Pediatr Surg Int (2008) 24:685–688
DOI 10.1007/s00383-008-2130-z

ORIGINAL ARTICLE

Antegrade continence enema (ACE): current practice

Chandrasen Kumar Sinha · Alka Grewal · Harry C. Ward

Accepted: 27 February 2008 / Published online: 12 April 2008

Abstract The purpose of this study was to assess current status of antegrade continence enema (ACE) procedure taking into account the recent improvement in the technique and outcome. Reviewing our record of 48 patients with ACE procedure performed between January 2002 and May 2007, we found that the underlying diagnoses were idiopathic constipation in 56%, anorectal malformation in 31%, spina bifida in 8% and Hirschsprung's disease in 4%. Mean age of operation was 10.7 years. Appendix was used as stoma in 73% of cases. Stomal stenosis requiring revision was seen in 6% of cases and continence was achieved in 92% of cases. A systematic search of database was performed for the same period. Twenty-four studies describing 676 patients were found. The mean age was 10 years and various sites used for ACE were, right side of abdomen in 71%, umbilicus in 15% and left side of abdomen in 14%. The incidence of open and laparoscopic procedures were 87 and 13%, respectively. Appendix was used for stoma in 76% procedures. Other operative modalities were retubularised colon, retubularised ileum, caecal button and caecostomy tube, etc. The mean volume of enema fluid used was 516 ml. The mean evacuation time was 42 min. Stomal stenosis requiring revision was seen in 13% of cases. Continence was achieved in 93% of cases. There has been significant improvement in the outcome during last 5 years in comparison to the outcome published in late 1990s. Advancements in techniques, better-trained stoma care nurses and better stoma appliances could have played major role in this success.

C. K. Sinha (✉) · A. Grewal · H. C. Ward
The Royal London Hospital, London, UK
e-mail: cksinha@btinternet.com

Keywords Antegrade enema · Faecal incontinence · ACE procedure

Introduction

The first description of antegrade colonic irrigation was made over 100 years ago [1]. The concept of antegrade continence enema (ACE) procedure was proposed and popularised by Malone et al. [2], which provided a continent conduit on the abdominal wall. The goal was to improve the quality of life in children with faecal incontinence. The purpose of this study was to review our practice against a systematic review of the ACE procedure during the last 5 years, in the context of indications, operative modifications, complications and outcomes.

Patients and methods

We retrospectively reviewed our experience of ACE procedures performed between January 2002 and May 2007. For most patients in our series, the appendix was used in orthotopic manner with imbrication around the base of appendix, but the caecal wall was not fixed to the abdominal wall. ACE stoma was placed at the right lower quadrant of the abdomen and a 'V' flap was fashioned at skin level to prevent stenosis. These outcomes were compared with the other publications during the same period.

A systematic search of English literature was performed. Data from the patients who had undergone the ACE procedures (reports published between January 2002 and May 2007) were reviewed retrospectively. Studies that did not record specified variables were excluded from the analysis. Studies that reported data as median and range, were pooled using established formulas to predict mean and variance [3].

Results

Salient features of our study and the review of literature have been summarised in Table 1. The most common indication of ACE in our series was idiopathic constipation, whereas, spina bifida was the commonest indication in the literature review. We used conventional open surgery in all the patients, whereas, in the literature 13% of cases were found to be performed laparoscopically. As described in the literature, appendix was the most common conduit used by us as well. Various other methods described in the literature were, retubularised colon, retubularised ileum, left sided percutaneous endoscopic colostomy (PEC), caecal button, caecostomy tube, laparoscopic assisted caecal button and laparoscopic assisted percutaneous colostomy (LAPEC). In our series, full clean status (continence) was achieved in 92% of cases. Of them, 81% achieved this status after ACE alone and a further improvement in 11% was achieved by the use of Chait tube in three, internal sphincterotomy in one child (with ultrashort segment Hirschsprung disease) and excision of megarectum in another child (with anorectal malformation). In the literature review, the final outcome was described in 508 patients and overall continence was achieved in 93%. In 346 patients, continence was further classified into total (78%) and partial continence (16%). In the rest 162 patients, outcome was described as fully continent or incontinent (failure). In the latter group, full continence was achieved in 91% of cases. Our enema regimen [4] was bisacodyl stimulant enema, because of small volume and ease of administration. In the review of literature, use of many types of enema fluids (i.e. normal saline, golytely®, soap water, glycerol and various other combinations) were found. The mean volume of enema fluid used was 516 ml (range 180–3,000). Mean evacuation time of enema fluid was 42 min(range 5–60). Only four reports mentioned about transit study. Stomal stenosis requiring revision was reported in 13% of the cases and in 14% patients, leak of enema fluid was a significant problem.

