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Computed Tomography-Guided Short-Term Gasserian Ganglion Stimulation for the Treatment of Idiopathic Trigeminal Neuralgia: A Two-Case Report

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Background: Idiopathic trigeminal neuralgia (ITN) affects approximately 0.16% to 0.3% of the population, with severe complications occurring in 15% of cases. Existing treatments often yield suboptimal outcomes.

Case Report: This study evaluates the clinical efficacy of Gasserian ganglion stimulation (GGS) for ITN management in 2 patients. GGS led to significant symptom improvement in both patients, with one patient achieving complete remission. Compared to conventional therapies, GGS demonstrated a 30% higher efficacy rate, suggesting its potential as a superior therapeutic option. However, limitations include the small sample size and the mandibular nerve branch restriction.

Conclusions: Despite the constraints, our findings are noteworthy, as previous GGS research has primarily focused on treatment failure or nerve damage. Our study suggests GGS could transform ITN management by providing a more effective and less invasive treatment alternative.

Key words: Idiopathic trigeminal neuralgia, Gasserian ganglion stimulation, mandibular nerve, neuromodulation

BACKGROUND

Idiopathic trigeminal neuralgia (ITN) is defined by the absence of diagnostic tests confirming a lesion or underlying disease that could explain the condition. It is characterized by stereotyped, paroxysmal attacks of intense, sharp pain lasting from one second to 2 minutes, affecting one or more divisions of the trigeminal nerve. The stimuli in specific areas can trigger the above pain attacks (1). The risk of developing trigeminal neuralgia increases with age, predominantly affecting individuals aged > 50, with an annual incidence rate of 25.9 per 100,000 among those aged ≥ 80 (2). Genetic factors have been implicated in ITN susceptibility. Studies (3) suggest an association between ITN and genes, such as SLC6A4, which encodes the serotonin transporter and regulates serotonin levels, potentially influencing pain intensity and the efficacy of carbamazepine treatment for ITN.

Current therapeutic options for ITN include tricyclic antidepressants, anticonvulsants, microvascular decompression, Gamma Knife (Elekta, Stockholm, Sweden)lesioning, balloon compression, and pulsed radiofrequency (RF) therapy. The chronic and recurrent nature of ITN necessitates long-term management, imposing a significant economic burden on patients and health care systems.

Clinical studies on Gasserian ganglion stimulation (GGS) for the trigeminal nerve region remain limited. However, the few small-sample clinical studies and case reports suggest the potential utility of GGS in ITN treatment. Herein, we present 2 cases where GGS was used for effective ITN management. Written informed consent was obtained from all participating patients.

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FIRST CASE

A 49-year-old woman presented with ITN affecting the mandibular nerve (V3) branch on the right side of her face. She rated her pain as 6/10 on the Numeric Rating Scale (NRS-11) and reported experiencing frequent, intense attacks (5-6 times per day), each lasting 3-5 seconds. She described the pain as stabbing and knife-like, accompanied by hyperpathia in the V3 distribution. Despite the pain, the patient could eat and wash her face without significant difficulty.

Her medical history included treatment with carbamazepine (0.1 g twice daily) and previous peripheral RF therapy of the V3 branch, which initially reduced her pain to an NRS-11 score of 4/10. However, after 2 weeks, the pain recurred to an NRS-11 score of 6/10. She had a history of diabetes mellitus and was receiving medical therapy for its management. Magnetic resonance imaging of the trigeminal nerve showed no evidence of vascular compression or other abnormalities that could explain the neuralgia.

Intervention

A trial of stimulation targeting the Gasserian ganglion was planned for the right side in August 2023. Upon arrival in the operating room, the patient was positioned supine on the computed tomography (CT) table. Routine electrocardiographic monitoring and oxygen administration were performed. The surgical site was disinfected, and the patient was intubated and placed under general anesthesia. A positioning grid was placed on her face, and a coronal CT scan (1-mm slice thickness) was conducted to locate the foramen ovale. The entry point and percutaneous puncture pathway were planned, with local infiltration anesthesia using 0.33% lidocaine. A needle was advanced toward the foramen ovale under CT guidance. Following confirmation via CT scan (Fig. 1A and 1B), the stimulation electrode was implanted, and its positioning was reevaluated. The electrode was gradually adjusted to the trigeminal ganglion under CT guidance. A trigeminal nerve stimulator lead (model 977D260, 60-cm length, Medtronic, St. Paul, MN) was inserted to ensure optimal placement, with the most distal contact positioned within the foramen ovale and the most proximal contacts within the ambient cistern, following the cisternal segment of the trigeminal nerve. The electrode was fine-tuned to target the Gasserian ganglion, with stimulation parameters set to tonic mode (pulse width: 250 μs, frequency: 40 Hz, constant current amplitude: 3 mA, contact polarity: 1– and 2+). The stimulation effectively covered the original pain area, significantly improving the symptoms. The electrode was secured, and an aseptic dressing was applied. The procedure was uneventful, and the patient remained hemodynamically stable throughout. After resuscitation, the stimulation parameters were utilizing the following ranges: amplitude: 1.0-3.5 mA, pulse width: 250-500 μs, and frequency: 40-100 Hz. No adverse events were reported, such as cerebrospinal fluid leakage or electrode dislocation. The GGS electrode was implanted and kept for 14 days. The electrodes were removed after a local disinfection towel was applied. The patient discontinued medication one week after surgery. At the 6-month follow-up, her NRS-11 score had declined to 1/10, and she no longer experienced stabbing or knife-like pain. She expressed high satisfaction with the GGS therapy.

