Beyond the Back: The Science of Lumbar Epidural Steroid Injections

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Learning Point of the Article:

Chronic low back pain, a major global health issue, often stems from intervertebral disc disease and facet joint arthritis. Epidural steroid injections (ESIs) have been effective for short-term pain relief, particularly in cases of lumbar disc herniation, by reducing inflammation around compressed nerves. Techniques like selective nerve root blocks (SNRBs) and caudal epidural steroid injections (CESIs) offer targeted and broader treatment options respectively. Post-injection exercises are crucial for long-term recovery and preventing recurrence. Despite generally being safe, ESIs require careful consideration of potential complications and contraindications. Further research is needed to enhance their long-term efficacy and safety.

Introduction

Chronic low back pain causes significant morbidity and increases the global burden of disability. It has been shown to increase psychological, physical, and monetary load on the world population. In the USA alone, it causes an economic burden of 100 billion dollars/year [1]. Low back pain has been referred to as sciatica pain, lumbar radiculopathy, lumbar nerve entrapment, and neurogenic claudication. It is basically pain arising from the lower back region and radiating like a current to the lower limbs. The two prime causes of this low back pain with radiculopathy are intervertebral disc disease and facet joint arthritis [2]. The pathological aging changes happening in intervertebral disk cause disk herniation and other degenerative diseases such as lumbar canal stenosis and chronic instability. Lumbar radiculopathy or sciatica is mainly caused by compression of the nerve by protruded nucleus pulposus, which is the jelly like material of intervertebral disk [3,4].

Most of the patients with intervertebral disk disease and sciatica can be managed with conservative measures. These include anti-inflammatory analgesics, neuropathic medications such as pregabalin and gabapentin, regular exercises, and epidural steroid injections [5-7]. These measures help to prevent surgery. Significant compression of nerves with no relief from conservative measures qualifies to surgical intervention [2].

ESI, which has been used since 1952, is mainly used for lumbar and neck pain with radicular pain. It has shown excellent and quick results with minimal adverse effects. The ESI consists of injecting the steroids with or without local anesthetic medication in the epidural space to decrease the discogenic source of pain [8-11].

LSEI can be divided according to the needle route (interlaminar, transforaminal, or caudal). In this article, we will go over the various approaches for intralaminar (between the 2 adjacent laminae of lumbar vertebrae), transforaminal (through the intervertebral foramen), and caudal (through the sacral hiatus) epidural steroid injections [12-14].

Understanding the Role of Epidural Steroids in Lumbar

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Author's Photo Gallery

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Spine

It is proposed that mechanical compression of nerves causes inflammatory molecules and neurochemicals to be released, which causes radicular irritation. Neurochemicals like substance P, phospholipase A2, vasoactive intestinal peptide (VIP), and calcitonin gene-related peptide are released by the herniated nucleus pulposus in the epidural space. These chemicals irritate and make nerve roots, nerve fibers, and dorsal root ganglia hypersensitive to pressure and stretch causing radicular pain. Changes in ion physiology in sensory nerves cause increased pain perception. Corticosteroids in epidural space, where the actual inflammation happens, help to cease inflammatory processes thereby decreasing pain [15,16].

Many publications have shown good results with ESI in lumbar spine ailments. Manchkanti et al. in their meta-analysis of around 70 clinical trials have shown good results with lumbar disc herniations, whereas mediocre and dismal results in spinal stenosis and failed back syndrome patients, respectively [17]. Furthermore, the same author has shown effective treatment done by ESI in lumbar canal stenosis and lumbar radicular pain [18]. A prospective trial by Kennedy et al. showed a good pain relief in lumbar radiating pain, albeit the pain relief has been temporary [19]. Singh et al. in his paper showed that two-level transforaminal injections have resulted in better pain relief than single-level injection mostly in multi-level disk problems [20].

There is good evidence of short-term pain relief in lumbar pathologies with ESI. However, due to only short-term relief, additional modalities of treatment like physiotherapy need to be added for long-term pain relief [21,22].

Selective Nerve Root Blocks (SNRB)

Technique-SNRB is done in prone positions. Pillows can be used to make patients comfortable. An oblique image is taken to visualize the foramen between two adjacent vertebrae. The oblique image shows the classical "scotty dog neck", which is the target for the needle to aim at. Before insertion of the needle, local anesthetic like bupivacaine or lidocaine can be injected locally in the skin and subcutaneous region, to alleviate pain of needle insertion.

Later, a 22-number spinal needle is inserted at the starting point guided by X-ray. The needle is navigated slowly to the target point of the "Scotty Dog Neck region". Multiple X-rays need to be taken to avoid misplacement of needle. A lateral X-ray of lumbar spine is done to check the depth of needle in the intervertebral foramen, to prevent any nerve injury chances. Once the needle is adequately in the foramen in lateral X-ray and at the scotty dog neck in oblique X-ray, the radiopaque contrast dye is injected to identify the epidural flow along the nerve root in AP and lateral X-ray shoots. A particulate steroid like dexamethasone with or without local anaesthetic like bupivacaine is injected in the epidural space. The injection of steroid is followed by removal of needle immediately and local pressure to prevent any bleeding [23].

SNRB is an epidural injection technique which targets a single nerve. This kind of injection is used to diagnose and treat lumbar radiculopathy. If the nerve root block is for diagnostic purposes, only a local anesthetic can be injected. For therapeutic purposes, local anesthetic plus a steroid like dexamethasone is added [24].

