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A comparative study of transcutaneous interferential electrical stimulation plus behavioral therapy and behavioral therapy alone on constipation in postoperative Hirschsprung disease children

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ABSTRACT

Purpose: We assessed the effectiveness of transcutaneous interferential (IF) electrical stimulation on constipation in postoperative Hirschsprung's disease (HD) patients.
Methods: Thirty HD children (18 boys and 12 girls) with constipation who had no surgical complication were enrolled and then randomly divided into two treatment groups. The control group underwent only behavioral therapy comprising high fiber diet, hydration, toilet training and pelvic floor muscles exercises while; the IF group underwent behavioral therapy plus IF electrical stimulation. Patients underwent anorectal manometry before and 6 months after the treatment. In addition, a complete bowel diary with data on the frequency of defecation per week, stool form and the number of fecal soiling episodes, a constipation score and a visual pain score were obtained from all patients before, after treatment and 6 months later.
Results: Constipation symptoms were improved in 10 (66%) and 4 (26.6%) patients in IF and control groups, respectively at 6 months of follow up ($P < 0.03$). Frequency of defecation per week significantly increased after the treatment in the IF group compared with control group at the 6 months of follow up (5.4 ± 2.1 vs. 3.3 ± 1.8 per week, respectively; $P < 0.009$). In addition, mean pain score was significantly decreased in IF group compared with controls after treatment ($P < 0.05$).
Conclusion: IF electrical stimulation is an effective adjunct to behavioral therapy to overcome symptoms of constipation in postoperative HD patients.

Constipation is an important disorder in children with Hirschsprung's disease (HD). A considerable number of postoperative HD patients suffer from ongoing severe constipation [1]. Constant stool passage is expected after the resection of recto–sigmoid colon in HD patients, yet constipation is observed in one third of the cases [2]. Possible explanations include absence of internal anal sphincter reflex, aganglionic remnants or paradoxical contraction of the external anal sphincter that leads to a functional constipation [1,2]. Infrequent and/or painful defecation, fecal incontinence, and abdominal pain are the most frequent symptoms in these patients that can cause significant psychological and behavioral problems and has a considerable impact on their social integration [1,3,4].

Constipation as a common digestive ailment can easily persist into adulthood if left untreated. Surgical treatment is needed for about one third of the patients with persistent constipation who fail to respond to the routine medical and behavioral treatments [1]. While the use of laxatives, biofeedback therapy and regular behavioral modifications are suggested for chronic constipation, severely constipated cases may need to undergo more radical approaches such as ileo–rectal anastomosis [1,4].

Recently, it was found that constipation can be significantly improved through neuromodulation. [5–7]. Electrical stimulation therapies have long been used for conditions such as bladder dysfunction and pain management [5,8,9]; diarrhea has been reported to be a recurring side effect in many cases. Interferential (IF) current is a form of electrical stimulation administered by the transcutaneous application of alternating medium frequency current with a sinusoidal waveform [9]. It has been previously investigated and has shown beneficial results in children with slow transit constipation [10,11]. As a result transcutaneous electrical stimulation has been proposed as an effective method to

Abbreviations: HD, Hirschsprung's disease; IF, interferential; PFM, pelvic floor muscles; RAIR, rectoanal inhibitory reflex.

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treat constipation [5,12]. The purpose of this study was to assess the effectiveness of transcutaneous IF electrical stimulation on constipation in postoperative HD patients who suffered from constipation.

1. Materials and methods

1.1. Participants

This was a single center, with balanced randomization study conducted in Tehran, Iran. Between May 2008 and October 2014, 30 postoperative HD children with persistent constipation who had no operative complication were recruited from pediatric surgery clinic at Children's Hospital Medical Center in Tehran, Iran. The patients were at least 4 years old and the diagnosis of HD had been confirmed for them through rectal biopsy. All patients had already undergone surgical treatment (transanal Soave pull-through); bowel dysfunction assessments were performed using clinical measures (history, physical examination and barium enema if necessary). Anastomosis stricture, fistula and remaining aganglionic segment after surgical treatment had been ruled out in each patient by history, physical examination, barium enema and rectal biopsy.

Patients who had constipation, positive history for passing of hard stool, and episodes of fecal soiling with irregular emptying of the bowel (Bristol Stool Form 1 and 3) [13] were included in the study. Constipation was defined according to the Rome III criteria [14] as having at least two of the following features for at least two months; a maximum of 2 defecation times per week, at least one episode of incontinence after toilet training, painful defecation and passing of hard stool with large diameter, positive history of fecal impaction or bowel movements that clogged the toilet. Additionally all included patients had failed to respond to at least six months of conventional therapy such as dietary modification and use of laxatives. Patients who had inflammatory or metabolic diseases and complication of surgical procedure were excluded from the study. The treatment protocol was approved by the local ethics committee of Tehran University of Medical Sciences (project n. 29,631). All procedures complied with the Declaration of Helsinki. Patients and their parents were educated about the study procedures and informed consents were signed by all enrolled participants or their medical proxy.

