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Research Article

Comparison of the clinical implications of stellate ganglion block versus interlaminar cervical epidural deposition of steroid and local anesthetic in the treatment of unilateral cervical radicular pain

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Abstract

Objective: To demonstrate through electronic chart review that the same analgesic efficacy reported in patients with unilateral cervical radicular pain undergoing ultrasound-guided stellate ganglion block versus fluoroscopy-guided epidural depot can be obtained.

Material And Methods: Observational, descriptive, cross-sectional and retrospective study, carried out from March 1, 2020 to August 31, 2024, through the medical records of patients who met the inclusion criteria.

For the descriptive analysis, frequencies and percentages were used for qualitative variables and for quantitative variables, measures of central tendency and dispersion. The inferential analysis was carried out with the Wilcoxon test.

Results: 10 patients were divided into two groups, the first group consisting of three patients undergoing stellate ganglion block and the second with 7 individuals undergoing cervical epidural steroid deposition, who met the inclusion criteria and showed improvement in pain control with lower use of daily oral morphine doses and a high satisfaction scale.

Conclusions: There was a decrease in the daily oral morphine dose and a positive satisfaction scale in the two groups of patients undergoing pain intervention, as well as a decrease in neuropathic symptoms, thus opening a new interventional option for the control of cervical radicular pain.

Keywords: Unilateral cervical radicular pain, stellate ganglion block, epidural steroid depot

INTRODUCTION

Neuropathic pain

According to the International Association for the Study of Pain, IASP, neuropathic pain is pain caused by injury or disease of the somatosensory nervous system.

Worldwide, neuropathic pain is estimated to be around 10% in the general population, particularly in the head and neck areas where it can be disabling for patients. It is associated with a higher incidence if there is a history of diabetes (26%), herpes zoster (19%) and post-surgical pain (10%).[1 2]

- Classification of neuropathic pain by etiology

Central: Includes causes such as history of cerebrovascular disease, multiple sclerosis, pain related to spinal cord injury, complex regional pain syndrome.[2]

Peripheral: Related to diabetic polyneuropathy, induced by chemotherapy, radicular pain or chronic post-surgical neuropathic pain.[2]

Radicular pain is defined as pain that radiates in the distribution of a dermatome, while radiculopathy is accompanied by objective loss of sensitivity, strength and alteration in tendon reflexes, and these usually occur together.[3]

Radicular pain at the cervical level has a reported prevalence of 13.4%, and is defined as a radiated pain perceived in the upper limb that is caused by irritation or compression of a nerve in the cervical spine. [1 3]

The most frequently affected nerve is C6 and clinically it is expressed on the lateral side of the arm and hand.

Among the three most common causes of cervical spinal nerve compression and irritation are posterolateral herniation of the intervertebral disc in 20-25%, disc degeneration leading to a decrease in neuroforaminal height and cervical spondylosis. [2]

Diagnosis of radicular pain

- Diagnostic scales

PAIN DETECT

It is based on patient information without the need for a physical examination.

It has a sensitivity of 85% and a specificity of 80%: [2]

DOULEUR NEUROPATHIQUE 4 QUESTION (DN4)

It has seven items related to symptoms perceived by the patient plus three findings in the physical examination. [2]

With a score equal to or greater than 4, it gives a sensitivity of 83% and specificity of 90%.

LEEDS ASSESSMENT OF NEUROPHATIC SYMTOPS (LANSS)

It has five items related to the symptoms reported by the patient and two findings in the physical examination. [2]

With a sensitivity of 82-91% and specificity of 80-94%.

These diagnostic scales must be correlated with the clinical picture through a detailed physical examination that includes the evaluation of muscle tone, strength, osteotendinous reflexes, sensitivity and vasomotor/sweat activity. [2 3]

These tests, plus physical examination, can be complemented with imaging studies such as magnetic resonance imaging, which is preferred for this group of patients, and even electrophysiological tests to better define the affected region/area. [2 3 4]

Pharmacological Treatment

-First line

Medications are part of the first and second line of treatment for neuropathic pain. An assessment is made within the first 3 to 8 weeks after starting treatment to consider the response to pharmacological management, whether the patient has significant relief or adverse effects, and assessing whether a dose adjustment or change of drug is necessary. [2]

Among the drugs described as first-line drugs are Gabapentinoids and tricyclic antidepressants.

