

USE OF STELLATE GANGLION BLOCK IN THE TREATMENT OF POSTURAL ORTHOSTATIC TACHYCARDIA SYNDROME: A NOVEL CASE REPORT

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- Background:** Postural orthostatic tachycardia syndrome (POTS) is a debilitating chronic condition characterized by an excessive increase in heart rate when transitioning from a lying or sitting position to standing. It impacts millions of people globally and is linked to a wide range of subsequent symptoms.
- Case Report:** This case report describes the novel use of stellate ganglion block (SGB) in a 41-year-old woman with a 15-year history of debilitating POTS symptoms. Given the failure of conservative management, the clinical team pursued a left SGB. Nine weeks postprocedure, the patient reported a pulse in the normal range under 100 beats per minute and 100% resolution of all symptoms that affected her quality of life.
- Conclusions:** The application of an SGB led to a remarkable reduction in the symptoms from POTS in this patient, showcasing its promise as a novel therapeutic strategy. This innovative approach not only alleviated the patient's distress but also opened new avenues for treatment.
- Key words:** Stellate ganglion block, POTS, autonomic, case report
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BACKGROUND

Postural orthostatic tachycardia syndrome (POTS) is a condition characterized by an excessive increase in heart rate (HR) when transitioning from a supine to an upright position. Specifically, it is defined by an HR increment of at least 30 beats per minute (bpm) within 10 minutes of standing or head-up tilt, in the absence of orthostatic hypotension (defined as a drop in systolic blood pressure of ≥ 20 mm Hg or diastolic blood pressure of ≥ 10 mm Hg within 3 minutes of standing). In children and adolescents, an increase of at least 40 bpm is required. For a POTS diagnosis, patients must experience symptoms of orthostatic intolerance for at least 6 months, with exclusion of other conditions that could explain the tachycardia, such as fever, anemia, hyperthyroidism, medications, etc (1-3).

The most common symptoms of orthostatic intolerance in POTS patients include lightheadedness, palpitations, and presyncope, alongside gastrointestinal (nausea, gastroparesis), neuropsychiatric (mental clouding, anxiety), and systemic (fatigue, dyspnea) symptoms. POTS is a heterogeneous syndrome with several recognized subtypes – including neuropathic, hypovolemic, hyperadrenergic, and autoimmune-associated POTS. The pathophysiology involves a mix of mechanisms, including excessive sympathetic drive, volume dysregulation, impaired sympathetically mediated vasoconstriction, and deconditioning (1,2,4).

POTS impacts millions of patients, leading to substantial functional impairment and reduced quality of life. Its prevalence is estimated to be 0.1% to 1% in the general population, but largely considered under-

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diagnosed (1,4). POTS is a significant cause of chronic disability, with 70.5% of patients reporting symptom-related financial hardship and 36% losing > \$10,000 USD annually (5).

Currently, there are limited therapeutic interventions for POTS. Conventional therapies aim for HR reduction through intravascular volume expansion, reduction of venous pooling, parasympathomimetic action, sympatholytic effects, and sinoatrial node modification (6). However, these therapies have limitations, including systemic side effects and limited efficacy of both cardiac and noncardiac manifestations of POTS. Stellate ganglion block (SGB) has been used to manage sympathetic-mediated pain and vascular insufficiency syndromes. Few studies report the effectiveness of SGB for sympathetic overactivity in long COVID; however, there are no reported studies regarding efficacy for POTS. This case report presents the first reported use of SGB to treat POTS.

CASE REPORT

A 41-year-old woman with a history of POTS presented to the interventional pain clinic.

Her POTS symptoms started 15 years prior without any known precipitating event, and she received a POTS diagnosis 10 years ago. Her symptoms included fatigue, dizziness, nausea, irritable bowel syndrome (IBS) (multiple episodes of diarrhea per day), mental clouding, sporadic elevated HR ranging between 150-200 bpm, temperature dysregulation, and anxiety inhibiting her ability to perform her activities of daily living or stand for > 20 minutes. Previous treatments included an abdominal binder, metoprolol, duloxetine, amitriptyline, dextroamphetamine, low-dose naltrexone, dietary changes, and hydration, with minimal relief of symptoms.

