The impact of transcutaneous electrical stimulation therapy on appendicostomy operation rates for children with chronic constipation—a single-institution experience

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Abstract
Purpose: Appendicostomy for antegrade continence enema is a minimally invasive surgical intervention that has helped many children with chronic constipation. At our institution, since 2006, transcutaneous electrical stimulation (TES) has been trialed to treat slow-transit constipation (STC) in children. This retrospective audit aimed to determine if TES use affected appendicostomy-formation rates and to monitor changes in practice. We hypothesized that appendicostomy rates have decreased for STC but not for other indications.

Methods: Appendicostomy-formation rate was determined for the 5 years before and after 2006. Children were identified as STC or non-STC from nuclear transit scintigraphy and patient records.

Results: Since 1999, 317 children were diagnosed with STC using nuclear transit scintigraphy with 121 during 2001 to 2005 (24.2/year) and 147 during 2006 to 2010 (29.4/year). Seventy-four children had appendicostomy formation. For 2001 to 2005, appendicostomy-formation rates for STC and non-STC children were similar: 5.4 per year (n = 27) and 4.8 per year (n = 24), respectively. For 2006 to 2010, appendicostomy-formation rates were 1.2 per year (n = 6) for STC and 3.2 per year (n = 16) for non-STC (χ², P = .04).

Conclusion: Since 2006, appendicostomy-formation rates have significantly reduced in STC but not in non-STC children at our institute, coinciding with the introduction of TES as an alternative treatment for STC. Transcutaneous electrical stimulation has not been tested on non-STC children in this period.

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persistent therapy for chronic constipation despite the variety of medication currently available. Surgery is the last resort offered to these patients to overcome their intractable symptoms and to improve quality of life.

Since its description by Malone et al [6] in 1990, the colostomy with antegrade continence enema (ACE) has been considered as a less invasive surgical option in the treatment of chronic constipation. Before that, numerous extensive surgical procedures have been described, and most of them were associated with high morbidities and high rates of symptom recurrence [7-12]. Antegrade continence enema is considered in the treatment of patients with severe symptoms of chronic constipation, particularly for soiling and incontinence. Appendicostomy formation with ACE has been described in both adults and children and is well tolerated as a treatment for chronic constipation. At our institute, the appendix is used as a conduit, and the stoma is created laparoscopically [13,14]. Appendixostomy has become our preferred procedure to treat children with symptoms of intractable chronic constipation, both for slow-transit constipation (STC) and non-STC patients (including those with persisting symptoms after surgery for anorectal malformation or Hirschsprung disease). Our review in 2005 showed that ACE provided good management in 81% of 42 patients with STC [15].

Recently we began using transcutaneous electrical stimulation (TES) as an alternative treatment to appendicostomy for children with STC since 2006 [16-20]. Transcutaneous electrical stimulation (a noninvasive form of electrical stimulation) using interferential current has been used by physiotherapists to treat painful musculoskeletal conditions and bladder incontinence. Improved symptoms and quality of life in STC children after TES have been reported by our group [16-20]. We aimed to determine the operation rates for appendicostomy before and after the introduction of TES to audit the changes in practice. We hypothesized that the rates for appendicostomy would decrease for STC children after the introduction of TES, if the symptoms were successfully treated.

1. Methods

This is a retrospective review of the treatment options (appendicostomy [13-15] vs TES) taken by children having intractable chronic constipation in a single tertiary institution. From 1999 to 2010, STC was diagnosed by nuclear transit scintigraphy (NTS), as holdup of radioactivity in the transverse colon [21-23], specifically if there was greater than 40% radiotracer retained in the transverse colon at 24 hours and/or greater than 30% at 48 hours or with mean geometric center of less than 2.7 and/or less than 3.7 at 24 and 48 hours, respectively.

Children with intractable chronic constipation (>2 years) attending gastroenterology or medical clinics were referred to a surgeon (JMH) with a special interest in this subject. After the diagnosis of STC had been made (clinical presentation and confirmed on NTS), options of treatment were discussed and offered to parents and child. The options offered were appendicostomy and/or TES. The choice of therapy was decided by the parents/child. Detailed discussion on the management plans for the child’s chronic constipation was conducted by JMH, and the decision made for ACE formation if this option will help to improve the child’s symptoms and with the parent/child committed to the treatment. Moreover, ACE was considered as a surgical option to improve the child’s quality of life if medical therapies had failed. These children were on regular follow-ups, at 3 to 6 monthly intervals. Since 2006, TES began being offered as an alternative treatment for children with STC, avoiding surgery in some. However, for those who did not respond to TES, ACE was offered after TES with the aim to improve their symptoms.

Appendicostomy-formation rate was determined by retrospective review of operation and medical records for all patients in our institute for the 5 years before and after 2006 in 2 subgroups (STC and non-STC), by Y.Y.Y.

Statistical analysis was performed using χ² test, and P < .05 was considered as significant.

