Archives of Anesthesiology and Critical Care (In Press); x(x): xx-xx.

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Research Article

Comparison of the Effect of Caudal Epidural and Trigger Point Steroid Injections on Pain Control in Patients with Chronic Low Back Pain

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ARTICLE INFO

Article history:
Received 09 March 2025
Revised 30 March 202
Accepted 14 April 2025

Keywords:
Low back pain;
Caudal epidural;
Pain management;
Trigger points

ABSTRACT

Background: Chronic spinal pain can be managed through various approaches, including surgical options and interventional techniques like epidural injections and trigger point injections. However, there is a notable lack of comparative research addressing the effectiveness of these two specific methods in alleviating chronic low back pain. This study aimed to evaluate and compare the pain relief outcomes associated with caudal epidural steroid injections and trigger point steroid injections in patients suffering from chronic low back pain.

Methods: Sixty patients aged between 20 and 75 years, who had been dealing with chronic low back pain for more than 12 weeks and had a Visual Analog Scale (VAS) score exceeding three, were randomly assigned into two groups of thirty. One group received caudal epidural injections, while the other group was treated with trigger point injections. In the caudal epidural group, a mixture of corticosteroid and 2 mg of ropivacaine was administered under ultrasound guidance at the caudal epidural site. Similarly, the trigger point injection group received the same dosage of corticosteroid and local anesthetic, injected into the identified trigger points under ultrasound guidance. Participants were monitored for six weeks after the injections, with pain levels evaluated at weeks 2, 4, and 6 using the VAS. A two-way ANOVA analysis was conducted to identify differences in pain relief between the two groups.

Results: The findings showed significant differences in pain levels between the two groups. Patients who received caudal epidural injections reported a more substantial reduction in pain compared to those who received trigger point injections. Additionally, the caudal epidural group exhibited a continuous decrease in pain levels at the follow-up assessments from weeks 2 to 6.

Conclusion: This study indicates that caudal epidural steroid injections are a safe and effective method for managing and reducing chronic low back pain. Given these results, caudal epidural injections should be considered a viable treatment option for patients experiencing chronic low back pain.

Introduction

Low back pain (LBP) is a common condition defined by discomfort in the lower back and can radiate to the lower limbs, affecting individuals from the rib cage to the buttocks [1]. It is primarily classified into two types based on the underlying cause: specific low back pain, which has identifiable sources such as herniated discs, infections, fractures, spinal deformities, or tumors; and non-specific low back pain, where the cause is not clearly defined [2]. Approximately

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DOI:

90% of low back pain cases are classified as non-specific, typically persisting for over three months without links to recognizable specific pathologies like infections, tumors, osteoporosis, or serious spinal issues [3, 4]. Studies show that 60% to 80% of people experience low back pain at some stage in their lives [5].

Pain, as a complex experience, encompasses various dimensions—physical, psychological, social, and spiritual—and is often described as an unpleasant psychological and sensory experience associated with actual or potential tissue damage. Chronic pain management is crucial, as poor handling can adversely affect both physical and mental health, reduce the quality of life, and lead to significant disabilities [6]. This situation contributes to substantial economic costs, including direct medical expenses and indirect costs such as treatment complications, job absenteeism, reduced mobility, functional impairments, and associated compensations that impact individuals and society [7].

Pain is among the most prevalent health issues experienced over a lifetime and significantly affects quality of life [8]. It is often one of the earliest complaints voiced by patients, leading to social withdrawal for those suffering from long-lasting discomfort [9]. This withdrawal fosters feelings of isolation and limitation, confining many individuals to their homes and workplaces, with regular medical consultations intensifying their fatigue and straining family relationships [10].

Conservative Treatments for Lumbosacral Radicular Pain

For managing lumbosacral radicular pain, a range of non-surgical medical treatments is often recommended. These include lifestyle modifications, physical therapy, exercise, oral and localized analgesics, and epidural steroid injections [11]. The main goal of conservative care for low back pain is to either delay or prevent the need for surgical intervention. Many patients with low back pain experience significant improvement or resolve their symptoms with conservative strategies, thus surgery is typically reserved for those who do not respond to these treatments.

Epidural steroid injections are commonly utilized to address lumbosacral radicular pain and are considered a minimally invasive option that effectively targets both acute back pain and related leg symptoms [12]. These injections can be administered through various techniques, such as caudal, interlaminar, or transforaminal approaches, delivering corticosteroids—and sometimes local anesthetics—directly to the epidural space near the pain source [13-14]. Advances in technology have improved the ability of anesthesiologists to perform these injections, solidifying this technique's reputation as a reliable method for pain management. While there is ongoing discussion about the best conservative treatments, numerous studies suggest that epidural steroid injections can improve quality of life and alleviate lumbosacral radicular pain, potentially delaying the need for more invasive surgical options [15].

