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# VAGUS NERVE STIMULATION THERAPY: A NON-PHARMACOLOGICAL THERAPY FOR ADOLESCENTS WITH EPILEPSY

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## ABSTRACT

Vagus nerve stimulation (VNS) is a type of neuromodulation, which is a treatment that alters the activity of nerves. Vagus nerve stimulation involves implanting a device that sends regular, mild pulses of electrical energy to the brainstem through the Vagus nerve in the neck. After reaching the brainstem, the electrical charge is discharged to different areas of the brain to change the way brain cells work. The Vagus nerve is one of 12 pairs of cranial nerves that send electrical signals between the brain and different parts of the neck, head, and torso. They control many of the body's functions.

About one-third of adolescents with epilepsy don't fully respond to anti-seizure drugs. Vagus nerve stimulation may be an option to reduce the frequency of seizures in people who haven't achieved control with medications.

Key Words: Vagus Nerve, Epilepsy, Cranial Nerve, Adolescents

## INTRODUCTION

About one-third of adolescents with epilepsy don't fully respond to anti-seizure drugs. Vagus nerve stimulation may be an option to reduce the frequency of seizures in people who haven't achieved control with medications.

Vagus nerve stimulation (VNS) is a type of neuromodulation, which is a treatment that alters the activity of nerves. Vagus nerve stimulation involves implanting a device that sends regular, mild pulses of electrical energy to the brainstem through the Vagus nerve in the neck. After reaching the brainstem, the electrical charge is discharged to different areas of the brain to change the way brain cells work[1].

Vagus nerve stimulation works like a pacemaker for the heart, VNS is sometimes called a "pacemaker for the brain."

Vagus nerve stimulation may also be helpful for people who haven't responded to intensive depression treatments, such as antidepressant medications, psychological counseling (psychotherapy) , and electroconvulsive therapy (ECT).

**FUNCTIONS OF VAGUS NERVE STIMULATION**

The Vagus nerve is one of 12 pairs of cranial nerves that send electrical signals between the brain and different parts of the neck, head, and torso. They control many of the body's functions.

The Vagus nerve is cranial nerve X (10) and is the longest cranial nerve. We have one Vagus nerve on each side of the body. Both start at the brainstem and pass through the neck to the chest and abdomen.

The Vagus nerve is part of a circuit that links the neck, heart, lungs, and abdomen to the brain.

It works as

As an aid to control seizures, VNS is thought to:

Improve blood flow to critical areas of the brain.

Alter the chaotic electrical pattern that happens during a seizure.

Increase the level of neurotransmitters (specifically nor-epinephrine and serotonin) in the brain that may control seizure development.

As an aid to manage depression, VNS is thought to:

Alter the level of specific neurotransmitters in the brain that play a role in regulating mood.

As an aid for stroke rehabilitation, VNS is thought to:

Stimulate the motor cortex area in the brain, which controls the ability to move arms and hands.[2]

**VAGUS NERVE STIMULATION**

Vagus nerve stimulation involves the use of a device to stimulate the Vagus nerve with electrical impulses. An implantable Vagus nerve stimulator is currently FDA-approved to treat epilepsy and depression.

There's one Vagus nerve on each side of the body, running from the brainstem through the neck to the chest and abdomen.

In conventional Vagus nerve stimulation, a device is surgically implanted under the skin on the chest, and a wire is threaded under the skin connecting the device to the left Vagus nerve. When activated, the device sends electrical

signals along the left Vagus nerve to the brainstem, which then sends signals to certain areas in the brain. The right Vagus nerve isn't used because it's more likely to carry fibers that supply nerves to the heart.

New, noninvasive Vagus nerve stimulation devices, which don't require surgical implantation, have been approved to treat epilepsy, depression, and pain.

**INDICATIONS**

Vagus nerve stimulation therapy will be done the people

Are 4 years old and older

Have focal (partial) epilepsy

Have seizures that aren't well-controlled with medications

Have chronic, hard-to-treat depression (treatment-resistant depression)

Haven't improved after trying four or more medications or electroconvulsive therapy (ECT), or both

Continue standard depression treatments along with Vagus nerve stimulation

Additionally, researchers are studying Vagus nerve stimulation as a potential treatment for a variety of conditions, including headaches, rheumatoid arthritis, inflammatory bowel disease, bipolar disorder, obesity, and Alzheimer's disease.

