Retrospective Study

Utility of Cervical Sympathetic Block in Treating Post-Traumatic Stress Disorder in Multiple Cohorts: A Retrospective Analysis

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Background: Post-traumatic stress disorder (PTSD) is a prevalent and debilitating condition in the United States. Success rates for evidence-based therapies are inconsistent, and many suffer in silence due to the stigmata associated with seeking traditional mental health care. This has led clinicians to explore new therapeutic options, with cervical sympathetic blockade (CSB), performed at the stellate and/or superior cervical ganglion levels, recently emerging as a promising treatment option. Rapid therapeutic onset, improved compliance, and high clinical efficacy rates have made this an attractive approach for both providers and patients. However, to date, CSB as a treatment of PTSD has primarily been used in male patients with military-related trauma.

Objective: To evaluate the efficacy of CSB as a treatment option for PTSD in both genders and multiple etiologies of psychological trauma.

Study Design: Retrospective cohort study.

Setting: An established anesthesia pain clinic in Chicago, IL, USA.

Methods: Following retroactive IRB approval, 484 consecutive cases of patients diagnosed with PTSD and treated with CSB, performed by a single provider (December 2016 – February 2020) were analyzed. The primary outcome measurement was the PTSD Checklist Score version DSM IV (PCL-4). Patient demographic and clinical information collected included age, gender, type of trauma leading to PTSD, history of suicidal attempts, and psychiatric medication use.

Results: After exclusion of cases due to missing data points, 327 patients were included in the final statistical analysis, having completed both PCL-4 pre and post CSB, between 7- and 30-days post-intervention. The patient population included military men (n = 97), civilian men (n = 85), military women (n = 13) and civilian women (n = 132). We identified 21 types of self-reported trauma leading to PTSD. Average decrease in PCL score for men and women was 28.59 and 29.2, respectively. Statistical analysis of the male population with a military background showed a significantly greater change in corresponding PCL scores than civilians (PCL-M change = -31.83 vs PCL-C change = -24.89). Likewise, women who had a military background had a significantly greater reduction in PCL score than civilians (39.15 vs 28.23). Statistically significant improvements in PTSD symptoms were noted independent of the causative trauma type, gender, age greater than 20, previous suicide attempts, or use of prescription medications for PTSD. Among the 21 types of reported trauma, 19 types reached statistical significance.

Limitations: Limitations include the limited scope of observation giving exclusive focus on pre- and post-PCL data, the limited duration of observation, the self-reported nature of the patient-provided data, and the provision of treatment by a single physician.

Conclusion: CSB seems to be an effective treatment for PTSD symptoms irrespective of gender, trauma type, PTSD-related drug use, suicide attempt, or age.

Key words: Stellate ganglion block, superior cervical ganglion block, regional anesthesia, treatment-refractory post-traumatic stress disorder, treatment-resistant PTSD, cervical sympathetic block

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Post-traumatic stress disorder (PTSD) is a prevalent and potentially debilitating disorder typically occurring as a result of exposure to physical violence, natural disasters, or other severe stressors. The World Health Organization (WHO) World Mental Health Surveys determined the lifetime prevalence of PTSD to be approximately 3.9% in the general population and 5.6% among the trauma-exposed (1). Higher percentages are seen in populations who have experienced one or more forms of trauma, such as war-related trauma, physical or sexual violence, and accidents (2). For instance, the prevalence of PTSD in post-deployment US infantry personnel has averaged 10%-20% (3). Additionally, the lifetime prevalence of PTSD for women who have been sexually assaulted has been reported to be 50% (4). When contextualized for the total prevalence of PTSD in women, sexual assault alone is found to be the inciting trauma in 16% of cases (4). Less obvious stressors can also serve as inciting events for the development of PTSD. Preliminary evidence has suggested that psychological stressors, including the current COVID-19 pandemic, are likely to contribute significantly to PTSD incidence (5).

Current Treatments of PTSD

Several treatment guidelines currently exist for patients with PTSD. These treatment approaches can be classified as pharmacological therapies or psychotherapies, including cognitive behavioral therapy (CBT), cognitive processing therapy (CPT), prolonged exposure, hypnotherapy, and others. The US Department of Veterans Affairs has mandated that all veterans treated for PTSD have access to either prolonged exposure therapy or cognitive processing therapy (6).