Tricyclic antidepressants

The mechanism by which tricyclic antidepressants improve neuropathic pain is due to their effect on inhibiting the reuptake of serotonin and norepinephrine, as well as blocking histamine, adrenaline, acetylcholine and sodium channels. This also explains their broad profile of side effects. Their use is recommended for four to eight weeks and if during this time adequate control is not achieved, consider adjuvant management or change of management. [2]

Serotonin and norepinephrine reuptake inhibitors

These drugs are considered in various international guidelines as the first line of treatment, with the most studied being duloxetine and venlafaxine. This group of drugs facilitate descending inhibition by blocking the reuptake of serotonin and norepinephrine at the central level. [2]

It has been shown to have clinical benefits in controlling peripheral pain. With a trial period of the first four to six weeks. [2]

Gabapentinoids

Which include gabapentin and pregabalin are a group of anticonvulsant medications that work by blocking presynaptic alpha-2 calcium channels on the dorsal horn, inhibiting the release of neurotransmitters. [2]

They are considered first-line agents in the management of neuropathic pain.

Topics: lidocaine and capsaicin

The side effect profile of first-line drugs requires caution in dose adjustment, assessment of the occurrence of adverse effects, and special considerations in risk groups such as the elderly. [2]

Therefore, the use of topical drugs for the management of neuropathic pain has been considered, particularly in localized neuropathic pain, with the aim of reducing the systemic effects of the treatment.

Topical lidocaine acts by decreasing the ectopic activation of peripheral nerves, among the considerations is the anatomical location of the pain site, for example in hands/fingers, where its placement is complicated, in terms of symptom improvement versus pregabalin, no greater benefits are shown in relation to the decrease in pain intensity, its standard test period is three weeks. [2]

Capsaicin acts by binding to the TRPV1 receptor located in the A δ chain of C fibers, resulting in the release of substance P. Prolonged exposure to this substance causes overstimulation and depletion of substance P, leading to nerve desensitization and reversible nerve degeneration. Its use is recommended at a concentration of 8%, but it is considered third to fourth line and in patients who do not tolerate oral administration, since its application is painful. [2]

-Second line

Combination therapy

Approximately 45% of patients use two or more drugs to treat neuropathic pain due to the difficulty of adequately controlling it. [2]

Most guidelines recognize multimodal therapy as an important part of pain treatment. Within the group of drugs considered second-line are atypical opioids such as tapentadol and tramadol, which within their described mechanisms of action is their weak binding to the Mu opioid receptor in addition to the inhibition of serotonin and norepinephrine reuptake at the supraspinal level, making them useful in the management of neuropathic pain. [2]

- Interventional treatment

Cervical radicular pain responds adequately to epidural steroid administration, but in the case of chronic pain, the efficacy of this procedure is limited and management adjacent to the dorsal root ganglion may be considered. [3 4]

Epidural steroid administration

The aim of this technique is to deposit steroids in the epidural space close to the inflamed neural tissue responsible for the clinical picture. These produce anti-inflammatory effects due to the inhibition of the arachidonic cascade through the inhibition of phospholipase A2.

This technique can lead us to achieve a reduction in surgical intervention by up to 80%. [3]

To perform this technique with greater safety and success, the use of fluoroscopy is required; however, the limited availability of this tool in some centers prevents offering this therapeutic alternative. [4]

Sympathetic inhibition with local anesthetics

Local anesthetics exert their action primarily by interrupting nerve conduction through the inhibition of voltage-gated sodium channels.

Local anesthetics differ in duration of action due to affinity for plasma protein binding. Anesthetics with higher protein affinity have preference for sodium channels and a longer duration of action. They act more on small, fast pain fibers (Ad).[5]

Like other interventional procedures for pain, they are considered safe and well tolerated. Contraindications for this procedure include infection, allergy to the drugs administered, malignancy near the treatment site, uncorrectable coagulopathy (INR >1.5 or platelet count <50,000), inability to remain prone or supine, patient refusal or inability to give consent. [5]

History of stellate ganglion block (SGB)

The SGB was first used in 1930 for precordial pain due to angina. Since then, there has been extensive use for other indications not associated with pain management, such as post-traumatic stress management, hot flashes, and vascular insufficiency. [5]

Anatomy of the stellate ganglion

Also known as the cervicothoracic sympathetic ganglion, this ganglion is present in 80% of the population by the fusion of the inferior cervical ganglion and the first thoracic sympathetic ganglion. Within its limits it is located anteriorly between the transverse process of C7 and the first rib, posteriorly is the vertebral artery, medially the scalene muscle group and inferiorly is the pulmonary apex. The GE is responsible for providing sympathetic information to the upper extremities, thorax, head and face, achieving both pre and post ganglionic block of these fibers. [6] [7] [8]

