

Interventional Management of Low Back Pain: A Comprehensive Review of Epidural Steroid Injections and Related Techniques



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Abstract

Lower back pain (LBP) represents a significant global health burden, impacting individuals' quality of life, productivity, and financial stability. While acute episodes may resolve spontaneously, chronic LBP persists beyond 12 weeks, necessitating a multidisciplinary approach to management. This comprehensive review examines the interventional management of LBP, with a focus on Epidural Steroid Injections (ESIs) and related techniques. ESIs, administered into the epidural space surrounding spinal nerves, aim to alleviate inflammation and nerve compression-induced pain. However, they carry inherent risks, including infection, nerve damage, and allergic reactions. Comparative effectiveness studies highlight varying outcomes associated with different interventions, emphasizing the need for individualized treatment plans.

Guidelines from professional organizations advocate for a patient-centered approach, prioritizing non-pharmacologic therapies as first-line treatments. Integrating evidence-based practices and considering patient preferences and clinical circumstances are crucial in optimizing outcomes. This review also discusses patient selection criteria, safety considerations, and long-term outcomes associated with interventional management techniques. By adhering to established guidelines and integrating a range of therapeutic options, clinicians can effectively address the multifaceted challenges posed by LBP, ultimately enhancing patient well-being, and improving treatment outcomes. A holistic approach, encompassing both conservative and interventional modalities, is essential in the comprehensive management of LBP.

Keywords: Lower Back Pain; Interventional Management; Epidural Steroid Injections (ESIs), Chronic Low Back Pain

Abbreviations: LBP: Lower Back Pain; ESIs: Epidural Steroid Injections; BMI: Body Mass Index; NSAIDs: Nonsteroidal Anti-Inflammatory Drugs; ODI: Oswestry Disability Index; RFA: Radiofrequency Ablation; ASIPP: American Society of Interventional Pain Physicians; ACP: American College of Physicians; NASS: North American Spine Society; FDA: Food and Drug Administration

Introduction

Lower back Pain is considered one of the disabilities with the highest global prevalence, having an impact on the financial stability of individuals who suffer from it due to the inability to physically work and expensive recurrent needs for physical

treatment, lowering their physical productivity. During the acute episodes considered from 4-6 weeks, many incidents were self-resolved within several weeks. In the Chronic LBP, the pain persists beyond 12 weeks [1]. The Symptoms of both

presentations depend on lumbosacral nerve roots that produce radiculopathy or radicular pain. The focus of managing LBP is to decrease symptoms and return patients to normal activity levels as soon as possible.

The treatment is a multidisciplinary approach and differs in complexity, including conservative measures, including physical therapy and rehabilitation, psychological interventions, such as biofeedback and cognitive-behavioral therapy, and pharmacological and interventional pain procedures. When conservative measures fail, the importance of interventional treatment, such as spinal injections, can be used as diagnostic, prognostic, or therapeutic for LBP. Interventional management includes facet injections, diagnostic discography, SIJ interventions, and epidural steroid injections (ESIs) that are going to be discussed in this review and the most used for spinal stenosis or herniated nucleus pulposus controlling mild to moderate pain with the purpose of reducing the percentage of surgical intervention [2].

Background and Rationale

The pathophysiology of lower back pain depends on the etiologic cause of the symptoms. Still, it consists of the degeneration of the vertebral and/or intervertebral disks, facet joints, ligaments of the spine and/or sacrum, and sacroiliac joints, all of which cause compression and damage to the spinal cord and nerve roots. Some of the etiological causes include trauma, degenerative, oncologic, infectious, inflammatory, metabolic, referred pain, postural, congenital, and psychiatric, all of which, depending on their timeline, can be classified as acute lower back pain (less than 6 weeks) or chronic back pain (more than 6 weeks) [3]. Although the specific etiology of LBP in patients remains nonspecific at times, factors like age, BMI greater than 30 kg/m², stress, occupation, smoking, and genetics are known causes of increased risk of developing lower back pain [4]. Based on the high prevalence of lower back pain and with the rise of opioid use in the past years, other techniques and treatment forms were started to be studied to find a solution as well as decrease pain and disability since opioids do not offer pain relieving properties as previously thought [5].

