

Vagus Nerve Stimulation: A Case Report

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Abstract

Case Report

The vagus nerve has a dual anti-inflammatory property through its afferent and efferent fibers. We have shown that there is an inverse relationship between vagal tone and plasma TNF α level in patients suffering from ulcerative colitis, and have reported, for the first time, that chronic vagus nerve stimulation has anti-inflammatory property in a rat model of colitis and in a pilot study performed in seven patients with moderate ulcerative colitis. Two of these patients failed to improve after 3 months of vagus nerve stimulation but five were in deep remission (clinical, biological and endoscopic) at 6 months of follow-up and vagal tone was restored. We report the case of a patient with antecedents of ulcerative colitis, who suffers from symptoms of dysautonomia and whose exploration has objectified a vagal deficiency. The vagus nerve stimulation has then allowed a significant regression of his symptoms.

Keywords: Vagal tone and plasma, ulcerative colitis, stimulation symptoms.

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INTRODUCTION

The vagus nerve (VN), the longest cranial nerve in the body, not only regulates the physiology system but also is involved in controlling the cardiovascular, respiratory, immune, and endocrine systems. Similarly, it has been recognized that the VN communicates with the immune system and that it has anti-inflammatory properties. This new case report describes how vagus nerve stimulation can be a new therapeutic option in the treatment of symptoms in dysautonomia secondary to ulcerative colitis

CASE REPORT

A 56-year-old man with no cardio-vascular risk factor and having an ulcerative colitis in his past medical history, consults for functional signs of dysautonomia

- An empty head feeling
- Visual disturbances with blurred vision
- Palpitations
- Weakness in the legs
- Hyperventilation access
- Anxiety
- Chest pain

And in whom the clinical examination finds a hemodynamically and respiratory stable patient.

The cardiovascular examination has shown no abnormality. Para-clinical tests were also normal:

- Electrocardiogram
- Echocardiography
- Coronary angiography
- thyroid hormones
- Blood test

The patient has then undergone an autonomous nervous system exploration in our cardiological department. The results were as follows:

- ECG: Regular sinus rhythm at 65c/mn.
- Deep breathing test: The vagal response was 4%.
- Hand grip test :
 - The vagal response was 4%.
 - The sympathetic peripheral alpha response was 20%.
- **Hyperventilation test**
 - An increased heart rate from 65 BPM to 68 BPM.
 - A decrease in the blood pressure from 130/80 mmhg to 126/86 mmhg.
- **Mental Stress**
 - Central sympathetic alpha response : 16%.
 - Sympathetic beta response: 4%.
- **Orthostatic Testing**
 - Vagal response to 60%.
- **Finally**
 - Central and peripheral alpha sympathetic hyperactivity

- Sympathetic beta and weak device.
- A very weak vagal response.

A vagal stimulation was then indicated. The patient has been put under medical treatment with phenobarbital at low doses.

A regular follow-up of the patient showed a regression of the symptoms and an improvement of the vagal response.

DISCUSSION

The VN has a major impact on the immune system. It has been shown that there is an increased incidence of intestinal inflammation in patients who undergo vagotomy. To now, there is no solid data supporting this assumption. Only one study reports an increased incidence of ulcer disease, septicemia, and mortality in patients who underwent vagotomy following traumatic injury [1].

Although the anti-inflammatory effect of VNS has been well demonstrated in a variety of disease models, the main problem remains the absence, or the very limited vagal innervation of the spleen [2]. The adrenergic innervation of the spleen is more abundant, however, arising from prevertebral sympathetic ganglia, particularly from the celiac ganglion [3,4] vagal efferents have been proposed to activate these adrenergic neurons through interaction with $\alpha 7$ nAChR [4], affecting cytokine production in the spleen via sympathetic fibers running in the splenic nerve.

The anti-inflammatory effects of VNS were evaluated initially in patients with epilepsy; VNS reduced the IL-6 and increased the IL-10 serum levels [5, 6] and diminished the IL-8, TNF, IL-1b, and the IL-6 production [7,8]. Recently, a small open pilot study in patients with rheumatoid arthritis provided the first evidence in humans that VNS has the potential to improve immune-mediated diseases.

The final evidence that activation of the vagal anti-inflammatory pathway is a breakthrough for the clinical management of immune-mediated inflammatory diseases will ultimately have to come from clinical trials evaluating specific nicotinic agonists or electrical, pharmacological, or nutritional activation.

Recent advances in basic and preclinical science reveal that reflex neural circuits inhibit the production of cytokines and inflammation in animal models. One well-characterized cytokine-inhibiting mechanism, termed the "inflammatory reflex," is dependent upon vagus nerve signals that inhibit cytokine production. It previously was unknown whether directly stimulating the inflammatory reflex in humans inhibits TNF production. Together, these results establish that vagus nerve stimulation targeting

the inflammatory reflex modulates TNF production and reduces inflammation in humans [9, 10].

CONCLUSION

It is now clear that vagal nerve is extremely precious not only for the homeostasis of a variety of organ systems but also for the regulation of appetite, mood, and inflammation. The therapeutic potential of stimulating or blocking the VN, either electrically or pharmacologically, is being explored gradually, and the exact pathways and mechanisms of action are becoming understood. Non-invasive devices to stimulate the VN have been developed, although the optimal stimulation parameters and the type of nerve fibers to be stimulated remain to be determined. Clinical studies are ongoing and will hopefully soon confirm that the VN should be handled with great care rather than being cut.

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