Table 1 Current practice in ACE procedure

ACE features	Review of literature ($n = 676$)	Our series ($n = 48$)
Mean age	10.7 years	10 years
Indication of ACE		
Spina bifida	67% ($n = 452$)	8% ($n = 4$)
Idiopathic constipation	17% ($n = 113$)	56% ($n = 27$)
Anorectal malformation	10% ($n = 66$)	31% ($n = 15$)
Hirschsprung's disease	2% ($n = 11$)	4% ($n = 2$)
Other	5% ($n = 34$)	
Site		
Right	71% ($n = 478$)	100% ($n = 48$)
Left	14% ($n = 93$)	
Umbilicus/periumbilical	15% ($n = 105$)	
Technique		
Open procedure	87% ($n = 588$)	100% ($n = 48$)
Laparoscopic	13% ($n = 88$)	
Conduit used		
Appendix	76% ($n = 512$)	73% ($n = 35$)
Retubularised colon	12% ($n = 84$)	19% ($n = 9$)
Retubularised ileum	4% ($n = 29$)	8% ($n = 4$)
Left sided PEC	2% ($n = 14$)	
Caecal button	2% ($n = 12$)	
Caecostomy tube	1% ($n = 10$)	
Laparoscopic assisted caecal button	1% ($n = 7$)	
LAPEC	1% ($n = 7$)	
Complications		
Stomal stenosis needing revision	13% (74/549)	6% (3/48)
Leak	14% (55/397)	15% (7/48)
Outcome ($n = 508/48$)		
Continence	93% ($n = 472$)	92%($n = 44$)
Incontinence	7% ($n = 36$)	8% ($n = 4$)
Mean follow-up period in months	22 (range 6–64)	24 (range 6–48)

Discussion

The ACE procedure has now been widely accepted as an effective treatment for faecal incontinence and constipation. Early experiences have been published in the past [5, 6]. We tried to look into our practice of ACE procedure during the last 5 years which is comparable with current published results. Variations in the management of the ACE procedure are numerous as described below with reference to our practice.

The original Malone technique was a right lower abdomen incision for dissecting appendix and a small cuff of caecum with its preserved blood supply. The tip of appendix was amputated and sutured to the mucosa of caecum after creating a submucosal tunnel through a taenia of the caecum. The seromuscular layer of caecum was sutured over appendix. The idea of reverse implantation of the appendix was to create a non-refluxing conduit. The stoma was formed at a previously marked site by anastomosing the cuff of caecum to a broad based skin flap [2]. This technique was soon taken over by orthotopic appendicocaecostomy with maintaining native blood supply to the appendix [7–9]. It was advised to imbricate around the base of appendix and also caecal fixation to the inside of abdominal wall to make it continent [7, 9]. However, in a recent study it was found that caecal fixation and wrap plus fixation was unnecessary [10]. Some authors favoured

placing the stoma into the umbilical fold, rendering it virtually invisible to others [9, 11]. Other authors preferred to use the left side of abdomen as stoma [12–14]. While most (over 75%) of the authors used the appendix to make the stoma, others used retubularised ileum, open caecal button, caecostomy tube and retubularised colon (descending, transverse and sigmoid) [14–19]. The recent trend is towards minimally invasive procedures. Various operative techniques used successfully were laparoscopic assisted ACE, laparoscopic assisted caecal button, laparoscopic assisted percutaneous colostomy and percutaneous endoscopic caecostomy and colostomy [10, 13, 20–24]. We have kept our techniques for the formation of the stoma as simple as possible; with adherence to the original concept of delivering the stimulus for evacuation of the whole large bowel into the caecum as described above.

Stomal stenosis and leaks were the most common complications of ACE procedure. Various methods described in the literature for reducing the incidence of stenosis were insertion of Chait tube, ACE stopper and combined approach of maceoscopy and colonoscopy, etc. [25–27]. In our series, we found stenosis requiring revision in only 6% of cases. This could probably be due to splitting the tip of appendix and using a 'V' flap of skin. Leakage from stoma was found in 14% of cases of the review as opposed to 15% of our series. Half of our cases responded to conservative treatment and the rest required Chait tube. The options described in the literature for leaking ACE were caecal imbrication around the appendix, stoppers, placement of tubes (Chait or silastic) and injection of Deflux® into the submucosal layer at the junction of conduit and colon [7, 9, 25–28]. Other important complications of ACE procedures are abdominal pain, granulation tissue, stomal infection, stomal prolapse, perforation, peritonitis and adhesion-obstruction. We treat granulations with a cream containing triamcilonone and topical antibiotics with good results.