It is then used mainly for painful syndromes, especially in the upper extremities. [1]

Mechanism of stellate ganglion inhibition

Sympathetic blocks temporarily reduce the activity of the sympathetic nerves that run parallel to the spine, being useful in visceral, vascular and neuropathic pain. [5]

Blocks are commonly used to assess pain attributable to a sympathetic etiology. The local anesthetic is administered adjacent to the sympathetic neural structures interrupting neural communication in the affected region. [5]

GE inhibits the cardiovascular sympathetic response, glandular secretion, bronchial contraction and pain conduction given by the innervation of sympathetic fibers of this ganglion, which are distributed over the head, neck, upper extremities, shoulders and heart. Studies have revealed its usefulness in pain processes due to migraine and cluster headache, this due to the effect of sympatholysis and weakening of the vascular inflammatory response. Its use has been described in neuropathic pain such as that related to phantom limb, for orofacial pain, tinnitus, Meniere's syndrome, post-herpetic neuralgia or in acute pain, in addition, it has other indications not related to pain such as vascular insufficiency, Raynaud's disease, arterial embolism in thoracic limbs, cardiac arrhythmias, post-traumatic stress disorder or in case of hyperhidrosis. [5]

Techniques for stellate ganglion inhibition.

It is performed under ultrasound guidance to identify the C6 vertebral body, on the Chassaignac tubercle (C6) anterior to the neck of the first rib and extending upward to the lower portion of the transverse process of C7. It is located on the anterior surface of the lateral border of the longus colli muscle. The GE node is located posterior to the common carotid artery, anterior to the vertebral artery, and its lower pole is located near the costocervical trunk of the subclavian artery. The node is structurally separated from the posterior aspect of the cervical pleura by the suprapleural membrane. This explains the increased risk of pneumothorax and vertebral artery injury at the level of C7. The esophagus, recurrent laryngeal nerve, trachea, and vertebral column are located medial to the GE. The stellate ganglion measures between 1 and 2.5 cm long, 1 cm wide, and 0.5 cm thick. It is called a stellate ganglion because of its star shape, but it can be fusiform, triangular or globular.

Post-procedure evaluation

The procedure is generally considered successful when the patient experiences pain relief. [5]

If the causes of pain are multifactorial, there may be partial pain control. [5]

Signs of complete sympathetic blockade of the head: Horner's syndrome (miosis, ptosis and anhidrosis) is a sign of successful blockade of the trunk or head, also associated with enophthalmos, conjunctival injection, unilateral nasal congestion (Guttman's signs) and hyperemia of the tympanic membrane. [5]

Signs of complete sympathetic blockade of the extremities: This can be detected from two tests, one is the activity of the adrenergic fibers responsible for blood flow with the resulting increase in temperature and the activity of the sympathetic cholinergic fibers, responsible for the absence of sweating. More commonly, a combination of increased skin temperature between 1-2° C and anhidrosis is used to confirm complete sympathetic blockade in the upper extremity after SGB. [5]

Associated complications

Minor complications: Headache, pain at the puncture site, vagal reflex, paresthesia, dysesthesia, nasal congestion, temporary motor deficit in the thoracic limbs if the local anesthetic spreads to the brachial plexus, related to the volume and concentration of the drug, temporary dysphonia, dysphagia or dyspnea due to the spread of the local anesthetic to the laryngeal nerve.[9 10]

Major complications: Spinal cord injury in the administration of drugs at the epidural level caused by a direct injury to the spinal cord, infection at the puncture site, poisoning by local anesthetics, epidural hematoma, respiratory compromise in patients with pre-existing lung disease and this due to the spread of the drug to the phrenic nerve. As well as pneumothorax if the approach is performed close to the pleura. [5 9 10]

GOALS

General Objective:

To assess, through the integration of information present in the clinical record, the efficacy of ultrasound-guided stellate ganglion block with local anesthetic plus steroid versus fluoroscopy-guided epidural local anesthetic plus steroid depot in unilateral cervical radicular pain.

Particular Objective:

Identify the socio-demographic variables of the population studied.

