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Home transcutaneous electrical stimulation to treat children with slow-transit constipation☆

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Abstract

Purpose: This study aimed to test the effectiveness of home transcutaneous electrical stimulation (TES) when patients with slow-transit constipation (STC) were trained by a naive clinician.

Methods: A surgeon was trained to teach the TES method to STC children who then self-administered at home (1 hour a day, 3-6 months) using a battery-powered interferential stimulator. Bowel diaries, PedsQL4.0 questionnaires, and radio-nuclear colonic transit studies were completed before and after treatment.

Results: Thirty-two children (16 female; mean age, 8.3 years; range, 3-17 years) self-administered 3 to 6 months of TES. Three did not return diaries. Group 1 (n = 13) started with less than 3 bowel actions per week, and group 2 (n = 16), with more than 3 bowel actions per week. Defecation frequency increased in 69% of group 1 (mean, 1.4-3.0 per week; $P = .02$). Soiling frequency decreased in 50% of group 2 (5.4-1.9 per week, $P = .04$). Of 13 patients, 7 improved with development of urge-initiated defecation. Abdominal pain decreased in 48% (1.6 episodes per week to 0.9 per week, $P = .06$). Stool consistency improved in 56%. There was significant improvement in child-reported and parent-reported PedsQL Scores. Colonic transit improved in 13 of 25 patients.

Conclusion: Home TES provides a new treatment for STC children, with 50% of treatment-resistant patients benefited. Success requires clinician training and close patient contact. Transcutaneous electrical stimulation increased defecation and reduced soiling.

Slow-transit constipation (STC) is a severe form of chronic constipation and may comprise up to half of the patients with chronic, treatment-resistant constipation [1]. Slow-transit constipation is characterized by slow proximal colonic transit demonstrated readily by nuclear transit scintigraphy (NTS) [2-4]. Surgery is offered as the final resort for STC children with the options including appendicostomy for antegrade continence enemas, colostomy, or colectomy [5].

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Transcutaneous electrical stimulation (TES) has been used by physiotherapists to treat painful musculoskeletal conditions and bladder incontinence for more than 20 years [6,7]. Diarrhea was reported as a side effect when treating bladder incontinence [8]. Transcutaneous electrical stimulation delivered by physiotherapists was shown to improve bowel function in STC children [9], with significantly faster colonic transit on NTS [10]. In a pilot study of STC children trained by the physiotherapist to use a battery-powered interferential machine at home, TES increased defecation frequency and reduced soiling [11]. In this study, we aimed to test the effectiveness of home TES when patients were trained by a naive clinician rather than a physiotherapist.

1. Methods

1.1. Patient group

This was a prospective study of STC children at a tertiary pediatric hospital. This study was approved by the institutional ethics committee (HREC 26173). All children had chronic constipation and soiling for a minimum of 2 years and had failed to respond to medical treatments such as dietary modifications, behavioral therapy, and oral and/or rectal laxatives and were investigated by NTS. The diagnosis of STC was made by NTS as described previously [2-4], specifically if there was $\geq$ 40% radiotracer retained in the transverse colon at 24 hours and/or $\geq$ 30 % at 48 hours or with mean geometric center of $\leq$ 3.0 and/or $\leq$ 4.2 at 24 and 48 hours, respectively. Children who fulfilled the above criteria were offered home TES. They were excluded if they had implants that may be interfered by TES, for example, children with ventriculoperitoneal shunt or cardiac pacemaker. From March 2009 to September 2010, 38 STC children (17 female; mean age, 8.9 years; range, 3-17 years) and parents were recruited, were taught to self-administer TES, and were given an interferential stimulator (see below) to take home. A surgeon (YIY) was trained by a physiotherapist on the principles and use of TES. YIY learned the problems in performing the training from the initial 6 STC patients, then he used this experience to develop the protocol for home TES and the method to collect meaningful data from patients. These 6 patients were not included in the data analysis. This group highlighted the importance of establishing patient-clinician rapport to get good compliance and understanding of TES use, to gather appropriate and useful data from patients on symptoms, and to motivate patients/parents recording and returning their bowel diary. One child already had an appendicostomy for antegrade continence enemas when recruited. No children had TES before this study. At recruitment, it was explained to patients and parents that TES was an experimental and alternative treatment, and consent was obtained for their participation in the trial. It was also explained that surgery or other interventions might be considered if this treatment failed.

1.2. Stimulation regimen

Parents of the children and older children were trained to use the 9-V battery-operated, rechargeable interferential stimulator (INF 4160; Fuji Dynamics Ltd, Kowloon, Hong Kong) by YIY at a 1-hour clinic session with personal demonstration on the use of TES stimulator, proper placement of electrodes, appropriate connections of leads, and with reassurance on the safety of TES for home treatment. Stimulation was performed or monitored by the parent(s) at home (1 hour daily for 3-6 months) with frequent contacts with YIY, by telephone or e-mail, to ensure compliance of treatment and also to ensure continuous recording of bowel diary. Two self-adhesive 4-cm^2 electrodes were placed on the anterior abdominal wall at the level of the umbilicus of the child, and 2 other electrodes were placed on the back between T9 and L2 on either side (Fig. 1) [9]. The current from the electrodes was crossed diagonally from front to back. Interferential treatments delivered a 4-kHz carrier frequency, a beat frequency of 80 to 160 Hz with an intensity of less than 33 mA as previously described [9].

1.3. Outcome measures

Bowel diary and PedsQL4.0 questionnaires were administered before and during treatment. Two groups were identified by defecation frequency before treatment: group 1, less than 3 bowel actions (BAs) per week, and group 2, more than 3 BAs per week. Careful instructions were given to patients and/or parents to record the bowel diary with details on soiling, defecation frequency, stool consistency based on Bristol Stool Scale (BSS), abdominal pain, and sensation to defecate before and during treatment. Primary end points were decreased soiling, increased defecation frequency, improved stool form, and increased sensation of defecation/urge-initiated defecation. As a secondary end point, colonic transit was measured by NTS before and after TES.

The following changes were considered improvement: (1) defecation frequency of more than 3 (for those who started with <3 BAs per week), (2) an increasing proportion of stool consistency to BSS type 4, (3) reducing frequencies of soiling and abdominal pain, (4) increase of PedsQL scores, and (5) faster colonic transit. Patients who required appendicostomy formation for washout after TES were considered as failed therapy.

The effects of TES on STC symptoms were evaluated statistically by paired *t*-test (for parametric measures) or χ^2-test (for nonparametric measures, eg, stool consistency and urge to defecate). $P < .05$ was considered significant.

2. Results

Thirty-eight STC children were enrolled. The first 6 were used for learning, and data were not analyzed. Thirty-two