The main indication of ACE procedure was overflow incontinence but gradually this method has been tried in various causes of constipation with increasing success. In most series, this procedure was offered when maximal medical treatment failed. Curry et al. [6] described the success of ACE in three categories: full success, partial success and failure. The fully continent group was totally clean or with minor leakage on the night of enema. The partial continent group was having significant stomal/rectal leakage and occasional major leaks. They still had to wear protection but it was perceived as an improvement by the child and/or by the parent. Failure was described as regular soiling or continued constipation with no perceived improvement, whatsoever. Based on this description, full success, partial success and failure rates were reported as 78, 16 and 6%, respectively (in the literature review). Some series classified their outcome as full continent (success) or incontinent (failure). Using this description, the success and the failure rates were 91 and 9%, respectively. It can be speculated that probably these authors have added their partially successful cases in either groups depending on their final impression. Other studies have used scoring system (e.g. modified Holschneider and Tempton). We feel that partial success is a vague term in defining success. Depending on the clinical impression, patients' and parents' satisfaction, final outcome should be divided into two extreme categories, i.e. total continent or incontinent (as used in our study). The patients who are still improving should be kept on incontinent side till a stable status is achieved.

Faecal incontinence has detrimental emotional effect on a child. It has been shown in various studies that ACE improves the quality of life significantly [29–31]. Most of these assessments were done with structured questionnaires answered either on the phone or by mail. Compliance of the patient and family is an important issue in the success of ACE. Most of the authors mentioned that, when discussing the outcome of ACE procedure with patients and families, the realistic target should be described as significant improvement rather than perfection or complete cure.

The ACE procedure has had a successful journey so far. In comparison to the initial experience of 300 cases published in 1999, where overall success rate was 79% and stomal complication was 30% [6], the outcome of current practice is much better. With advancements in facilities (especially increasing expertise of stoma nurses and stoma appliances), the ACE procedure has a promising future. The ACE procedure is not a replacement of conventional medical treatment, rather it is indicated when this has failed or has become intolerable for patients and families. Presence of dysmotility (slow transit) is an important cause of failure which should always be kept in mind. Sacral nerve stimulation (SNS) is a newer, but costly modality of minimally invasive procedure in the treatment of slow transit constipation, where a pulse generator and electrodes are implanted to stimulate sacral nerves. Studies in adults have shown it to be effective, however, before its use in children more evidence, perhaps based on colonic manometric and rectal sensitivity findings, is required (for its indications, especially against a background of potential improvement in children) [32, 33].

References

1. Cataldo PA (1993) History of stomas. In: Mackeigan JM, Kataldo PA (eds) Intestinal stomas: principles, techniques and management. Quality Medical Publishing, St Louis, pp 3–37
2. Malone PS, Ransley PG, Keily EM et al (1990) Preliminary report: the antegrade colonic enema. Lancet 336:1217–1218

