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REVIEW

Blind caudal epidural injection for sciatica in resource-limited practice: a narrative review

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Abstract

Sciatica is a common and disabling condition often resulting from lumbar disc pathology, with epidural steroid injections representing an established option when conservative treatment fails. Among the three principal epidural approaches, caudal epidural injection (CEI) is the oldest and technically simplest technique. While contemporary practice increasingly favors image-guided and more targeted approaches, blind CEI remains clinically relevant in selected settings. This narrative review examines the anatomical basis, technique, safety profile, and evolving role of blind CEI in the management of low back pain and sciatica. Particular attention is given to its favorable safety characteristics, largely related to its anatomical trajectory, which avoids close proximity to the spinal cord and major radicular arteries. Serious complications are rare, and minor adverse effects are typically transient and self-limiting. Blind CEI can be performed without radiological guidance, which makes it a practical option in outpatient clinics, emergency departments, and other low-resource or technically limited settings. In such environments, it may offer a reasonable and accessible therapeutic intervention when imaging-based techniques are unavailable.

Keywords

Injections, Epidural; Sciatica; Low back pain; Physical and rehabilitation medicine

1. Introduction

Sciatica, characterized by radiating pain along the sciatic nerve pathway [1], often arises from lumbar disc herniation, significantly impacting patients' quality of life [2]. Initial management typically involves conservative approaches, including different kinds of physical therapy and oral medications [3]. When conservative measures fail to provide adequate relief, interventional pain management techniques, such as epidural steroid injections, are considered.

Epidural injections can be administered via three main routes: caudal (CEI), interlaminar (IL), and transforaminal (TF). They deliver anti-inflammatory medications directly into the epidural space with the aim of reducing inflammation and relieving pain caused by dural or nerve root compression [4]. While TF and IL epidural injections have recently gained prominence due to their more targeted approach and demonstrated superior efficacy in recent studies [5–7], blind CEI may offer a unique alternative, particularly in terms of accessibility and safety in low-tech settings.

Although some evidence suggests that CEI may not always provide equivalent pain relief to TF or IL injections in certain cases [8, 9], its role in specific clinical conditions should still be considered today.

2. Anatomy and technique

The blind CEI approach involves reaching the epidural space without radiological equipment through the sacral hiatus, an opening located at the caudal end of the sacrum [10].

The sacral cornua are two bony prominences at the lower end of the spine and sacrum, with the sacral hiatus located between them. This hiatus, situated beneath the sacrococcygeal ligament (SCL), subcutaneous fat, and skin, marks the inferior boundary of the epidural space. Identifying these landmarks is essential for accurate CEI administration, though they may not always be easily palpable [11].

Standard procedure begins with the patient lying prone, with a pillow placed under the pelvis to achieve appropriate pelvic tilt. After identifying the sacral hiatus and disinfecting the area, local anesthetic is infiltrated into the skin and subcutaneous tissues.

A needle of at least 3.5 inches (about 9 cm) is generally used in adults to reach the epidural space [4], although the exact length depends on the patient's anatomy. The needle is then advanced at a 45-degree angle between the sacral cornua, through the hiatus, and into the sacral canal (Fig. 1).

After the needle tip perforates the SCL, a characteristic loss of resistance (often described as a "pop") is perceived, signifying penetration of the SCL and entry of the needle tip into the epidural space. In the traditional technique, the needle

