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ORIGINAL ARTICLE

Transcutaneous electrical nerve stimulation for postoperative pain relief after arthroscopic rotator cuff repair: a prospective double-blinded randomized trial

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Background: Arthroscopic rotator cuff repair (ARCR) can be associated with significant postoperative pain. Concern for opioid abuse has led surgeons to identify alternative, efficacious methods of postoperative analgesia. To determine whether transcutaneous electrical nerve stimulation (TENS) can have a similarly beneficial effect after shoulder procedures, we conducted a prospective double-blinded randomized trial in patients undergoing outpatient ARCR.

Methods: All patients undergoing ARCR of a full-thickness rotator cuff tear by the senior authors were identified. Patients with a history of recent narcotic use or prior narcotic abuse and those under management of a pain control specialist were excluded. Patients were randomized into 2 groups, active or placebo TENS, and used the device for 4 sessions/day for 45 minutes/session for the first postoperative week. All patients received Percocet 5/325 mg (oxycodone/acetaminophen) for use as rescue pain pills. One-week narcotic consumption and visual analog scale pain scores were compared between groups.

Results: The final analysis included 37 patients (21 active,16 placebo). Baseline and procedural differences were not different between groups. At 1 week postoperatively, patients in the active group had significantly lower pain scores (3.6 ± 2.1 vs. 5.8 ± 1.2; $P = .008$). Postoperative Percocet consumption during the initial 48 hours (12.8 ± 4.7 vs. 17.2 ± 6.3; $P = .020$) and during the first week (25.2 ± 9.9 vs. 33.8 ± 14.3; $P = .037$) was also significantly lower in the active group.

Conclusion: Results from this prospective double-blinded randomized trial demonstrate that compared with placebo TENS, active TENS can result in significantly less pain and reduced opioid use in the immediate postoperative period after ARCR, suggesting that TENS may be potentially useful in a multimodal approach to managing postoperative pain.

Level of evidence: Level II; Randomized Controlled Trial; Treatment Study

Keywords: Transcutaneous electrical nerve stimulation; rotator cuff; opioid; analgesia; placebo; randomized, double-blinded

Approval for this study was obtained from the New York University Langone Medical Center Office of Science and Research Institutional Review Board. Investigation conducted at New York University Hospital for Joint Diseases, New York, NY, USA.

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Arthroscopic rotator cuff repair (ARCR) has been proven to provide significant clinical benefits, such as pain relief and improvement in quality of life, in patients with symptomatic rotator cuff disease.[1,3,8,11,23,27,33] Consequently, the overall volume of ARCRs has increased significantly during the past decade.[16,25]

Whereas ARCR provides excellent short- and long-term clinical results, the procedure is associated with significant postoperative pain.[40] Pain control can affect overall participation in rehabilitation and long-term outcomes and may be reflected in satisfaction levels of the patients. As reimbursements in health care continue to be tied to patient satisfaction, it becomes increasingly more important to identify and implement efficacious and cost-effective methods of analgesia. Historically, traditional methods of postoperative analgesia have centered around oral opioids.[40] Opioids, however, can have significant side effects, such as respiratory depression, ileus, urinary retention, and somnolence.[18,30,31] Furthermore, there is a high potential and concern for opioid dependence. Therefore, recent orthopedic literature has encouraged continued investigation of alternative methods of analgesia to address the "opioid epidemic."[24,26,28,34]

A particular modality of postoperative analgesia that has generated interest is transcutaneous electrical nerve stimulation (TENS).[9,19,35,39] TENS has been reported to reduce postoperative pain scores and opioid consumption after total joint arthroplasty.[2,22,38] The proposed mechanism of action of TENS centers around activation of inhibitory mechanisms for opioid receptors in the brainstem and spinal cord, resulting in a reduction of primary and secondary hyperalgesia.[13,14,20,21] To determine whether TENS can have a similarly beneficial effect after arthroscopic shoulder surgery, we conducted a prospective double-blinded randomized trial in patients undergoing outpatient ARCR. We hypothesized that TENS therapy in the immediate postoperative period after ARCR would result in clinically and statistically significant reductions in both pain levels and prescription narcotic use.

Methods

A computer algorithm was used to randomly assign participants to receive an active TENS or placebo TENS unit. Both patients and operating surgeon remained blinded to allocation group during the entire data collection period. A research associate enrolled all patients by a standard informed consent process and collected outcome data.

Inclusion and exclusion criteria

Inclusion criteria included all patients undergoing ARCR for repair of a full-thickness rotator cuff tear by the senior authors (A.S.R., Y.W.K.). Exclusion criteria included concomitant diagnosis of adhesive capsulitis (0), preoperative use of opioid narcotic medications 2 weeks before surgery (4), prior history of narcotic abuse (2), and those under the management of a pain management specialist (4). In addition, patients with prior experience with TENS (11), those who refused to use Percocet 5/325 mg (oxycodone/acetaminophen) tablets as postoperative pain rescue medication (2), and those who indicated that they were unable to accurately record pain levels and Percocet use for the entirety of the first postoperative week (14) were excluded from enrollment.

Written consent was obtained from all eligible patients before the scheduled arthroscopic shoulder surgery. However, the patients were not enrolled in the study until the ARCR procedure was confirmed. All patients completed a preoperative American Shoulder and Elbow Surgeons (ASES) survey along with visual analog scale (VAS) pain scores to document baseline shoulder function and pain scores.

Surgical technique

All patients enrolled in this study completed the surgical procedure under interscalene nerve block and intravenous sedation at an outpatient surgical center, and their rotator cuff tendons were repaired with 1-6 suture anchors. Concomitant procedures, such as acromioplasty, distal clavicle excision, and biceps tenodesis, were recorded and can be found in Table I.

Table I Demographic, baseline, and operative data

	Active (n = 21)	Placebo (n = 16)	*P* value
Male/female	11/10	7/9	.743
	Mean (SD)		
Age (y)	60.5 ± 11.1	56.4 ± 12.2	.304
Preoperative ASES score	51.6 ± 18.2	49.4 ± 14.3	.699
Preoperative VAS score	4.4 ± 2.5	4.8 ± 2.2	.642
No. of suture anchors used	2.3 ± 1.4	2.5 ± 1.5	.726
No. of concomitant procedures	1.3 ± 0.8	1.3 ± 0.8	.900
	% (N/n)		
Acromioplasty	80.9% (17/21)	75.0% (12/16)	.705
Biceps tenodesis	33.3% (7/21)	43.7% (7/16)	.733
Biceps tenotomy	9.5% (2/21)	12.5% (2/16)	.773
Distal clavicle resection	9.5% (2/21)	6.3% (1/16)	.718

ASES, American Shoulder and Elbow Surgeons; *VAS*, visual analog scale; *SD*, standard deviation.