SECOND CASE

A 67-year-old woman presented with trigeminal neuropathy persisting for 3 months, primarily affecting the V3 branch on the left side of her face. She had previously undergone treatment at several other hospitals, but her symptoms did not improve. The condition resulted in persistent numbness and shock-like pain throughout the day and night, with pain episodes occurring 5-6 times per day without a predictable pattern. Mouth opening or face touching triggered severe pain. She had no significant medical history. Her daily pain score on the NRS-11 was 8/10, and the severity of symptoms significantly impaired her quality of life. Despite treatment with pregabalin, carbamazepine, and neurotrophic agents, no pain relief was achieved. Given the refractory nature of her pain, a trial of GGS was initiated using the same implantation technique as described in the first case.

Intervention

A decision was made to proceed with a GGS trial. Under general anesthesia, a Medtronic peripheral lead (model 977D260, 60-cm length, Medtronic, St. Paul, MN) was placed under CT guidance through the foramen ovale onto the Gasserian ganglion (Fig. 2). The patient tolerated the procedure well and underwent 5 days of stimulation before device removal. The optimal stimulation site was determined based on patient feedback, with maximal paresthesia elicited at the point of pain. The appropriate positioning of the stimulator lead was confirmed via CT imaging and patient response. The

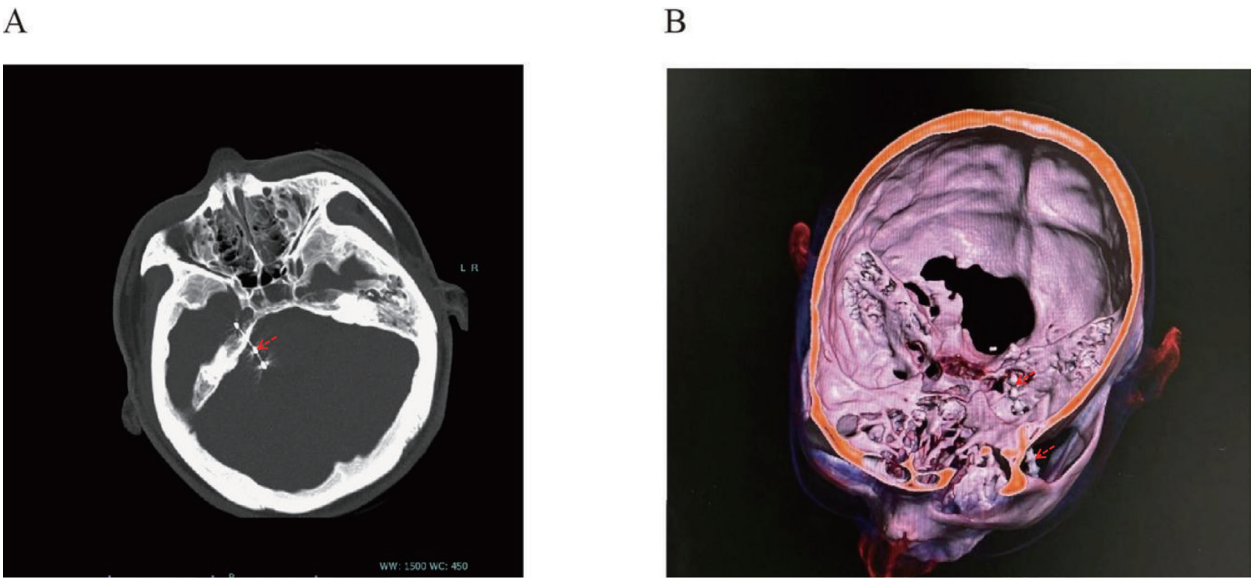

Fig. 1. CT scan showing the stimulation lead positioned at the Gasserian ganglion. (A) Intracranial-connected white beads indicate the SCS-implanted electrode. The red arrow points to the stimulation electrode. (B) Three-dimensional reconstruction of the puncture approach. The white beads in the figure are SCS-implanted electrodes. The red arrow points to the stimulation electrode. CT, computed tomography; SCS, spinal cord stimulator.

lead was tunneled over the left inferior dental nerve and extended to the chest (Fig. 2). After resuscitation, the stimulation parameters were utilizing the following ranges: amplitude: 0.8-3.0 mA, pulse width: 300-500 μs, and frequency: 40-100 Hz. No adverse events were reported, including cerebrospinal fluid leakage or electrode dislocation. Three months postprocedure, her NRS-11 score had decreased to 3/10, with occasional mild pricking sensations at night. Her oral medication regimen was adjusted to ibuprofen and codeine phosphate tablets (0.2 g, twice daily). At the 6-month follow-up, she reported discontinuing oral analgesics, experiencing only mild numbness on the left side of her face.