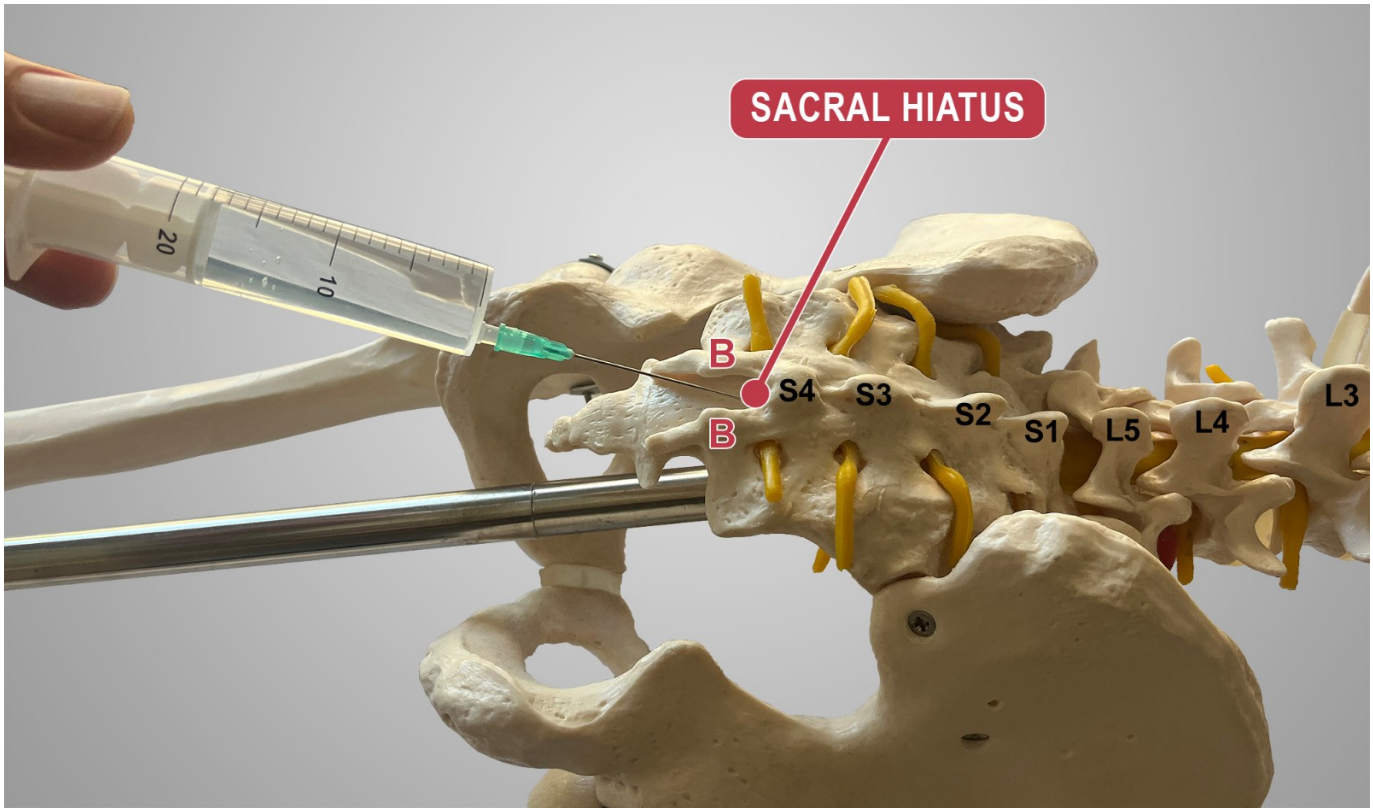

FIGURE 1. Demonstration of the caudal epidural injection (CEI) technique on a skeletal model. The needle is shown entering the sacral canal through the sacral hiatus (marked with a red circle). The sacral cornua are indicated by letters B. Spinous processes of sacral (S4–S1) and lumbar vertebrae (L5–L3) are labeled. Original figure created by the authors.

is subsequently reoriented to a more horizontal trajectory, approximately parallel to the axis of the sacral canal, and cautiously advanced an additional 3–5 cm within the canal prior to injectate administration. In contrast, a newer and safer method advocates no further advancement or only minimal advancement, with injectate delivery initiated immediately after the needle tip passes through the SCL [12].

Correct placement is confirmed by aspiration to ensure no blood or cerebrospinal fluid is drawn [13].

The clinician must take special care to avoid puncturing the dura, which usually terminates in the sacral canal at the S2 level. The distance between the end of the dural sac and the apex of the sacral hiatus is approximately 30–60 mm, but this value generally varies across populations [10].

If no blood or cerebrospinal fluid is aspirated, the injectate is administered slowly at a rate not exceeding 5 mL per minute. During the procedure, the clinician keeps their free hand flat on the patient's sacrum to monitor for swelling, which may indicate incorrect placement in the sacrospinalis muscle after about 10 mL of solution has been injected.

Typically, 10–20 mL of solution (containing 0.5% lidocaine or procaine, saline, and 8 mg dexamethasone) is most commonly administered during CEI. The injected volume is generally individualized according to patient size, sacral length, and the intended target level, with larger patients or those with a longer sacrum often receiving higher volumes within this range. After injection, the needle is gently withdrawn, and the patient is monitored in the prone position for 10 minutes, followed by supine observation for an additional 15 minutes [13, 14].

2.1 Dural pain hypothesis

In the context of CEI, the dura mater, the outermost tough fibrous layer surrounding the spinal cord [15], plays a crucial role in pain generation.

Lumbar pain can often be attributed to intervertebral disc protrusions that are pushed back through the posterior longitudinal ligament (PLL), impinging on the anterior (ventral) surface of the dura mater, as shown in Fig. 2.

When a disc slips posteriorly and makes contact with the ventral part of the dura mater medially, it can result in localized pain, commonly known as lumbago. Furthermore, if the displaced disc material moves laterally and presses against the dural sleeve surrounding a nerve root, it can cause radiating homolateral pain into the extremity, characteristic of sciatica (Fig. 3).

That is why, in many instances, the scenario is such that radicular pain in the leg comes after local pain in the lower back, caused by the protruded disc moving from the central line more laterally [16, 17]. However, some patients present with predominant or isolated leg pain without significant preceding back pain.

CEI and the discovery that the dura mater is the actual cause of back pain are closely related.

The CEI technique was discovered in 1901 by Sickard, but it was not used for the treatment of sciatica until 1909, when Caussade and Queste reported its application [18]; the use of

