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Observation of the Therapeutic Effect of Ultrasound-Guided Stellate Ganglion Block on Sleep Disorders in Patients Recovered from COVID-19

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Abstract

Objective: This study aimed to observe the therapeutic effect of ultrasound-guided stellate ganglion block (U-SCG) on sleep disorders in patients who have recovered from COVID-19. **Methods**: A retrospective analysis was conducted on 39 patients with post-COVID-19 sleep disorders treated at the Department of Anesthesiology, Fourth Affiliated Hospital of Nanjing Medical University. The treatment involved a 7-day course of U-SCG, and the improvement in sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI). Evaluation time points were set at 1 month and 3 months after the completion of the treatment. **Results**: Following a 7-day course of U-SGB treatment, the total PSQI scores for all 39 patients were significantly lower than those recorded before treatment, both at 1 month and 3 months post-treatment. No severe complications occurred during the treatment process. **Conclusion**: Ultrasound-guided stellate ganglion block (U-SCG) demonstrated a significant improvement in the sleep quality of patients recovering from COVID-19, with a high level of safety. These findings suggest its potential for widespread clinical application.

Subject Areas

Anaesthesiology and Pain Management, Immunology

Keywords

Ultrasound-Guided Stellate Ganglion Block (U-SCG), Post-COVID-19 Sleep Disorders, Pittsburgh Sleep Quality Index (PSQI)

1. Introduction

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has had a significant global impact due to its sudden onset and high infectivity. A meta-analysis indicated that coronavirus infections could lead to symptoms such as delirium, anxiety, depression, manic symptoms, poor memory, and insomnia [1]. In a survey on post-COVID-19 mental and sleep disorders, sleep disturbances were found to be highly prevalent among patients following COVID-19 infection, likely associated with the stress response after COVID-19 infection and disturbances in circadian rhythms [2]. Prolonged insomnia poses a serious threat to both physical and mental health, indirectly impacting work and life quality. Stellate ganglion block can modulate the autonomic nervous system, endocrine system, and immune system [3]. This study utilized ultrasound-guided stellate ganglion block (U-SGB) therapy to treat 39 patients with sleep disorders following COVID-19 infection in our hospital. A single course of treatment was administered to improve their sleep quality, yielding promising results. The findings are presented below.

2. Research Subjects and Methods

General Information: A retrospective analysis was conducted on patients with post-COVID-19 sleep disorders treated at our anesthesia outpatient clinic from December 2022 to April 2023. Inclusion criteria comprised individuals who had contracted COVID-19 pneumonia a few months earlier, tested positive for nucleic acid, clinically classified as having mild to moderate infections according to the "Diagnosis and Treatment Plan for Novel Coronavirus Pneumonia" (6th edition), complained of sleep disorders, had complete follow-up data after treatment, and had not been reinfected with the novel coronavirus during a telephone follow-up three months after treatment completion. Eventually, 39 patients meeting these criteria were selected, including 30 females and 9 males. The average age was (43.84 ± 12.15) years, ranging from 20 to 66 years old.

Treatment Regimen: All patients received psychological intervention to ensure their emotional well-being and establish confidence. During treatment, patients were advised to abstain from alcohol and smoking, maintain regular routines, and avoid consuming stimulating foods. Ultrasound-guided stellate ganglion block (U-SGB) therapy was administered. The procedure involved positioning the patient in a supine position with a slight extension of the neck. Routine disinfection of the neck skin was performed. Under the guidance of a color Doppler ultrasound, the ultrasound probe covered with sterile gloves was placed at the C6 level to identify the esophagus, trachea, thyroid gland, internal jugular vein, and the neck muscle covering the anterior longitudinal ligament, C6 vertebral transverse process, and C6 nerve root. The probe was gently pressed between the trachea and the carotid artery to ensure the lateral displacement of the carotid artery. The probe was then continuously approached to the neck muscle under ultrasound guidance. Using ultrasound guidance, a puncture needle was directed through the lateral aspect of the trachea into the neck muscle, piercing the anterior longitudinal ligament. After confirming no blood return upon withdrawal, 4 ml of 1% lidocaine solution was injected. Following injection completion, patients were asked to assume a sitting position to facilitate the diffusion of the solution to the stellate ganglion. This procedure was performed once daily, alternating between the left and right sides, constituting a seven-day treatment course. (See Figure 1)

Evaluation Index: Trained outpatient nurses utilized the Pittsburgh Sleep Quality Index (PSQI) to assess the sleep quality of patients. Evaluation time points included before ultrasound-guided stellate ganglion block (U-SCG) treatment, one month after the completion of a treatment course, and three months post-treatment. Seven-factor scores were obtained based on the questions in the index, and the PSQI total score was calculated. Scores ranging from 0 - 5 were considered excellent, 6 - 10 good, 11 - 15 fair, and 16 - 20 poor.