Several treatment forms attempt to alleviate pain and reduce disability of patients with LBP. Transforaminal injections consist of a needle going through the foramina directly, where the nerve directly exists from the spine in the ventral epidural space, providing direct intervention to the site; this has been found to improve pain and have a significant improvement in the Oswestry Disability Index (ODI) through 4 weeks [6]. Interlaminar epidural injections deliver the treatment to the dorsal epidural space, making this intervention more adequate for patients with multifocal back pain as it covers more space than the transforaminal injections. Although the latter is safer and has fewer contraindications than the transfemoral, it has limited outcomes throughout the studies as most of the approaches had limited ventral epidural space

coverage. A study found no statistical significance in the ODI scores between Transfemoral epidural, and a technique called oblique interlaminar injection, suggesting it has similar efficacy with fewer contraindications [7].

Facet Joint injections are one of the most common pain-relief techniques used, as they insert steroid treatment in the intra-area of the facet joint identified as the issue with relatively low risks for complications [8]. Sacroiliac (SI) joint pain is a common etiology of lower back pain. Therefore, SI joint injections are one of the most common procedures for lower back pain. Studies have shown significant differences in pain reduction in patients with SI pain; however, there is no statistical difference between the two most common steroid preparations for SI joint injections (methylprednisolone and triamcinolone) [9].

Types of Interventions

Interventional management of low back pain (LBP) encompasses a variety of techniques aimed at alleviating pain and improving function. Epidural Steroid Injections (ESIs) are a common and practical approach. ESIs involve the percutaneous delivery of corticosteroids into the epidural space surrounding the spinal nerves. This procedure aims to reduce inflammation and alleviate nerve compression or irritation pain. ESIs can be administered via interlaminar or transforaminal approaches, each offering distinct advantages depending on the specific pathology and patient characteristics [10]. In the interlaminar approach, the medication is injected into the epidural space between the laminae of adjacent vertebrae, providing widespread coverage of multiple nerve roots. On the other hand, the transforaminal approach involves direct injection of the steroid into the foraminal region, targeting a specific nerve root responsible for the pain.

This approach offers more precise medication delivery to the affected nerve root, potentially enhancing therapeutic efficacy [11]. Additionally, nerve root and medial branch blocks are commonly utilized interventions for LBP. Nerve root blocks involve injecting anesthetic and/or steroid medication directly around a specific spinal nerve root suspected to be the source of pain. Similarly, medial branch blocks target the medial branches of the dorsal rami that innervate the facet joints, aiming to interrupt pain signals from these joints. Both techniques can serve diagnostic and therapeutic purposes, identifying pain generators and providing symptomatic relief [12]. Furthermore, radiofrequency ablation (RFA) may be employed for longer-lasting pain relief in cases of facet joint-mediated LBP. RFA utilizes thermal or pulsed radiofrequency energy to denervate the medial branches responsible for transmitting pain signals from the facet joints, offering prolonged relief from chronic LBP [13]. The interventional management of LBP encompasses a range of techniques, including ESIs via interlaminar and transforaminal approaches, nerve root blocks, medial branch blocks, and radiofrequency ablation. Each intervention has unique

mechanisms of action and therapeutic targets, providing clinicians with a comprehensive armamentarium for effectively managing LBP and improving patients' quality of life.

Safety and Adverse Effects

Epidural Steroid Injections (ESIs) constitute a prevalent interventional approach for managing lower back pain, often attributed to inflammation or nerve irritation. Since their inception, initially utilized by medical pioneers such as Fidel Pages of Spain and further documented by practitioners worldwide, including Dogliotti of Italy, Gutierrez of Argentina, Vasconcelos of Brazil, and Dawkins of England, ESIs have become widely adopted for their potential efficacy [14]. Administered within the epidural space—a real anatomical region housing structures such as epidural fat, spinal nerves, veins, and arteries—ESIs aim to alleviate pain by delivering analgesic drugs directly to affected areas [15]. Despite their therapeutic benefits, ESIs carry inherent risks and potential adverse effects that necessitate careful consideration. Infections stemming from the procedure pose a significant concern, potentially leading to severe sequelae if left unaddressed. Strict adherence to sterile and standardized techniques during administration is imperative to mitigate this risk. Furthermore, the invasive nature of ESIs leaves patients vulnerable to nerve damage, with inadvertent injury to adjacent nerve structures posing the risk of weakness, numbness, or tingling sensations in corresponding regions.

