing	3(1.2)	1(1.6)	4(1.2)
Increased leg pain with radicular symptoms	1(0.4)	1(1.6)	2(0.6)
Vasovagal reaction	1(0.4)		1(0.3)
Rash	1(0.4)		1(0.3)
Transient leg weakness	1(0.4)		1(0.3)
Dizziness	1(0.4)		1(0.3)
Increased blood serum (258 mg/dL) in an insulin-dependent diabetic	1(0.4)		1(0.3)
Intraoperative hypertensive episode	1(0.4)		1(0.3)
Episode of nausea	1(0.4)		1(0.3)

* n(%). Lumbar spinal stenosis; HNP, herniated nucleus pulposus.

A more recent report by these authors on the complications of fluoroscopy-guided caudal ESIs showed a minor complication rate of 15.6% per injection, including insomnia on the night of the procedure, vasovagal reactions, infrequent nausea, and otherwise as in the study just mentioned.²⁵

OUTCOMES

Published success rates for ESI vary between 18 and 90%.^{2,3,11,15} Koes et al reviewed 12 to 13 randomized controlled trials published on the use of caudal or lumbar ESIs.²⁶ Eight of the 12 studies had methodological flaws. The 4 best studies were equally divided between showing a benefit and not. Looking at all 12 studies, 6 were positive with respect to improved outcome and 6 manifested no benefit. Another contemporary review includes that by Buchner et al, who studied 36 patients less than 50 years of age with radicular pain, positive straight leg raising, MRI-proven prolapsed discs at L4-5 or L5-1, and no history of previous spinal surgery, spinal stenosis, cauda equine syndrome, or major motor deficits.²⁷ Patients were randomized to conservative therapy (rest, NSAIDs, tramadol, physical therapy) or conservative therapy plus ESIs (100 mg methylprednisolone in 10 ml 0.25% Bupivacaine, three injections in 14 days).

The ESI patients had a greater improvement in straight leg raising and a tendency to better pain relief and functional recovery, yet no statistically significant benefit was sustained at the 6-week or 6-month follow-up.

Cannon and April have recently stated that lumbosacral ESIs "have a favorable role in the non-operative treatment of the true radicular pain," especially with corticosteroid delivered to the pathologic site.

Of six qualified studies of ESIs, three are supportive of the treatment, three neutral as to the benefit, and two others are positive specifically for the caudal approach. These authors state that there are fewer data as to the benefit of the transforaminal technique. They advocate the caudal approach for L5-S1 pathology, the translaminar approach for patients with discs above (especially for patients with unilateral symptoms), placement of deposteroid one level below in patients with central or posterolateral discs, and an at-the-level placement for anyone receiving a

transforaminal approach.

Based on these reviews, it is reasonable to suggest the following about ESI application:

- Patients with a history of radiculopathy and a corresponding dermatomal sensory change, who have not responded to conservative therapy in 4 to 6 weeks, seem to be the most likely to benefit. As in all patients for interventional procedures, the absence of major coagulation defects must be documented.
- Patients with a clinically significant herniated disc, diagnosed by both physical and laboratory findings, who have not improved with conservative therapy should be considered. The increased risk of infections in diabetics should be acknowledged.
- Patients with a primary diagnosis postural/musculoskeletal back pain who have intermittent radicular-like symptoms and who have not improved with conservative therapy measures over 8 to 10 weeks may benefit. Doses less than 80 mg methylprednisolone should be used.
- Patients with established low back pain syndromes who develop a flare-up of symptoms should be evaluated carefully before ESIs are provided. The treatment may be of less benefit in those with longstanding pain, previous surgery, and preoccupation with vocational or legal issues and in patients who smoke heavily.
- Patients with cancer-related pain who are thought to have tumor invasion of nerve roots (which causes an inflammatory pathology) may benefit from ESIs.

CONCLUSION

Back pain is a common, pervasive, and expensive problem. The workup of any patient with acute, subacute, or chronic back pain must clarify whether the patient is seriously ill or not. It is essential to acknowledge that patients in pain want to know what is

causing the pain, not so much what they do not have.

Treating the *cause* of the pain is more likely to be successful than merely treating the *symptom* of pain. Patients should be actively selected for all procedures including ESIs, *each time* they present for treatment. The clinical decision at that time is based on assessment of their particular physical and nonphysical findings.

ESIs are not to be viewed as generic treatment for all patients with back pain complaints. Rather, nerve blocks are but one component of a coordinated treatment program that balances the continuation of effective therapy with the cessation of any that is not working or that may be causing side effects. ESIs can help patients achieve the goals of acute and chronic pain management.

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