Spinal Cord Stimulation

One alternative your doctor might explore when other methods have failed is spinal cord stimulation (SCS) (figure 20.1). This therapy involves the application of microcurrents of electricity to certain areas of the spinal cord. The most common use of SCS in North America is to treat pain. However, in Europe these devices are used to treat blood flow insufficiency, in the legs and heart. While we don't know for certain how SCS works, there are several well-developed theories and we are learning more every year about the mechanism of action. Improvement in our understanding has been aided by some of the recent developments in this field including new waveforms and frequencies. Patients who achieve pain relief will also typically demonstrate some improvement in function as their pain limitations improve.

SCS until recently typically involved 'tonic' stimulation in the 50-100 Hz. range which was accompanied with the patient experiencing a sensation of tingling in the painful area of the body, 'covering the painful area,' which results in a reduced perception of pain centrally in the brain. Recently, there have been several developments in the area of SCS which have resulted in improved success rates and better functional outcomes while also eliminating the need to feel the tonic sensation (tingling), 'parasthesia free.' One technique uses stimulation at high frequencies (>1000 Hz.), such that the tingling is so fast that it is 'sub-threshold,' in other words undetectable by the patient. The other technique uses intermittent pulses of high frequency stimulation followed by brief recovery periods trying to mimic normal CNS communication.

Some will confuse SCS with TENS (transcutaneous electrical nerve stimulation) units (with this, pads are worn on the skin over the painful area of the body), but SCS is something entirely different. If you've tried TENS (a less invasive, topical form of electrical stimulation) and haven't had success with that therapy, don't assume SCS won't work for you.

SCS was developed for the treatment of neuropathic (nerve) pain. This pain is typically associated with injury to nerves and is described by patients as burning, shooting, or tingling. It may be associated with other neurologic changes like painful numbness or a greatly increased sensitivity to things that would not normally produce pain, such as light touch. For example, diabetes can attack nerves in the arms and legs and produce a severe burning or tingling sensation that might be associated with numbness and pain. Nerve pain typically does not respond well to narcotic pain relievers. When it was first used in patients, SCS was more or less restricted to the treatment of purely neuropathic pain of the arms or legs. Recent advances in technology have made it more useful for the management of neuropathic pain in other areas of the body, such as in the back, neck, or pelvis.

Getting Started with Spinal Cord Stimulation

This therapy is not for everyone. First of all, it involves having a medical device implanted into your body. Although some physicians advocate earlier use of this modality, most will at least attempt a more conservative treatment approach and only turn to SCS if those methods fail to achieve adequate relief for the patient. Like spinal drug delivery systems, SCS systems are expensive, so the Medicare program and most major insurers require a psychological evaluation to screen for conditions that can limit this therapy's effectiveness. You will have to perform a trial before the permanent implant is inserted. SCS trials typically last three to seven days, but may last weeks when necessary to evaluate effectiveness in certain patients. For the trial, your doctor will place wires inside your spine through a needle placed into the epidural space; these will be steered to lie over specific areas of your spinal cord which correlate with your pain pattern. During the procedure, you are typically aware enough to answer questions about whether you feel stimulation and where you feel it. The doctor will try to find a position for the wires that allows electrical stimulation, perceived as a soothing tingling sensation, overlying the painful areas. Once

a good location is identified, your doctor will secure wires, called leads, to your skin. A temporary external pulse generator (battery) will be attached to the end of the lead that's outside your body, and this is programmed to provide stimulation (a soothing tingling sensation) to the areas of the body where pain is experienced. A good way to think of stimulation techniques is as a distraction therapy; it covers up or masks the pain by giving the central nervous system a different sensation in the same area as the pain. There are eight different contacts on each lead, and each of those can be positive, negative, or off. You and your doctor literally have thousands of combinations available to optimize the stimulation pattern. You will carry the external pulse generator around with you during the trial period, and you will be asked to keep track of whether the stimulation relieves pain and what effect it may have on your ability to do your activities of daily living. At some point you and your doctor will then decide whether it makes sense to have one of these devices permanently implanted into your body. Depending on the particulars of your case and your doctor's local practice, the test procedure might be conducted by one doctor (an interventional pain physician) and the permanent implantation might be done by a spine surgeon.

How it Works

The permanent SCS system typically consists of a programmable (and possibly rechargeable) pulse generator (the battery) that generates the individual and particular stimulation pattern for that patient. One company has recently developed a system that only requires insertion of the leads and is powered externally by an external generator. The generator is connected under the skin to leads that are placed in the spinal canal as described above. Your "mileage" on the battery will be determined by how often you use it and how high the settings are. Replacing the battery means replacing the entire pacemaker- sized pulse generator. The leads come in two types: those that can be placed through a needle (percutaneous leads) and those that are placed surgically (paddle leads). Paddle leads are more stable in terms of position and more energy efficient, but traditionally have been associated with the need for greater surgical trauma during insertion and hence a longer recovery period .

Both approaches have their merits and you should discuss these with your physician. One advantage of SCS is that it gives you quite a bit of control. You will get a controller that works a lot like the remote for your TV. You can turn it on or off, select different therapeutic programs, and control the stimulation. Another major advantage of SCS is that it uses electricity instead of drugs, so there are no nasty side effects to speak of. In fact, many patients who use these systems find they can reduce their daily medication intake, and some can even eliminate medications altogether.

Side Effects and Complications

As with any surgery, there are risks associated with implanting these devices. One of the most problematic is infection. Because these devices are a foreign body and therefore do not receive direct blood flow, an infection in your unit probably will not respond to treatment with antibiotics, and the system will likely have to be removed. You can have another device put in after the infection is completely resolved (typically 3-6 months), but you might have to work with an infectious disease specialist the next time around.

Once you have an SCS system implanted, you may or may not be able to undergo MRI examinations with the various systems differing vastly in their degree of MRI compatibility. The wires of the stimulator leads or the generator can heat up and theoretically cause damage. In some cases, you might be able to have an MRI of the head or an extremity in a special scanner, but otherwise a CT scan may be a reasonable substitute. Another potential problem with SCS systems is that the lead wires can migrate, which causes a loss in coverage over the painful areas and makes the device less effective than before. In some cases, the units can be reprogrammed to get the stimulation back. If reprogramming doesn't work,

then the leads might require surgical repositioning. Other mechanical complications include lead fracture, which requires lead replacement.