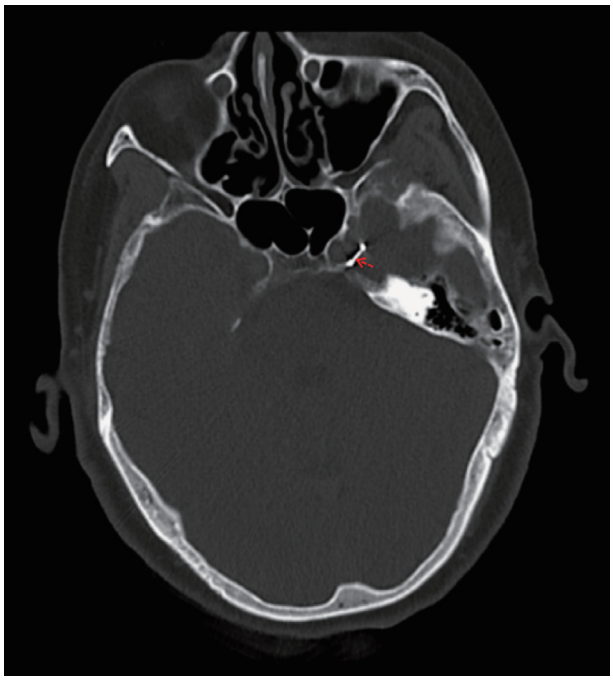

Fig. 2. CT scan confirming the placement of the stimulation lead at the Gasserian ganglion. The dumbbell-shaped highlighter in the intracranial region is the SCS-implanted electrode. The red arrow points to the stimulation electrode. CT, computed tomography; SCS, spinal cord stimulator.

DISCUSSION

The V3 division is most frequently involved in ITN, followed by the maxillary nerve (V2) division (4-8). GGS represents a promising therapeutic approach for refractory trigeminal neuralgia and should be considered prior to invasive interventions (9). A significant advantage of this neuromodulation technique is its absence of pain exacerbation, which aligns with existing literature reports (10). In addition, most studies (11) focus on GGS treatment of the V2 in postherpetic trigeminal neuralgia; whereas, peripheral nerve block and RF therapy are mainly used for the V3 (12). Treatment options for

ITN mainly consist of minimally invasive interventional treatments, including trigeminal nerve branch blocks, RF ablation, Gasserian ganglion RF, chemical neurolysis, and percutaneous microcompression (13). However, these approaches are associated with nerve destruction and a high risk of recurrence.

In this report, although the special device (Medtronic 977D260) was for spinal cord stimulation it has been investigatedoff-label for trigemnal neuralgia. At present, there is no report of cerebrospinal fluid leakage, electrode infection, and other complications, which has good lateral safety and analgesic effect in clinic (14). The Visual Analog Scale score of 2 patients with ITN who received GGS treatment was reduced by > 50%, which is consistent with the results of the current study (15). Studies (16) reported that while patients achieved significant pain relief initially, this decreased to 38% at long-term follow-up, suggesting diminishing efficacy over time. Therefore, further research is needed to determine if this is related to neural repair mechanisms.

Our case report aimed to evaluate the efficacy of GGS for ITN before resorting to more destructive surgical techniques. The primary advantages of this method are its minimally invasive nature, reversibility (nondestructive approach), and lower economic burden compared to other medical or surgical interventions (17). Additionally, it does not exacerbate pain, aligning with the findings of a previous study by Kc E et al (18).

We propose that early stimulation of the Gasserian ganglion during ITN treatment may modify pain progression. A study (9) involving 22 patients who underwent GGS for refractory trigeminal neuropathy concluded that initiating stimulation as early as possible could improve treatment outcomes.

Our study has certain limitations. First, the small sample size may limit the generalizability of the findings. Second, the treatment was restricted to the V3 branch region, confining our conclusions to this specific anatomical area. Future studies should aim to include a larger and more diverse patient population and explore the efficacy of GGS in other regions affected by ITN.

CONCLUSIONS

Our findings represent a significant advancement in the ITN treatment field, highlighting the potential of GGS as a viable therapeutic option for ITN management.

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