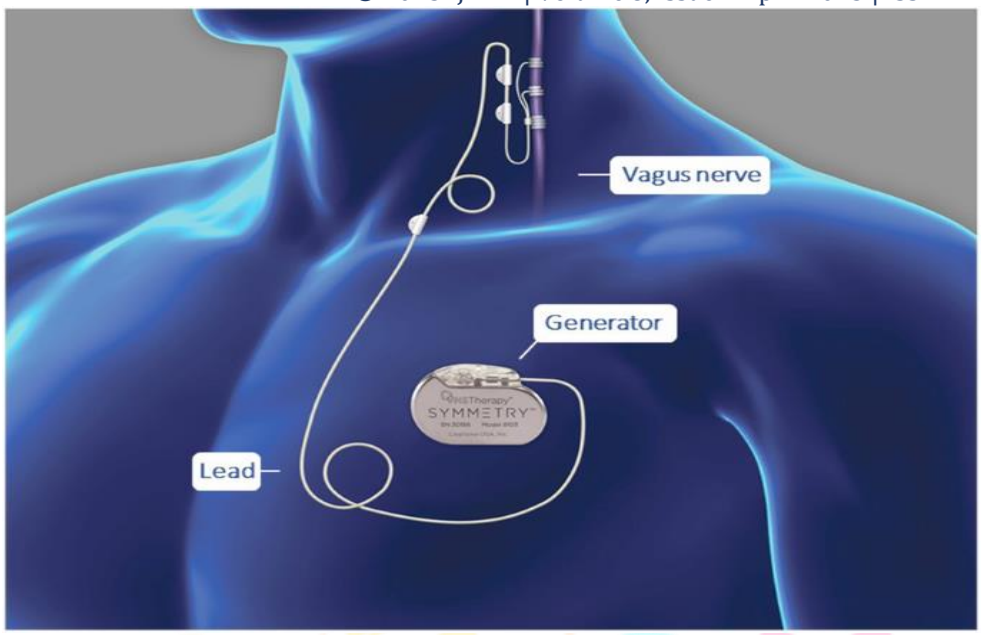
**PROCEDURE**

Surgery to implant the Vagus nerve stimulation device can be done on an outpatient basis; The surgery usually takes an hour to an hour and a half. The procedure will be done under local anesthesia or general anesthesia

The surgery itself doesn't involve the brain. Two incisions are made, one on the chest or in the armpit (axillary) region, and the other on the left side of the neck. The coil electrodes at the end of the lead wire are gently wrapped around the left Vagus nerve through the incision made. Then guides the insulated lead wire extends from the electrodes from the neck and down to the chest at the chest incision. They then connect the end of the electrode to a battery. The battery is a little bigger than a silver dollar. It goes through the incision into the chest into a pocket made over muscle.

The pulse generator is implanted in the upper left side of the chest. The device is meant to be a permanent implant, but it can be removed if necessary.

The pulse generator is about the size of a stopwatch and runs on battery power. A lead wire is connected to the pulse generator. The lead wire is guided under the skin from chest up to the neck, where it's attached to the left Vagus nerve through the second incision.




**AFTER THE PROCEDURE**

The pulse generator is turned on during a visit to a hospital a few weeks after surgery. Then it can be programmed to deliver electrical impulses to the Vagus nerve at various durations, frequencies, and currents. Vagus nerve stimulation usually starts at a low level and is gradually increased, depending on symptoms and side effects.

Stimulation is programmed to turn on and off in specific cycles — such as 30 seconds on, and five minutes off. The patient may have some tingling sensations or slight pain in the neck and temporary hoarseness when the nerve stimulation is on.

The stimulator doesn't detect seizure activity or depression symptoms. When it's turned on, the stimulator turns on and off at the intervals selected by the doctor. Patients can use a hand-held magnet to initiate stimulation at a different time, for example, if sense an impending seizure.

The magnet can also be used to temporarily turn off the Vagus nerve stimulation, which may be necessary when the patient does certain activities such as public speaking, singing, or exercising, or when eating if you have swallowing problems.

Patients need to visit their doctor periodically to make sure that the pulse generator is working correctly and that it hasn't shifted out of position. Check with a doctor before having any medical tests, such as magnetic resonance imaging (MRI), which might interfere with the device.[3]

**RISKS**

For most people, Vagus nerve stimulation is safe. But it does have some risks, both from the surgery to implant the device and from the brain stimulation.

**SURGERY RISKS**

Surgical complications with implanted Vagus nerve stimulation are rare and are similar to the dangers of having other types of surgery. They include:

- Pain where the cut (incision) is made to implant the device
- Infection
- Difficulty swallowing
- Vocal cord paralysis, which is usually temporary, but can be permanent

SIDE EFFECTS AFTER THE PROCEDURE

Some of the side effects and health problems associated with implanted Vagus nerve stimulation can include:

- Voice changes
- Hoarseness
- Throat pain
- Cough
- Headaches
- Shortness of breath
- Difficulty swallowing
- Tingling or prickling of the skin
- Insomnia
- Worsening of sleep apnea

For most people, side effects are tolerable. They may lessen over time, but some side effects may remain bothersome for as long as you use implanted vagus nerve stimulation.

Adjusting the electrical impulses can help minimize these effects. If side effects are intolerable, the device can be shut off temporarily or permanently[4]

**PROGNOSIS**

Implanted Vagus nerve stimulation isn't a cure for epilepsy. Most people with epilepsy won't stop having seizures or taking epilepsy medication altogether after the procedure. But many will have fewer seizures, up to 20 to 50 percent fewer. Seizure intensity may lessen as well.

It can take months or even a year or longer of stimulation before the patient notice any significant reduction in seizures. Vagus nerve stimulation may also shorten the recovery time after a seizure. People who've had Vagus nerve stimulation to treat epilepsy may also experience improvements in mood and quality of life.

Research is still mixed on the benefits of implanted Vagus nerve stimulation for the treatment of depression. Some studies suggest the benefits of Vagus nerve stimulation for depression accrue over time, and it may take at least several months of treatment before patients notice any improvements in depression symptoms. Implanted Vagus nerve stimulation doesn't work for everybody, and it isn't intended to replace traditional treatments.

## CONCLUSION

Vagus nerve stimulation doesn't cure epilepsy. It probably won't completely stop seizures, either, and need to continue taking anticonvulsant medication. The goal of VNS is to reduce the number, length, and severity of the seizures.

Studies of implanted Vagus nerve stimulation as a treatment for conditions such as Alzheimer's disease, headaches, and rheumatoid arthritis have been too small to draw any definitive conclusions about how well it may work for those problems. More research is needed.[5]

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