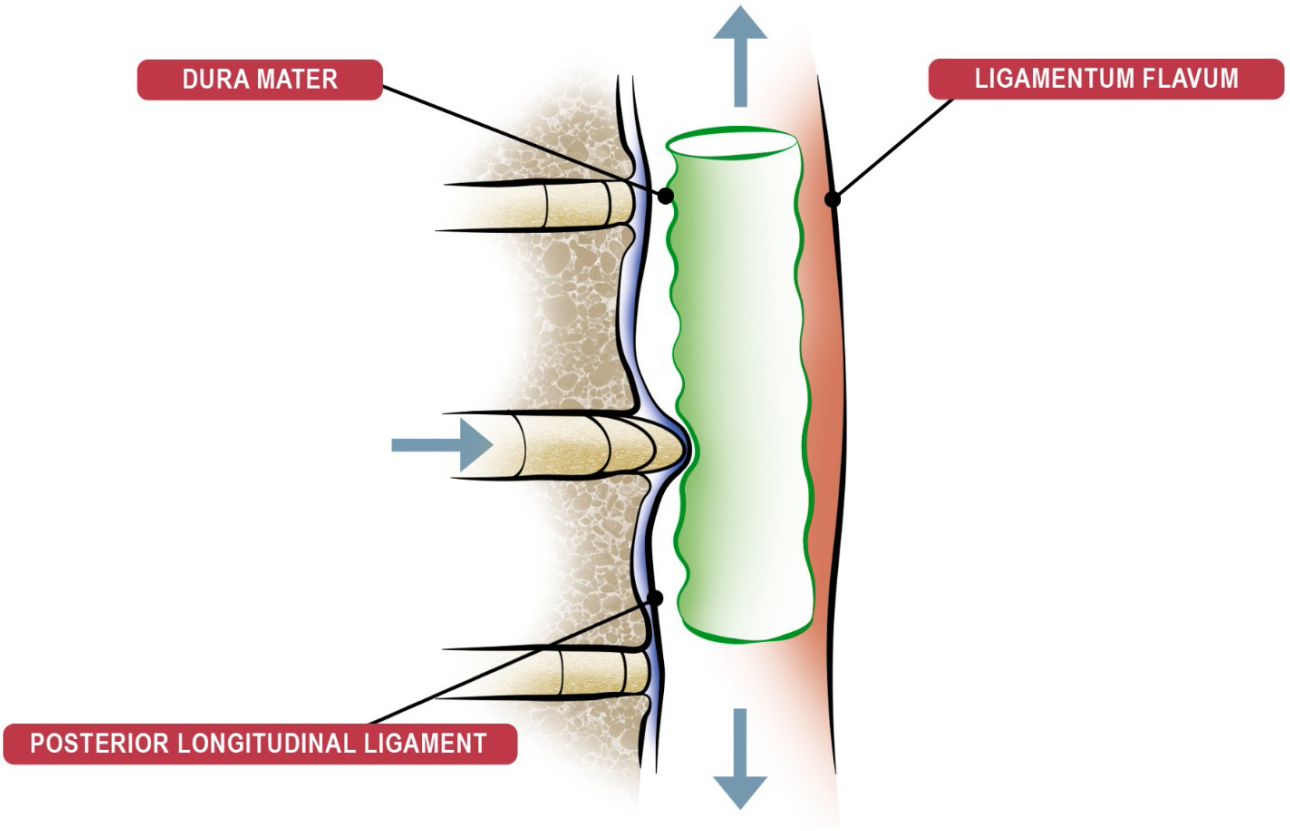

FIGURE 2. Protruded intervertebral disc in the sagittal section that has moved posteriorly through the posterior longitudinal ligament, pressing against the ventral side of the dura mater. Ligamentum flavum is also visible, which is the posterior barrier of the intervertebral canal and epidural space. Original figure created by the authors.

