

Vagal nerve stimulation approved, common procedure for complex epilepsy

by Douglas Kondziolka, MD

Vagal nerve stimulation (VNS) is an approved and common procedure for medically refractory complex epilepsy. Although the precise mechanism of the response is still unknown, there are a number of observations that justified its initial use for epilepsy and its continuing strong role for many patients. The importance of the vagus nerve and its potential effect on the electroencephalogram (EEG) extends back to the 1930s. In the 1980s, it was demonstrated that VNS could attenuate motor seizures in animals induced by strychnine as well as tremors, and that the potential beneficial effects on seizure suppression lasted longer than the acute stimulation.

Human VNS implants began over 20 years ago. In the vast majority of patients, the device is implanted on the left vagus nerve. From a cardiac perspective, the right side innervates the sinoatrial node and the left innervates the atrioventricular node with less influence over heart rate. A right-sided VNS implant can be placed if access to the left nerve is compromised in some way, but this is uncommon.

Based on extensive research, VNS is used for partial complex epilepsy, generalized epilepsy, and has been evaluated in major depression. It has been shown that the acute effect of VNS can be used to terminate a seizure, and the chronic effect of VNS can inhibit seizure activity and thus decrease the likelihood that new seizures will occur. A "VNS responder" has been defined as patients who report 50% or greater reduction in seizure frequency, and indeed the vast majority of our patients achieve such benefit. Almost all request that their pulse generators are replaced when they near the end of service, typically lasting six to nine years.

There are a number of theories to the mechanism of VNS, but many believe that it exerts its effect by direct afferent action rather than indirect afferent projections. The anatomy of this remains poorly understood, although there is evidence to support that noradrenaline released from the amygdala may be important related to projections from the nucleus of the solitary tract.

The locus coeruleus may similarly have a key modulating role. Indeed, direct electrical stimulation of the locus coeruleus reduces kindling produced by amygdala stimulation.

Patients with medically refractory epilepsy that is multifocal in origin and not amenable to other forms of surgery can be considered for vagus nerve stimulation. Working together with the patient's neurologist who will subsequently program the device, the patient and family/ caregivers are instructed about the surgical technique, postoperative care, risks, and outcomes. The procedure is performed under general anesthesia and typically takes one to two hours to complete. The majority of patients are discharged from the hospital the same day. Two small wounds are made - one in a transverse neck crease and the second below the clavicle and closed with subcuticular sutures. The current model

of the pulse generator

is much smaller than earlier models and is barely seen in most patients. The newer AspireHC model combines the circuitry of the Demipulse model generator with a higher capacity battery, which can offer extended performance for patients at higher stimulation settings.

The vagus nerve is exposed within the carotid sheath, and positive and negative electrode coils are gently placed around the nerve together with an anchoring coil to stabilize the position of the electrode against neck movement. The risks of infection, pain, or device malfunction are low. In my own experience, I have not seen any problems with hemodynamic effects of vagus nerve stimulation. One young patient developed a hoarse voice approximately five days after surgery during strenuous activity, but this resolved over several months.

Implantation of pulse generators for the care of patients with epilepsy, movement and behavioral disorders, pain, and cardiac dysrhythmias has become increasingly common. VNS is one of the most important surgical options for patients with complex epilepsy that can provide a great deal of benefit to both patients and caregivers. •