3. Hozo SP, Djulbegovic B, Hozo I (2005) Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol 5:13 doi:10.1186/1471-2288-5-13
4. Keshtgar AS, Ward HC, Clayden GS (2004) Diagnosis and management of children with intractable constipation. Semin Pediatr Surg 13:300–309
5. Graf JL, Strear C, Bratton B et al (1998) The antegrade continence enema procedure: a review of the literature. J Pediatr Surg 33:1294–1296
6. Curry JJ, Osborne A, Malone PSJ (1999) The MACE procedure: experience in the United Kindom. J Pediatr Surg 34:338–340
7. Griffiths DM, Malone PS (1995) The Malone antegrade continence enema. J Pediatr Surg 30:68–71
8. Squire R, Kiely EM, Carr B et al (1993) The clinical application of the Malone antegrade colonic enema. J Pediatr Surg 28:1012–1015
9. Levitt MA, Soffer SZ, Pena A (1997) Continent appendicostomy in the bowel management of fecally incontinent children. J Pediatr Surg 32:1630–1633
10. Koivusalo A, Pakarinen M, Rintala RJ (2006) Are cecal wrap and fixation necessary for antegrade colonic enema appendicostomy? J Pediatr Surg 41:323–326
11. Koyle MA, Kaji DM, Duque M et al (1995) The Malone antegrade continence enema for neurogenic and structural fecal incontinence and constipation. J Urol 154:759–761
12. Kim SM, Han SW, Choi SH (2006) Left colonic antegrade continence enema: experience gained from 19 cases. J Pediatr Surg 41:1750–1754
13. Rawat DJ, Haddad M, Geoghegan N et al (2004) Percutaneous endoscopic colostomy of the left colon: a new technique for management of intractable constipation in children. Gastrointest Endosc 60:39–43
14. Liloku RB, Mure PY, Braga L et al (2002) The left Monti–Malone procedure: preliminary results in seven cases. J Pediatr Surg 37:228–231
15. Lee SL, Rowell S, Greenholz SK (2002) Therapeutic cecostomy tubes in infants with imperforate anus and caudal agenesis. J Pediatr Surg 37:345–347
16. Yerkes EB, Rink RC, Cain MP et al (2002) Use of a Monti channel for administration of antegrade continence enemas. J Urol 168:1883–1885
17. Casio S, Flett ME, Hunt D et al (2004) MACE or caecostomy button for idiopathic constipation in children: a comparison of complication and outcomes. Pediatr Surg Int 20:484–487
18. Surfield GA, Andrewa D (2005) Tapered terminal ileum conduit for antegrade continence enemas. Pediatr Surg Int 21:989–990
19. Herndon CDA, Cain MP, Casale AJ et al (2005) The colon flap/extension malone antegrade continence enema: an alternative to the Monti–Malone antegrade continence enema. J Urol 174:299–302
20. Casale P, Grady RW, Feng WC et al (2004) A novel approach to the laparoscopic antegrade continence enema procedure: intracorporeal and extracorporeal techniques. J Urol 171:817–819
21. Yagmurlu A, Harmon CM, Georgeson KE (2006) Laparoscopic cecostomy button placement for the management of fecal incontinence in children with Hirschsprung's disease and anorectal anomalies. Surg Endosc 20:624–627
22. Antao B, Ng J, Robert J (2006) Laparoscpic antegrade continence enema using a two-port technique. J Laparoendosc Adv Surg Tech A 16:168–173
23. Kim J, Beasley SW, Maoate K (2006) Appendicostomy stoma and antegrade colonic irrigation after laparoscopic antegrade continence enema. J Laparoendosc Adv Surg Tech A 16:400–403
24. Biryani D, Barrow E, Hodson P et al (2007) Endoscopically placed caecostomy buttons: a trial ACE procedure. Colorectal Dis 9:373–376
25. Chait PG, Shandling B, Richards HM et al (1997) Fecal incontinence in children: treatment with percutaneous cecostomy tube placement: a prospective study. Radiology 203(3):621–624
26. Lopez PJ, Ashrafian H, Clarke S et al (2007) Early experience with the antegrade colonic enema stopper to reduce stomal stenosis. J Pediatr Surg 42:522–524
27. Farrugia MK, Melville D, Boddy SA (2007) Coming face to face with the stenotic MACE—combined Maceoscopy and colonoscopy (the rendez-vous procedure): a preliminary report. J Pediatr Surg 42:685–687
28. Koivusalo A, Pakarinen MP, Rintal RJ (2006) Treatment of a leaking ACE conduit with deflux injection. Pediatr Surg Int 22:1003–1006
29. Yerkes EB, Cain MP, King S et al (2003) The Malone antegrade continence enema procedure: quality of life and family perspective. J Urol 169:320–323
30. Aksnes G, Diseth TH, Helseth A et al (2006) Appendicostomy for antegrade enema: effect on somatic and psychsocial functioning in children with myelomeningocele. Pediatrics 109:484–488
31. Matrix KD, Novotny NM, Shelley AA, et al (2007) Malone antegrade continence enema (MACE) for fecal incontinence in imperforate anu improves quality of life. Pediatr Surg Int 23(12):1175–1177 (Epub ahead of print)
32. Dinning PG, Fuentealbas SE, Kennedy ML et al (2005) Sacral nerve stimulation initiates propagating pressure waves throughout the colon in patients with slow transit constipation. Neurohastroenterol Motil 17:A76
33. Wong SW, Lubowski DZ (2007) Slow transit constipation: evaluation and treatment. Anz J Surg 77:320–328