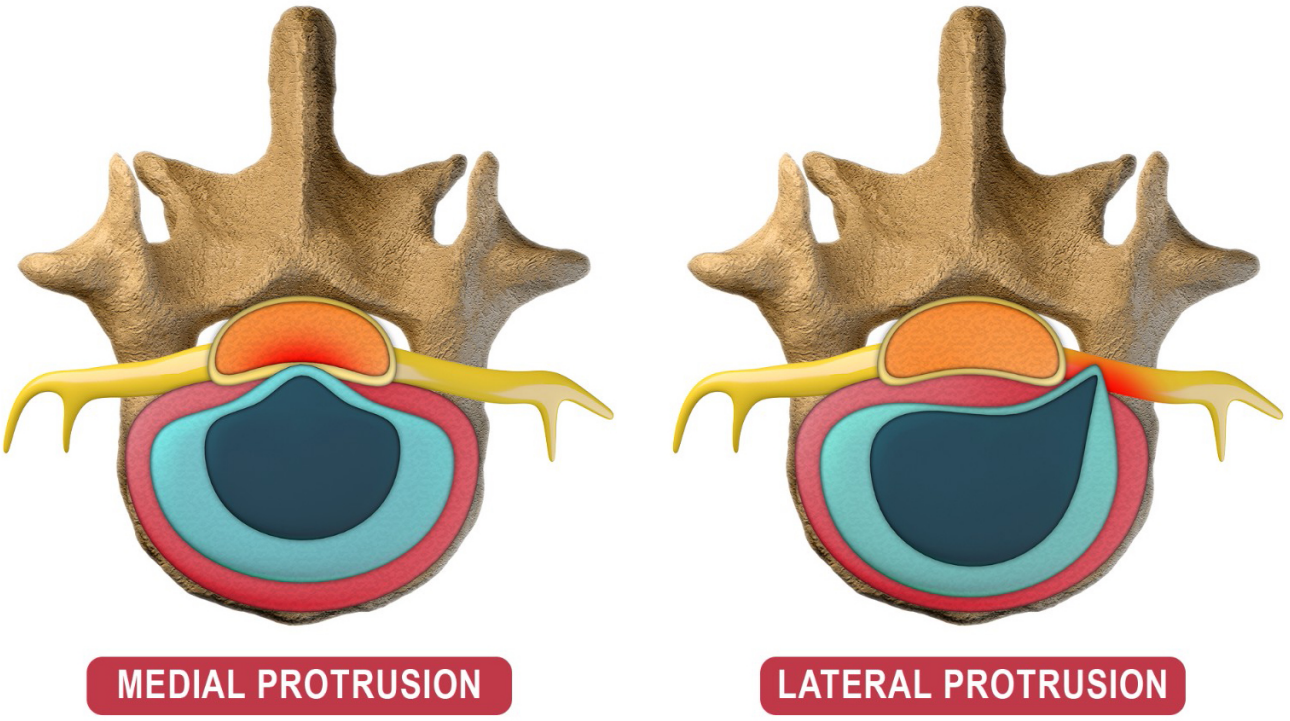

FIGURE 3. Displays two cases of disc protrusion viewed in the transverse section. The left image shows a medial disc protrusion pressing on the middle part of the dura mater, while the right image depicts a lateral disc protrusion pressing on a nerve root. Original figure created by the authors.

corticosteroids in injections only began in the 1950s.

Cyriax began using CEI in 1937, administering large volumes of up to 50 mL of 0.5% procaine into the spinal canal through the sacral hiatus, which resulted in temporarily reduced pain or even complete cessation of pain shortly after the injection. This solution primarily bathed structures inside the spinal canal, such as the posterior wall of the PLL, the dura mater, and the nerve roots surrounded by the dural sac, as well as the anterior side of the ligamentum flavum. Since this weak procaine solution was not strong enough to penetrate through those structures, but only desensitize their surfaces, Cyriax inferred in the Lancet Journal 1945 that the dura mater is the structure responsible for low back pain [19].

Subsequent studies have confirmed that the dura mater, particularly its ventral surface, is richly innervated with sensory and nociceptive fibers, similar to the PLL [15, 20].

This was a significant step forward, because at the time it was believed that disc degeneration was the main cause of lumbar pain. Several observations contributed to the exploration of the dural hypothesis. Postmortem studies revealed that large disc protrusions were asymptomatic in a substantial proportion of cases. In addition, a poor correlation was frequently observed between clinical symptoms and radiological findings of degenerative disc disease. Furthermore, despite a higher prevalence of degenerative disc changes in elderly individuals, the incidence of back pain was lower in this population compared with middle-aged adults. Taken together, these findings supported the rationale for considering alternative pain-generating mechanisms [16].

2.2 Other epidural techniques of today

Caudal approach is the first and oldest epidural technique; IL came later, followed much later by TF. All these epidural techniques are also commonly used today for the treatment of sciatica or lumbago.

IL epidural injections are administered between two laminae, aiming to deliver medication to the posterior part of the epidural space. There are two main types of IL epidurals: midline (sagittal) IL and parasagittal IL (Fig. 4). Since the parasagittal IL injection is given slightly more laterally, the medication may more readily reach the ventral epidural space, where the primary pathology is often located [21, 22]. This is believed to be the reason why the parasagittal IL technique is more successful than the midline IL injection.

The goal of TF injections is to deliver medication through the lateral intervertebral foramen directly into the anterior epidural space, targeting the affected nerve root. Unlike caudal and IL epidural injections, the TF approach is highly specific, allowing precise targeting of a particular spinal level and individual nerve root. Because the medication is delivered in close proximity to the site of pathology, only small volumes of injectate are required. This makes the TF approach particularly suitable for treating lateral pathologies, including nerve root–related pain, lateral recess stenosis, and lateral disc herniation [9].

2.3 Safety and simplicity of CEI

Today, CEI is commonly performed under fluoroscopic or ultrasound guidance, as recommended by the North American Spine Society (NASS) 2007 (Grade A for contrast-enhanced fluoroscopy) and the American Society of Interventional Pain Physicians (ASIPP) 2021 guidelines (preferring image guidance for higher precision) [23, 24]. This represents a significant evolution from earlier practices; for much of the 20th century, prior to the introduction of radiological guidance, CEIs were performed using a blind approach.

James Cyriax, one of the pioneers of CEIs, reportedly administered over 50,000 blind CEIs with a minimal number of complications and no lasting adverse effects, further illustrating its favorable safety profile [25]. Furthermore, Ombregt has administered over 10,000 injections since the 1980s, with no reports of lasting adverse effects or major complications [13].

One of the most compelling arguments for CEI is its simplicity, which is supported by the recommendations of the British Society for Rheumatology. They advise that trainees gain experience with CEI by first observing ten procedures, followed by performing ten more under supervision before being deemed competent to administer independently [26].

In technologically equipped medical facilities, the use of ultrasound or fluoroscopic guidance to improve procedural accuracy has become the standard of care. Some authors have even proposed hybrid approaches combining imaging modalities to further enhance procedural safety [27].

When compared with the other two epidural approaches, the principal comparative advantage of the caudal technique is its ability to be performed relatively safely under blind conditions, which may be particularly useful in technically limited or resource-constrained settings. Dernek *et al*. [28] found that the blind CEI method is a safe and effective option for patients with chronic low back pain who lack radiological screening, are not surgical candidates, or have not benefited from conservative treatments, with generally favorable post-injection outcomes.

While some studies report that blind CEIs yield results in pain relief and functional improvement similar to epidural injections performed with radiological guidance [29], others point out that incorrect administration occurs in 26% of cases [26].

3. Discussion

3.1 Safety

When considering the possibility of severe and serious complications or adverse effects, the CEI approach is somewhat safer than the other two epidural methods. This can be inferred from the fact that this anatomical route typically bypasses highly vital structures such as the spinal cord and major radicular arteries.