However, veterans remain reluctant to seek care, with half of those in need not utilizing mental health services. The long duration of time and consistent follow-up required for these treatments, coupled with the social stigma of seeking psychiatric care, often hinder both civilian and military patients' desire to seek and continue treatment. Among veterans who begin PTSD treatment with psychotherapy or medication, drop-out rates are reported to be as high as 20%-40% in randomized clinical trials and considerably higher in routine practice (3). While therapeutic efficacy is reported to be achieved in 60%-80% among patients compliant with medical treatment, intention-to-treat analysis shows efficacy decreases to approximately 40% when accounting for patients not completing treatment (3).

Cervical Sympathetic Block as a Treatment of PTSD

Stellate ganglion block (SGB) has emerged relatively recently as a promising treatment option for the relief of PTSD symptoms. SGB involves the injection of local anesthetic in proximity to the stellate ganglion, typically performed at the level of the 6th cervical vertebra (C6), which leads to inhibition of sympathetic activity to the brain as well as the upper extremity and face. SGB for therapeutic treatment of psychiatric conditions was first described by Karnosh et al (7) in 1947 for clinical depression. The potential of sympathetic modulation to treat PTSD-related symptoms was later demonstrated by Telaranta et al (8), who performed endoscopic thoracic sympathectomy for the treatment of social phobia and PTSD in 1998. This was then followed by a report into the utility of SGB as a treatment of PTSD by Lipov et al in 2008 (9).

Interest in SGB for the treatment of PTSD has increased considerably over the past decade as it is reported to offer rapid and sustained relief. Since 2008, multiple reports have documented significant efficacy of SGB for PTSD, including a 2019 randomized, controlled trial of 113 patients, which demonstrated that those receiving SGB had significantly improved scores on assessments of PTSD-associated symptoms, distress, anxiety, pain symptoms, physical functioning, and mental functioning compared to placebo (10).

In patients with PTSD who fail to respond to SGB targeting a second level of the cervical sympathetic chain, notably the superior cervical ganglion block (SCGB), was shown to safely and significantly improve symptoms at one month compared to baseline (11). Henceforth, we use the term cervical sympathetic block (CSB) to refer to SGB alone or followed by SCGB. The objectives of our cohort study were to evaluate the efficacy of CSB as a treatment option for PTSD in both genders and multiple etiologies of psychological trauma. The primary outcome measurement for this study was the PTSD Checklist Score version DSM IV (PCL-4) score.

Materials

Study Design and Patients

This retrospective cohort study was performed and reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines (12).

Our practice has been treating PTSD routinely by the use of CSB since 2006, leading to publication of this therapeutic approach in 2008 (9). The patients included in the current study were treated in our clinic for PTSD between December 2016 and February 2020. Prior to patient data analysis, institutional review board approval was obtained (Integ Review, #IRCM-2020-250) to de-identify patient data for statistical comparison of PCL-4 scores. All procedures were performed at an established anesthesia pain practice performed by a single anesthesia/pain fellowship-trained physician with over 30 years of experience using fluoroscope-guided CSB.

Both the military (PCL-M) and civilian (PCL-C) versions used consist of a 17-item, self-reported, single-page questionnaire endorsed by the National Center for PTSD. Slight differences in the wording of included questions exist between questionnaire versions to account for the presence or absence of military and/or combat experience. Patients are asked to quantify the ongoing prevalence of specific symptoms in their life, related to previously traumatic experiences. The patients respond to each question on a 5-point scale from "Not at all" (1) to "Extremely" (5), with total scores ranging from 17 (no symptoms) to 85 (maximal symptoms).