Another approach for low back pain management is the use of trigger point injections, which are invasive procedures aimed at treating myofascial pain. This technique involves injecting a local anesthetic directly into a trigger point—defined as a highly sensitive area within a tight band of muscle. Trigger points are often linked to chronic pain and restricted mobility. Optimally, trigger point injections should be part of a comprehensive, multimodal treatment plan, which may include exercise therapy, physical therapy, and medication. The immediate pain relief from trigger point injections can increase patients' ability to tolerate other therapies, aiding in recovery, especially for those with low pain tolerance during physical therapy. Although trigger point injections are effective for managing pain related to specific muscle areas, they should always be conducted as part of a thorough treatment strategy, following a comprehensive evaluation of the patient [16]. In light of these considerations, the current study seeks to investigate the comparative effectiveness of caudal epidural steroid injections versus trigger point injections in managing pain for patients experiencing chronic low back pain.

Methods

This research was conducted as a single-blind clinical trial and received ethical approval from the Ethics Committee of Shahid Beheshti University of Medical Sciences. The sample size was determined to be 23 participants based on a 95% confidence interval and an 80% power, accounting for the observed standard deviation. To accommodate potential dropouts, 30 subjects were selected for each group. Initially, out of 100 patients referred to Akhtar Hospital, 60 individuals aged between 20 and 75 years who had been experiencing chronic low back pain for over 12 weeks and had a Visual Analog Scale (VAS) score greater than 3 were randomly chosen.

Inclusion criteria for participation included being literate, having idiopathic low back pain, being between 45 and 75 years old, being able to walk, having a VAS score exceeding 3, and experiencing pain for more than 12 weeks. Exclusion criteria focused on participant safety and included any neuromuscular disorders, a history of spinal trauma, radicular pain linked to lumbar spine problems, rheumatic diseases, prior physical therapy or spinal injections in the past six months, psychiatric disorders, spinal tumors, infections, bleeding disorders, neurological sensory or motor deficits, a history of spinal surgery, and morbid obesity.

Ethical standards were upheld by ensuring the study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences. During the study, researchers provided thorough explanations of the objectives to the participants. They were informed about their right to withdraw from the study at any time without impacting their medical care and that their personal information would remain confidential. Each participant completed and signed an informed consent form.

Research staff conducted face-to-face discussions and provided an educational brochure that outlined the injection procedure, follow-up appointments, and any necessary laboratory tests. Participants were then randomly allocated to either the caudal epidural injection group or the trigger point injection group. In the caudal epidural group, a mixture of corticosteroids and a local anesthetic (2 mg of ropivacaine) was administered into the caudal epidural space under ultrasound guidance. In the trigger point injection group, the same medication was injected into the identified trigger points, also guided by ultrasound. Participants were monitored for six weeks after the procedure, with evaluations taking place at weeks 2, 4, and 6 to assess pain levels using the Visual Analog Scale (VAS), where patients rated their pain intensity.

Visual Analogue Scale

The Visual Analogue Scale (VAS) is a tool used to assess a patient's overall level of pain. This scale is represented as a 10-centimeter line, where a score of 0 signifies no pain, scores from 1 to 3 indicate mild pain, scores from 4 to 6 reflect moderate pain, and scores from 7 to 10 represent severe pain. Reports on the internal consistency of this tool have shown reliability values ranging from 0.85 to 0.95 [17].

In the data analysis phase, mean values, standard deviations, frequency distributions, and graphical representations were employed to organize and summarize the data collected. The Kolmogorov-Smirnov test was utilized to evaluate the normal distribution of the data. Following verification of statistical assumptions, a two-way ANOVA was conducted at a 95% confidence level using statistical software version 22.

Results

The study included 60 participants, composed of 36 men (60%) and 24 women (40%), with ages spanning from 20 to 75 years and a mean age of 53.5 years. The Kolmogorov-Smirnov test indicated that the data followed a normal distribution ($P > 0.05$). Pre-intervention analysis showed no significant differences in VAS scores between the two groups ($t=0.67$, $p>0.05$). For data analysis, a 2×3 repeated measures ANOVA (week × group) was performed, with results detailed in (Table 1).

The analysis revealed a significant main effect of the treatment group ($F1,58=249.203$, $p<0.05$), a significant main effect of time ($F1,58=234.047$, $p<0.05$), and a noteworthy interaction between group and time. The significant effect associated with the treatment group indicates that the VAS scores differed substantially, with the caudal epidural injection group experiencing greater pain relief compared to the control group. The significant effect of time suggests that pain reduction trends were statistically significant throughout weeks 2, 4, and 6 for the caudal epidural injection group ($F1,58=140.760$, $p<0.05$).

Discussion

The aim of this study was to assess the effects of caudal-epidural steroid injections compared to trigger point injections on pain management in patients with chronic low back pain. The results indicated a significant difference in pain levels between the caudal-epidural injection group and the control group, with the former demonstrating a more substantial reduction in pain. Additionally, the caudal-epidural injection group showed a consistent trend of decreasing pain levels over the course of weeks 2, 4, and 6.