By contrast, a simple comparison of needle trajectories in other epidural methods reveals their greater potential for serious complications. In sagittal IL injections, excessive needle advancement can directly traumatize the cauda equina.

Similarly, TF epidural injections carry the risk of inadvertent nerve root puncture or, more critically, intra-arterial injection into a radicular artery—most notably the artery of

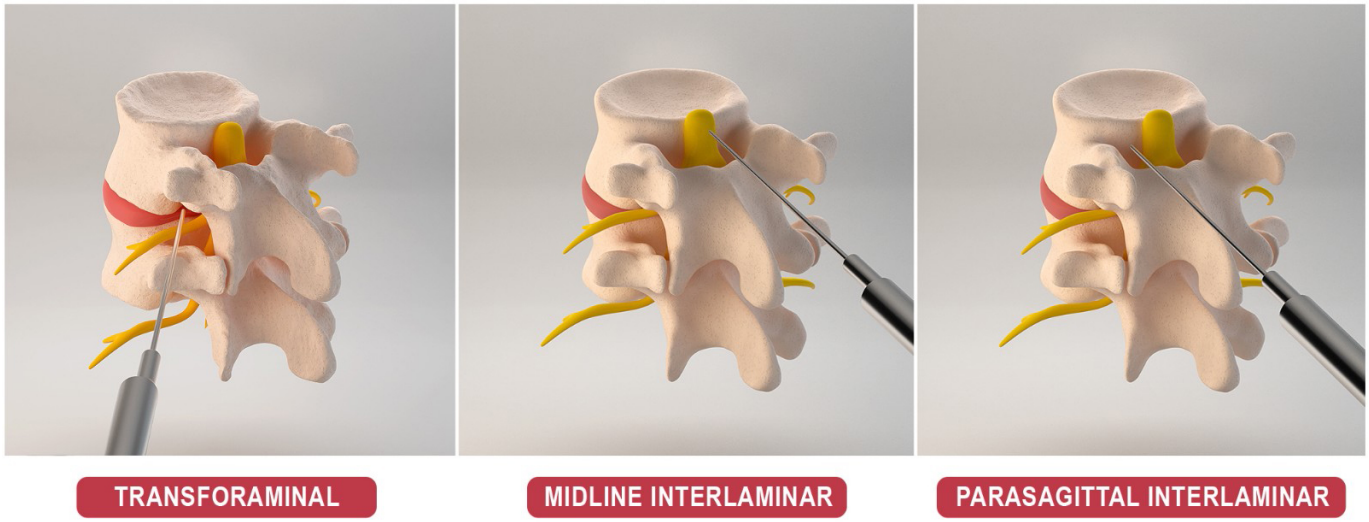

FIGURE 4. Illustrates three types of other epidural techniques and the path of the needle for each. The far-left image shows the transforaminal epidural, the middle image depicts the midline interlaminar, and the far-right image represents the parasagittal interlaminar approach. Original figure created by the authors.

Adamkiewicz, which supplies the anterior spinal cord and may result in severe ischemic injury [30].

Although rare, TF injection has been linked to catastrophic neurological complications, including infarction of the spinal cord [31–33].

Particulate corticosteroids have been implicated in this serious condition following accidental intra-arterial administration. Therefore, current guidelines recommend non-particulate corticosteroids, such as dexamethasone, as the preferred choice for all types of epidural injections [34, 35].

Singh *et al.* [36], comparing selective nerve root blocks with CEIs in patients with chronic lumbar radiculopathy, observed similar clinical outcomes, with CEIs demonstrating a safer profile.

With respect to procedural risks, CEIs are most commonly associated with two potential complications: inadvertent dural puncture and intravascular injection. Dural puncture may occur when the dural sac extends more caudally than usual due to anatomical variation, or when the needle is advanced excessively in a cranial direction within the sacral canal.

Rather than advancing the needle tip excessively cranially, this risk can be substantially reduced by releasing the injectate immediately after passing the SCL—a new approach that we strongly advocate. As previously noted, traditionally, operators usually advance the needle tip 3–5 cm cranially after passing the SCL in an effort to approach the presumed site of pathology. However, to minimize the risk of accidental dural puncture, only minimal advancement is necessary. As illustrated in Fig. 5, in this case, a needle insertion of less than 2.45 cm was sufficient to access the epidural space.

Because the patient is positioned prone with the pelvis tilted cranially, injection of the solution immediately beneath the SCL allows gravity to facilitate cephalad spread of the injectate toward the upper lumbar levels, where dural protrusions or dural sleeve impingement are most commonly encountered.

This approach is further supported by recommendations from other authors to avoid needle insertion near the S2 level to reduce the risk of accidental intrathecal injection [12]. Additionally, the use of an introducer needle with a catheter has been suggested as a potential risk factor for epidural hematoma, though further research is needed [37].

Our suggested approach aligns with findings from a study published in 2015. The study involved two groups receiving ultrasound-guided CEIs. One group received the injection using the traditional method, with the injectate administered after advancing the needle beyond the SCL into the sacral canal. The other group received the injection immediately upon passing through the SCL, without any further needle advancement, representing the new, minimal-advancement approach. The author reports that the incidence of intravascular injection was 24% with the conventional technique, compared to 0% when using the new approach [12].

