STELLATE GANGLION BLOCK FOR LONG COVID

Tabitha Block and Jonathann Kuo

What is Long COVID?

Long COVID, formally known as Post-Acute COVID-19 Syndrome (PACS), is a variety of persistent symptoms that affects patients who have recovered from acute infection by the SARS-CoV-2 virus. Some individuals infected with COVID-19 experience new, returning, or ongoing health problems as a result of the SARS-CoV-2 virus. Most commonly, long COVID symptoms may include dyspnea (difficulty breathing), chronic fatigue, post-exertional malaise, neurocognitive issues such as difficulty concentrating ("brain fog"), persistent cough, chest pain, headache, heart palpitations, joint or muscle pain, diarrhea, insomnia, fever, dizziness, rash, anosmia (loss of smell), or ageusia (distortion of taste) (1).

Who is at risk for developing Long COVID?

Long COVID can affect any individual who has been infected with the SARS-CoV-2 virus, even if their initial symptom presentation was mild or asymptomatic. The majority of patients who experience mild COVID symptoms will recover within 7-10 days, but patients with long COVID will present with various symptoms despite negative SARS-CoV-2 test results. Further, clinical studies show that 87% of recovered individuals who were previously hospitalized due to severe COVID symptoms experience the persistence of at least one symptom for over 60 days (2). As PACS is a new disease, real-world data continues to inform known risk factors, disease incidence, prevention and treatments. Research has identified four quantifiable risk-factors for long COVID at the time of initial COVID-19 diagnosis: 1) type 2 diabetes 2) SARS-CoV-2 RNAemia 3) Epstein-Barr virus viremia 4) specific autoantibodies. Persistence of chronic inflammation, some psychological symptoms like post-traumatic stress may also represent risk factors for developing long COVID (1-3). In addition to individuals who experience severe disease, women and individuals with comorbidities have an increased risk of developing long COVID (1).

What treatments exist for long COVID?

As long COVID is a new disease that can affect many different organ systems, treatment of long COVID can be extremely difficult. Treatment plans for patients with long COVID are typically multi-disciplinary and focus on symptomatic management and treatment of underlying problems (4). Some symptoms, such as cough or fever, can be managed using over-the-counter medications like acetaminophen, but other symptoms, such as brain fog, are difficult to treat with traditional protocols. Despite the use of traditional treatments, many long COVID patients experience debilitating symptoms that can delay their return to work and diminish quality of life. This disease can have a significant social and economic impact on individuals struggling with long COVID symptom management. As such, we can design an individualized treatment plan that targets your long COVID symptoms depending on your specific needs. These treatment

options include Stellate Ganglion Blocks, High-Dose Vitamin C and Glutathione IV Infusions, NAD+ IV Infusions, and Exosome Infusions.

What are stellate ganglions?

Stellate ganglions (SG) are two nerve clusters associated with the activation of the sympathetic nervous system, the branch of the nervous system that is responsible for initiating "fight-or-flight" responses to impending danger and fear. Under normal conditions, sympathetic responses are initiated following appropriate stimuli, such as an increase in sweating and heart rate when running from a bear or while slamming on the brakes to avoid a car accident. The sympathetic nervous system is essential for normal functioning and survival because sympathetic responses liberate extra energy and equip the body to deal with emergency situations. Despite this vital role, overstimulation or dysregulation of the sympathetic nervous system can result in altered SG signaling, leading to dysfunctional or inappropriate physiological responses (also referred to as dysautonomia)(5). Dysautonomia is abnormal activity of involuntary body functions that are regulated by the sympathetic nervous system, such as heart rate, breathing and digestion. The SG carries sympathetic signaling to most organ systems (6). As such, dysautonomia can have detrimental effects on numerous organ systems and can severely impair quality of life.

What are stellate ganglion blocks and what do they treat?

Stellate ganglion blocks (SGBs) are minimally-invasive procedures used to treat various sympathetic nervous system-related disorders, including post-traumatic stress disorder (PTSD), complex regional pain syndrome, ventricular arrhythmia, and, more recently, long COVID. SGBs work by anesthetizing the physical source of sympathetic overdrive, the stellate ganglion nerve cluster (SG). As such, SGBs are able to effectively "reset" the sympathetic nervous system and restore normal biological function, providing rapid and significant symptom relief of even the most severe sympathetic symptoms. SGBs have been widely shown to provide significant and long-lasting relief for patients with PTSD and anxiety who experience sympathetic overdrive symptoms (9-13). SGBs have also been used to treat sympathetic nervous system-related conditions of the head, neck and upper body ranging from cardiac applications to complex regional pain syndrome (14-15). Recent research indicates SGBs can be used to safely and effectively treat symptoms of long COVID (16). By targeting the root cause of dysautonomia in long COVID patients, SGBs may reduce sympathetic hyperactivity and increase cerebral blood flow, providing patients with significant symptom relief.

How is a dysfunctional "fight-or-flight" response related to long COVID?

