Percutaneous Electrical Neurostimulation for Detoxification in Opioid-Dependent Chronic Pain Patients

The use of this unique, nonpharmaceutic outpatient technique can accomplish a safe, cost-effective, and rapid reduction in the use of opioids, even when previous weaning methods have been unsuccessful.

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The process of dose-reduction in opioid-dependent patients (detoxification) always has been challenging. However, when the scenario also includes a chronic, severe pain problem, as either an initiating or underlying cause of that dependence, the process can be significantly more difficult.

**Development of Addiction**

The National Institute of Drug Abuse (NIDA) defines dependence as “a state in which an organism functions normally only in the presence of a drug” that is “manifested as a physical disturbance when the drug is removed (withdrawal).”\(^1\) NIDA defines addiction as “a chronic, often relapsing brain disease that causes compulsive drug seeking and use, despite harmful consequences to the addicted individual and to those around him or her. Although the initial decision to take drugs is voluntary for most people, the brain changes that occur over time challenge an addicted person’s self-control and hamper his or her ability to resist intense impulses to take drugs.”\(^2\)

Different parts of the brain are responsible for addiction to and dependence on opiates. It is thought that with addiction, the reward pathway—which includes the ventral tegmental area (VTA), the nucleus accumbens, and the prefrontal cortex—is activated, releasing the neurotransmitter dopamine. In dependence, the thalamus and brainstem are activated. Thus, it is possible to be dependent on an opioid, without being addicted to it. (Although, if one is addicted to a drug, he or she most likely is dependent on it as well.)\(^3\)

**Traditional Treatment Techniques**

The traditional biobehavioral management techniques for treating addiction include Twelve Step programs (ie, Alcoholics Anonymous), cognitive behavioral techniques (CBT), or spiritual methods that were originally designed for the treatment of alcoholism. Over time, these techniques have been adapted to address other drugs of abuse, with varying degrees of success. These approaches were eventually combined with pharmacologic agents (drugs for detoxification) to facilitate the process of opioid abuse treatment and address withdrawal symptoms. Unfortunately, none of these techniques specifically address the situation when the patient also presents with an underlying pain problem. In such patients, the treatment process has proven much more difficult, with fewer successful outcomes and higher relapse rates.

We, along with many other centers, have employed various methods to weaken opioid-dependent pain patients, again with varying degree of success. These methods include blind cocktail weans, simultaneous decrease/increase drug regimens with non-opioid pharmacologic agents, and the use of traditional detox medications—all usually combined with biobehavioral management techniques for self-activated pain control as well as substance abuse education. Often times, however, these techniques are not adequate to overcome the underlying pain barrier toward detoxification.

**Use of PENS in Opioid Detoxification**

Initially, we began using percutaneous electrical nerve stimulation (PENS) as a nonpharmacologic pain management technique when a device became available for outpatient use. PENS originally was used as an alternative to traditional transcutaneous electrical techniques, such as transcutaneous electrical nerve stimulation, interferential, or H-wave, and fully implanted modalities, such as spinal cord stimulation, or deep brain stimulation.

When we used PENS in a standardized protocol for pain control, we found a moderate, but statistically significant, decrease in pain reporting on the Visual Analog Pain Scale (VAPS). We serendipitously discovered that there was a profound simultaneous decrease in use of opioids.

Initially, this occurred without specific instructions by the physician to lower the dosage. This finding was the impetus to study PENS further.

Previous research has shown that acupuncture may have some effects on drug dependence.\(^4\) Because PENS has similar features to auricular acupuncture, we decided to use PENS to wean or reduce the dose of opioids in chronic pain patients who have been using these
medications in significant dosages for more than 1 year.

**Ambulatory Application**

PENS is the only ambulatory, physician applied, minimally invasive application of electrical neurostimulation implanted directly into the neurovascular bundles of the external ear (image on page xx). During our research, we verified implant locations by transillumination, as well as with specific location skin impedance measurements. When the device is applied, a generator is positioned behind the ear and connected to three 10-cm, 30-gauge wires, each attached to a 1-mm 30-gauge needle. Electrical impulses are transferred with this system to target branches of cranial nerves V, VIII, IX, and X, as well as branches of the lesser and greater occipital nerves, and, ultimately, to both cranial and cervical sympathetic fibers. The neurostimulator is programmed to operate in 3-hour on/off cycles for 4 days, after which the patient removes the device and electrodes. The patient is seen for follow-up 1 week after implantation. Our protocol has included provisions for repeat implantations (between 4 and 6 sessions were possible).