Moreover, individuals with bleeding disorders or those undergoing anticoagulant therapy face an elevated risk of bleeding complications during ESI administration. Anaphylactic reactions to injected substances present another potential hazard, warranting prompt medical intervention in affected patients. Additionally, patients with Diabetes Mellitus may experience transient elevations in blood glucose levels following ESI administration, necessitating careful monitoring and management. Insights gleaned from various studies shed light on the safety and efficacy of ESIs and related techniques. For instance, Southern et al. found that approximately 20% of patients with chronic lumbar discogenic pain experienced significant pain reduction following fluoroscopically guided epidural steroid injections [16]. However, a notable proportion of patients experienced procedure failure, necessitating further interventions. Similarly, studies by Lee et al. and Garvey et al. demonstrated promising outcomes regarding pain reduction following fluoroscopic interlaminar epidural steroid injections and trigger-point therapy, respectively [17,18].

Patient Selection Criteria

There are various recommendations for interventions in managing low back pain, including exercise to reduce the risk of future back injuries; this is done through three goals, which include improvement or elimination of impairment in back flexibility and strength along with improvement in endurance activities. The second goal is to reduce the intensity of back pain, while the

third goal of the exercise is to reduce back pain-related disability through desensitization of fears and concerns by altering pain attitudes and beliefs and improving effect [19]. All patients should start exercising soon to help fulfill these goals. Along with such interventions, in patients with subacute back pain (4-12 weeks in duration), adjunctive pharmacological therapy is often prescribed.

Pharmacological therapy begins with the use of NSAIDs, which can be replaced with acetaminophen if NSAIDs are intolerable. In patients for whom NSAIDs do not provide an adequate response, the addition of muscle relaxants is often required. Patients who encounter disabling symptoms unresponsive to nonpharmacological treatment along with previously aforementioned pharmacological treatment must resort to opioid treatment. It is, however, not intended to be used for chronic pain management due to the harmful effects and risk of dependency. The use of Epidural Spinal Injections is yet a viable option to help aid patients with low back pain. Even though it is still unclear which type of conservative intervention is superior, several studies have proved that ESIs can increase patients' quality of life, relieve lumbosacral radicular pain, and reduce or delay more invasive interventions, such as spinal surgery [20].

The etiology of back pain only sometimes requires imaging and is sometimes overused. Patients and clinicians believe diagnostic imaging is an important test to locate the source of low back pain (33 studies, high confidence); patients with chronic low back pain believe pathological findings on diagnostic imaging provide evidence that pain is real (12 studies, moderate confidence); and clinicians ordered diagnostic imaging to reduce the risk of a missed diagnosis that could lead to litigation, and to manage patients' expectations (12 studies, moderate confidence) [21]. The history of present history is critical in diagnosing low back pain, and etiologies can range from musculoskeletal to cardiac and gastrointestinal causes, amongst others. Imaging should be reserved for patients with alarming symptoms or who fail to improve with initial management. Imaging of choice is X-ray, but specific etiologies such as spinal stenosis and cord compression can benefit from additional imaging such as MRI if required.

Comparative Effectiveness

Epidural Steroid Injections (ESIs) constitute a prevalent interventional approach for managing lower back pain, often attributed to inflammation or nerve irritation. Since their inception, initially utilized by medical pioneers such as Fidel Pages of Spain and further documented by practitioners worldwide, including Dogliotti of Italy, Gutierrez of Argentina, Vasconcelos of Brazil, and Dawkins of England, ESIs have become widely adopted for their potential efficacy. Administered within the epidural space—a real anatomical region housing structures such as epidural fat, spinal nerves, veins, and arteries—ESIs aim to alleviate pain by delivering analgesic drugs directly to affected areas. In evaluating the comparative effectiveness of various

interventional approaches for managing low back pain, studies have provided valuable insights into the outcomes associated with different interventions. Comparative analyses have often focused on parameters such as pain relief and functional improvement to assess the efficacy of treatments.

For instance, studies comparing outcomes between fluoroscopically guided epidural steroid injections (ESIs) and other techniques, such as trigger point injections or sacroiliac joint injections, have demonstrated varying degrees of pain reduction and functional enhancement [22]. Furthermore, investigations exploring the effectiveness of combined or sequential interventions have shed light on their potential synergistic benefits. By integrating multiple modalities, such as ESIs, alongside physical therapy or acupuncture, clinicians aim to optimize treatment outcomes and address multifaceted aspects of low back pain. Studies assessing the efficacy of such combined approaches have highlighted the importance of individualized treatment plans tailored to patient needs and preferences. Comparative effectiveness research in interventional management of low back pain underscores the importance of considering various factors, including pain relief, functional improvement, and patient satisfaction.