Advancing the needle too far cranially increases the risk of accidental dural puncture, whereas excessive anterior advancement raises the likelihood of intravascular injection, as the venous plexus, a structure predominantly located anteriorly in the sacral canal, typically terminates at the S4 level or below [38, 39]. By following this guidance, both of these risks can be minimized.

3.2 Diagnostic value and mechanical effect of CEI

The caudal approach is regarded as the least targeted method, as the medication tends to disperse over a broad area [10].

While the lack of precision in CEI can be seen as a limitation, it also provides a key advantage: from a single injection point, the medication can spread over a broad area, potentially covering multiple lumbar intervertebral levels [10, 40, 41].

This may be advantageous in multilevel or bilateral pathology or when the exact pain source is unclear, as it provides a convenient and effective way to treat multiple levels simultaneously. Additionally, it proves especially valuable for patients lacking radiological findings or where the precise disk level causing pain remains unclear, offering a straightforward

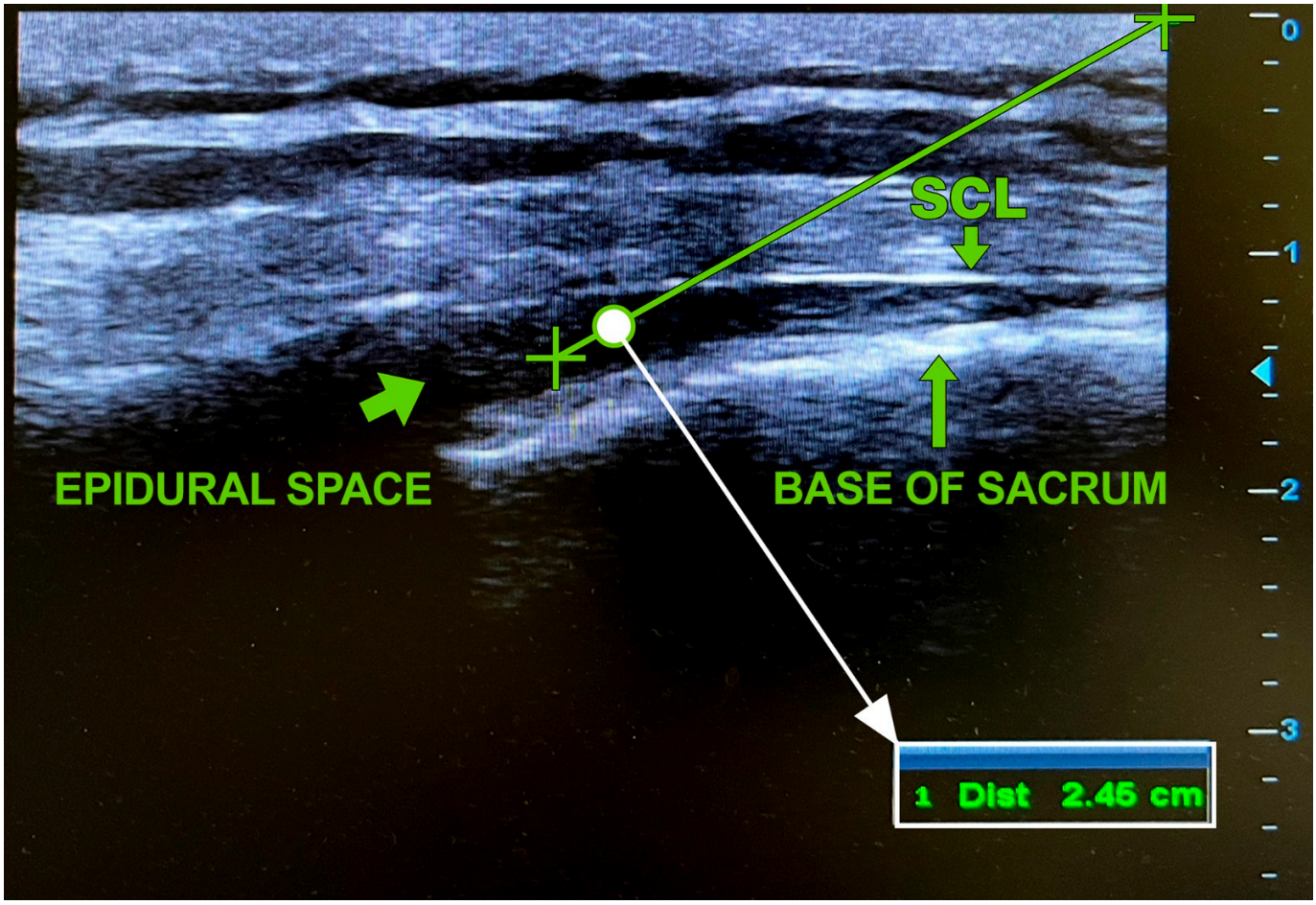

FIGURE 5. Ultrasound image of the sacral hiatus. The epidural space, the base of the sacrum, and the sacrococcygeal ligament are marked. The measurement shows the distance from the apex of the hiatus to the entry point into the epidural space, which is 2.45 cm. The measurement was obtained using calipers on the ultrasound machine. Original figure created by the authors. SCL: sacrococcygeal ligament.

approach to addressing multiple spinal segments at once.

Historically, some authors (*e.g.*, Cyriax) proposed that temporary pain relief after large-volume CEI with local anesthetic could suggest involvement of structures within the spinal canal, such as the dura mater or nerve roots [19]. In clinical practice, significant short-term relief following a CEI may raise suspicion that the pain originates from the spinal canal, such as dural or nerve root irritation, rather than from peripheral structures like the hip, sacroiliac, or facet joints.