Due to the patient's nonresponse to conservative management, the clinical team decided to pursue a left SGB. The patient was placed in the right lateral decubitus position, and the left paratracheal region at the level of the cricoid cartilage was prepped and draped in a sterile fashion. Then 3 mL of 1% lidocaine was injected into the subcutaneous tissue to provide superficial anesthesia. The junction of the vertebral body and the anterior tubercle at C6 was identified under fluoroscopy (Fig. 1). A 22G, 3.5-inch spinal needle was advanced until contact was made with the C6 vertebral body at the junction between the vertebral body and the tubercle. The needle was then withdrawn

approximately 1 mm. Correct needle position was confirmed under fluoroscopy with 2 mL of Omnipaque 300, which demonstrated good paratracheal spread with no evidence of intrathecal, epidural, intravascular, or myoneural spread (Fig. 2). After a negative aspiration, 10 mL of a mixture of lidocaine 2% and bupivacaine 0.5% was slowly injected. Lidocaine was primarily used for its ability to offer a faster onset of sympathetic blockade, which can help accelerate the onset of clinical effect and improve patient comfort during the early postprocedural period. Overall, the patient tolerated the procedure well, and no complications were noted. The patient's blood pressure and HR were continuously observed before, during, and after the SGB. She remained hemodynamically stable, with no hypotension, bradycardia, or other complications noted following the block. Although blood pressure records were not readily accessible, it was noted that the patient had stable blood pressures before and after the procedure.

Two weeks postprocedure, the patient reported that she had significant symptomatic improvement, including total resolution of syncope and dizziness, the ability to stand for > 30 minutes, pulse in the normal range under 100 bpm, improved nausea, improved IBS symptoms, and resolution of hot flashes. At 6 and 9 weeks postprocedure, she reported 100% relief of all symptoms (Table 1). She had since been able to discontinue her metoprolol and terazosin cardiac medications. Overall, she described her results as "profound" and "life changing."

DISCUSSION

This case highlights the potential for SGB as an interventional therapy for POTS. Given the autonomic symptoms associated with POTS, it is reasonable to assume that a therapy like SGB, which works by interrupting the sympathetic nervous system's activity, can yield such positive results. Though to our surprise, this patient experienced dramatic and long-lasting results after her SGB, reporting complete alleviation of all symptoms for multiple months. To the best of our knowledge, this is the first documented case of an SGB for POTS.

The stellate ganglion is an autonomic nervous system ganglion formed by the fusion of the inferior cervical sympathetic ganglion and the first thoracic sympathetic ganglion, anatomically located anterior to the neck of the first rib (7). Functionally, the stellate ganglion plays a crucial role in the sympathetic innervation of the head, neck, and upper extremities. It contains neurons that are

responsible for the sympathetic regulation of various physiological processes, including vasomotor control, sweating, and cardiac function. It is also involved in the modulation of pain and vascular insufficiency syndromes, especially in the upper extremities (7,8).

Fibers from the stellate ganglion innervate the heart's conduction system and myocardium, thereby influencing HR and contractility (9,10). Consequently, blocking the stellate ganglion should effectively remove sympathetic input to the heart from that pathway, leading to a decrease in HR and overall sympathetic tone. In

the context of POTS, particularly the hyperadrenergic subtype, where excessive sympathetic activation contributes to tachycardia and symptoms, interrupting the sympathetic outflow via SGB can directly counteract the conditions' pathophysiology. By acutely reducing cardiac sympathetic stimulation, an SGB may blunt the exaggerated HR response upon standing and improve orthostatic tolerance. Additionally, cervical sympathetic blockade can increase cerebral blood flow, potentially improving symptoms of brain fog and presyncope that result from cerebral hypoperfusion in POTS (11). In es-

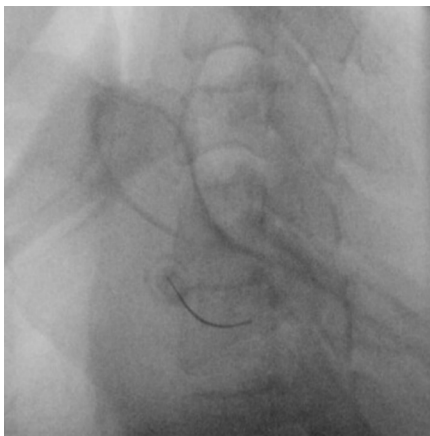


Fig. 1. Intraoperative PA radiographic views of left-sided needle placement at the C6 vertebral body, at the junction between the vertebral body and the tubercle. PA, posteroanterior.



Fig. 2. Needle placement with contrast spread. Demonstrating good paratracheal spread with no evidence of intrathecal, epidural, intravascular, or myoneural spread.

Table 1. POTS Likert scale. A numeric scale from 0 to 10 that measures the severity and frequency of POTS symptoms: 0 means nonexistent symptoms, while 10 means most severe possible with frequent occurrences.