Sympathetic innervation plays a critical role in the communication between the immune system and the nervous system. As such, dysregulation of this relationship can have serious health consequences (16). In general, feedforward loops (physiological mechanisms that "turn on" a biological pathway) are essential to the body's ability to elicit a rapid immune response to

infection, and feedback loops (physiological mechanisms that "turn off" a biological pathway) may mitigate inflammation levels to prevent inflammation-related damage (16). As such, a balance between sympathetic feedforward and feedback loop signaling is required for normal communication between the immune and nervous systems. Many pathologies disrupt this relationship, promoting sympathetic responses (e.g. elevated cytokine and catecholamine levels) and subsequent inflammation (16). In such pathologies, the vagus nerve, which is responsible for counteracting sympathetic responses, communicates information about pro-inflammatory biomarkers to the brainstem (16). When sympathetic signaling becomes dysregulated, the brainstem integrates this information into behavioral responses (i.e. sickness behaviors), which closely resemble long COVID symptoms (16). Persistent hyperactivation of the sympathetic nervous system can physically alter the connection between the vagus nerve and the brainstem, leading to prolonged dysautonomia (16). Research suggests that continued hyperactivation of the sympathetic nervous system may be at least partially responsible for persistent inflammation-related long COVID symptoms (16). Similarly, prolonged dysautonomia is associated with impaired cerebral blood flow (CBF) in many conditions (e.g., myalgic encephalitis/chronic fatigue syndrome and postural orthostatic tachycardia syndrome) which have clinical presentations that parallel many symptoms of long COVID (16). In general, impaired CBF causes a range of clinical symptoms such as cognitive dysfunction, impaired memory and attention, and reduced visual, gustatory or olfactory function (16).

How do SGBs treat long COVID?

Numerous case reports have demonstrated significant long COVID symptom relief following SGB treatments (16). Anesthetizing the physical source of sympathetic hyperactivation (the SG) via SGB recalibrates the communication network between the immune and nervous systems toward a pre-COVID balance and may effectively reduce long COVID symptoms (16). SGBs may alleviate some neurocognitive symptoms of long COVID by increasing CBF and improving perfusion to brain structures involved in sensory perception or processing (16). Indeed, SGBs have been utilized for the treatment of anosmia for years prior to the COVID-19 pandemic (17). Studies suggest that SGBs may be an effective treatment for dysautonomia-related long COVID symptoms and may provide long-lasting relief of anosmia and dysgeusia (16-17).

One recent case study demonstrating long COVID symptom relief following SGB treatments studied a 42-year old female who presented with long COVID symptoms eight months after the onset of her initial non-critical COVID course. This patient demonstrated significant and lasting symptom relief following two SGB procedures (16). The patient complained of many characteristic long COVID symptoms, including low oxygen saturation, debilitating fatigue, difficulty concentrating, mental fogginess, and diminished and altered sense of smell and taste (anosmia and dysgeusia, respectively). Following the initial SGB, the patient reported immediate ipsilateral improvement in anosmia and dysgeusia and significant improvement in concentration and mental clarity. Immediately after the second SGB, the patient

experienced complete restoration of bilateral olfactory and gustatory function. At both the two week and 60-day follow up, the patient reported no change in these symptom improvements, suggesting SGBs provided significant and lasting relief of three long COVID symptoms: anosmia, dysgeusia and cognitive impairments (16).

Another recent case study reported on a 44-year old female who experienced long COVID symptoms for eight months prior to intervention with bilateral SGBs (16). The patient presented with significant cognitive impairment, dysgeusia, anosmia, stuttering speech, right sided paresis, memory deficits, impaired coordination, debilitating fatigue and inability to concentrate. Immediately following the first SGB procedure, the patient reported a significant improvement in anosmia and dysgeusia. At the two week follow-up, the patient reported a drastic resolution of stuttering speech and 75% improvement in all other long COVID symptoms. At the 60-day follow up, the patient reported durable restoration of olfactory and gustatory function, normal levels of fatigue, restoration of cognitive function, and absence of other long COVID symptoms (16).

The significant improvement of long COVID symptoms following bilateral SGBs described in these case studies indicate an important role of dysautonomia and cerebral blood flow in the pathophysiology of long COVID (16). As such, the application of SGBs in treating long COVID is extremely promising. SGBs have a well-established safety profile and current research suggests that SGBs may effectively reduce dysautonomia and neurocognitive symptoms in at least a subset of long COVID patients.

What happens during a Stellate Ganglion Block?

Stellate Ganglion Blocks are highly effective and safe minimally-invasive outpatient procedures performed under monitored care anesthesia (light sedation). Using X-ray fluoroscopy and ultrasound, your physician will guide a small needle into the neck region that contains the stellate ganglion nerve cluster. Once the needle position is confirmed, a local numbing anesthetic (e.g. bupivacaine or lidocaine) is injected into the stellate ganglion. The entire procedure is performed under ultrasound guidance and takes an average of 20 minutes to complete (13).

Successful SGBs will elicit a physiological response known as “Horner’s Syndrome” (16). Horner’s Syndrome may include facial flushing, ipsilateral ptosis (drooping of the eye on the same side the SGB was performed), meiosis (decreased pupil size), eye redness, reduced sweating and hoarseness (16). This response typically lasts between 4-8 hours and, in the vast majority of cases, will subside by the following day. Your physician will monitor you for evidence of Horner’s Syndrome for about 15 minutes after the completion of your procedure.

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