Patients with PTSD were included in the study if they had a pre-procedure PCL score of 35 or above, as described by the psychometric properties of PTSD checklist by Monson et al (13). Patients had active PTSD and were seen in an interventional pain clinic for CSB. These patients were asked to complete a pre-procedure and post-procedure PCL-C IV (civilian) or PCL-M IV (military) as appropriate. Post-procedure PCL was obtained between 7- and 30-days post-intervention. PCL scores obtained were stratified by patient demographic and clinical information collected, and included age, gender, type of trauma leading to PTSD, history of suicidal attempts, and psychiatric medication use. Detailed informed consent was obtained prior to performing all procedures. Each patient was informed that if no significant change was noted in PTSD symptoms following SGB, they would then receive a SCGB after a 20-minute observation interval. Patients were allowed to elect to receive light sedation performed by a board-certified anesthesiologist.

Stellate Ganglion Block Technique

Following sedation or local anesthetic as per patient preference, the patient was placed in a supine position and appropriate ASA-mandated monitors were placed. The skin over the anterior and right side of the neck was cleaned with chlorhexidine-isopropyl alcohol preparation. Fluoroscopy (GE 1999) was used to identify the C-6 vertebral level transverse process. The skin at the injection site on the lateral neck was anesthetized with 1 mL of 1% lidocaine. A 22-gauge, 3.5-inch Quincke needle was inserted to the appropriate depth where contact was made with the ventrolateral aspect of the C6 vertebral body. The needle was withdrawn at 1 mm. Lateral view of the spine was obtained and the needle tip was confirmed to be dorsal to the ventral aspect of the vertebral body. After negative attempted aspiration, while monitoring the patient, 1.0 mL of Isovue-200 was injected under fluoroscopic guidance. If intravascular spread was identified or spread was not noted along the cephalad and caudal aspect longus colli muscle belly, the needle tip was repositioned.

Upon obtaining appropriate contrast spread, 0.5 mL of 0.5 % bupivacaine with 5 µg/mL clonidine was injected. After observing the patient for 30 seconds, an additional 7 mL of 0.5% bupivacaine with 5 µg/mL clonidine was slowly injected over 1.5 minutes for a total injection volume of 7.5 mL to achieve blockade of the C6 cervical sympathetic ganglion. The needle was withdrawn, and an adhesive bandage was placed on the injection site. The patient was taken back to the recovery room and allowed to awaken. The presence or absence of a resultant Horner's syndrome was noted, which is an effect of the blockade, not an adverse event.

The patient was then interviewed to assess their response to prior memory of trauma. If the patient reported being or was subjectively identified to still be hyper-reactive, the patient was returned to the operating room to receive a SCGB.

Superior Cervical Ganglion Block Technique

Again, fluoroscopy was used for needle placement. This time, the skin at the injection site on the lateral neck was anesthetized with 1 mL of 1% lidocaine. A 22-gauge 3.5-inch Quincke needle was inserted to a depth where contact was made with the ventrolateral aspect of the C3 vertebral body. The needle was pulled back 1 mm. Lateral view of the spine was obtained and the needle tip was confirmed to be dorsal to the ventral aspect of the vertebral body. After negative attempted aspiration, while monitoring the patient, 1.0 mL of Isovue-200 was injected with fluoroscopic guidance. If intravascular spread was identified or spread was not noted along the longus colli muscle belly traveling from inferior-lateral to superior-medial and following the lateral border of the superior oblique portion of the longus colli, the needle tip was repositioned. Upon obtaining appropriate contrast spread, 0.5 mL of 0.5% bupivacaine with 5 μg/mL clonidine was injected. After observing the patient for 30 seconds, an additional 2.5 mL of 0.5% bupivacaine with 5 μg/mL clonidine was slowly injected over 1.5 minutes for a total injection volume of 3 mL to achieve blockade of the superior cervical ganglion. The needle was withdrawn, and an adhesive bandage was placed on the injection site.

The patient was then returned to the recovery room, placed in a supine position, and monitored for an additional 60 minutes before discharge. Specific precautions were given, such as the presence of a temporary Horner's syndrome and the possibility of a temporary dysphonia or dysphagia. Both before and after the procedure, the patient was informed as to possible life-threatening procedure-related adverse events and informed to urgently present to the emergency room if experiencing respiratory or cardiac issues. All patients tolerated the procedure well.