**PENS Study Design**

Thirty-five patients were included in the study. All the patients were taking chronic daily oral opioids on an ongoing basis for longer than 1 year. Inclusion criteria required that the patient not be considered a surgical candidate for the chronic pain problem(s) for which the opioids were prescribed; in addition, the patients needed to be stable, with no active substance abuse as determined by urine drug screening (Table 1). All of the patients had failed multiple other pain management techniques.

![Table 1. Protocol for PENS Treatment](http://www.practicalpainmanagement.com/sites/default/files/imagecache/lightbox-large/images/2015/10/15/t1_0.png)

The study protocol provided for weekly or biweekly sessions of PENS implantations, objective monitoring of sympathetic nervous system, energy level, mood, and sleep parameters, as well as results reviews and instructions for the forthcoming session. We explained the protocol to the patient, and once they accepted the protocol, it was initiated. We implanted the devices at an outpatient surgery center because the potential hemodynamic effects of the device were not known. To optimize locations for needle placement, we placed patients in a supine position and evaluated both ears using skin galvanic response. When we identified the appropriate ear, we positioned and prepped it. We covered the implantation sites with local anesthetic cream. Then, we activated a pulse generator and applied it to the skin directly behind the ear with a sterile adhesive. Lastly, we implanted the 3 electrodes in the appropriate locations and covered them with small waterproof dressings.

After we reviewed pre- and post-procedure vital signs, the patient was discharged home. None of the patients had any hemodynamic
changes sufficient to merit either removal of the devices or discontinuation of the treatment throughout the study.

**Monitoring During Study**
To affectively monitor patient progress during treatment, at each treatment session we gave a preprinted 7-day progress report to the patient, and asked them to track and record daily VAPS, energy levels, sleep scores, and mood, anxiety, and depression scores. These were all done on basic 0 to 10 VAPS to avoid any patient confusion. We also tracked any changes or titration of the medications from baseline and daily throughout the treatment, reviewing these with the patient at each implantation session.

**Study Results**
Of the 35 patients enrolled in the study, 31 were able to complete the study. The average number of PENS sessions was 5.13. The diagnoses of the patients varied, and some patients had more than one pain diagnosis (Table 2). Change in parameters included on the VAPS showed an aggregate overall improvement of 41%, energy level showed an improvement of 41%; mood level showed an improvement of 55%; and sleep patterns showed an improvement of 46%.

![Table 2: Pain Conditions of the 31 Study Subjects](http://www.practicalpainmanagement.com/sites/default/files/imagecache/lightbox-large/images/2015/10/15/t2_2.png)

The mean reduction in opioid dosage was 75% in the 31 patients who completed the study (Table 3). Again, results will total more than 31 because some patients were prescribed more than one opioid.

![Table 3: Types of Opioid Medication, Starting and Ending Dosage in the 31 Study Subjects](http://www.practicalpainmanagement.com/sites/default/files/imagecache/lightbox-large/images/2015/10/15/t3_o.png)

**Conclusion**
We found that the outpatient auricular implantation of PENS in a multi-week protocol provided statistically significant improvements in VAPS ratings. Perhaps more importantly though, it provides an even more significant reduction in patients’ use of controlled substances in a relatively short timeframe (4 to 5 weeks), even in patients who had been taking them for longer than 1 year. This was accomplished without any use of traditional pharmacologic detox agents, traditional outpatient treatment program, or Narcotic Anonymous/AA sessions.
We describe the first unique treatment format that does not employ either talk or drug therapy for detoxification of opioid-dependent patients. We concluded that the use of this technique can accomplish a safe, cost effective, rapid, and significant reduction in the use of these substances, even when previous methods have proven unsuccessful. Further study is necessary to determine the most effective combination of parameters (implantation sessions, adjunct biobehavioral techniques, and implantation intervals).

View Sources (/treatments/interventional/stimulators/percutaneous-electrical-neurostimulation-detoxification-opioid#fieldset)

Last updated on: October 21, 2015
First published on: October 1, 2015