These findings align with previous research conducted by Carassiti et al. [18], Celenlioglu et al. [19], Goel A et al. [20], and Parr et al. [21], all of whom reported the effectiveness of caudal-epidural injections in alleviating pain in chronic low back pain patients. For instance, Celenlioglu et al. [19] highlighted caudal-epidural injection as a highly effective option for chronic pain relief. Similarly, Parr et al. [21] provided compelling evidence of both short-term and long-term pain alleviation achieved through the use of local anesthetics and steroids in treating chronic pain conditions such as disc herniation or radiculitis. Moreover, there's a considerable body of evidence supporting the use of caudal epidural injections for managing axial or chronic discogenic pain, spinal stenosis, and post-surgical pain syndromes.

While several hypotheses have been proposed regarding the mechanisms through which epidural steroid injections provide pain relief, the precise mechanism remains unclear. Further research is necessary to elucidate the underlying processes involved in the efficacy of these injections in pain management.

Table 1- Results of the two-way ANOVA on VAS scores between two groups

Dependent variable	df	MS	F	P
Group	1	135.200	249.203	0.001
Week	1	80.033	234.047	0.001
group× week	1	48.133	140.760	0.001
Error	58	0.342		

According to one widely accepted theory, steroid injections reduce inflammation by inhibiting pro-inflammatory cytokines and the enzyme phospholipase A2, which are both critical in the inflammatory process [22]. It is also suggested that the combination of steroids and local anesthetics alleviates pain by disrupting the conduction process in non-myelinated C fibers, therefore preventing ectopic discharges in compressed spinal nerve roots through their stabilizing effects on neural membranes [23]. Additionally, local anesthetics may enhance blood flow to ischemic spinal nerve roots [24]. The injected substances can also facilitate the removal of inflammatory cytokines through a process called adhesiolysis, which effectively breaks down scar tissue.

Caudal epidural steroid injection is considered one of the simplest and safest injection techniques available, with a low incidence of complications such as dural punctures and other adverse effects [25]. This technique poses fewer risks compared to interlaminar or transforaminal epidural steroid injections, and it has been performed safely on patients with coagulation disorders [26]. Moreover, for individuals suffering from low back pain who might experience discomfort in multiple areas, this method delivers a high dose of medication effectively over a large area in a single session [27].

Numerous studies have investigated the occurrence of adverse events following caudal epidural injections. A retrospective study by Botwin et al. [28] reviewed data from 257 caudal epidural injections and found that 4.7% of patients experienced insomnia after the injection, 3.5% reported non-position-related headaches that resolved within a day, 3.1% experienced increased back pain, 2.3% had facial flushing, 0.8% experienced vasovagal reactions, and 0.4% reported increased leg pain, all without any instances of dural puncture. In another study, Manchikanti et al. [29] noted that aspiration occurred in 50% of procedures, with a positive flashback in 14% of intravenous needle placements. While they did not report vasovagal reactions, motor weakness, or insomnia, 18% of participants did report soreness at the injection site, 5% noted increased pain, 4% experienced muscle spasms, and another 4% reported swelling, while 3% had non-positional headaches, and 1% each reported nausea, vomiting, fever, and numbness. Goodman et al. [30] pointed out potential side effects associated with intravascular injections, such as direct nerve damage, disc perforation, and air embolism; however, they did not report any dural punctures. A review by McGrath et al. [31] of 3,964 lumbar transforaminal epidural injections indicated that only a small fraction of patients experienced minor side effects like flushing, chest pain, headache, weakness, itching, leg cramps, and fever. Karaman et al. [32], assessing complications in 1,305 transforaminal epidural injections involving 562 patients, found vascular penetration in 7.4% of cases, with an overall minor complication rate of 11.5%. Their analysis showed that vasovagal reactions were the most common minor complication, occurring in 8.7% of procedures. In the current study, only a few participants reported mild side effects, including pain at the injection site, itching, and headaches.

However, this study does have limitations. Key limitations include the recruitment of patients from a single medical center, a relatively small sample size, a short follow-up period, the absence of repeated injections, and a lack of a control group. The primary strength of this research lies in its role as the first direct comparison between caudal epidural injections and trigger point injections for chronic low back pain, providing valuable insights to the existing body of literature. Overall, the findings suggest that caudal epidural steroid injections are a safe and effective option for managing chronic low back pain. Future prospective, randomized controlled trials with larger sample sizes and longer follow-up durations are essential to further explore the efficacy of these techniques in managing pain syndromes.

Conclusion

This study demonstrates that caudal epidural steroid injections are a safe and effective method for alleviating chronic low back pain. Given these results, caudal epidural injections should be regarded as a valid treatment option for patients suffering from chronic low back pain.

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