Data Collection

The primary outcome measurement for this study was the PCL-4 score, either the military (PCL-M) or civilian (PCL-C) version. Clinically meaningful change with regard to PTSD symptom improvement has been defined as a reduction of 10 on the PCL scale (14). The PCL has been validated for the screening, diagnosis, and determination of treatment response for PTSD patients (13-15). PCL-4 has been shown to have strong internal consistency, test-retest reliability, and validity similar to the Clinician Administered PTSD Scale (CAPS). Previous studies have demonstrated a strong correlation (0.929) of PCL with the CAPS diagnosis scale (16).

Data Analysis

Statistical analysis was performed by Elaine Eisenbeisz of Omega Statistics. SPSS version 22.0 (IBM Corp., Armonk, NY) and Graphpad QuickCalcs software were used for all descriptive and statistical analyses, consisting of analysis of variance (ANOVA) as well as one-sample and independent samples t-tests. Inferential tests were set at a 95% level of confidence ($P < 0.05$). This study was exploratory in nature and therefore, adjustments for multiplicity were not implemented.

Results

A total of 484 patients were initially collected for chart review and data analysis. One hundred and fifty-seven patients were excluded from the study due to missing data points, primarily due to missing pre- and/or post-PCL scores. Thus, a total of 327 records, over the time period of December 2016 through February 2020, were included for final analysis. All 327 patients included in the study were treatment naïve to CSB. Among them, 244 patients received the dual block of SGB followed by SCGB. The patient population consisted of 182 men, including military men (n = 97) and civilian men (n = 85), as well as 145 women, including military women (n = 13) and civilian women (n = 132). We identified 21 types of self-reported trauma.

Patients

Group comparisons between genders for the mean change in PCL scores from pre- to post-intervention was performed with an independent samples t-test. Although the women had a slightly greater mean change in PCL scores (M = -29.20, SD = 16.26), the results were not statistically significant when compared to men (M = -28.59, SD = 18.74; $P = 0.756$). Further comparisons of variables were performed on men and women separately.

Men who had a military background had a significantly greater change in PCL score (M = -31.83, SD = 17.76) than did men who did not have a military background (M = -24.89, SD = 19.26, $P = 0.012$) (Fig. 1A). No statistically significant findings in men were noted between age groups, history of suicide attempts, or use of psychiatric medication (Table 1).

Likewise, women who had a military background had a significantly greater change in PCL score (M = -39.15, SD = 18.02) than did women who did not have a military background (M = -28.23, SD = 15.81, $P = 0.020$) (Fig. 1B). No statistically significant findings in women were noted between age groups, history of suicide attempts, or use of psychiatric medication (Table 2) .

When considering the data set as a whole, changes in PCL scores from pre- to post-intervention showed a drop greater than 10 points in 81% of patients (265/327), greater than 15 points in 74.9% of patients (245/327), and greater than 20 points in 69.7% of patients (228/327).

Trauma Type Categories

All trauma types reached statistical significance for the male patients analyzed with one-sample t-tests for a difference from zero in the change in PCL scores from pre- to post-test, with the exception of parental issues/stress (n = 2, $P = 0.187$), domestic violence (n = 3, $P = 0.052$), and bullying/hazing (n = 5, $P = 0.427$) (Table 3).

For women, all trauma types reached statistical significance for the female patients with one-sample t-tests for a difference from zero in the change in PCL scores from pre- to post-test, with the exception of injury/death of a loved one (n = 19, *P* = 0.063), work stress/fear (n = 2, *P* = 0.138), parental issues stress (n = 6, *P* = 0.127), and bullying/hazing (n = 2, *P* = 0.866) (Table 4). Of note, the PCL score for the bully/hazing trauma type increased from pre- to post-intervention for women.

Comparative tests were not performed on the outcome of PCL score change between the trauma types because a patient could have been classified into more than one trauma type. Thus, the independence of groups was not assured.

Safety and Patients' Tolerability

There were no significant adverse events in the 327 patients who received CSB requiring admission to a hospital or who received interventions. One patient became significantly hypertensive, which resolved 3 after hours following careful observation. Some patients reported temporary hoarseness, and difficulty swallowing, likely due to local anesthetic spread leading to recurrent laryngeal nerve block. All symptoms spontaneously resolved within 12 hours from injection.

