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SURGICAL TECHNIQUES AND INNOVATIONS

Anorectal Malformations: the Brooke Ileostomy Technique Moves to the Colon

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Abstract
Colostomy is considered by most authors the first step of treatment for neonates affected by high or intermediate anorectal malformations (ARMs). However, for this subset of patients, the debate between total diverting colostomy (TDC) and loop colostomy (LC) is still ongoing among the paediatric surgeons community. The aim of this paper is to present our experience consisting in applying the Brooke technique, until now used only for ileostomy, in order to perform a functionally diverting loop colostomy (FDLC) in patients with high or intermediate ARMs. At our institution, from January 2014 to December 2018, 12 patients (6 males and 6 females) with high or intermediate ARMs underwent colostomy according to the Brooke ileostomy technique. The only complication observed was mild proximal stoma prolapse in 1 patient. Creation and closure of the stomas were easy, and the final cosmetic result was very satisfying in all patients. We believe that this is a promising technique since it might overcome the drawbacks of a TDC as it is less invasive, easier, and quicker to perform. Furthermore, it guarantees final better cosmetic results, albeit functioning as a TDC.

Keywords Anorectal malformations · ARMs · Colostomy · Loop colostomy · Brooke ileostomy · Stoma

Introduction

Many neonatal surgeons consider a diverting colostomy as relevant to the early management of obstructive congenital bowel anomalies such as imperforate anus and cloaca [1]. In a seminal publication, Peña proposed a divided (split) descending colon colostomy to avoid loop prolapse, urinary tract infections, and faecaloma within the megarectum [2]. Debate continues between a divided (split) colostomy (DC) and a loop colostomy (LC), although a recent retrospective study found no difference for prolapse, UTI, and megarectum [3].

This paper presents our 4-yr experience, from January 2013 to December 2018, with a neonatal defunctioning colostomy created according to the Brooke technique for ileostomy in a pilot study of 16 patients (8 males and 8 females) with ARMs (Table 1). Construction and closure of the stoma were less invasive, with a final aesthetic scar that was pleasing to the parents. Complications were limited to one minor proximal loop prolapse.

Patients and Methods

From January 2014 to December 2018, patients with ARMs were managed with a neonatal Brooke-style colostomy based on Brooke's principles for an ileostomy. There were 13 children with an imperforate anus and a rectal anomaly and 2 children with a cloaca (Table 1). Another male child with a caudal duplication syndrome had a duplication of the penis, of the colorectum, and of the bladder, with each rectum ending separately in a fistula on each urethra. The colon was single from the descending colon proximally.

The medical records were reviewed for colostomy-related complications, namely, local infection, dehiscence, bleeding, prolapse, stoma retraction, urinary tract infection, rectal faecaloma, rectal dilatation requiring subsequent rectal tapering, and for the aesthetic result after stoma closure.

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Table 1 ARM's type

N patients	ARM's type
4	Imperforate anus and recto-bulbar fistula
2	Imperforate anus and recto-prostatic fistula
6	Imperforate anus and recto-vestibular fistula
1	Imperforate anus without fistula
2	Cloaca with a < 3-cm common channel
1	Caudal duplication syndrome with 2 fistulae ending separately as a fistula to each urethra

The Brooke-Style Colostomy

Through a 2-cm oblique skin crease incision in the left iliac fossa the distended sigmoid colon is deflated with a 19-gage venous cannula, or a 4F catheter passed through an antimesenteric absorbable 6/0 purse-string suture, to allow easy exteriorization of the transition between the sigmoid and descending colon. The proximal portion, which can be widely exteriorized, is identified. In patients with recto-vestibular fistula, a 6F rectal catheter passed into the fistula facilitates identification of the distal part. The exteriorized 2 cm of the adjacent loops are sutured to each other and attached circumferentially at the abdominal wall. Following Brooke's ileostomy technique, the distal loop is opened 2 mm above the skin level for almost the half circumference, and the distal margin sutured to the skin. The proximal limb is everted on itself to produce a nipple effect and to overlie the distal stoma, through which the distal colon and rectum are washed (Figs. 1 and 2). A high pressure distal colostogram can be performed, before the definitive repair, by introducing the contrast medium through a Foley catheter inserted in the distal stoma.

Results

Healing was uneventful without infection or wound dehiscence. There was one minor proximal loop prolapse that was reduced manually, and a child with a recto-prostatic fistula and bilateral Grade-3 vesicoureteral reflux developed a urinary tract infection. Rectal tailoring was undertaken for another child during the reconstruction for imperforate anus.

Colostomy closure was routine with mobilization and resection of the stoma and a wide end-to-end anastomosis.