To evaluate neuropathic pain scores with DN4 pre and post procedure

Evaluate pain intensity with ENA pre and post procedure

Evaluate the degree of patient satisfaction through the post-procedure Likert scale

Evaluate MEDD pre and post procedure.

MATERIAL AND METHODS

The present research study was carried out by reviewing the clinical records of patients with unilateral cervical radicular pain who had an imaging study showing some alteration, during the period from March 2020 to August 2024, treated in the outpatient clinic of the Pain Clinic of the National Cancer Institute.

Sampling process

A review was carried out of the records of patients treated in the outpatient clinic of the Pain Clinic of the National Cancer Institute during the period from March 1, 2020 to August 31, 2024 who met the inclusion criteria.

After identifying the target population, the study variables will be identified and then data collection will begin.

Inclusion criteria: patients diagnosed with cervicalgia with unilateral cervical radicular who were treated at the pain clinic of the National Cancer Institute in the period from March 1, 2020 to August 31, 2024 and who underwent an ultrasound-guided stellate ganglion block or a unilateral cervical steroid depot.

Exclusion criteria: All patients who do not have a diagnosis of cervicalgia with unilateral cervical radicular pain or who have undergone any other interventional pain procedure other than ultrasound-guided stellate ganglion block or unilateral cervical steroid deposition.

RESULTS

From a universe of 840 patients, who underwent interventional procedures for cervical pain of different etiologies, according to the inclusion criteria, 10 patients were identified who met them, being included in our study.

Table #1: *Gender of the Population (Both Procedures)*

	Frequency	%
Man	6	60
Women	4	40
Total	10	100

Source: Own elaboration, INCan

Of the 10 participants, 4 were women (40%) and 6 were men (60%), with an average age of 55 (range 38 to 77 years).

Three men and four women underwent fluoroscopically guided epidural steroid deposition, and one man and two women underwent ultrasound-guided stellate ganglion block.

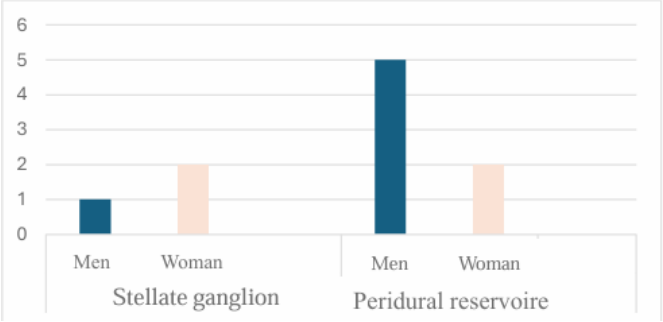


Figure 1: *Gender of Population by Procedure*

Source: Own elaboration, INCan

The approach for performing the stellate ganglion block was from the left side in 2 patients and from the right side in 1 patient.

Table 2: *Site of approach in Stellate Ganglion Block*

Type of procedure	Side	Frequency	%
Stellate ganglion	**Left**	2	66.7
	Right	1	33.3
	Total	3	100

Source: INCan, own elaboration

And for the administration of epidural steroid depot, it was observed that the most frequently addressed vertebral level was C7-T1.

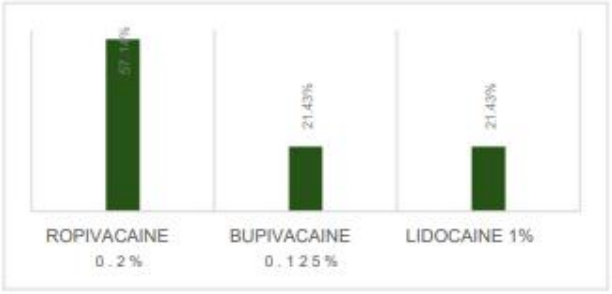
Table 3: *Vertebral level approached for Epidural Reservoir*