Discussion

The purpose of this retrospective analysis was to determine the therapeutic benefit of CSB, in this case either SGB alone or with SCGB, on symptoms of PTSD in various cohorts of patients stratified by gender, age, history of military background, history of suicide attempts, use of psychiatric medication, and types of inciting trauma. Although treatment with SGB alone has been shown to improve PTSD symptoms, we show that targeting a second cervical ganglion in patients who do not respond to SGB alone remains a safe and effective treatment option. Additionally, while previ-

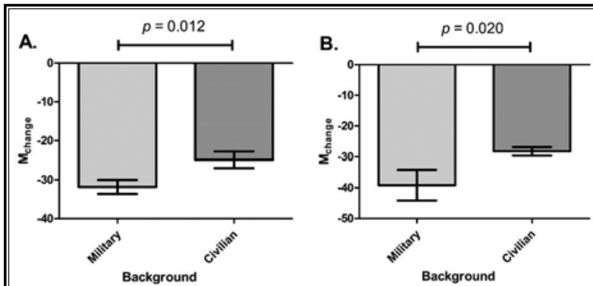

Fig. 1. *Mean change in PCL score from pre- to post-intervention (Mchange) in (A) men and (B) women, based on military or civilian background.*

Table 1. *Measures of central tendency and variability for the change in PCL score from pre- to post-intervention for the subgroup of men (n = 182).*

Variable/Group	n	M_{change}	$SD_{Mchange}$	$SE_{Mchange}$	Min	Max	95% CI LCL	95% CI UCL	$M_{change} = 0$ *p*	*P* value
All records	182	-28.59	18.74	1.39	-68.00	29.75	-31.33	-25.85	< 0.0005	
Age Group										0.644
0-19 years	4	-16.00	18.89	9.44	-43.00	0.00	-46.05	14.05	0.189	
20-39 years	73	-28.39	19.99	2.34	-65.00	29.75	-33.05	-23.72	< 0.0005	
40-59 years	75	-28.40	17.92	2.07	-68.00	6.00	-32.52	-24.28	< 0.0005	
Over 60 years	12	-28.13	18.09	5.22	-57.00	2.00	-39.62	-16.63	< 0.0005	
Military Background										0.012
Military	97	-31.83	17.76	1.80	-68.00	7.00	-35.41	-28.26	< 0.0005	
Civilian	85	-24.89	19.26	2.09	-65.00	29.75	-29.04	-20.74	< 0.0005	
Suicide Attempt										0.892
No	153	-28.67	18.79	1.52	-68.00	29.75	-31.67	-25.67	< 0.0005	
Yes	29	-28.16	18.85	3.50	-61.00	2.00	-35.33	-20.98	< 0.0005	
Use of PTSD Rx										0.479
No	75	-29.24	19.45	2.25	-68.00	29.75	-33.71	-24.76	< 0.0005	
Yes	107	-27.77	18.56	1.79	-65.00	7.00	-31.20	-24.21	< 0.0005	

Abbreviations: n = group size; M_{change}= Mean change in PCL scores; $SD_{Mchange}$= Standard deviation for M_{change}; $SE_{Mchange}$ = Standard error for M_{change}; 95% CI = 95% Confidence Level for M_{change}; LCL = Lower confidence limit; UCL = Upper confidence limit; M_{change} = 0 *P*= *P* value for one sample t-test comparing M_{change} to 0.

Table 2. *Measures of central tendency and variability for the change in PCL score from pre- to post-intervention for the subgroup of women (n = 145).*

