RESEARCH PAPER

Comparison between Cervical Epidural and Stellate Ganglion Block in Management of Complex Regional Pain Syndrome of the Upper Limb: A Prospective Comparative Study

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Received: 04th June, 2026; Revised: 05th July, 2026; Accepted: 20th July, 2026; Available Online: 25th July, 2026

ABSTRACT

Complex Regional Pain Syndrome (CRPS) is a neuropathic pain syndrome resulting from complex pathophysiological mechanisms affecting multiple levels of the nervous system. This work aimed to evaluate two regimens (cervical epidural block and stellate ganglion block) efficacy of treatment in easing chronic refractory pain in cases had upper limb CRPS after orthopedic trauma. Prospective comparative study included 90 patients with upper limb CRPS admitted to Pain Clinic, Tanta University Hospitals. The cases were divided into 2 equal groups: Group 1: Ultrasound (U/S) guided stellate ganglion block and group 2: C-arm guided unilateral cervical epidural block. Brief Pain Inventory short form was significantly decreased immediately after injection, at 3 and 6 months than baseline BPISF in both group 1 (from 8 (7-9) at baseline to 1 (0-2) at 6 months) and group 2 (from 8 (7-8) at baseline to 1 (0-1) at 6 months) (P. value <0.05). BPI-SF was insignificantly different at baseline, immediately after injection, at 3 and 6 months between both groups. Pregabalin total dose was significantly decreased at 3 and 6 months than baseline dose in group 1 and group 2 (P<0.05). There was an no significant difference between both groups regarding pregabalin total dose at baseline, 3 months, and 6 months. Both cervical epidural block and stellate ganglion block are safe and effective for pain control in upper limb CRPS, with no significant difference between techniques.

Keywords: Cervical Epidural, Stellate Ganglion Block, CRPS, Upper Limb

How to cite this article: Hegazy A.H.M, Hekal K.E.A, Abu Elyazed M.M.E, Afandy M.E, Amr M.M, Comparison between Cervical Epidural and Stellate Ganglion Block in Management of Complex Regional Pain Syndrome of the Upper Limb: A Prospective Comparative Study. 2026;16(72s): 377-381. DOI: 10.25258/ijddt.16.72s.44

Source of support: None

Conflict of interest: None

INTRODUCTION

Complex Regional Pain Syndrome (CRPS) is a neuropathic pain syndrome resulting from complex pathophysiological mechanisms affecting multiple levels of the nervous system [1, 2]. This condition usually occurs after a primary surgical procedure along with the severity of the fracture, probably not only due to casting or bracing pressure but also due to excessive distraction with an external fixator or during Open Reduction with an Internal Fixation (ORIF) or following trauma causing lasting pain and/or concurrent dysfunction in the sensory, motor, autonomic, and trophic domain. CRPS is further classified into types I and II. The latter involves the identification of a specific nerve lesion [3, 4].

CRPS clinical diagnosis is distinguished by a highly variable prognosis and manifestation[2]. The central nervous system (CNS) is obvious location of significant components of CRPS pathophysiology. It may be appropriate to depict CRPS as a neurological condition. In CRPS, cognitive and affective information processing is influenced by cortical areas, sensory, and motor systems. CRPS acute phase may be significantly influenced by neurological disease and inflammatory elements of the nervous system [5].

Pain is disproportionate to tissue injury extent and continues beyond typical anticipated duration of tissue healing [4]. CRPS treatment is multimodal, physical therapy, incorporating psychotherapy, and pharmacologic therapy to complement interventional procedures. Within pharmacotherapy, drugs most often utilized include gamma-aminobutyric acid receptor agonists (e.g., pregabalin and gabapentin), non-steroidal anti-inflammatory drugs and N-methly-D aspartate receptor antagonists (e.g., Ketamine) [6, 7].

For treatment of CRPS, a tried-and-true technique for nerve blocking of sympathetic ganglia in lower cervical and higher thoracic regions is stellate ganglion block [8]. Differential block is present in epidural blocks, including sensory, motor, and sympathetic block. Nerve functions are blunted to varying degrees and at varying rates. Sensory block develops more rapidly than motor block and is associated with a reduced local anaesthesia concentration when accompanied by sympathectomy [9].

