PROCEDURE

# Vagus nerve stimulation

Vagus nerve stimulation uses an implanted device to send electrical pulses that may reduce seizures or severe depressive symptoms.

**PURPOSE**
Reduce seizures or treatment-resistant depressive symptoms

**PROCEDURE TYPE**
Therapeutic surgery with implanted chest generator and neck lead

**WHERE IT IS DONE**
Operating theatre

**ANAESTHESIA**
General anaesthesia

**HOW LONG IT TAKES**
About 1 to 2 hours

**PREPARATION**
Fasting and medication plan from the surgical team

**RECOVERY**
Usually same day; no driving after general anaesthesia

**MAIN RISKS**
Voice change, swallowing problems, infection, nerve injury

**RESULTS**
Assessed over weeks to months after programming begins

## Overview

Vagus nerve stimulation, or VNS, uses a small implanted device to send regular electrical pulses to the vagus nerve. This nerve carries signals between the brain and many parts of the body.

The pulse generator sits under the skin of your upper chest. A thin wire runs under the skin to the left side of your neck, where it connects to the left vagus nerve.

VNS is mainly used alongside other treatment for epilepsy that has not been controlled with medicines. It may also be considered for carefully selected adults with long-term or recurring depression that has not improved after several treatments.

This article covers implanted VNS. Handheld devices that stimulate the nerve through the skin

do not require this operation and are used for different purposes.

## Why the procedure is performed

For epilepsy, VNS aims to reduce how often seizures happen, shorten them, or make recovery easier. It is not usually expected to stop every seizure, and antiseizure medicines are normally continued.

VNS may be considered when medicines have not controlled seizures and surgery to remove or destroy the area causing them is unsuitable, too risky, or not wanted.

For depression, VNS may be considered after several adequate courses of medication or other established treatments have not worked. Improvement may take months. Access, regulatory approval, and insurance coverage differ between countries and health systems.

## Who should and should not have it

A specialist team should first confirm that VNS fits your diagnosis, previous treatment, goals, and overall health. It is not the right option for everyone.

Implanted VNS may be considered for:

VNS should not be implanted after the left vagus nerve, or both vagus nerves, have been surgically cut in the neck. Surgery may be delayed if you have an active infection or are not well enough for general anaesthesia.

Tell the team about heart rhythm problems, fainting, breathing conditions, sleep apnoea, swallowing difficulties, previous neck surgery, pregnancy, and other implanted devices. These do not always prevent VNS, but they may change the assessment or monitoring needed.

Your future need for MRI scans also matters. Some scans are possible with certain VNS systems under specific conditions, while others are restricted.

- Drug-resistant epilepsy when further medication alone is unlikely to be enough
- Epilepsy that cannot be treated safely with surgery directed at one brain area
- Severe, long-lasting or recurring treatment-resistant depression in selected adults

## How to prepare

The treating facility's own instructions take priority because fasting rules and medication plans

differ.

Give the team a complete list of your medicines, supplements, allergies, and implanted devices. Ask specifically about blood thinners and medicines for diabetes. Do not stop antiseizure medicines, antidepressants like sertraline or fluoxetine , or other prescribed medicines unless the team tells you to.

You may be asked to:

Tell the team if you develop a fever, skin infection, cough, or other illness before the procedure. Also tell them if pregnancy is possible.

- Stop eating and drinking for a set time before anaesthesia
- Arrange for an adult to take you home and stay with you
- Avoid lotions, jewellery, or cosmetics near the neck and chest
- Follow instructions about washing before surgery

## What happens during the procedure

You are given general anaesthesia, so you are unconscious and do not feel the operation.

The surgeon makes a small incision on the left side of your neck and identifies the vagus nerve. A flexible electrode is gently wrapped around the nerve.

A second incision is made in the upper chest. The pulse generator is placed under the skin, usually below the collarbone. The connecting wire is passed under the skin from the neck to the chest.

The team tests the system, closes both incisions, and applies dressings. The generator may be left off initially and programmed at a later appointment after healing has started.

## Recovery and what to expect afterward

Pain is usually centred around the neck and chest incisions. Soreness, bruising, or a pulling feeling can last for several days. Use pain relief as directed.

You can usually drink and eat once you are fully awake. Softer foods may feel more comfortable if your throat is sore.

Gentle walking is encouraged, but avoid heavy lifting, strenuous exercise, and movements that pull on the incisions until your surgical team says they are safe. Follow the wound-care instructions you receive.

You cannot drive home after general anaesthesia. Ask when you may drive again. Epilepsy-related driving restrictions still apply even if VNS reduces your seizures.

