The Successful Use of Left-sided Stellate Ganglion Block in Patients That Fail to Respond to Right-sided Stellate Ganglion Block for the Treatment of Post-traumatic Stress Disorder Symptoms: A Retrospective Analysis of 205 Patients

Dr. Sean W. Mulvaney, MD; Dr. James H. Lynch, MD; Kamisha E. Curtis, MS; Tamara S. Ibrahim, MS

ABSTRACT

Introduction:

Ultrasound-guided stellate ganglion block (SGB) is an injection of local anesthetic (8mL of 0.5% ropivacaine) in the neck to temporarily block the cervical sympathetic trunk which controls the body's fight-or-flight response. This outpatient procedure takes less than thirty minutes and is immediately effective. Our goal was to determine if a left-sided stellate ganglion block is effective for treating posttraumatic stress disorder (PTSD) symptoms. While right-sided SGB has been extensively studied, left-sided SGB has not been formally evaluated for this indication.

Materials and Methods:

Our hypothesis was that patients who fail to improve following a right-sided SGB will report significant improvement following a left-sided SGB. A retrospective chart review was conducted for patients who received SGB for PTSD symptoms between August 2019 and March 2020. All procedures were performed at an established musculoskeletal practice by the same anesthesia/pain fellowship-trained physician. Subjects included those who underwent a left-sided SGB (LSGB) only after non-response to a right-sided SGB (RSGB). Non-response was defined as less than 10 points of improvement on a PTSD Checklist (PCL-5).

Results:

Out of 205 patients, 20 did not respond to an RSGB and were included in our analysis. Ten of these patients subsequently received an LSGB, and 90% responded favorably (PCL-5 mean improvement = 28.3 points).

Conclusions:

Based on our sample of 205 patients receiving SGB for PTSD, we concluded that at least 4.4% did not respond to a right-sided SGB but did have a significant response to a left-sided SGB.

INTRODUCTION

Background

Post-traumatic stress disorder (PTSD) is defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as a pathologic trauma and stressor disorder that occurs following exposure to severe trauma.[1] Lebovitz et al. first described the use of stellate ganglion block (SGB) to treat PTSD in 1990.[2] This procedure has emerged within the past 10 years as a successful modality to treat post-traumatic stress symptoms primarily through targeting dysfunction of the autonomic nervous system.[3] The right-sided SGB (RSGB) procedure has been evaluated and supported in many peer-reviewed publications, including a level one randomized clinical trial in 2019 supporting this modality's safety and effectiveness in the successful treatment of PTSD.[4–6]

Stellate ganglion block for PTSD has been traditionally performed on the right side at the sixth cervical vertebra (C6) level based on our understanding of the essential role of the right hemisphere in the human stress response.[7] Our techniques have been per standard protocols and in accordance with published treatment guidelines.[8] Stellate ganglion block effects are immediate and profound, with up to 80% of patients reporting a 50% reduction in symptoms.[9] The duration of SGB effects is variable depending on the patient's current situation, type and severity of inciting trauma, compliance with psychotherapy, and individual resilience factors. In our experience, the benefits from SGB last for at least 3-4 months. In our practice, 15% of patients have a less robust response to SGB despite seeing some improvements in their symptoms.

Objectives

We postulated that a left-sided SGB (LSGB) may be beneficial for some patients due to side-to-side variations in functional neuroanatomy. Having searched online medical databases for studies of LSGB in the treatment of PTSD, we believe this

Uniformed Services University of the Health Sciences, Military and Emergency Medicine, Bethesda, MD 20814, USA

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is the first description of this alternative technique for stellate ganglion block in the treatment of post-traumatic stress symptoms for individuals who fail to respond as anticipated to an RSGB.

MATERIALS AND METHODS

Study Design

Between August 2019 and March 2020, our practice modified its treatment algorithm to include offering an LSGB only after patients first failed to improve as anticipated following an RSGB (RSGB). Nonresponse was defined in patients who had obvious Horner's syndrome findings but failed to improve at least 10 points on a PTSD Checklist Version 5 (PCL-5).[10] The PCL-5 is a 20-item self-reported questionnaire designed to assess PTSD symptomatology including symptoms of re-experiencing, avoidance, and hyperarousal. The PCL has demonstrated excellent reliability and validity in primary care settings.[11] Nonresponders to RSGB were offered the option to undergo the same ultrasound-guided procedure on the left side; however, almost half of the patients were unable to accept this because of financial or time constraints. Due to the risk of serious airway compromise with inadvertent bilateral blockade of the recurrent laryngeal nerves, the LSGB was performed at least 24 hours after the RSGB to allow adequate time for anesthesia effects to subside. An LSGB is a commonly accepted low-risk procedure in the treatment of left upper limb sympathetically mediated pain.[12] See Figure 1 for the analysis of treatment with addition of an LSGB.