Statistical Analysis: Statistical analysis for the comparison before and after treatment was conducted using SPSS 18.0 software, and one-way repeated measures analysis of variance (ANOVA) was employed to validate the measurement data.

3. Results

Table 1 presents the comparison of various PSQI scores before and after treatment for all patients. The results of one-way repeated measures ANOVA demonstrated a significant difference in PSQI total scores before ultrasound-guided stellate ganglion block treatment, one month after completing the course, and three months post-treatment ($F = 225.49$, $P < 0.001$). Bonferroni multiple mean comparison results indicated that the PSQI total score one month after treatment was significantly lower than before treatment ($P < 0.001$), and the PSQI total score three months after treatment was also significantly lower than the pre-treatment level ($P = 0.003$). Note: PSQI refers to the Pittsburgh Sleep Quality Index. (See Table 2)

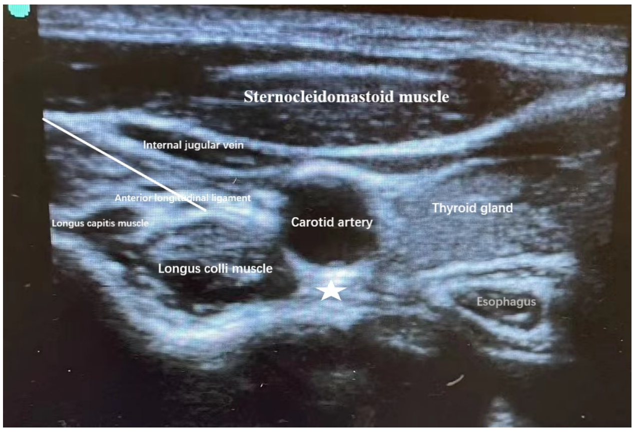

Figure 1. The positions marked with white stars indicate the location of the cervical sympathetic chain.

Table 1. Mean ± Standard deviation of PSQI values before treatment, 1 month after treatment, and 3 months after treatment.

Time	Cases	Sleep Quality	Sleep Onset Time	Sleep Duration	Sleep Efficiency	Sleep Disorders	Hypnotic Medication	Daytime Functioning
Before Treatment	39	2.35 ± 0.58	2.69 ± 0.57	2.0 ± 0.95	2.18 ± 1.10	1.51 ± 0.60	2.28 ± 1.23	2.28 ± 0.10
1 Month After Treatment	39	0.82 ± 0.39	1.46 ± 0.50	0.87 ± 0.66	1.18 ± 0.91	1.0 ± 0.0	1.31 ± 1.03	1.12 ± 0.52
3 Months After Treatment	39	0.87 ± 0.57	1.61 ± 0.49	1.33 ± 0.62	1.64 ± 0.90	1 ± 0.0	1.26 ± 0.97	1.08 ± 0.42

Table 2. Comparison of total PSQI scores in patients before treatment, 1 month after treatment, and 3 months after treatment.

Time	Cases	PSQI (x ± S)	Analysis of Variance FP		Multiple mean comparison
Before Treatment (T0)	39	15.28 ± 0.56	F=225.49	P < 0.001	T0 > T2 > T1
1 Month After Treatment (T1)	39	7.77 ± 0.37			
3 Months After Treatment (T2)	39	8.80 ± 0.42			

4. Discussion

COVID-19, the novel coronavirus disease, stands as the most significant infectious disease of the 21st century. Beyond affecting the terminal bronchioles and respiratory bronchioles upon infection, the virus can also impact organs like the liver, kidneys, and digestive tract, potentially leading to multi-organ failure [4]. Post-recovery from COVID-19, many patients tend to experience sleep and psychological disorders. A study involving 186 COVID-19 patients within six months of infection found that only 8.8% remained free of mental symptoms, while 91.2% exhibited various psychological manifestations: poor sleep quality (64.8%), post-traumatic stress disorder (28.6%), somatization (41.8%), obsessive-compulsive disorder (19.8%), depression (11.5%), anxiety (28%), terror-anxiety (24.2%), and psychosis (17.6%) [5]. A study in China, involving a six-month follow-up of 1733 patients post-COVID-19 recovery, reported that 26% of participants experienced sleep difficulties [6]. The reasons behind these issues might stem from factors such as unstable blood circulation, neuronal damage, hypoxic injury, and immune-related damage caused by the viral infection [7]. Furthermore, due to its novelty, limited understanding of COVID-19 leads to heightened tension, fear, and anxiety among patients, exacerbated by the psychological stress resulting from changes in medical and living environments during isolation, which could also contribute to decreased sleep quality among COVID-19 patients.