There is a current research gap as although stellate ganglion block and cervical epidural block are both used in CRPS management, limited comparative evidence exists regarding their relative effectiveness and safety.

Therefore, the aim of work was to assess two regimens effectiveness (cervical epidural block and stellate ganglion block) of treatment in relieving CRPS in cases had upper limb CRPS following orthopedic trauma.

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PATIENTS AND METHODS

Study Design and Setting:

This prospective comparative study involved 90 cases with upper limb CRPS admitted to Pain Clinic, Tanta University Hospitals, Egypt from April 2023 to April 2025. All patients provided informed written consent. The investigation was conducted with approval of Ethics Committee of the Faculty of Medicine at Tanta University (approval code: 36264M058/3/23).

Participants:

The inclusion criteria included cases of both sexes who were over age of 21, exaggerated pain of upper limb trauma to degree of tissue injury and persisted beyond typically anticipated time for tissue recovery, and CRPS cases according to the Budapest criteria [10], where at least one symptom or sign in three of four categories (Vasomotor, Motor/trophic, Sensory, Sudomotor/edema) no other diagnosis, daily pain intensity is 7 or more for at least 3 months on numerical rating scale (NRS) despite of conventional treatment that including (pharmacologic therapy non-steroidal anti-inflammatory drugs, antiepileptic, antidepressants). Patients had major interventional pain procedures recently, like nerve blocks or implantable therapies, had unstable mental conditions, such as untreated bipolar disorder, post-traumatic stress disorder, major depression, severe personality disorder, or psychotic illness, known drug dependency or addiction due to psychostimulant drugs, hepatic or renal impairment, active injection site infection, known allergies to treatments used for this investigation, prior neck surgeries, Raynaud's disease or Raynaud's phenomena, or coagulopathy were excluded.

Sample Size:

The sample size calculation was performed using G. power 3.1.9.2 (Universität Kiel, Germany). The sample size was based on the following considerations: 0.05 α error and 80% power of the study with assumption that pain relief was adequate in 80% of the best treatment groups, while only 51% of the least favorable treatment groups experienced it, according to a previous study [11]. Eight cases were added to each group to overcome dropout. Therefore, 90 patients were allocated in each group (45 patients in each group).

Grouping Allocation:

The patients were divided into two equal groups: Group 1 (n=45): US guided stellate ganglion block. Group 2 (n=45): C-arm guided unilateral cervical epidural block.

Intervention Procedures

Group 1: U/S guided stellate ganglion block:

The procedure was anterior paratracheal approach on cervical sympathetic chain. Under U/S guidance, stellate ganglion block was typically performed at C6 vertebra level using a high-frequency linear probe placed transversely on neck. In transverse view, key anatomical landmarks included superficial to deep: skin, subcutaneous tissue, internal jugular vein, sternocleidomastoid muscle, carotid artery, and thyroid gland. Deeper structures included the anterior tubercle of C6 (Chassaignac tubercle), longus colli muscle, and prevertebral fascia. Injection target was fascial plane just anterior to longus colli muscle, beneath prevertebral fascia and medial to carotid artery. Proper needle placement was confirmed by the separation of the prevertebral fascia with a small amount of saline, followed by slow injection of local anesthesia. Care was taken to prevent vertebral artery injury, which lies laterally and posteriorly in the transverse foramen. A 22-gauge, 5-cm needle was inserted under visualization with U/S, and a total volume of 8 mL including 6 mL of lidocaine 0.125% and 8 mg of dexamethasone was administered. To rule out intravascular positioning, the remaining portion of the proper dosage was given following the injection of a 0.5-mL test dose. A successful stellate ganglion blockade demonstrated specific clinical signs which included miosis, anhidrosis, ptosis, and flushing of the extremities.