In the normal course of our clinical practice, the following data are routinely collected to guide treatment plans for our patients seeking care for PTSD: baseline PCL-5 score, 1-week post-SGB PCL-5 score, and 1-month post-SGB PCL-5 score. We received Institutional Review Board approval (#IRCM-2020-250) to de-identify these symptom checklists and compare the PCL-5 scores at each time period. The primary end point for this analysis was the average improvement in PCL-5 scores from baseline to 1 week post-procedure.

Setting

All procedures were performed at an established musculoskeletal practice by the same anesthesia/pain fellowship-trained physician (S.W.M.) who has performed over 1,500 ultrasound-guided SGBs.

Participants

The population selected for treatment in this private practice clinic were diverse in demographics and type of trauma (See Table I). Only patients with baseline PCL-5 scores $\geq$40 (range 42-73, moderate to severe PTSD) were selected for analysis since this range of scores is more likely consistent with a diagnosis of PTSD.[10]

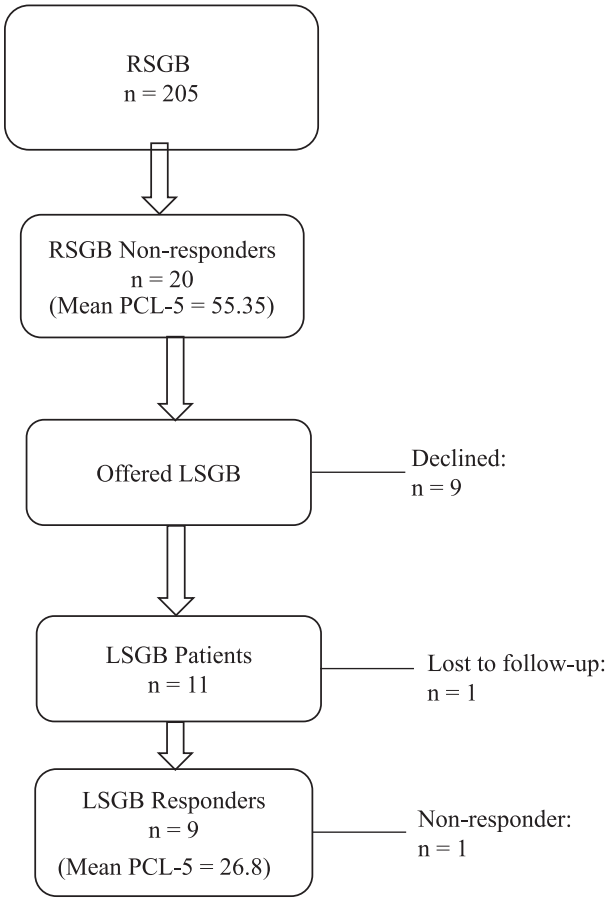

FIGURE 1. Analysis of treatment with addition of left-sided stellate ganglion block.

TABLE I. Patient Demographics and Characteristics

Demographics	
Average age [Range]	53 years old [34-65 years]
Category	Number (%)
Race/Ethnicity	
White/Non-Hispanic	6 (60)
Black/African American	0 (0)
American Indian/Alaskan Native	2 (20)
Hispanic	1 (10)
Unknown	1 (10)
Sex	
Female	6 (60)
Male	4 (40)
Trauma type	
Military/Combat-related	2 (20)
First responder (EMS, Firefighter, Police)	2 (20)
Childhood trauma	1 (10)
Motor vehicle accident	1 (10)
Trauma not specified	4 (40)
Smoking status	
Smoker	0 (0)
Nonsmoker	10 (100)

Study Size

We hypothesized that some percentage of RSGB nonresponders would have a robust, clinically significant response to an SGB on their left side. To assess this hypothesis, two sets of data were created for each patient: PCL-5 score 1 week after an RSGB and PCL-5 score 1 week after an LSGB. Ten patients provided follow-up data at 1 week for both their RSGB and LSGB. Therefore, from an initial group of 205 patients, 10 met criteria to evaluate our hypothesis.

Statistical Methods

The Wilcoxon signed-rank test was used to analyze our paired data, as our data were not normally distributed.

RESULTS

Right-Sided Stellate Ganglion Block (N = 10)

Out of 205 patients, 117 responded to an RSGB while 20 failed to respond to an RSGB. Sixty-eight patients failed to provide a PCL-5 score at 1 week and were therefore excluded from this analysis. The mean change in PCL-5 score for the 10 RSGB nonresponders from baseline to 1 week after RSGB was 6.2 (compared to 35.13 in the RSGB responder group). This slight improvement in these 10 patients is not statistically significant (P-value = .11; 95% CI: −2.00 – 13.00) and is less than the minimal clinically important difference (MCID) for this instrument.[11]

Left-Sided Stellate Ganglion Block (N = 10)

Eleven of the 20 RSGB nonresponders then received an LSGB. One patient was lost to follow-up. This group's mean PCL-5 score decreased from 55.1 at baseline to 26.8 at 1 week post-LSGB. This was a mean decrease of 28.3 points following an LSGB—a value over twice the magnitude of the MCID (P-value = .017; 95% CI: 4.00 – 50.00; Table II).

