

# Neuromodulation of the Stellate Ganglion and Treatment of Intractable Hiccups

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## Introduction

Hiccups are the result of sudden, irregular contractions of the diaphragm followed by closure of the larynx resulting in the pathognomonic ‘hic’ sound. Intractable medically refractory hiccups are defined as hiccups lasting for more than one month. Intractable hiccups (IH), while rare, are more than a benign nuisance. Typically, a self/time-limited condition, IH can be a significant source of patient morbidity and mortality contributing to nutritional deficiencies, insomnia, and psychological distress. Lesions to the reflex arc, including the midbrain, phrenic, vagus and intercostal sympathetic nerves, exacerbated by various neurological, gastrointestinal, and pulmonary pathologies have been implicated in the etiology of IH. IH has also been linked to infectious disease, metabolic/toxic causes, surgery, and psychosomatic illness.

## Pertinent Anatomy: Nerves and Neurological Pathways

- **Phrenic Nerve:** The phrenic nerve, which innervates the diaphragm, is a critical player in the hiccup reflex. Damage or irritation to this nerve, such as from surgery or mechanical compression, is often implicated in prolonged hiccup episodes.
- **Vagus Nerve:** The vagus nerve has sensory and motor functions in the chest, abdomen, and diaphragm. Vagal stimulation mediates the afferent limb of the reflex arc.
- **Brainstem (Medulla):** The brainstem, particularly the medulla oblongata, houses the central pattern generator for hiccups. Lesions or disturbances here, such as in strokes or neurodegenerative diseases, can lead to persistent hiccup episodes.

## Case Report

53-year-old male with a past medical history of right upper extremity sympathetically mediated pain, alcohol use disorder and alcohol withdrawal seizures presents for evaluation and management of IH with no known inciting trigger. He is a nonsmoker. CT head is unremarkable. The patient reports that his hiccups are temporarily mitigated by initiating his gag reflex, alcohol intoxication, and carbonated beverages. Since the onset of IH, the patient has been found unresponsive requiring intubation and ICU level of care due to alcohol abuse.

Medication trials include baclofen and methocarbamol with no relief from IH. The patient was started on chlorpromazine 10 mg every 6 hours as needed with no effect. Status post 4 stellate ganglion blocks of alternating laterality, his symptoms persisted. There was a measurable delta in temperature for 3 out of 4 blocks. The patient reported one continuous twenty-four period symptom free during the course of his treatment. However, the patient’s IH always returned. The patient has received his first in a series of lidocaine infusion with phrenic blockade as the next step in management. The patient remains in treatment at the time of this presentation.

## Emerging Therapies: Trends in Treatment

### ➤ Lidocaine Infusion

Emerging evidence suggests that intravenous lidocaine infusions can effectively treat intractable hiccups, particularly in cases where conventional treatments fail. Lidocaine, a sodium channel blocker, interrupts the electrical impulses involved in the hiccup reflex. By modulating neuronal excitability, lidocaine infusions have shown promising results in reducing the frequency and severity of hiccups. Several case reports and small studies have indicated a positive response to lidocaine infusions in patients with intractable hiccups. The exact mechanism by which lidocaine exerts its anti-hiccup effect remains under investigation.

## Outcomes of Lidocaine Infusion

- Rapid reduction in the frequency of hiccups after administration.
- Prolonged symptom relief, often lasting days to weeks post-infusion.
- Few reported side effects when administered under controlled conditions.

More research is needed to determine optimal dosing protocols and long-term efficacy, but lidocaine infusions remain a valuable tool in the armamentarium against intractable hiccups.

## Medication Management

The pharmacological management of intractable hiccups often involves the use of several drug classes, many of which target the central nervous system. Common medications include:

- **Baclofen:** GABA-B receptor agonist that reduces muscle contractions by inhibiting the central nervous system’s motor activity. Baclofen is particularly effective in patients with neurological causes of hiccups.
- **Gabapentin:** An anticonvulsant that modulates neuronal excitability and has shown efficacy in reducing hiccup frequency.
- **Chlorpromazine:** A dopamine antagonist traditionally used in psychiatric care, Chlorpromazine has been a mainstay in treating intractable hiccups. Sedation tends to limit its long-term use.
- **Metoclopramide:** A dopamine antagonist, used to treat gastrointestinal conditions, has been shown to reduce hiccup frequency by modulating the brain-gut axis via the vagus nerve.

## Interventional Treatments for Refractory Cases

- **Phrenic Nerve Block:** By administering a local anesthetic to the phrenic nerve, clinicians can temporarily halt the reflex responsible for diaphragm contractions. This procedure has shown success in select cases of intractable hiccups, particularly those caused by irritation or damage to the nerve.
- **Vagus Nerve Stimulation:** Although still under investigation, vagus nerve stimulation (VNS) has been suggested as a potential treatment for intractable hiccups via reflex arc disruption.

## Conclusion

Understanding the neurological basis of IH and employing a combination of pharmacological and interventional treatments—such as lidocaine infusions, nerve blockade, and nerve stimulation—can provide relief for patients suffering from this distressing condition. As research continues, particularly into the mechanisms of lidocaine infusions and other emerging therapies, a standardized treatment protocol is likely on the horizon. Collaboration between anesthesiologists, neurologists, gastroenterologists, and psychiatrists remain critical in managing this complex condition and optimizing patient outcomes.