2. Results

In the non-STC group (n = 40, Table 1), the indications for appendicostomy formation were anorectal retention with fecal incontinence, neurogenic bowel, previous anorectal malformation, and cystic fibrosis. For non-STC children, appendicostomy formation was 4.8 cases per year (n = 24) from 2001 to 2005 and 3.2 cases per year (n = 16) from 2006 to 2010 (Fig. 1 and Table 2).

Since 1999, 317 children were diagnosed with STC using NTS (Table 2) with 49 cases from 1999 to 2000, 121 cases from 2001 to 2005 (24.2 cases per year), and 147 cases from 2005 to 2010 (29.4 cases per year). Seventy-three children had appendicostomy formation, with 33 in STC children and 40 in non-STC children. The appendicostomy formation in STC patients was 5.4 cases per year (n = 27) from 2001 to 2005, significantly lower with 1.2 cases per year (n = 6) from 2006 to 2010 (P < .05) (Fig. 1, Table 2).

The decrease of appendicostomy-formation rate in STC children was also significantly different from the non-STC

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Indications for appendicostomy in non-STC children from 2001 to 2010</th>
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<tbody>
<tr>
<td>Indication</td>
<td>No. of patients</td>
</tr>
<tr>
<td>Anorectal retention/functional fecal retention</td>
<td>27</td>
</tr>
<tr>
<td>Neurogenic bowel</td>
<td>7</td>
</tr>
<tr>
<td>Anorectal malformation</td>
<td>5</td>
</tr>
<tr>
<td>Cystic fibrosis</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
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group ($\chi^2, P = .04$). The recruitment rate for TES therapy for STC children averaged at 27 cases per year (total = 134) from 2006 to 2010.

From 2006 to 2010, 2 of these 134 STC children with continued poor quality of life had appendicostomy formation after using TES for 3 to 6 months, without improvement of their symptom of soiling.

In the 33 STC children who had appendicostomy formation from 2001 to 2010, 4 children went on to have colostomy formation, and 2 children had sigmoid colectomy (3 colostomy formation and 1 sigmoid colectomy in 2001-2005 and 1 colostomy formation and 1 sigmoid colectomy in 2006-2010).

3. Discussion

At our institute, appendicostomy for ACE has been offered since the 1990s as a surgical treatment in children with symptoms of intractable chronic constipation not responding to medical therapies [13-15]. There was an initial rush in appendicostomy formation in 2000 to 2001 followed by a reduction in number. It was performed almost equally in STC and non-STC children to 2006 (Fig. 1). Our most recent long-term follow-up study has demonstrated the reduction of laxative use and ACE washouts in STC children after TES [24]. Since 2006, the appendicostomy formation rate has fallen significantly, and this coincides with the introduction of TES therapy as an alternative treatment for children with STC. Transcutaneous electrical stimulation was found to be effective in overcoming the symptoms of chronic constipation in STC children, producing improved quality of life [17] as well as increased colonic transit measured objectively by NTS [18], and also improving colonic contractions measured by colonic manometry (unpublished). Because it is noninvasive, TES is offered and accepted as an alternative treatment before considering surgical intervention with 27 patients per year having TES compared with 5 patients per year having appendicostomy formation. Over the most recent 5 years (2006-2010), 2 of 134 patients had appendicostomy formation after TES. With the increasing success of TES as a promising new noninvasive option to treat STC, it is being considered before appendicostomy or other surgery.

Surgery is the last resort to treat chronic constipation and should only be considered if medical therapy has failed. Until recently, conventional surgical management of treatment-resistant constipation comprised either a bowel resection (colectomy) and ileorectal/cecorectal/ileosigmoid anastomosis or a segmental colectomy, with or without the formation of a stoma [7-10,25-34]. The incidence of surgical intervention was almost similar to the prevalence of STC [25,27,35,36], which often failed to respond to aggressive medical therapy. These procedures are invasive and carried with them high morbidity and mortality as frequently reported [7-10,32,37,38]. In addition, favorable long-term outcomes have been disappointing in most studies [39-42].

In recent years, however, the use of a continent appendix stoma as first described by Malone et al [6,43] has become...
The effectiveness and the safety of TES therapy in chronic constipation are promising but still in an experimental stage. With more centers showing interest in using TES to treat chronic constipation, we hope that a multicenter study will be possible.

This study is based on 10 years’ experience of a single institute and has shown that since the introduction of TES, it has reduced our rate of surgical intervention for children with STC, consistent with the early promising results in our trials. For fecal incontinence in children with outlet obstruction after pull-through operations, however, ACE is still required because TES has not been tested formally in this group.

We are aware that because we have promising results of using TES to treat children with STC, we will have the tendency to offer this treatment to considering surgical intervention, and hence, there will be selection bias in the choice of therapy. However, if TES was not effective in overcoming the symptoms of children with STC, they would present again with recurrent symptoms and be given appendicostomy. This occurred in only 2 of 134 patients treated by TES (2006-2010) who had persistent symptoms.

In conclusion, the operation rates in our institute for appendicostomy formation have reduced significantly in children with STC, coinciding with the introduction of TES as a successful alternative treatment. By contrast, appendicostomy formation rate has not changed in non-STC children during this period, and it is not yet known whether TES is effective in children with outlet obstruction.

### References