Long Term Outcomes

A systematic examination of four randomized trials revealed that the disparities in disability outcomes between lumbar vertebral fusion and nonsurgical interventions did not meet the criteria for clinically significant differences as set forth by the US Food and Drug Administration (FDA) [23]. The participants included individuals who had endured at least one year of low back pain unresponsive to standard nonsurgical treatments, with exclusion criteria typically encompassing significant psychiatric or somatic illnesses, ongoing compensation issues, or other chronic pain conditions. Among these trials, one involving 289 patients indicated that lumbar vertebral fusion outperformed unstructured nonsurgical therapy at the two-year follow-up in terms of pain reduction (33% versus 7%), disability alleviation (25% versus 6%), return-to-work rates (36% versus 13%), and self-perceived improvement (63% versus 29%) [24]. However, three other trials failed to discern any distinct or clinically relevant discrepancies between surgical and nonsurgical interventions, with two trials needing to be more adequately powered and a third experiencing a high crossover rate between treatment groups [25]. Subsequent analysis at the four-year follow-up of two of these randomized trials revealed no discernible advantage of spinal fusion surgery over cognitive intervention and exercise-based treatments [26,27].

Guidelines and Recommendations

Guidelines and recommendations for the interventional management of low back pain emphasize a patient-centered approach that integrates evidence-based practices from various professional organizations. The American College of Physicians (ACP) recommends non-pharmacologic therapies as first-

line treatments, including exercise, acupuncture, and spinal manipulation, with pharmacologic options such as NSAIDs or muscle relaxants considered if necessary [28]. Similarly, the American Society of Interventional Pain Physicians (ASIPP) emphasizes careful patient selection and the use of fluoroscopic guidance for epidural steroid injections, highlighting their role as part of a comprehensive treatment plan for chronic low back pain [29]. Meanwhile, the North American Spine Society (NASS) underscores the importance of shared decision-making and individualized treatment plans, advocating for a combination of conservative and interventional therapies tailored to the patient's needs [30].

These guidelines prioritize a holistic approach to low back pain management, acknowledging the multifactorial nature of the condition and the diversity of available treatment modalities. Clinicians can optimize treatment outcomes and improve patient satisfaction by considering patient preferences, clinical circumstances, and available evidence. Noninvasive therapies are generally favored as initial interventions, with interventional procedures such as epidural steroid injections reserved for cases where conservative treatments have failed to provide adequate relief. Adherence to established guidelines fosters the delivery of high-quality care in the interventional management of low back pain. Integrating a range of therapeutic options and promoting shared decision-making can address the complex needs of patients with low back pain, ultimately enhancing outcomes and promoting patient well-being.

Conclusion

Lower back pain management represents a global challenge, affecting individuals' quality of life, financial stability, and productivity. With the distinction between acute and chronic presentations and a myriad of potential etiologies, the treatment landscape for lower back pain encompasses a multidisciplinary approach ranging from conservative measures to interventional procedures. Epidural Steroid Injections (ESIs) are a common and practical interventional approach to alleviate inflammation and nerve compression-induced pain. However, despite their efficacy, ESIs pose inherent risks and potential adverse effects, necessitating careful consideration and adherence to standardized techniques. Insights from comparative effectiveness studies shed light on the varying outcomes associated with different interventions, emphasizing the importance of individualized treatment plans tailored to patient needs and preferences.

Guidelines and recommendations from professional organizations advocate for a patient-centered approach, prioritizing non-pharmacologic therapies as first-line treatments and integrating evidence-based practices to optimize outcomes. By considering factors such as patient preferences, clinical circumstances, and available evidence, clinicians can effectively navigate the complex landscape of lower back pain management. Adherence to established guidelines fosters high-quality care,

promoting patient well-being and enhancing overall treatment outcomes. In essence, a holistic and evidence-based approach, encompassing both conservative and interventional modalities, is essential in addressing the multifaceted challenges posed by lower back pain and improving the lives of affected individuals.

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