	Prior to Procedure	2 wk Postprocedure	6 wk Postprocedure	9 wk Postprocedure
Tachycardia (HR in the 150-200 bpm range)	7	0	0	0
Presyncopal Symptoms (Grey Vision With Standing, Dizziness)	7	0	0	0
Nausea	8	1	0	0
Standing for About 20 min at a Time	10	0	0	0
ADLs (Taking Showers, Washing Dishes)	10	0	0	0
Temperature Dysregulation (Hot Flashes)	9	0	0	0
IBS (Diarrhea)	10	2	0	0
Average Score	8.7	0.4	0	0

Abbreviations: HR, heart rate; bpm, beats per minute; ADLs, activities of daily living; IBS, irritable bowel syndrome; min, minute; wk, week.

sence, an SGB might reset autonomic balance in these patients, breaking the cycle of autonomic dysregulation. Our patient's dramatic response supports the idea that modulating the cardiac sympathetic supply via an SGB can favorably alter the cardiovascular hyperadrenergic state underlying POTS.

SGBs have been investigated in the past for their effects on autonomic symptoms, including HR modulation in patients with sinus tachycardia and long COVID. A study (12) of SGB in patients with inappropriate sinus tachycardia found that SGB significantly reduced resting HR by approximately 9-12 bpm. For long COVID, SGB has shown promise in reducing symptoms of fatigue, cognitive issues, and autonomic dysfunction. Studies (13,14) reported significant symptom relief in long COVID patients following SGB, suggesting that the procedure may help "reboot" the autonomic nervous system by blocking cervical sympathetic chain activity. Collectively, these studies reinforce the role SGB can play in modulating autonomic function and HR, with implications for managing conditions like POTS.

An interesting aspect of this case worth noting is that this patient's POTS symptoms remained abated long after the local anesthetic should have worn off. Bupivacaine's direct effect lasts only on the order of a few hours, but the therapeutic effects of an SGB can persist beyond the anesthetic's life (15). In pain management, e.g., an SGB is considered successful if pain relief outlasts the anesthetic duration. Some patients report relief for days or weeks after a single block, suggesting that SGBs may induce a longer-lasting reset of sympathetic tone or interrupt a pathologic feedback loop. In fact, the American Academy of Pain Medicine, in its 2022 guidelines, stated that pain relief following sympathetic nerve blocks (including SGB) generally outlasts the pharmacologic effects of the local anesthetic and may be long-lasting in some cases, sometimes persisting for days or weeks (16). Thus, the benefit our patient experienced is likely not due to the presence of bupivacaine in the body, but rather due to a form of chemical neuromodulation similarly seen with pain management. The SGB may have recalibrated autonomic reflexes, leading to prolonged symptom relief even once the drug effect subsided.

Given the dramatic symptom resolution observed with this patient, future investigations must rigorously evaluate SGB in POTS through larger cohort studies and randomized controlled trials. Such studies are critical to confirm efficacy, delineate safety, and determine the du-

ration of therapeutic benefit after SGB, as the longevity of symptom relief (beyond the ~ 9-week improvement noted in this case) remains unknown. Comparative trials should also benchmark SGB against established first-line noninvasive therapies for POTS – including graded exercise programs, expanded fluid and salt intake, compression garments, and cognitive-behavioral therapy, to clarify its relative benefit and appropriate role in management. Additionally, stratified research is warranted to explore differential responses among POTS subtypes (neuropathic, hypovolemic, autoimmune, etc), given their distinct underlying pathophysiology and potentially varied sympathetic involvement. Recognizing current data limitations (e.g., lack of objective pre- and postblockade hemodynamic measurements), future studies should incorporate standardized autonomic testing (such as HR and blood pressure assessments) to objectively quantify SGBs' effects.

Further mechanistic research is also needed to elucidate how SGB modulates autonomic function – e.g., whether blocking cervical sympathetic outflow "reboots" aberrant autonomic networks or attenuates proinflammatory autonomic signaling. In particular, studies should monitor the durability of symptom relief over extended follow-up, evaluate the safety profile of repeated or bilateral SGB in this population, and refine patient-selection criteria (e.g., identifying which patients with refractory POTS or specific phenotypes are most likely to benefit from sympathetic blockade). Collectively, these future directions will help establish a more robust evidence base and guide the optimal integration of SGBs into the therapeutic arsenal for POTS.

Our patient did not report any side effects post-SGB, but possible adverse effects of an SGB include temporary Horner syndrome, hoarseness, dysphagia, and transient weakness of the upper extremity due to the local anesthetic. Rare but serious complications include pneumothorax, hematoma, and infection. Patients must be informed about the possibility of transient bradycardia or hypotension due to the blockade of sympathetic outflow, which can affect cardiovascular function (10).

CONCLUSIONS

This case report highlights the potential of SGB as a treatment for the symptoms of POTS. The profound alleviation of symptoms in our patient aligns with previous reports demonstrating the efficacy of SGB in managing other types of autonomic dysfunction and complex clini-

cal conditions. While these findings are encouraging, it is imperative to establish the long-term efficacy and safety of SGB in POTS patients. Future studies should focus on

larger patient cohorts and include randomized controlled trials to provide robust evidence for the integration of SGB into standard POTS management protocols.

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