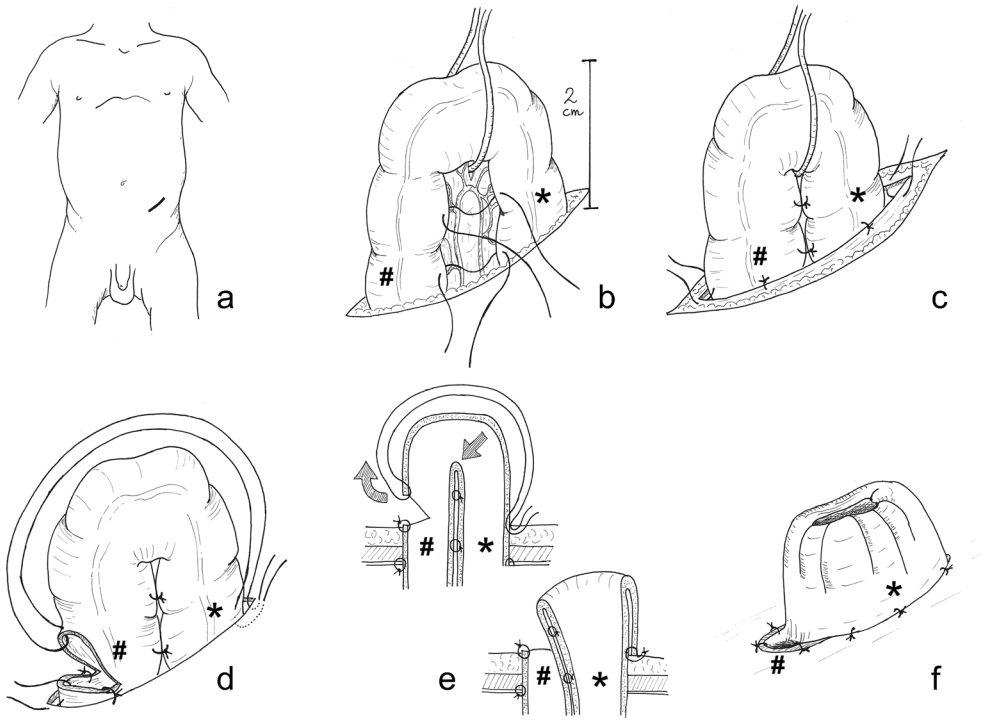

Fig. 1 **a** The abdominal cavity is entered by an approximately 2-cm-long incision on the left flank; **b** the two limbs of the loop, which are two cm in length, are joined together with two seromuscular stitches; **c** the loop is sutured circumferentially with 6 absorbable interrupted stitches to the peritoneum and afterwards to the fascia; **d** by bipolar forceps an almost semi-circumferential incision of the colic wall is performed at the distal end of the colic loop, 2 mm above the skin surface, and the distal edge of the colic incision is secured to the skin by three full thickness stiches; **e** 3 absorbable stiches are placed starting from the skin 5 mm away from the cutaneous edge, then through the seromuscular layer 2 mm above the skin level, again to the seromuscular layer at the level of the proximal edge of the incision and eventually back to the skin at 2 mm from the cutaneous edge. These stitches are placed at 12, 4, and 8 o'clock and they allow the proximal limb to be everted; **f.** the proximal stoma slightly protruding looks like a small trunk that covers and then closes the distal one which lies conversely on the skin plane like a cutaneous fistula. (* Proximal loop; # distal loop)

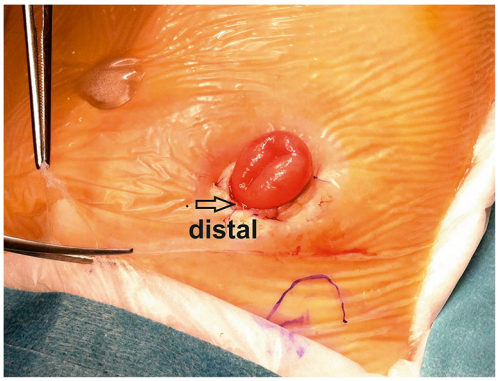

Fig. 2 Final aspect with distal stoma covered by proximal everted limb

Healing was uncomplicated, and the final mature scar was aesthetically acceptable to the parents.

Discussion

There is still debate surrounding a neonatal colostomy as the first step in the management of ARMs and the best technique for its construction [1]. Peña stated that a DC instead of a LC was mandatory to avoid faecal spillover to the distal loop and formation of faecaloma in the rectum, which he considered responsible for post-operative infection, anorectal anastomotic dehiscence, and megarectum [2]. A significant exposure was necessary to widely separate the proximal and distal stomata for the colostomy bag to overlie only the proximal stoma. He advocated that there was a lesser incidence of prolapse and easier accessibility of the distal stoma for contrast studies prior to full reconstruction [2]. However, a second laparotomy was necessary at the time of stoma closure, with a less satisfactory scar. Recent studies have shown no difference in complications between DC and LC [4, 5]. Despite this evidence, many paediatric surgeons still favour the Pena widely split diversionary colostomy [5].

The present emphasis on minimally invasive surgery and abdominal and scar aesthetics renders the additional surgery for stoma construction and closure, and a poorer scar, less acceptable to parents and to many paediatric surgeons. We propose the Brooke-style colostomy because it has the advantages of a widely divided colostomy without its drawbacks. Even though both stomata lie within the colostomy bag, the everted proximal limb tends to cover over the distal stoma and to not allow faecal spillover into the distal loop. In our small pilot study of 12 patients over 4 years, complications have been limited to one minor proximal loop prolapse that was reduced manually and to one urinary tract infection in a child with a recto-bulbar fistula and concomitant Grade-3 bilateral vesicoureteric reflux.

Conclusions

We recommend the Brooke-style colostomy as a better alternative to the DC and the LC since it satisfies the necessary criteria of avoiding faecal spillover into the distal loop, gives easy access for distal loop washout and studies, and particularly because of the lesser surgery required for construction and closure, the minimal complications, and a superior aesthetic residual scar.

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Author Contributions Giovanni Boroni Manuscript writing, operative work
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Anna Lavinia BulottaExtensive literature search, data analysis
Filippo Parolini Data analysis, Reviewing of the manuscript
Susanna Milianti Data analysis
Paolo Orizio Data acquisition
Daniele AlbertiConceptualization, study design, operative work

Compliance with Ethical Standards

Conflict of Interest We hereby declare that the following information relevant to this article are true to the best of our knowledge:
- The above-mentioned manuscript has not been published, accepted for publication, or under editorial review for publication elsewhere and it will not be submitted to any other journal while under consideration for publication in your Journal.
- We have no financial relationship relevant to this article to disclose; there is not any conflict of interest relevant to this article.
- All authors participated in the concept and design, analysis and interpretation of data, and drafting and revising the manuscript, and they have approved the manuscript as submitted.

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