Level of approach	Frequency	%
T2-T3	1	14.3
C7-T1	6	85.7
Total	7	100

Source: Own elaboration, INCan

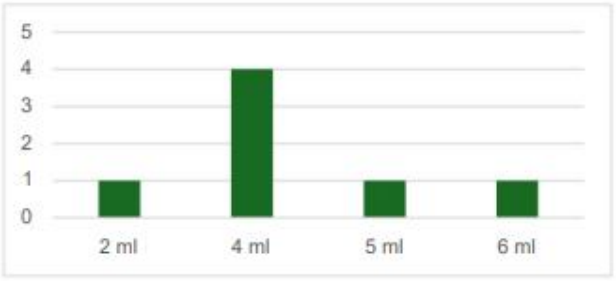
Regarding the drugs administered, dexamethasone was used in 100% of cases for both stellate ganglion block and cervical peridural steroid deposition. Regarding the local anesthetics administered, 0.125% bupivacaine was used for US-guided stellate ganglion block in all patients, and 0.2% ropivacaine was used in 4 patients, 0.125% bupivacaine in one patient, and 1% lidocaine in one patient for fluoroscopy-guided peridural deposition. Regarding the volume, quantified in milliliters, administered in the performance of US-guided stellate ganglion block, 4 ml was administered in one patient while 5 ml was administered in the other two, and for epidural deposition, 2 ml was administered in one patient, 4 ml in four patients, and in one patient, 5 and 6 ml were administered respectively, with an average volume of 4 ml being administered in the patients undergoing said procedure.

Figure #2: *Type of local anesthetic used for performing cervical epidural depot*



Source: Own elaboration, INCan

Figure #3: *Milliliters used in fluoroscopically guided cervical epidural reservoir*



Source: Own elaboration, INCan

Regarding adverse events, no incidents or accidents were reported during the procedures, either immediately after their completion or immediately afterward, identified during the post-procedure review consultation on day +7.

Regarding the daily oral morphine dose consumed (MEDD), under the Wilcoxon test to evaluate the efficacy of interventionism in order to decrease the MEDD for pain control where a $p < 0.05$ was obtained. This means that interventionism, regardless of the interventional procedure to which the patient was subjected, does decrease the consumed dose of opioid for pain control, compared between the US-guided stellate ganglion block the MEDD decreased by 46.15% while in the fluoroscopy-guided cervical epidural depot it decreased by 39.70% in a pre and post intervention measurement.

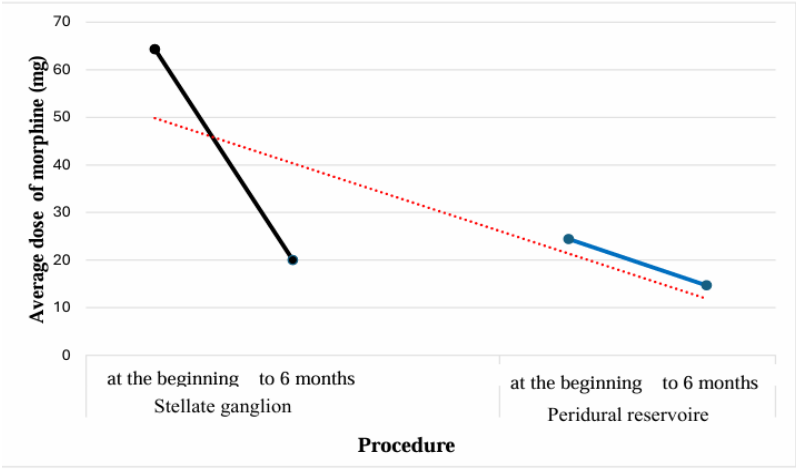


Figure 4: *Average oral morphine dose at baseline and at 6 months by procedure*

Source: own elaboration, INCan

Seeking to determine which of the two procedures was more effective in controlling neuropathic symptoms under DN4, there was a statistically significant decrease in the number of neuropathic symptoms in both procedures ($p<0.05$) at 1, 3, and 6 months after the intervention.

