Journal of Pediatric Surgery 52 (2017) 783–790

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Loop versus divided colostomy for the management of anorectal malformations: a systematic review and meta-analysis

Fouad Youssef, Ghaidaa Arbash, Pramod S. Puligandla, Robert J. Baird *

The Division of Pediatric General and Thoracic Surgery, The Montreal Children's Hospital of the McGill University Health Centre, Montreal, Quebec, Canada, H4A 3J1

ARTICLE INFO

Article history:
Received 17 January 2017
Accepted 23 January 2017

Key words:
Anorectal malformation
Loop
Divided
Systematic review
Meta-analysis

ABSTRACT

Background: The ideal colostomy type for patients with anorectal malformations (ARM) is undetermined. We performed a systematic review and meta-analysis of short-term complications comparing loop and divided colostomies.
Methods: After review registration (PROSPERO: CRD42016036481), multiple databases were searched for comparative studies without language or date restrictions. Gray literature was sought. Complications investigated included stomal prolapse/hernia/retraction, wound infections, and urinary tract infections (UTIs). Two reviewers independently assessed study eligibility and the quality of included studies. Meta-analysis of selected complications was performed using Revman 5.3, with $p < 0.05$ considered significant.
Results: Twenty-six studies were included, and four were multi-institutional. Reporting standards were highly variable. Studies scored between 6 and 9 of possible nine stars on the NOS. Overall, 3866 neonates with ARM were incorporated, in which 2241 loop colostomies and 1994 divided colostomies were reported. Of 10 studies reporting short-term complications, the overall rate was 27%. Meta-analysis demonstrated no significant difference in the incidence of UTIs, (OR: 2.55 [0.76, 8.58], $p = 0.12$), while loop colostomies had a significantly higher prolapse rate (See figure). No publication bias was noted.
Conclusions: A colostomy for patients with an ARM is a source of considerable morbidity. Divided colostomies reduce the risk of subsequent prolapse and may represent the preferred approach.
Level of evidence: 3A

Anorectal malformations (ARM) encompass a wide range of congenital deformities that often necessitate complex reconstructive skills. Prior to definitive repair, colostomies are commonly performed to divert the fecal stream [1]. Two variations of colostomy are performed; loop, and divided colostomies, both of which have considerable risks of post-operative complications related to the stoma site (prolapse, retraction, stenosis) or inadequacy of diversion (urinary infections) [2]. A loop colostomy involves fixing an opened intestinal loop (typically descending colon) to one incision in the abdominal wall without complete transection of the intestine. On the other hand, a divided colostomy entails complete division of the bowel loop resulting in a proximal colostomy and separated distal mucous fistula that are typically sutured to the abdominal wall through separate incisions. While the traditional approach has favored a divided colostomy, [3] newer publications seem to suggest comparable results using a loop [4].

Both stoma options are associated with specific merits and drawbacks and no consensus has been reached regarding the optimal procedure for a given anatomic configuration. The relative ease of creation and eventual takedown of the loop colostomy is generally balanced against the more definitive diversion associated with a true divided colostomy. As such, the aim of this study is to compare the short-term outcomes between the loop and divided colostomies in patients with anorectal malformation via a formal systematic review and meta-analysis.

1. Materials and methods

1.1. Search strategy

The protocol of this review was prospectively registered in PROSPERO (CRD42016036481), (http://www.crd.york.ac.uk/PROSPERO/). With no date or language restrictions, the following online sources were searched: AMED, PubMed, Africa-wide information, EMBASE, Global Health, Biosys, MEDLINE, Cochrane, LLAOS, and Web of Science in January 2016. With the guidance of our institution's scientific librarian, each of these databases was approached through a particular search strategy in accordance with the database design (Appendix A). The reference lists of the included studies were also hand-checked for any pertinent articles. Gray literature was sought, by exploring the abstracts of the relevant conferences and contacting available authors for unpublished data when possible. Only comparative studies were included in the qualitative analyses, and of these comparative studies, only studies that looked solely at ARM were included in the quantitative analyses.

1.2. Definitions

Through the course of this review, the following definitions were used:

A. Loop Colostomy: The use of the opened bowel loop as a stoma without the complete splitting of the intestinal wall which resulted in one stoma opening on the skin.

* Corresponding author at: Division of Pediatric General and Thoracic Surgery, The Montreal Children's Hospital, 1001 Decarie Boulevard, Montreal, QC, H4A 3J1.
E-mail address: robert.baird@mcgill.ca (R.J. Baird).

http://dx.doi.org/10.1016/j.jpedsurg.2017.01.044
0022-3468/

B. Divided Colostomy: The complete splitting of the bowel loop resulting in two stoma openings on the skin with two separated skin incisions.