Caudal Epidural Steroid Injections (CESI)

Technique: The patient is positioned in a prone position for injection with buttocks uncovered. Parts are cleaned and prepped. An AP view of sacrum is taken to locate the sacral hiatus. Local anesthetic is injected at the site of entry of the spinal needle, in skin, and subcutaneous tissue. The epidural needle is injected through skin and subcutaneous tissue into the sacral hiatus region. To gauge the position of needle, X-rays in AP and lateral position are taken. As the needle is passed around the area of S2-3, the incidence of dural injury is minimal. Similar to SNRB the contrast radiopaque dye is injected and the flow of the dye is analyzed both in AP and lateral X-ray to confirm an uniform epidural spread. A cocktail of around 20 mm with local anesthetic like bupivacaine diluted to 0.25% for only sensory anesthesia and steroid-like dexamethasone is injected slowly. It is important to ascertain that the flow to injection is uniform without any significant pressure on the plunger of the syringe [23].

SNRB functions like a precision-guided rocket on a single nerve, but CESI acts like a carpet bombing on several lumbar levels. As a result, CESI is most commonly employed in cases of multiple-level lumbar canal stenosis resulting in neurogenic claudication. As the injection flows through the sacral hiatus, the medication volume preferably should be significantly increased, approximately 20–25 ml, to reach upper lumbar disc levels [25]. The advantages of CESI include simplicity of access and deployment, as well as a low incidence of dural puncture. However, feeling of using a large volume of medicine administered, improper placement in about 38% of instances, and uncontrolled dissemination of anesthetic agent are possible drawbacks of CESI [25].

Role of Exercises After Injections

Regular back strengthening exercises are important after lumbar epidural steroid injections (LESIs) because they promote healing and lower the chance of recurrence based on

the author's experience. Recent literature has shown that regular low back and core exercises have helped to improve muscle strength, flexibility, and gross spinal stability. These also complement the pain relief contributed by ESIs. Regular exercise also helps to reduce the discomfort of muscle spasm and improves functional ability post-ESIs [26]. The exercise regime utilized after ESI should contain amalgamation of core strengthening, flexibility exercises, and cardiovascular exercises. Functional improvement after exercises is due to increased flexibility in muscles and ligaments of the lumbar region aiding into improved range of motion of spinal segments. Aerobic exercises increased the blood flow to the lumbar musculature and connective tissues, causing early healing and reduced stiffness and discomfort [27]. Therefore, post-ESI regular exercises help to enhance the effectiveness of the pain relief and improve functional recovery. These exercises also help to prevent any further episodes of lumbar discomfort due to improved flexibility and strength of muscles and facet joints.

Complications and Precautions with Epidural Injections

Complications

Epidural steroid injections (ESIs) are typically safe techniques, although they do pose the possibility of adverse results, which are rare. The current research implies that severe problems occur in fewer than 1% of instances [28]. Bleeding and infection are possible, albeit rare, concerns associated with any invasive procedure. Allergic responses to injectable drugs, nerve damage, and temporary numbness or tingling in the limbs are rare but recorded consequences. Dural puncture, albeit rare, can cause positional headaches. Epidural abscesses, hematomas, and temporary or chronic back or lower extremity discomfort are among the most significant consequences. Temporary adverse effects of steroids include flushing, fluid retention, weight gain, increased blood glucose, and mood disturbances. Adrenal suppression is possible, especially in individuals who get several injections over time [23]. Hence it is authors personal opinion that these procedures should be done by surgeons, who are trained in managing these complications.

Precautions

Certain absolute contraindications to LESI include systemic or local infection, blood disorders, allergic responses, and localized malignancy, which all represent major dangers to the patient's safety and well-being [28,29]. Relative contraindications, such as uncontrolled diabetes, congestive cardiac failure, use of blood thinners like aspirin/clopidogrel, and pregnancy (due to radiation hazard), must be carefully considered due to probable consequences, while they may not completely rule out the ESI [23]. Clinicians must balance the risks and benefits to ensure patient safety and optimal treatment outcomes.

Role of Particulate Versus Non-Particulate Steroid Injection

Particulate steroids, which include triamcinolone, methylprednisolone, and betamethasone acetate, were selected for their "depot effect," which extends the medicine effect to pathological sites [30]. However, these steroids can accumulate and cause neurological harm by blocking microvasculature [31]. Non-particulate steroids, such as dexamethasone, are smaller and do not agglomerate under light microscopy. The potential analgesic benefit of particulate steroids has not been confirmed in the literature, resulting in a preference for non-particulate steroids in transforaminal ESI [32].

Conclusion

Lumbar epidural steroid injections (LESIs) are an invaluable non-surgical option for treating persistent low back pain and radiculopathy which are both therapeutic and diagnostic in nature. Numerous studies have shown that LESIs are useful in giving short-term pain relief, but their long-term effectiveness is debatable. Along with LESIs, including regular back-strengthening exercises in rehabilitation programs can improve results and enable individuals to manage their pain more effectively and prevent recurrence. Despite a small number of concerns, doctors must carefully assess contraindications and potential hazards to guarantee patient safety and optimal treatment outcomes. Moving forward, additional study and method modification will improve the efficacy and safety of LESIs for treating lumbar spine problems.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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