Use of Percutaneous Electrical Nerve Stimulation (PENS) for Treating ECT-Induced Headaches

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Five patients who experienced migrainelike attacks associated with electroconvulsive therapy (ECT) were treated using a novel nonpharmacologic therapy known as percutaneous electrical nerve stimulation (PENS). In this sham-controlled preliminary evaluation, PENS therapy proved to be a useful alternative to opioid analgesics for the acute treatment and/or prevention of ECT-induced headache.

Key words: migraine, percutaneous electrical nerve stimulation, electroconvulsive therapy

Abbreviations: ECT electroconvulsive therapy, PENS percutaneous electrical nerve stimulation, VAS visual analog scale

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A link between depression and migraine has been recognized for more than a hundred years.[1] The association between depression and migraine has also been investigated in genetic analysis of family inheritance patterns.[2] In 1975, Gomez reported that migraine was one of the most common side effects immediately after electroconvulsive therapy (ECT).[3] More recently, Weinstein confirmed that both tension and migraine-type headaches can occur as a sequela of ECT.[4]

Percutaneous electrical nerve stimulation (PENS) is a novel nonpharmacologic analgesic therapy which combines the advantages of both transcutaneous electrical nerve stimulation (TENS) and electroacupuncture. Preliminary studies have demonstrated its efficacy in the management of both acute[5] and chronic pain syndromes.[6] These five cases illustrate the potential beneficial effect of PENS as a primary therapy for acute ECT-evoked headaches. The effect of PENS (versus sham PENS) therapy on post-ECT head pain was assessed by a blinded observer, and the results are summarized in the Table.

Patient 1.–A 47-year-old woman with clinical depression and a history of migraine presented for an acute course of ECT. She underwent a series of nine ECT sessions with a standardized anesthetic technique. After each of the first four treatment sessions, she experienced the onset of a severe, bilateral, throbbing headache requiring the administration of opioid analgesic medication (intravenous meperidine 50 to 75 mg) in the recovery area. Prior to her fifth ECT session, she consented to a trial with PENS therapy for treatment of her head pain after ECT. When she awoke from anesthesia with her typical ECT-evoked headache, ten 32-gauge, stainless steel, acupuncturelike needle probes were inserted to a depth of 1 to 3 cm bilaterally into the temporalis muscles and the paraspinous muscles at the dermatomal levels illustrated in the Figure. The probes were connected to a low output (5 mA), battery-powered electrical generator and stimulated at a frequency of 4 Hz for 30 minutes. The headache completely abated over the subsequent 60 minutes without the need for any opioid analgesic medication. In an attempt to prevent her post-ECT headache, the PENS therapy was administered in an identical fashion for 30 minutes prior to induction of anesthesia for her next ECT treatment. Upon awakening from anesthesia, the patient reported no headache in the recovery area and remained completely headache-free at 60 minutes after the ECT treatment. At the subsequent ECT session, the patient

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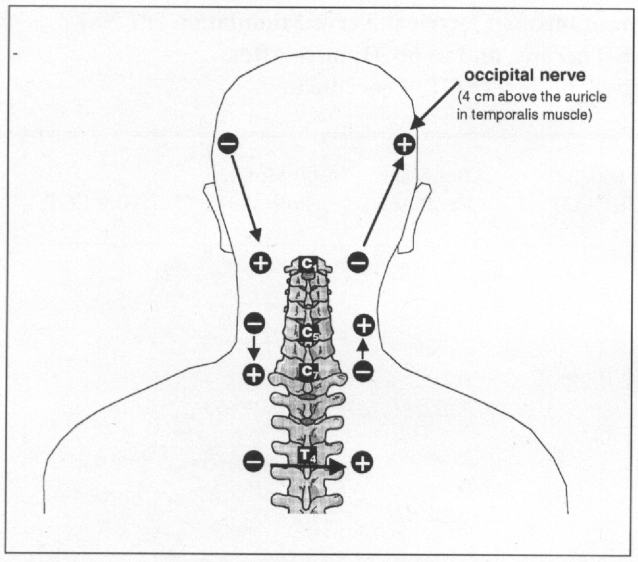
Visual Analog Scale Scores for Head Pain Prior to Percutaneous Electrical Nerve Stimulation (PENS), Immediately after PENS or Sham PENS Therapy, and at 60 Minutes After Completion of the Electroconvulsive Therapy (ECT) Procedure