The cessation or reduction of pain following a CEI has prompted clinicians to consider its potential use as a diagnostic tool.

This immediate pain relief, induced by the anesthetic, is also evidenced in a randomized controlled trial by Murakibhavi *et al.* [42] investigating CEI's effects on lower back pain. Notably, pain scores on the Visual analogue scale (VAS) decreased from 8.06 to 2.02 right after the procedure. Interestingly, this swift improvement showed a relative correlation with sustained benefits observed during follow-up assessments [42].

Although no studies were identified that specifically examined CEI as a diagnostic tool, the principles of selective nerve root blockade, using local anesthetics to temporarily relieve pain and confirm nerve involvement, are analogous to those applied in TF approaches.

The perspective on this topic appears to have evolved over time. A 2005 systematic review by Clifford R. Everett *et al.* [43] reported moderate evidence supporting the diagnostic value of selective nerve root blocks performed via TF injection. However, a 2019 systematic review by Rebecca Beynon *et al.* [44] questions the reliability of these diagnostic blocks, determining that their overall utility is uncertain and low, particularly owing to low specificity.

It appears that a persistent challenge in the diagnostic utility of interventional blocks, including facet joint blocks, sacroiliac (SI) joint blocks, TF injections, and CEI, is the lack of standardized protocols to eliminate false-positive responses [45, 46].

In the case of CEI, this issue may be further complicated by obstructed flow of the injectate due to anatomical variations such as a midline septum, bony obstruction, or fibrosis, which may create false-negative results by limiting cranial spread and reducing the potential diagnostic reliability of the procedure.

Although the concept of CEI as a diagnostic tool remains clinically intriguing, findings must be interpreted cautiously and corroborated with the patient's clinical history, physical examination, and available imaging.

Beyond the well-known analgesic effects of steroids, it has

been suggested historically that the lasting effect of CEIs may also result from the large volume of injectate mechanically creating space between the disc and the dura mater or dural sleeve, or potentially breaking down scar tissue around the affected nerve root. This reasoning explains why, in the past, volumes of up to 200 mL were occasionally administered [47, 48].

Additional supporting evidence comes from patient reports during CEIs, who often describe a sensation of pressure or bloating in the lumbar region or even the affected leg. This subjective experience suggests that the mechanical effect of injectate spread may contribute, at least in part, to the overall therapeutic outcome.

Previously, it was commonly believed that injecting larger volumes, besides their mechanical effect, would push the injectate cranially to reach higher lumbar levels. This notion was challenged by a Korean study from 2001, which concluded that 10 mL of injectate is generally sufficient to reach the mid to lower lumbar area (L3) in most patients, and that increasing the volume does not usually deliver medication significantly farther cranially [49].

More recent evidence from MR epidurography studies (2015), however, has shown that larger volumes may be required to reach higher lumbar levels, particularly in patients with a longer sacrum, allowing medication to extend to levels such as L3–L4. Nevertheless, the distribution of the medication remains influenced by individual anatomy, with a substantial portion still draining laterally through the intervertebral foramina rather than migrating uniformly cranially [14, 49].

3.3 Current trends and comparative effectiveness

Documented effectiveness of CEI in recent scientific studies has tended to appear less robust, especially in comparison with the targeted approaches increasingly adopted in high-resource settings.

Analysis of Medicare data from 2000–2018 shows a shift of usage from CEI and IL to TF injections, driven by perceived superior efficacy for radicular pain [50].

While Singh and Manchikanti (2002) indicated that CEI is equally effective as other methods in the management of chronic low back pain [51] a 2021 comparative systematic review and meta-analysis assessing three routes of epidural injections for lumbar disc herniation assigned Level II evidence to the CEI, whereas TF and IL approaches were rated at Level I evidence [5].

Although some newer recent studies suggest that CEI achieves relatively comparable outcomes to TF injection in post-lumbar surgery chronic pain and in S1 radiculopathy [52, 53], recent guidelines (ASIPP 2021) maintain Level II evidence for CEI in chronic spinal pain, also recommending image guidance where available but acknowledging utility in resource-limited environments [23].

Recent efforts to enhance CEIs have included adjunctive therapies such as ozone. A randomized controlled trial showed that adding ozone to ultrasound-guided CEI in lumbosacral canal stenosis did not improve pain or disability outcomes compared to steroid alone, though it offered some additional benefit in walking distance [54].

Over the years, caudal and IL epidural injections were more commonly used than TF injections. However, recent trends show a shift, with a decrease in the use of caudal and IL injections and a rising preference for TF epidural injections [23, 50, 55].

There is a growing trend among practitioners toward favoring TF injections, which is paralleled by an increasing number of research studies focusing on the TF approach [56].

A 2024 systematic review and network meta-analysis found that TF epidural injections were most effective for long-term pain relief and functional improvement, whereas parasagittal IL injections provided superior short-term pain reduction. Caudal approaches, although included in the analysis, did not demonstrate superiority in either outcome [7].

In a broader context, the meta-analysis by Knezevic *et al*. [57] indicates that the parasagittal IL approach appears safer and more effective than TF and midline IL techniques for lumbar epidural anesthesia, with benefits lasting up to six months. They found insufficient evidence to support the superiority of the TF approach and suggested that its frequent use is mainly driven by higher costs rather than clear advantages in pain relief [57].