Variable/Group	n	M_{change}	$SD_{Mchange}$	$SE_{Mchange}$	Min	Max	95% CI		M_{change} = 0	*P* value
							LCL	UCL	*P*	
All records	145	-29.20	16.26	1.35	-62.00	17.00	-31.87	-26.54	< 0.0005	
Age Group										0.807
0-19 years	7	-23.29	16.06	6.07	-45.00	-1.00	-38.14	-8.43	0.007	
20-39 years	43	-29.63	16.04	2.45	-56.00	17.00	-34.57	-24.70	< 0.0005	
40-59 years	71	-28.51	16.70	1.98	-62.00	1.00	-32.47	-24.56	< 0.0005	
Over 60 years	13	-27.77	12.01	3.33	-44.00	-6.00	35.03	-20.51	< 0.0005	
Military Background										0.020
Military	13	-39.15	18.02	5.00	-59.00	-9.00	-50.04	-28.27	< 0.0005	
Civilian	132	-28.23	15.81	1.38	-62.00	17.00	-30.95	25.50	< 0.0005	
Suicide Attempt										0.192
No	112	-28.25	16.37	1.55	-59.00	17.00	-31.31	25.18	< 0.0005	
Yes	33	-32.45	15.69	2.73	-62.00	-7.00	-38.02	-26.89	< 0.0005	
Use of PTSD Rx										0.167
No	48	-26.55	14.82	2.14	-49.00	0.00	-30.85	-22.24	< 0.0005	
Yes	97	-30.52	16.84	1.71	-62.00	17.00	-33.91	-27.13	< 0.0005	

Abbreviations: n = group size; M_{change} = Mean change in PCL scores; $SD_{Mchange}$ = Standard deviation for M_{change}; $SE_{Mchange}$ = Standard error for M_{change}; 95% CI = 95% Confidence Level for M_{change}; LCL = Lower confidence limit; UCL = Upper confidence limit; M_{change} = 0; *P* = *P* value for one sample t-test comparing M_{change} to 0.

ous studies have primarily focused on male patients with military-based trauma, our study demonstrates the widespread applications of CSB to most populations with heterogeneous psychosocial backgrounds. The results of this study show that CSB appears to be equally promising for women as well as men, and has statistically equivalent benefit regardless of psychiatric variables, including a history of suicide attempts or use of psychiatric medications. Additionally, the data suggest that the source of inciting trauma may not impact the potential degree of clinical response a patient may have to CSB for treatment of PTSD, as a clinically significant reduction of PTSD symptoms was noted with most sources of trauma. However, patients with military backgrounds demonstrated greater reductions in absolute PCL score post-procedure, likely attributed to initial higher baseline PCL scores pre-procedure. This may indicate an association between greater severity of disease and a more dramatic improvement following CSB. It is also worth noting that differences between PCL-C and PCL-M may affect their ability to detect reductions in PTSD severity. Yet, specific reasons for this difference may require further study.

Such findings suggest that the current model for treating psychological trauma may benefit from a paradigm shift by considering that psychological trauma may produce biological changes to the central nervous system, such as over-activation of the amygdala (17). Our results suggest that these physiological changes may be reversible following CSB and help resolve PTSD-related symptoms, currently recognized as psychological. In fact, deactivation of the amygdala following SGB has been previously demonstrated (18).

While the exact physiological mechanism of CSB's effect on PTSD symptoms remains unknown, a previous evidence-based hypothesis has been published by our corresponding author (9). It takes into account the upregulation of the sympathetic network following trauma, shown by the increase of cerebrospinal fluid concentration of norepinephrine (NE), and a polysynaptic neurological connection from the stellate ganglion with the amygdala, a structure of the brain previously established to play a critical role in modulating PTSD symptoms (17,18). Blockade of the stellate ganglion likely reverses sympathetic nerve sprouting, which occurs post-trauma (pruning), thereby reducing NE levels and sympathetic supply to the amygdala, leading to a reduction in the sympathetic overactivation noted in PTSD (18,19).

Recently, the efficacy of SGB in the treatment of PTSD has been reported to be synergistically improved

Table 3. *Measures of central tendency and variability of PCL score from pre- to post-interventions according to trauma type, ranked from largest to smallest change, for the subgroup of men (n = 182).*