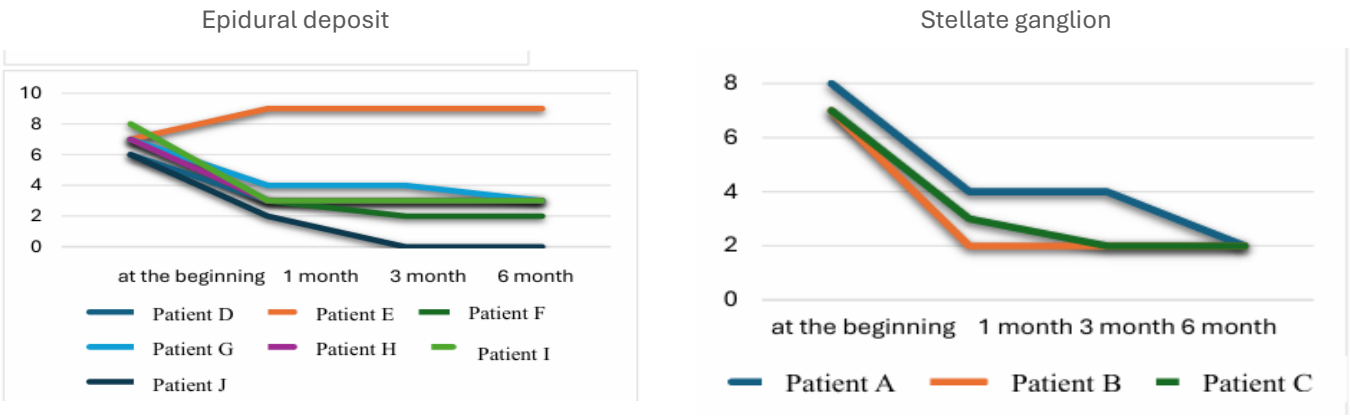


Figure 5: *Modification of DN4 after peridural steroid deposit and Stellate Ganglion Block* **Source**: Own elaboration, INCan

Regarding the measurement of pain intensity using the VAS scale before and after the US-guided stellate ganglion block procedure, there were no differences in the patients who underwent this procedure. On the other hand, in the patients who underwent fluoroscopy-guided cervical epidural deposition, there were differences before and immediately after the procedure, so we would be inferring that the initial and post-procedure VAS did decrease statistically significantly in the patients who underwent steroid epidural deposition, but not in the stellate ganglion block.

Despite these results, when questioned, under the scale of patient satisfaction with the Likert scale it was reported that the patients were satisfied, where 90% satisfaction was obtained in the total of patients undergoing interventional pain procedures regardless of which of the two techniques was performed.

Table 4: *Post-Procedure Satisfaction Rate*

	Frequency	%
Completely agree	9	90.0
It was not mentioned	1	10.0
Total	10	100.0

$p<0.05$

Source: Own elaboration, INCan

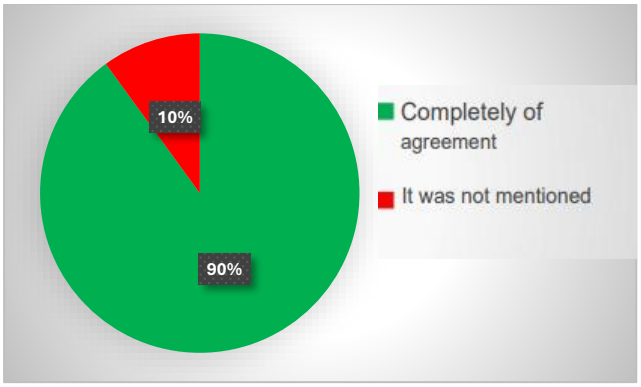


Figure 6: *Post-Procedure Satisfaction Rate (Likert Scale)* $p<0.05$

Source: Own elaboration, INCan

DISCUSSION

This study demonstrated that US-guided BGE is similar to fluoroscopy-guided cervical peridural steroid deposition in reducing neuropathic symptoms measured using the DN4 scale, as well as opioid use as part of pain treatment, as demonstrated in the study by Lee Kim. [10]

In addition, the positive results on the degree of patient satisfaction can be related to the control of symptoms associated with cervicalgia with radiculopathy, as studies have shown, including interventional procedures with these characteristics of pain, which do not respond adequately to pharmacological treatment, it is recommended to consider non-pharmacological therapies. Interventions such as the administration of local anesthetic and steroid could relieve pain. [3]

CONCLUSION

The prevalence of cervical spine pain is estimated to be up to 67%, with an impact on quality of life.

In search of accessible therapies that provide a benefit to the patient for pain relief, it has been decided to propose different interventional pain management methods in order to provide access to a larger population with reduced care time. For this reason, the performance of stellate ganglion block under ultrasound has been proposed as a therapeutic proposal.

According to our results, interventionism does reduce the opioid dose consumed for pain control, showing a greater reduction in MEDD with the use of US-guided stellate ganglion block of up to 46.1% versus fluoroscopy-guided cervical epidural depot with a decrease of 39.7%, in addition to the decrease in neuropathic symptoms and favorable patient satisfaction.

With these results we observe that there is a hopeful response to continue providing stellate ganglion block as a therapeutic option versus an epidural steroid depot.

Prospective clinical trials are required for the comparative evaluation of both interventional pain procedures and their implication in the management of cervicalgia with unilateral cervical radicular pain.

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Conflicts of Interest: The authors declare that they have no conflicts of interest.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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