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Case Report

Supraorbital Stimulation for the Treatment of Supraorbital Neuralgia: A Complication of Skin Erosion and Lead Extrusion

David Jacobs, MD, and Dalia Elmofty, MD

Over the past few decades, there has been growing interest in the use of peripheral nerve stimulation (PNS) to treat refractory headache disorders. Supraorbital nerve stimulation (SONS) is a form of PNS that has been used in the treatment of ophthalmic postherpetic neuralgia, trigeminal neuropathic pain, supraorbital neuralgia, chronic craniofacial neuropathic pain, chronic migraine headaches, and chronic cluster headaches (1-5).

There is no consensus on the exact mechanism of action of PNS in the scientific community. The clinical effectiveness of PNS can be explained by the "gate control theory" of pain. Electric currents activate peripheral large-diameter myelinated sensory afferent Aβ-nerve fibers resulting in the presynaptic signal inhibition of small-diameter nociceptive Aδ and C-fiber in the spinal cord producing an analgesic effect. PNS may also facilitate electrical and neurohormonal effects via altering levels of neurotransmitters and endorphins which are thought to contribute to chronic pain symptoms.

Several studies have shown the effectiveness of PNS in the treatment of refractory headaches. In a review (1) of prospectively collected data on patients who underwent PNS for craniofacial pain, 73% reported greater than a 50% improvement in pain intensity at an average of 35 months post-implantation. Another retrospective case series (2) found SONS led to a statistically significant reduction in headache scores (pre-implantation pain score of 7.5 ± 0.4 which decreased to 3.5 ± 1.2 at 30 weeks [P = 0.0047]) with a 50% reduction in opioid consumption up to 30 weeks post-implantation in patients with supraorbital neuralgia. We present a case of supraorbital neuralgia successfully treated with SONS for 10 months, which was subsequently complicated by skin erosion, and lead extrusion necessitating device removal.

From : Department of Anesthesia, University of Chicago

Author for correspondence: Dalia Elmofty, MD
Address: Department of Anesthesia, University of Chicago, 5841 South Maryland Ave. Chicago, IL 60637
E-mail: delmofty@dacc.uchicago.edu

CASE DESCRIPTION

A 57-year-old male with a history of squamous cell carcinoma of the palate status post palatectomy, chemotherapy, and radiation, presented to the pain clinic with complaints of chronic frontal headaches. The headaches were described as persistent pain in the forehead with occasional shock-like paresthesia in the supraorbital nerve distribution. He reported a baseline intensity of 5/10 associated with exacerbations reaching an intensity of 10/10 once per week, lasting 30 minutes. Physical examination demonstrated tenderness with palpation over the right maxilla and bilateral supraorbital ridge with reproduction of symptoms. He failed multiple preventative pharmacological therapies. He had 2 diagnostic bilateral supraorbital nerve blocks that led to a greater than 90% improvement in symptoms lasting 8 weeks followed by radiofrequency ablation (RFA) resulting in greater than 50% relief for approximately 1 year. He underwent a repeat RFA which only provided 3 weeks of relief. The patient felt that the blocks were uncomfortable and led to skin changes at the injection site. Bilateral orbicular oculi muscle botulinum toxin injections were performed and provided greater than 90% improvement for 6 weeks. He expressed interest in a treatment option that would provide a longer duration of relief and supraorbital nerve stimulation was discussed. A 3-day supraorbital stimulator trial resulted in greater than 90% pain relief and improved quality of life with a decrease in analgesic requirement. He proceeded to have a permanent implantation performed under

general anesthesia. Two percutaneous 8-electrode leads were placed via a lateral approach. An incision was made above the nasal ridge, over the left lateral temple, and behind the left ear. An introducer needle was used to tunnel the leads subcutaneously across the level of the supraorbital ridge. The leads were then anchored behind the left ear. A 3-centimeter incision was made at the left infraclavicular region and the internal pulse generator (IPG) pocket site was created with blunt dissection. The leads were tunneled from the ear incision, down the neck, and towards the pocket site. An ultrasound was utilized to identify vital structures during the neck tunneling.

Approximately 5 months post-implantation, the patient developed a "pimple-like" structure in the mid-brow area that he lanced and noted drainage of "cottage cheese-like" substance. He also reported a lack of stimulation over his right supraorbital region. On exam, a healed scab without drainage was noted. An ultrasound examination performed in clinic revealed migration of the right lead with no signs of subcutaneous inflammation. The patient underwent computerized tomography of the head and neck that confirmed lead migration and the lack of infection (Fig. 1). Approximately 3 months later, the wires eroded through the skin in the mid-brow region (Fig. 2). He subsequently underwent extraction of the device.

DISCUSSION

Complications associated with PNS can result from hardware (lead, IPG) migration or malfunction, surgical related issues (pain, infection, hematoma), and surgical technique (IPG pocket location, lead length, lead orientation to the nerve). The most commonly reported PNS complication is lead migration (5). Our discussion will include complications associated with other PNS modalities (ONS, auriculotemporal nerve stimulation (ATNS)), maxillary nerve stimulation (MNS), and infraorbital nerve stimulation (IONS)) in addition to SONS, given the small number of studies published.

We present a case of skin erosion resulting in lead extrusion. The underlying etiology resulting in skin erosions is unclear. An associated infection at the site can lead to obvious skin breakdown resulting in exposure of any components of the PNS. Skin erosions can result from pressure necrosis of the skin secondary to the superficial nature of the placement of the leads or silicone anchors. It could also be related to contact dermatitis or an allergic reaction to the components of the PNS.