3.4 Positioning CEI in clinical practice

It is quite intuitive that radiologically guided and specialized epidural techniques will become increasingly prevalent within high-tech clinics, hospitals, and among highly specialized medical personnel.

However, smaller practices, emergency departments, and similar low-resource settings managing sciatica can particularly benefit from the blind caudal approach, thanks to its safety, ease of learning and performance, low cost, and feasibility for less specialized medical staff with limited interventional expertise.

Additionally, a case report by Bubic and Oswald (2021) demonstrated the successful use of an ultrasound-guided CEI in the emergency department for the management of refractory radicular low back pain. The procedure resulted in immediate and complete pain relief, allowing the patient to avoid hospital admission and be discharged directly from the emergency department (ED). The authors themselves posed the question: “Why should an emergency physician be aware of this?”, highlighting the surprising lack of familiarity with this procedure among many clinicians in the emergency setting [58].

Although this case utilized ultrasound guidance, the transition from blind to ultrasound-guided CEI is straightforward. This is supported by a recent study on the learning curve, which demonstrated rapid skill acquisition and a proficiency plateau after training, with median times for landmark identification and procedure performance decreasing significantly [59]. This suggests that blind CEI can serve as an entry point in low-resource settings, easing the adoption of ultrasound guidance as equipment becomes available.

3.5 Limitations and risks of blind CEI

Anatomical limitations of CEI technique include the potential lack of visible surface landmarks in individuals with significant body habitus, morbid obesity, or anatomical variations. Additionally, the sacral hiatus may be absent in approximately 4% of cases, while a bony septum is present in about 2% of individuals [8]. Furthermore, the pathway from S4 to the upper lumbar levels can occasionally be obstructed, preventing cranial migration of the injectate to the target lumbar segments [60].

When compared with image-guided CEIs using ultrasound or fluoroscopy, the blind approach is associated with similar procedural risks but presents additional challenges. These include more difficult anatomical orientation, reduced accuracy of needle placement, and a potentially increased likelihood of unrecognized intravascular injection.

Although aspiration testing is routinely performed, inadvertent vascular entry may still occur, with reported rates of intravascular injection during non-image-guided CEIs ranging from 9% to 14%. In addition, as with all pharmacological interventions, allergic reactions remain a potential risk [40, 61, 62].

While routine aspiration is performed during CEIs to detect intravascular or intrathecal placement (*i.e.*, blood or cerebrospinal fluid), a positive finding is informative, yet the technique is frequently associated with false-negative results [63].

Some studies using more advanced techniques than conventional fluoroscopy, such as digital subtraction angiography (DSA) during epidurography, report somewhat higher rates of intravascular injection [64].

Even when ultrasound guidance is used for CEI, it does not reliably detect intravascular entry, which remains a notable limitation compared to fluoroscopy with contrast [65].

Looking across all three epidural steroid injection approaches combined, serious complications—epidural hematoma or infection—are extremely rare, occurring in less than 0.01% of cases. Dural puncture is more common, occurring in fewer than 1% of these procedures [66, 67].

Minor complications associated with CEI include transient local pain at the injection site, temporary worsening of radicular symptoms, vasovagal reactions, headache, flushing or facial redness, dizziness, nausea, mild leg swelling, transient sensory disturbances, temporary skin changes at the injection site, and short-term metabolic effects such as elevated blood glucose levels. These events are generally self-limiting and resolve without long-term consequences [4, 68].

Within the included literature and our search strategy (PubMed, Web of Science, Google Scholar, 2018–2025 plus seminal works), we did not identify any reports of severe neurological injury or fatal outcomes attributable to CEI. However, rare events may be underreported in narrative reviews or not captured by our search strategy.

As previously noted, unsuccessful blind CEI occurs in approximately one-quarter of patients [26]; however, these missed injections, where the medication is deposited paravertebrally, generally do not result in adverse effects.

Recommendations from ASIPP and other consensus statements suggest a maximum of four injections per year, with appropriate intervals between each [23].

4. Conclusion

Blind CEI is a simple, low-cost, and low-technology method that can be particularly useful in resource-limited settings.

Due to its minimal equipment requirements, it can be performed in low-tech outpatient clinics, emergency departments, or any facility that commonly treats low back pain and sciatica.

In settings where fluoroscopy or ultrasound guidance is unavailable, this technique offers a reasonable and accessible therapeutic option and may therefore be especially valuable in developing countries or healthcare systems with significant technological and financial limitations.

5. Literature review

A comprehensive literature search was conducted primarily using the PubMed database, focusing on publications from 2018 to 2025, including randomized controlled trials, systematic reviews and meta-analyses, as well as relevant case reports. To ensure adequate historical context, older and seminal publications were also reviewed. The search strategy included the following keywords and their combinations: caudal epidural injection, caudal epidural steroid injection, and blind caudal epidural injection. Additional literature searches were performed using Web of Science and Google Scholar to identify further relevant studies, although these searches were conducted less exhaustively.

AVAILABILITY OF DATA AND MATERIALS

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTIONS

VS and BB—participated in writing and revising the manuscript, contributed substantially to its conception, and conducted the literature search and review of online medical libraries. They both approved the final version of the article and accept responsibility for all aspects related to the review.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable. Written informed consent was obtained from the individual undergoing ultrasound examination, and the consent document has been included.

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Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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