Patient	Therapy Number	Baseline	After PENS Therapy	60 Minutes After ECT	After Sham Baseline	60 Minutes Procedure	After ECT
1	1	8*	0.5	0			
	2	8	0.3	0			
	3				8.8	7.9	9
	4	8.4	0	0			
2	1	9	0	0			
	2				9	8.7	9.4
	3	9.2	0	0			
	4	7	0	0			
3	1				7	5	7
	2	7	0	0			
	3	6.8	0	1			
	4				6.5	5	8
	5	7	0	0			
	6				6.7	4	7
4	1				8.6	7	9
	2	9.5	3	4			
	3	9	2	2			
	4				9	8	9.5
	5	9	6	7			
	6	8	2	3			
5	1	5	3	0			
	2	6	2	1			
	3	5	3	0.5			
	4				5	5	8

Visual analog scale headache scores ranged from 0 = none to 10 = severe.
* The baseline was obtained in the recovery area after the ECT treatment.

again experienced her typical headache on emergence from anesthesia. The following ECT session, the acupuncture-type needles were placed 45 minutes prior to induction of anesthesia and the wires were connected to the probes, but no electrical stimulation was applied ("sham PENS"—as this patient and the others in this report were aware of the lack of electrical stimulation with "sham PENS," they were told it was a different form of an acupuncture-type treatment) during the 30-minute treatment period. The patient again complained of her typical migrainelike symptoms immediately after the ECT treatment. Prior to her final ECT treatment, PENS therapy was repeated and the patient remained headache-free for 6 hours after the ECT treatment. She has required no further ECT treatments to date.

Patient 2.–A 57-year-old woman with depression who presented for ECT experienced severe, bilateral, tension-type headaches lasting from 8 to 48 hours after each ECT procedure. She was given an opioid-containing oral analgesic medication to relieve her post-ECT headache. After obtaining written informed consent, 10 acupuncture-type needle probes were placed in the montage illustrated in the Figure approximately 45 minutes prior to induction of anesthesia. At the time of the first PENS treatment, the patient was tearful and complaining of severe headache symptoms (9 on the 10 visual analog scale [VAS]). The



The positions of the acupuncturelike probes used for the treatment and/or prevention of headache after electroconvulsive therapy (ECT) with percutaneous electrical nerve stimulation (PENS) or sham PENS therapies. For the PENS treatments, the ten 32-gauge acupuncture-type needles were positioned in the soft tissue and/or muscle to a depth of 1 to 3 cm and stimulated at frequencies of 4 to 100 Hz using a low-output electrical generator.

needle probes were stimulated for 30 minutes at a frequency of 4 Hz. Following the PENS treatment, the patient reported feeling relaxed and her head pain had completely disappeared. More importantly, the patient emerged uneventfully from anesthesia after the ECT procedure without any headache. She subsequently underwent a sham PENS treatment (with the wires attached to the needles without electrical stimulation) and two repeat PENS treatments prior to ECT (Table).

Patient 3.–A 34-year-old woman with severe depression experienced bilateral migrainelike symptoms after each ECT treatment. She was administered an opioid-containing oral analgesic medication after ECT to relieve the headache. After signing the approved consent form, she received six consecutive sham PENS or PENS treatments in random order using the illustrated montage. All treatments were initiated 45 minutes before the ECT procedure. Although the acupuncturelike needles were placed in identical locations for both type of treatments, no electrical stimulation was applied during the sham procedures. For the PENS treatments, the needles were stimulated at 4 Hz for 30 minutes. The level of head pain before the treatments was 6 to 7 on the VAS (Table). Immediately after each of the three PENS treatments, the VAS pain scores were zero, and 0, 1, and 0 at 60 minutes after the ECT procedures (Table). The pain-free period lasted for 10, 12, and 12 hours, respectively. Immediately after the three sham PENS treatments, the level of head pain was reported to be 5, 5, and 4, and 7, 8, and 7 at 60 minutes after the ECT procedures.