The incidence of skin erosion in the literature ranges from 0-40% (Table 1). A retrospective chart review reported an 8.3% incidence of skin erosion

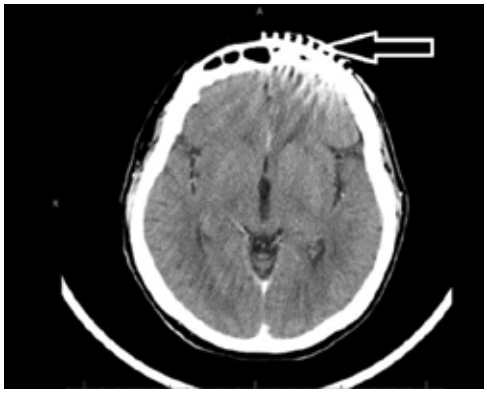

Fig. 1. Computerized tomography of the head revealing lead migration to the left without signs of a clinical infection (arrow).

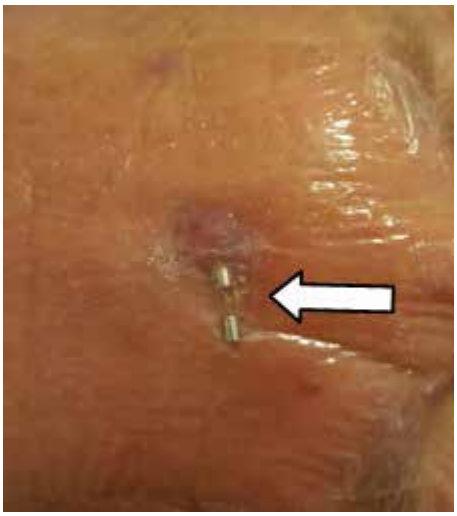

Fig. 2. Supraorbital lead (white arrow) eroding through the skin in the mid-brow area.

Table 1. Skin erosion with peripheral nerve stimulators for chronic intractable headache.

Author	Location of PNS	Skin erosion location	Time from implantation to skin erosion	Secondary infection
Our case	SON	Forehead (mid-brow)	10 months	Unclear (most likely skin flora)
Hann & Sharan (5)	SON/ON	Forehead (above the eyebrow)	not stated	No
Vaisman et al Case #3 (3)	SON/ION/ Maxillary	Not stated	3 years	No
Vaisman et al Case #5 (3)	SON	Forehead	1 year	Yes
Zhou et al Case #1 (4)	Left SON/ON/ATN	Silastic plastic anchor (scalp)	1.5 years	Yes
Zhou et al Case #2 (4)	Bilateral SON/ON/ ATN	Silastic plastic anchor	2 years	Yes

SON = Supraorbital nerve, ON = Occipital Nerve, ATN = Auriculotemporal nerve, ION = Infraorbital

with PNS used to treat chronic headache (4). In one study (1) on PNS implantation for craniofacial pain, 4 of which had SONS, there was a 4.5% incidence of skin erosion. The authors reported one case of skin erosion that occurred over the electrode tip (1). Another study (5) reported a 7.1% incidence of skin erosion in patients treated with SONS and ONS for chronic migraine. It occurred at the supraorbital electrode tip above the eyebrow, a location similar to our case, and was revised with the placement of the leads subperiosteally. More recently, a prospective multicenter study (6) reported a 4.5% incidence rate of skin erosion with ONS, and an average number of days between implantation and skin erosion of 98 days ± 62 days. Another study (2) with SONS for the treatment of supraorbital neuralgia reported a 20% incidence of superficial infection, but did not report an incidence rate for skin erosion. A retrospective case series (3) on patients who had SONS, IONS, and MNS reported a 20% incidence of infection, and 40% incidence of skin erosion.

Skin erosion can occur from an infection (Table 1). Viessman et al (3) reported a patient who developed a superficial infection at the site of the forehead resulting in lead extrusion approximately 12 months post-implantation. Zhou et al (4) reported 2 patients who developed skin erosions followed by infections at the silastic plastic anchor. One patient's device was removed 24 months post-implantation and the other was revised after lead erosion developed 18 months post-implantation (4). Falowski et al (7) also reported a case of skin erosion and infection at the site of the electrodes.

There are also reports of skin erosions not associated with infections (Table 1). The lead tip and silicon anchor site appears to be a common area for skin breakdown. Skin erosion can occur if the electrode is placed too superficially, but placing the electrode too deep in the soft tissue may lead to painful muscle spasms during electrode stimulation. Skin erosion may be prevented by placing supraorbital leads over the periosteum or pericranium in order to decrease lead motion and increase protection by a thicker skin covering the lead (6). Vaisman et al (3) reported a case that had skin erosion 36 months post-implantation without secondary infection and another patient in Hann (5) and Sharan's (6) had erosion over the eyebrow without secondary infection.

CONCLUSION

PNS is emerging as a treatment modality for refractory headaches. Although the positive response is encouraging, complications can significantly impact outcomes. Various approaches have been described for implantation. The case series and small studies currently published do not provide outcome data regarding the best surgical techniques to prevent skin erosion, lead extrusion, or migration. Lead migration is one of the most common complications with PNS.

It has been suggested that implanting the IPG at a distance (abdomen or gluteal area) may cause mechanical stress on the leads and increase the risk of migration. There is limited information in the literature regarding skin erosion and lead extrusion. The published literature does not answer questions such as: when post-implantation skin erosion is most likely to occur, what location is most susceptible to skin erosion, and what is the incidence of skin erosion from pressure necrosis, allergic reactions, or a secondary infection. There is a need for prospective, randomized, double-blinded, placebo-controlled studies with larger sample sizes to draw conclusions about the incidence of these events. Further studies should investigate these questions as SONS and other forms of PNS becomes a more ubiquitous method of analgesia for refractory headache.

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