Group 2: C-arm guided unilateral cervical epidural block:

Patients were positioned in a prone position. The C-arm and an 18-gauge were used to guide the local anesthetic infiltration of epidermis at the C7-T146 interspace, which contained 2-3 mL of 2% lidocaine. Tuohy needles were implanted at the C7-T1 interspace and directed toward the right or left epidural recess, contingent upon surgery location. Hanging drop technique was employed to verify the identification of epidural space entry. In order to verify the unilateral spread of the dye, 1 mL of non-ionized diluted dye (omnipaque 300) was injected to validate the needle's position. Following this, a test dose was administered, which consisted of 2 mL of lidocaine 2% and 1:200,000 epinephrine. After confirmation of position, 6 mL lidocaine 1% and 8 mg dexamethasone in a total volume of 8 mL was injected into the space. The patient was monitored for two hours before being discharged to his residence, where he took part in a rehabilitative exercise program and was regularly monitored. As needed, individualized psychological help was also provided. Every 2 to 3 weeks, the physician at Pain Clinic conducted an evaluation of each patient.

Measurements

NRS and the Brief Pain Inventory Short Form Questionnaire (BPI-SF) were employed to quantify pain degree prior to, during, and three to six months following injection. The BPI-SF is a validated tool widely used to assess pain severity and interference with daily activities. Patients can self-report their pain using an 11-point NRS. It was predicated only on capacity to carry out everyday tasks with (0): no pain and (10): the most excruciating suffering conceivable [10]. Assessment of pain and psychological effects using BPI-SF survey. The survey consisted of nine items that were self-administered and were intended to assess how severe a patient's pain is and how it affects their day-to-day activities. Cases were requested to evaluate their pain intensity at its worst, lowest, average, and current levels, as well as to provide a list of their current treatments and their perceived effectiveness. Furthermore, patients were requested to evaluate to which their discomfort impeded their general activity, attitude, normal occupation, interactions with others, sleep, and life quality on a nine-point survey [12].

Outcome Measures:

Primary outcome was decreasing level of chronic pain score using NRS. Secondary outcome was reduction in the degree of chronic pain using BPI-SF questionnaire (II) for cases had CRPS. Side effects and any complication were observed and recorded.

Statistical Analysis:

Statistical analysis was performed using SPSS version 28 (IBM Corp., Armonk, NY, USA). The data was examined for normalcy using histograms and the Shapiro-Wilks test. Unpaired student t-tests were used to examine quantitative parametric data, which were displayed as means and standard deviations (SD). Mann Whitney-test was employed for evaluating quantitative non-parametric data, which were presented as the median and interquartile range (IQR). Comparisons were conducted between the three time periods (baseline, three months, and six months) by employing the Friedman test. Post-hoc pairwise comparisons were applied when a significant difference was identified, employing the Wilcoxon signed-rank test with Bonferroni correction. Qualitative parameters were provided as frequencies and percentages (%) and examined using Fisher's exact test or Chi-square test, as applicable. When the two-tailed P-value was < 0.05, we considered the result statistically significant.

RESULTS

Age, sex, weight, height, body mass index (BMI) did not differ significantly between groups **(Table 1).**

Table 1: Baseline characteristics of the studied groups

		Group 1 (n=45)	Group 2 (n=45)	P. value
Age (years)		42.38±11.06	41.07±10.77	0.570
Sex	**Male**	32 (71.11%)	27 (60%)	0.267
	Female	13 (28.89%)	18 (40%)	
Weight (kg)		74.47±12.53	77.51±13.3	0.266
Height (m)		1.67±0.05	1.65±0.05	0.133
BMI (kg/m^2)		26.83±4.81	28.51±5.35	0.121

Data are presented as mean ± SD or frequency (%). BMI: body mass index. Unpaired student t-tests was used for quantitative data, and Chi-square test was used for qualitative data

Numerical rating scale was significantly decreased immediately after injection, at 3 and 6 months as than baseline NRS within group 1 and group 2 (P <0.05). When comparing between the studied groups, NRS was insignificantly different at baseline, immediately after injection, at 3 and 6 months between both groups (**Table 2).**