Many people return to desk-based work within several days, while physical work may require more time. Your recovery and job demands will guide the timing.

Once stimulation begins, you may notice brief hoarseness, coughing, throat tingling, or a change in voice during each pulse. These effects often become easier to tolerate as settings are adjusted.

## Risks and possible complications

Possible surgical complications include bleeding, infection, scarring, pain, and a collection of fluid around the device. The vagus nerve or nearby structures can be injured, although this is uncommon.

Stimulation-related effects can include:

Changes in heart rate can occur, particularly when the device is tested. The team may monitor your heartbeat during surgery and programming.

The wire can break or move, and the generator can malfunction. The battery eventually runs down and requires another operation to replace the generator.

Certain heat-based treatments called therapeutic diathermy must not be used after VNS implantation because they can cause serious injury. MRI and other procedures require device-specific precautions. Always show your VNS identification card before scans, operations, or medical treatments.

- Hoarseness or voice changes
- Cough, throat discomfort, or shortness of breath
- Difficulty swallowing
- Sleep disturbance or worsening sleep apnoea

## Results and follow up

Programming usually begins at a follow-up visit. A clinician places a programming wand over the generator and gradually adjusts the pulse strength and timing. Several appointments may be needed to balance benefit and side effects.

Results are not immediate. Seizure improvement is usually assessed over weeks to months.

Improvement in depression may take several months or longer. Some people have a meaningful response, while others receive little or no benefit.

Continue your prescribed medicines unless your specialist changes them. Keep a seizure diary or symptom record so changes can be assessed.

You may receive a magnet that can activate or temporarily interrupt stimulation, depending on how it is used. Your team will show you what to do. Routine follow-up also checks the battery, wire, incision sites, side effects, and device settings.

## Alternatives

For epilepsy, alternatives include trying other antiseizure medicines or combinations. This avoids surgery but can cause medication side effects and may not control drug-resistant seizures.

Testing for epilepsy surgery may identify a brain area that can be removed or treated with laser ablation. This can offer a greater chance of seizure freedom for some focal epilepsies, but it involves brain surgery and is not suitable when seizures arise from several areas or an important brain region.

Other options include dietary therapy, responsive neurostimulation, or deep brain stimulation. Dietary treatment requires close supervision and can be difficult to maintain. Other implanted stimulators involve brain surgery and suit different seizure patterns.

For depression, alternatives include further medication, psychotherapy, electroconvulsive therapy, repetitive transcranial magnetic stimulation, and ketamine-based treatment where available. These differ in speed, evidence, side effects, availability, and whether anaesthesia or repeated clinic visits are required. VNS involves surgery and usually works more slowly, but provides ongoing stimulation.

Choosing no implant and continuing supportive treatment is also an option. Ask what improvement is realistically expected and what would happen if you postpone or decline surgery.

## When to call your healthcare team

Contact your surgical team promptly for increasing redness, warmth, swelling, drainage, fever, worsening pain, or an opening in either incision. Also report persistent trouble swallowing, new breathing problems during stimulation, repeated vomiting, or a major change in voice that does not improve.

Seek emergency help for severe difficulty breathing, rapidly increasing neck swelling, chest pain, fainting, or signs of a severe allergic reaction. Follow your established emergency seizure plan for a prolonged seizure or repeated seizures without recovery.

If VNS is being used for depression, seek immediate help for thoughts of suicide, self-harm, or being unable to stay safe.

Mild hoarseness or throat tingling that occurs only during stimulation can usually be discussed at a routine programming visit, unless it is worsening or interfering with breathing, eating, or sleep.

## Common questions

Will I be asleep?

Yes. Implantation is normally performed under general anaesthesia, so you are unconscious throughout the operation.

Can I drive home?

No. Arrange for someone to take you home after the anaesthetic. Your usual seizure-related driving restrictions remain in place.

How painful is it?

Most people have temporary soreness around the neck and chest incisions. The team will give you a pain-relief plan. Severe or increasing pain should be reported.

When will I know if it is working?

VNS is assessed over time after programming begins. Changes in seizures may appear over weeks or months. Improvement in depression can take several months or longer.

Will I feel the stimulation?

You may notice throat tingling, coughing, hoarseness, or a voice change while a pulse is active. Programming adjustments can often make these effects easier to tolerate.

Can the device be turned off or removed?

The generator can be switched off with a programmer. Removal requires surgery, and part of the wire may sometimes be left around the nerve to avoid injury from scar tissue.

## Sources

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