Mean Change in RSGB Vs. LSGB

Comparison of the mean changes in RSGB and LSGB after 1 week indicates a statistically significant difference in effect for these patients (P-value = .01; 95% CI: −41.99 – −5.80). In these 10 patients, the RSGB intervention provided mild clinical improvement which was not of statistical significance, while the LSGB provided robust clinically and statistically significant improvement. See Table II for a summary of results.

TABLE II. PTSD Checklist Version 5 (PCL-5) Score Changes From Baseline to 1 Week in right-sided stellate ganglion block (SGB) nonresponders

	Baseline*	1 week	Δ-1 week**
Left-Sided SGB ($n = 10$)	55.1	26.8	28.3
Right-Sided SGB ($n = 10$)	61.6	55.4	6.2

*The difference in baseline mean PCL-5 scores before each treatment was insignificant (P-value = .14; 95% CI: −1.99 to −15.99).
**The difference in the change between the two treatment interventions is 22.1 (P-value = .01; 95% CI: −41.99 to −5.80).

DISCUSSION

The principal findings in this study support our intent, which was to trial a new procedure intended for use in a larger program of research. In this case, we have demonstrated that further evaluation is warranted for LSGB in the treatment of PTSD symptoms. The key results here which define the importance of this study are that the small percentage of trauma patients, who have been considered "nonresponders" to an RSGB, may simply have anatomical differences that require contralateral intervention. This provides hope for many PTSD patients who would otherwise abandon this treatment option after a single attempt.

There were several limitations to this study. The patients who opted to receive an LSGB after failing to respond to an RSGB returned for an LSGB at least 24 h post-RSGB as required. This requirement limited access to treatment for the patients, who were unable to, or chose not to, return following the RSGB, which may introduce sampling bias. Data on the reasons for which patients were unable to return for an LSGB or chose to forego LSGB treatment were not documented and limit this analysis. Additionally, our small sample size, retrospective design, and short-term follow-up make it difficult to form generalizable conclusions. By comparing two different procedures on the same patients, however, we are able to reliably utilize self-reported symptom score comparisons between an LSGB and an RSGB. In addition, the study suffered from a 33% loss-to-follow-up following RSGB. Finally, because the 10 individuals in our primary analysis received both RSGB and LSGB, the possibility of an additive effect must be taken into account. Still, the data presented here provide a valuable first look at a potential modification of standard RSGB, as well as a foundation for future research.

Adverse events were rare but not systematically evaluated in this study. There were three cases of temporary headache lasting several hours and two cases of self-limited, mild soreness at the injection site. Although not considered an adverse event in SGB, about 15% of patients had temporary hoarseness or globus sensation associated from anesthetic spread and inadvertent block of the recurrent laryngeal nerve.

Although the intent of this procedure is to block the cervical sympathetic chain and its associated ganglia, we cannot rule out that some clinical effects may be due to anesthetic spread as well as an inadvertent block of the vagus nerve. Questions also remain surrounding lateralization. Why some PTSD patients appear to respond better to an LSGB rather than an RSGB is unclear. Our findings, which demonstrate success on the left side in a small sample, challenge existing dogma that SGB should be performed only on the right side to treat post-traumatic stress symptoms. This approach has been

based in part on psychoneurobiological models that depict sympathetic predominance (including cardiovascular regulation) within right insular function, while parasympathetic regulation has been attributed to the left insula.[13] Several recent neuroimaging studies have also provided further evidence that such clear lateralization may be more complex than previously thought.[14,15] This issue certainly warrants further investigation.

CONCLUSIONS

This study reinforces that SGB has a profound and immediate effect on post-traumatic stress symptoms and should be considered as a valuable adjunct in the treatment of PTSD. Based on our sample of 205 patients receiving SGB for PTSD symptoms at least 4.4% of this total sample did not respond to an RSGB but did have a significant response to an LSGB.

An LSGB was effective in 90% of patients who did not respond to RSGB for PTSD symptoms at 1 week. These findings indicate that an LSGB should be considered when an RSGB fails to significantly improve a patient's post-traumatic stress symptoms. Further study is required in a larger population: these findings imply a normal variation in the laterality of the central autonomic network, which impacts the pathology of PTSD.

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CONFLICT OF INTEREST STATEMENT

None declared.

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