Table 2: Numerical rating scale changes of the studied groups

	Group 1 (n = 45)		Group 2 (n = 45)		P. value
Baseline	7	6 - 8	7	6 - 8	0.207
Immediately after injection	3	2 - 4	3	2 - 3	0.107
3 Months	1	1 - 2	1	1 - 2	0.619
6 Months	1	1 - 2	1	1 - 2	0.975
P value within the group	**P1< 0.001*, p2< 0.001*, p3< 0.001***		**P1< 0.001*, p2< 0.001*, p3< 0.001***		--

Data are presented as Median or IQR, * significant as P-value ≤ 0.05. P1: p value between baseline and immediately after injection, P2: p value between baseline and 3 months, P3: p value between baseline and 6 months. Mann Whitney-test was used for comparison between both groups, while the Wilcoxon Signed-Rank Test was used for intragroup comparison within group.

Within both groups, the Brief Pain Inventory short form was significantly decreased immediately after injection, at 3 and 6 months than baseline BPISF in group 1 (from 8 (7-9) at baseline to 1 (0-2) at 6 months) and group 2 (from 8 (7-8) at baseline to 1 (0-1) at 6 months) (P. value <0.05). When comparing between the studied groups, BPI-SF was insignificantly different at baseline, immediately after injection, at 3 and 6 months between both groups (**Table 3).**

Table 3: Brief pain inventory short form questionnaire of the studied groups

	Group 1 (n = 45)		Group 2 (n = 45)		P .value
Baseline	8	7 - 9	8	7 - 8	0.530
Immediately after injection	4	3 - 4	3	3 - 4	0.730
3 Months	1	1 - 3	2	1 - 2	0.508
6 Months	1	0 - 2	1	0 - 1	0.508
P value within the group	**P1< 0.001*, p2< 0.001*, p3< 0.001***		**P1< 0.001*, p2< 0.001*, p3< 0.001***		---

Data are presented as Median or IQR, * significant as P-value ≤ 0.05. P1: p value between baseline and immediately after injection, P2: p value between baseline and 3 months, P3: p value between baseline and 6 months. Mann Whitney-test was used for comparison between both groups, while the Wilcoxon Signed-Rank Test was used for intragroup comparison within group.

Within the studied groups, Pregabalin total dose was significantly decreased at 3 and 6 months than baseline dose in group 1 and group 2. When comparing between both groups, there was no significant difference between both groups regarding pregabalin total dose at baseline, 3 months and 6 months (**Table 4).**

Table 4: Pregabalin total dose (mg) of the studied groups

	Group 1 (n = 45)	Group 2 (n = 45)	P. value
Baseline	1080 ± 148.63	1060 ± 151.36	0.529
3 months	406.67 ± 145.23	386.67 ± 137.51	0.504
6 months	300 ± 0	300 ± 0	---
P value within the group	**P2 <0.001*, p3= 0.002***	**P2< 0.001*, p3= 0.015***	----

Data are presented as mean ± SD. * significant as P-value ≤ 0.05. P2: p value between baseline and 3 months, P3: p value between baseline and 6 months. Unpaired student t-test was used for comparison between both groups, while the Friedman test was used for intragroup comparison within group.

Regarding the complications, headaches occurred in 7 patients in group 1 and 9 patients in group 2. Hypotension occurred in 3 patients in group 1 and 4 patients in group 2. Neck pain occurred in 4 patients in group 1 and 6 patients in group 2. Nausea occurred in 2 patients in group 1 and only one patient in group 2. Dizziness occurred in 5 patients in group 1 and 3 patients in group 2, while dry mouth occurred in only one patient in group 1 and 2 patients in group 2. There was no significant difference between both groups regarding the incidence of headache, hypotension, neck pain, nausea, dizziness and dry mouth (**Table 5).**

Table 5: Complications of the studied groups

	Group 1 (n = 45)	Group 2 (n = 45)	P. value
Headache	7 (15.56%)	9 (20%)	0.581
Hypotension	3 (6.67%)	4 (8.89%)	1.00
Neck pain	4 (8.89%)	6 (13.33%)	0.739
Nausea	2 (4.44%)	1 (2.22%)	1.00
Dizziness	5 (11.11%)	3 (6.67%)	0.713
Dry mouth	1 (2.22%)	2 (4.44%)	1.00

Data are presented as frequency (%). Fisher's exact test or Chi-square test was used.