Patient 4.–A 56-year-old woman with a clinical depression syndrome refractory to antidepressant medications and a history of migraine presented for an acute course of ECT. After the initial ECT, she complained of a severe, throbbing, bilateral headache (with a score of 9 on a 10 VAS). After signing the approved consent form, she was administered two sham PENS and four PENS treatments in random order prior to her subsequent ECT procedures as summarized in the Table. The levels of head pain before each treatment ranged between 8.0 and 9.5 on the 10 VAS. Immediately after the four PENS treatments, the VAS pain scores were 3, 2, 6, and 2, and 4, 2, 7, and 3 at 60 minutes after the ECT procedures (Table). The duration of analgesia after the PENS treatments lasted from 3 to 6 hours. In contrast, immediately after the two sham PENS treatments, the VAS pain scores were 7 and 8, and increased to 9 and 9.5 at 60 minutes after the ECT procedures.

Patient 5.–A 54-year-old man (112 kg) with depression who presented for ECT experienced severe bilateral headache symptoms with VAS pain scores of 8 to 9 after each ECT treatment. He had been given an opioid-containing oral analgesic medication to relieve his post-ECT headache. After signing the approved consent form, he received four consecutive PENS or sham PENS treatments in random order using the illustrated montage. All treatments were administered 45 minutes before the ECT procedure for 30 minutes. For the three PENS treatments, the needle probes were stimulated at either 4 Hz, 15 to 30 Hz, or 100 Hz. The VAS head pain score before the treatment was 5 to 6 on the 10 scale. After the 30-minute PENS treatments, the VAS pain scores were 3, 2, and 3, and 0, 1, and 0.5 at 60 minutes after the ECT procedures (Table). The pain-free period lasted from 4 to 8 hours after each of the PENS treatments. After the sham PENS treatment, he refused to receive any further "acupuncture-type" treatments because he was dissatisfied with the pain relief.

COMMENTS

Post-ECT headaches have been reported to occur in 3% to 9% of patients undergoing ECT.[3,7] In patients with preexisting headache symptoms, the character of the pain typically progresses from a tension to a migrainous-type pattern.[7] It has been suggested that ECT induces changes in the serotonin receptor sensitivity that lowers the threshold for migraine.[8] Serotonin receptor agonist drugs (eg, sumatriptan, dihydroergotamine) have been reported to prevent migraine-type symptoms after ECT.[4,9] Peripheral electrical nerve stimulation (eg, electroacupuncture) has also been reported to alter the levels of serotonin within the central nervous system (CNS).[10,11] A study in rats demonstrated that electroacupuncture is capable of accelerating the synthesis and release of serotonin (5-HT) and norepinephrine in the CNS.[11]

Since transcutaneous peripheral electrical nerve stimulation has also been reported to produce acute neurochemical changes within the CNS,[12] it is possible that PENS produces its pain-relieving effects by stimulating the release of endogenous opioidlike substances within the CNS. The failure of sham PENS to produce an analgesic effect should not be interpreted to imply that acupuncture is ineffective in this patient population (because the needle probes were not positioned at classical acupoints).

These five cases demonstrate that PENS therapy can be utilized to reduce the need for opioid analgesic medication to treat ECT-evoked headaches in patients "at risk" for developing this complication. Furthermore, PENS therapy may prove to be an effective alternative to serotonin agonist drugs in preventing migraine-type symptoms after ECT. In the future, prospective, randomized, controlled studies will be required to determine the relative efficacy of PENS and serotonin agonist therapies in the prophylactic management of ECT-evoked headaches.

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