Of 237 HD patients who had been operated during the study period, 57 patients with persistent constipation assessed for eligibility and only 30 patients met inclusion criteria. They were randomly assigned in a balanced randomization study using random block sizes of 2 (ratio; 1:1) into two equal treatment groups. For allocation of the participants, a computer-generated list of random numbers was used. IF group ($n = 15$) underwent behavioral therapy combined with IF electrical stimulation. Control group ($n = 15$) received only behavioral therapy without IF electrical stimulation.

1.2. Primary evaluations

Before entering the study, a complete round of systemic and neurological examination including inspection and evaluation of perineum and its sensation, anorectal manometry, barium enema and rectal biopsy were performed for each participant. Parents were asked to complete a 14-day diary of bowel habits, providing data on the frequency of defecation per week, stool form (as normal, small pieces or large) and the number of painful defecation (abdominal pain) episodes before starting the treatment program, after end of treatment sessions and again 6 months after end of treatment sessions. A visual pain score (scale of 0 to 10, 10 being the worst) and a constipation score questionnaire (scale 0 to 30) [15] were filled out according to the parent's report, both before and after the end of treatment sessions and also after six months of follow up. In addition, children in both groups were evaluated with anorectal manometry before and 6 months after the end of treatment courses.

1.3. Treatment program

Fifteen children within the age range of 5 to 12 entered either the IF or the control group. Both groups received a 15-course treatment program two times per week. In every treatment session, all patients (IF and control groups) underwent behavioral therapy. In addition, in every treatment session patients in the IF group received IF electrical stimulation.

After completion of treatment courses, all patients underwent monthly clinical visits during the 6 months follow up in order to support the training program and to enhance compliance.

1.4. Behavioral therapy

Behavioral therapy included the use of painted pictures and short stories to simply explain gastrointestinal tract and pelvic floor muscle (PFM) functions, use of high fiber diet and fruit, hydration, toilet training and correction of defecation posture to the participating children and their parents. In every treatment session, optimal toilet training, correct defecation posture and use of foot support in small children were practiced. All patients were encouraged to eat fresh fruits, high fiber foods and intake fluid each day, especially water and apple, pear, and/or prune juice. Also, they were asked to avoid high fat foods, such as French fries and processed foods. Prior to starting the training program, the physiology and function of bladder and pelvic floor were explained by a pediatric physiotherapist orally to parents, and using painted pictures for children. Participants in both groups were trained to do regular exercises daily for at least 15 min; exercises included contraction of the PFM for 10 s followed by 30 s of relaxation, abdominal straining and bear-down maneuver. The physiotherapist trained all children to perform accurate PFM contraction, and to hold the contraction while keeping the abdominal muscles relaxed with hands placed on the perineum and abdominal wall or by putting the hands on their perineum and abdominal wall. Stool regulation is a necessary part of behavioral therapy program. Therefore, patients were asked to sit on the toilet 3 times a day after mealtime in a relaxed position for 5 min. This treatment program was also reinforced in every follow-up visit.

1.5. Interferential electrical stimulation

IF therapy consisted of fifteen sessions with 20 min each session and was delivered twice weekly. For all patients in the IF group an IF current device of 126 DS model, double-channel Tavanbakhsh Novin, Tehran, Iran was used, delivering a 4-kHz carrier frequency, a beat frequency sweep covering of 5–25 Hz for a duration of 250 μs, and a repeat time of 6 s with adjustable amplitude (0–50 mA). Electrical stimulation was applied by a pediatric physiotherapist according to the method of Chase et al. [16]. Two rectangular self-adhesive (2.5×3.5 cm) electrodes, one from each channel, were placed on the skin of the anterior abdominal wall bellow the costal margin bilaterally and two other electrodes from each channel were crossly placed on the back between T12 and L4 on either sides of the patients. The current from each channel crossed inside the abdomen. The intensity was increased until the patient declared a strong but comfortable level of sensory awareness with no muscle contractions. Maximum current intensity was below the pain threshold and was tolerated well by the patients.

1.6. Anorectal manometry

Anorectal manometry (Laborie Medical Technologies, Canada) was performed with patients at side-lying position, using an eight-channel water perfusion catheter before and 6 months after end of treatment courses. The catheter (pediatric water perfuse anorectal motility catheter with latex balloon, 4.5 mm, Canada) was inserted in the anal canal, and the mean maximal resting pressure was measured. Special attention was given to the recto–anal inhibitory reflex (RAIR) and sphincter

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