DISCUSSION

As regarding degree of pain, there was significant reduction in both NRS and BPI-SF immediately after injection, at 3 and 6 months than baseline in both groups. Yet when comparing the two groups, there was no significant difference.

Similar findings were reported in previous studies [13] reported a clinically substantial improvement in pain scores of over 75% at the post procedure stage and over 50% at one month and three months. Like our findings, Aloweidi et al., [14] discovered majority 88% of patients' sample experienced a substantial decrease in their pain scores. In order to attain a 50% reduction in Pain Score, an average of 8.6 sessions is required, and initial clinical improvement requires up to 2-3 sessions.

Our finding are supported by Datta et al., [11] who revealed in 287 patients underwent Stellate ganglion block with documented CRPS on medications. Spontaneous and provoked pain assessment was done with numeric pain rating scale (NPRS). The overall mean pain reduction was 73.2% (r = 0.83, P < 0.001) considering spontaneous and 55.8% (r = 0.77, P < 0.001) on provoked pain.

Moreover, Jadon et al., [15] performed SGB on 24 patients with a diagnosis of CRPS-not otherwise specified at weekly intervals until 50% relief in pain and functional activity of the limb was achieved. Pain and functional ability of the limb were assessed by visual analog scale (VAS) disabilities of the arm, shoulder, and hand (DASH) scores, respectively. VAS and DASH Scores were recorded before and one week after the procedure. The results were compared using appropriate statistical tests. All the patients in their study showed significant improvement in VAS (P = 0.001) and DASH Scores (P < 0.001).

As regards analgesic intake, based on the results, pregabalin total dose was significantly decreased at 3 and 6 months than baseline dose in both group 1 and group 2. Yet, there was no significant difference between both groups regarding pregabalin total dose at baseline, 3 months and 6 months.

Similar findings were reported in previous studies [13] observed a reduction in analgesic intake for pain by over 50% over a three-month follow-up period. The follow-up periods did not reveal any long-term complications. However, scarce studies measured the follow-up of reduction of neuropathic pain medications.

Our results concluded that both groups had no difference in incidence of headache, hypotension, neck pain, nausea, dizziness and dry mouth. To our knowledge, there were no previous studies compared the statistical difference of complications between both groups. Kim, [16] stated that complications rate was 1.1%, with only 0.06% of patients experiencing major problems. Nevertheless, no permanent disability, paralysis, or mortality were reported. Most of the complications were minor.

Consistent with our results, Aloweidi et al., [14] found only five cases had modest hemodynamic changes, including two cases of hypotension and three cases of bradycardia.

These were transient, alleviated by fluid control, without severe complications. Most common complication (56%) was afflicted limb's increased paralysis, which improved within an hour of the treatment. This was succeeded by cuff discomfort (17%), which improved within a few minutes of cuff deflation. In one of therapeutic regimens, only two patients had Horner's syndrome, which was not accompanied by any hemodynamic changes. This condition was resolved within a few hours. Other minor complications incidence, like vertigo or tinnitus, was 3%. Additionally, Aleanakian et al., [17] reported that volume and type of local anesthetics, magnitude of pain, temperature of the dorsal hands, heart rate, blood pressure, and occurrence of Horner's syndrome or complications were assessed. Incidences of complications (hoarseness 3.9%, dysphagia 3.4%, hematoma 0.6%) were lower than in non-ultrasound-guided techniques.

CONCLUSION

Both cervical epidural block and stellate ganglion block are safe and effective interventions for managing pain in upper limb CRPS, with comparable outcomes. Therefore, further investigations with larger sample size are recommended for more accurate results. Multi-center study is recommended and furthers studies with longer follow-up are needed.

LIMITATIONS

The limitations of the study were relatively small sample inevitably reduced statistical power of analysis, single center study making results less generalizable, absence of randomization, absence of control group of in our study and limited follow-up duration.

Acknowledgment: None.
Source of support: Nil.
Conflict of interest: None

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