Trauma Type	n	M_{change}	$SD_{Mchange}$	$SE_{Mchange}$	Min	Max	95% CI		$M_{change} = 0$
							LCL	UCL	*P*
Divorce/Family stress	4	-45.75	8.54	4.27	-51.00	-33.00	-59.34	-32.16	0.001
Parental issues stress	2	-43.00	18.38	13.00	-56.00	-30.00	-208.18	122.18	0.187
Combat warfare	75	-32.27	17.81	2.06	-68.00	4.00	-36.36	-28.17	< 0.0005
Domestic violence	3	-31.00	12.77	7.37	-42.00	-17.00	-62.72	0.72	0.052
Other trauma	27	-29.52	18.89	3.64	-58.00	0.00	-36.99	-22.05	< 0.0005
Physical violence/threat	9	-28.67	15.41	5.14	-43.00	0.00	-40.51	-16.82	0.001
Childhood physical abuse	16	-28.06	19.59	4.90	-60.00	-2.00	-38.50	-17.62	< 0.0005
Sexual assault abuse	7	-26.71	20.37	7.70	-43.00	6.00	-45.55	-7.88	0.013
Head injury	6	-26.58	10.72	4.37	-44.00	-14.00	-37.83	-15.34	0.002
Car or other accident	4	-25.50	15.84	7.92	-35.00	-2.00	-50.71	-0.29	0.044
Witness death/Traumatic event	8	-24.75	10.14	3.58	-44.00	-10.00	-33.23	-16.27	< 0.0005
Childhood emotional abuse	13	-24.12	21.60	5.99	-60.00	0.00	-37.17	-11.06	0.002
At least 1 childhood trauma	26	-24.02	19.77	3.88	-60.00	2.00	-32.00	-16.03	< 0.0005
Injury/death of loved one	13	-22.31	16.77	4.65	-56.00	1.00	-32.44	12.17	< 0.0005
Work stress fear	6	-21.83	14.73	6.01	-40.00	0.00	-37.29	-6.38	0.015
Health issues	7	-21.43	10.85	4.10	-35.00	-8.00	-31.46	-11.40	0.002
Don't know	11	-21.18	18.35	5.53	-58.00	7.00	-33.51	-8.85	0.003
Childhood sexual abuse	9	-17.00	17.41	5.80	-41.00	2.00	-30.38	-3.62	0.019
Bullying/Hazing	5	-13.85	35.04	15.67	-56.00	29.75	-57.36	29.66	0.427

Abbreviations: n = group size; M_{change} = Mean change in PCL scores; $SD_{Mchange}$= Standard deviation for M_{change}; $SE_{Mchange}$ = Standard error for M_{change}; 95% CI = 95% Confidence Level for M_{change}; LCL = Lower confidence limit; UCL = Upper confidence limit; M_{change} = 0 *P* = *P* value for one sample t-test comparing M_{change} to 0.

by targeting additional cervical sympathetic ganglia, particularly in patients who do not respond to SGB alone (11,20). The theoretical basis for the use of SGB followed by SCGB in the treatment of SGB-resistant PTSD lies in the fact that sympathetic efferent fibers supplying the brain all have a common origin from the spinal cord, primarily T-2 to T-4, with no efferent sympathetic fibers exiting the cervical spinal cord. Many of the efferent sympathetic fibers from the thoracic ganglia pass through the stellate ganglion and ascend to the superior cervical ganglion (21). Typically, sympathetic fibers follow the arterial supply. As per Moore et al, the stellate ganglion sympathetic fibers follow the vertebral artery to the brain, as opposed to the superior cervical sympathetic ganglion, which follows the internal carotid artery to the brain (22). Both of those arteries supply different parts of the brain, both separately and jointly. Thus, it follows that dual blockade of the sympathetic system would produce a more intense "rebooting" of the brain and thereby lead to increased pruning and clinically greater reduction of PTSD symptomatology (19).

Finally, the current analysis suggests that the advancement of psychological trauma care may require a paradigm shift based on the understanding that trauma is a biological injury with associated psychological changes. This biological injury can be targeted with CSB and marked gains may be obtained by further engagement with skilled talk-therapy providers. The combination of medical innovation with best practice talk-therapy treatment may lead to a new standard of care for individuals suffering psychological trauma. Testing this model may enlarge our current understanding of the trauma recovery process and propel innovation in the field of psychological trauma care.