Long-term insomnia sufferers may exhibit adverse events such as fatigue, reduced concentration, memory decline, and decreased work efficiency, impacting their regular work and life. Additionally, insomnia is associated with several clinical conditions like irritable bowel syndrome, fibromyalgia, asthma, and gastroesophageal reflux disease. If left untreated, it may escalate the risk of hypertension and coronary heart disease. Presently, pharmaceutical intervention remains the most prevalent approach for managing insomnia, utilizing drugs such as benzodiazepines, antidepressants, antihistamines, and melatonin receptor agonists. However, these medications, mostly psychiatric in nature, can severely impact the physiological structure of sleep, induce drug toxicity, and potentially lead to withdrawal reactions and addiction [8]. Currently, stellate ganglion block (SGB) is gaining increased clinical attention for improving sleep quality in insomnia patients.

The stellate ganglion, formed by the fusion of the sympathetic ganglia of C7, C8, and T1, also known as the cervicothoracic sympathetic ganglia, is targeted in the stellate ganglion block (SGB). This involves injecting a local anesthetic into the loose connective tissue near the stellate ganglion, temporarily and reversibly blocking the sympathetic nerves contained within, thereby modulating the autonomic nervous system. The primary mechanisms through which it improves sleep quality possibly include regulating melatonin secretion, suppressing stress responses and inflammation, adjusting cortical brain function, and regulating visceral activity and emotions, thus affecting the circulatory and endocrine systems [9]. The stellate ganglion is situated anterior to the transverse processes of C7 and T1 vertebrae, posterior to the subclavian and vertebral arteries, on the medial side of the scalene muscle group, above the lung apex, external to the longus colli muscle, surrounded by structures like the vertebral artery, subclavian artery, carotid artery, internal jugular vein, vagus nerve, and brachial plexus nerves. Due to its specific anatomical location, potential major complications of SGB might include local anesthetic toxicity, hematoma, pneumothorax, and inadvertent injection into the subarachnoid space. Ultrasound-guided stellate ganglion block not only enhances precision, ensuring efficacy and minimizing local anesthetic usage but also avoids damaging vital anatomical structures, making this technique safer and more effective for clinical use [10]. In this study, the SGB treatment regimen administered to 39 patients for seven days was conducted under ultrasound guidance, once daily, on alternating sides, using a 0.5 mm diameter needle. The entire needle insertion process was visualized under ultrasound guidance until the target site was reached, and after blood-free aspiration, 4 ml of 1% lidocaine was injected, with every 2 ml followed by aspiration, and patient's vital signs were closely monitored post-block. None of the patients experienced any of the above-mentioned complications.

The majority of patients treated in this study were female, consistent with numerous previous studies where female gender stood as an independent predictive factor for anxiety, fear, paranoia, and mental issues, likely due to biological factors and hormonal levels, making females more prone to these conditions [11]. With the use of a 0.5 mm diameter ultrafine needle and operation under ultrasound guidance, patients hardly sensed any pain from the puncture. Post-treatment, there were no significant complications or discomfort reported, resulting in high compliance among outpatient patients. Most patients reported significant improvements in sleep conditions after the second treatment, feeling notably better in their mental state the morning after treatment compared to before. After the completion of the treatment course, the sleep conditions of the 39 patients showed considerable improvement at one and three months, resulting in high satisfaction with the treatment. One middle-aged female patient, suffering from redness and itching in both eyelids after a COVID-19 infection, diagnosed with neurodermatitis by dermatology, showed significant improvement in redness and almost disappearance of itching symptoms after the fourth stellate ganglion block. Another female patient, experiencing numbness in the scalp at the crown before treatment, showed significant improvement after the second stellate ganglion block. A chronic allergic rhinitis patient, frequently experiencing sneezing and a runny nose upon waking up, showed significant improvement in sneezing and runny nose symptoms after the fourth treatment. This improvement could be attributed to the significant increase in blood flow to the head and face after the stellate ganglion block [12], causing local vasodilation, smooth blood circulation, and improving local nutrient supply, thereby impacting local inflammatory responses for the better.

Due to post-COVID-19 sleep disorders being a newly emerging condition, there is limited public understanding of it. The lack of specificity in the choice of medical departments during initial consultations, often not favoring anesthesia or pain clinics for treatment, has resulted in a limited sample size in this study. Additionally, no control group has been established, placing certain restrictions on the interpretation of results and general inferences drawn. In future research, increasing the sample size and implementing a control group will be instrumental in accurately assessing the efficacy of stellate ganglion blockade, while also eliminating potential confounding factors. Another limitation lies in the current absence of long-term follow-up data on treatment efficacy.

Subsequent efforts will focus on increasing public awareness and outreach to admit more patients with such conditions, thereby augmenting the sample size. A multi-center, randomized, controlled study will be conducted to provide a higher level of evidence for the diagnosis and treatment of patients in this category.

In conclusion, ultrasound-guided stellate ganglion block demonstrates precise efficacy for post-COVID-19 sleep disorders. It represents a safe and side-effect-free treatment modality, offering a directional approach to treatment strategies in these patients. However, continuous, in-depth research on a larger scale and with comprehensive methodologies remains imperative.

Conflicts of Interest

The authors declare no conflicts of interest.

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