Limitations

This is a retrospective cohort study. As such, limitations stem from the diverse patient selection, the limited scope of observation given the exclusive focus on pre- and post-PCL data, and the self-reported nature of the patient-provided data. Further, this report was limited due to inconsistent and short follow-up post-CSB, thus hindering the ability of this study to assess the du-

Table 4. *Measures of central tendency and variability of PCL score from pre- to post-interventions according to trauma type, ranked from largest to smallest change, for the subgroup of women (n = 145).*

Trauma Type	n	M_{change}	$SD_{Mchange}$	$SE_{Mchange}$	Min	Max	95% CI		$M_{change} = 0$
							LCL	UCL	*P*
Physical violence/threat	13	-33.91	13.31	3.69	-53.00	-12.00	-41.95	-25.87	< 0.0005
Childhood physical abuse	23	-33.64	16.13	3.36	-55.00	0.00	-40.62	-26.66	< 0.0005
Don't know	3	-32.67	7.51	4.33	-40.00	25.00	-51.31	-14.02	0.017
Sexual assault abuse	40	-30.96	16.25	2.57	-60.00	0.00	-36.15	-25.76	< 0.0005
Childhood sexual abuse	23	-30.80	15.94	3.32	-55.00	0.00	-37.70	-23.91	< 0.0005
Health issues	12	-30.17	14.16	4.09	-58.00	-10.00	-39.16	-21.17	< 0.0005
At least 1 childhood trauma	49	-29.79	14.77	2.11	-55.00	0.00	-34.03	-25.55	0.022
Divorce/Family stress	5	-29.20	17.85	7.98	-46.00	0.00	-51.37	-7.03	0.008
Car or other accident	7	-28.43	19.05	7.20	-52.00	-8.00	-46.05	-10.81	< 0.0005
Domestic violence	27	-28.36	15.53	2.98	-57.00	-4.00	-34.51	-22.22	< 0.0005
Childhood emotional abuse	27	-26.66	15.24	2.93	-55.00	0.00	-32.68	-20.63	< 0.0005
Injury/death of loved one	19	-26.26	19.03	4.37	-62.00	1.00	-35.44	-17.09	0.063
Work stress fear	2	-25.50	3.54	2.50	-28.00	-23.00	-57.27	6.27	0.138
Combat warfare	3	-25.33	18.23	10.53	-45.00	-9.00	-70.62	19.95	0.008
Parental issues stress	6	-25.33	14.43	5.89	-49.00	-7.00	-40.48	-10.19	0.127
Head injury	4	-23.50	22.40	11.20	-57.00	-10.00	-59.14	12.14	< 0.0005
Other trauma	17	-23.48	15.97	3.87	-52.00	0.00	-31.69	-15.27	< 0.0005
Witness death/Traumatic event	8	-22.80	20.12	6.36	-53.00	0.00	-37.19	-8.41	0.009
Bullying/Hazing	2	3.00	19.80	14.00	-11.00	17.00	-174.89	180.89	0.866

Abbreviations: n = group size; M_{change} = Mean change in PCL scores; $SD_{Mchange}$= Standard deviation for M_{change}; $SE_{Mchange}$ = Standard error for M_{change}; 95% CI = 95% Confidence Level for M_{change}; LCL = Lower confidence limit; UCL = Upper confidence limit; $M_{change} = 0$ *P* = *P* value for one sample t-test comparing M_{change} to 0.

ration of efficacy of CSB past the initial post-procedure assessment. In addition, all treatments provided in the current analysis were provided by the same physician, which has both the advantage of consistency in practice and technique while also limiting the scope of conclusions to CSB provided for treatments of PTSD by other providers. Thus, generalizations from this study to a particular provider and cohort should be done with care.

Conclusion

Results of our retrospective cohort study suggest that regardless of the mechanism of trauma and multiple other factors presented, CSB appears to hold promise for both women and men, with both military and non-military traumas. This large data set of 327 patients, each treated in our clinic, adds to other studies suggesting that persistent over-activation of the sympathetic system can be reversed in a large percentage of patients by performing CSB. Much is still unknown, and studies of CSB as a treatment for PTSD utilizing functional brain imaging are needed. Yet, CSB seems to offer much-needed hope for patients suffering from debilitating symptoms of PTSD.

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