1.3. Inclusion and exclusion criteria

According to 'PICOS' format, inclusion criteria for this review were the following:

- Population: All infants born alive with the diagnosis of ARM and who underwent either loop or divided colostomy at any point during their management.
- Intervention: Loop colostomy irrespective of the portion of large bowel where the stoma was performed.
- Control: Divided "split" colostomy irrespective of the portion of large bowel where the stoma was performed.
- Outcomes: The primary outcome was the incidence of stoma prolapse. Secondary outcomes included the following stoma-related complications: urinary tract infection, parastomal hernia, skin excoriation, stoma retraction, wound infection, stoma necrosis, stoma stricture, and stoma bleeding.
- Study type: Only comparative studies that incorporated newborns with ARM were included in this review; studies that looked only at ARM patients were included for quantitative meta-analyses.

Two investigators twice examined the resulted titles independently; the following exclusion criteria were applied: any study that did not include ARM patients, basic science or animal reports, case reports, and non-comparative studies. Identified abstracts were examined and further exclusions were applied to all non-relevant reports and to all the studies that did not contain either the primary or the secondary outcomes of this review. Full texts were retrieved for the studies that were considered pertinent by either reviewer. Full consensus of incorporated studies was then reached through discussion under the guidance of the senior author (RB).

1.4. Quality of included studies

Two reviewers independently evaluated the quality of included studies. The Critical Appraisal Skills Programme (CASP) Randomized Controlled Trials Checklist was used to evaluate available randomized controlled trials (RCT); [5] The Newcastle-Ottawa Scale (NOS) for case–control studies was used to critically appraise the quality of included case–control papers [6]. The NOS is designed to assess study quality in three broad domains: the selection of the study groups, comparability between the groups, and ascertainment of exposure. Stars are given for each of the quality items met by the study; every study gains a score of a maximum nine stars.

1.5. Statistical analysis

Meta-analysis was performed for primary and selected secondary outcomes using RevMan 5.3 (Copenhagen). The random effect model (Mantel–Haenszel approach) was used to create standard forest plots of effect size and error bars, with heterogeneity reported for each analysis. Publication bias was evaluated through the generation of a funnel plot of standard error against the log odds ratio, although a statistical evaluation of this plot was not undertaken. $P < 0.05$ was considered statistically significant for all analyses.

2. Results

The search results are shown in the PRISMA flow chart in Fig. 1. Out of 3129 titles found by online search and 8 by hand search, 1777 records were identified after duplicate removal. Title and abstract screening subsequently excluded 1737 records. Forty full-text papers were retrieved for further evaluation, of which 14 were also excluded. Finally, twenty-six studies were included. Two prospective [7,8], one randomized control study, [4] and 23 retrospective studies [1,2,9–29] were included for qualitative analysis, of which, 13 were included for quantitative analysis.

2.1. Qualitative analysis

The characteristics of the included studies are highlighted in Table 1. The years of publication spanned the era from 1980 to 2016. Sample sizes varied between 9 and 1470 cases of ARM/study. Four studies were multi-institutional [1,10,15,23]. Overall, 14 studies included patients with indications for colostomy other than the ARM (like Hirschsprung's disease) while the other 12 studies looked at the complications of colostomy only in ARM patients. A total of 3866 neonates with ARM were incorporated; in which 2241 loop colostomies and 1994 divided colostomies were reported. The overall average complication rate through the 26 studies was 27%. Out of the 26 included studies in this review, only 13 studies provided high quality data comparing loop and divided colostomy in ARM patients [1,4,7,11,13,15,17,20,22,23,25,28,29]. The other 13 studies included mixed indications of colostomy in addition to ARM rendering quantitative analysis impossible.

The quality of included studies is shown in Table 2. Included studies were of moderate to high quality, scoring between 6 and 9 out of possible nine stars.

2.2. Quantitative analysis

2.2.1. Stoma prolapse

Nine studies reported the incidence of prolapse as a complication of colostomy in patients with ARM [1,7,13,17,20,22,23,25,29]. The data from all but one of these 9 studies [7] were appropriate to be included for the meta-analysis. Three studies favored the divided colostomy (less prolapse) [1,20,23] while the other five demonstrated comparable results for prolapse between the two groups. Pooled data (2137 patients) favored the divided colostomy over the loop colostomy for the incidence of stoma prolapse. (OR: 2,34; 95% CI: 1.01 to 5.47; $P = 0.05$) (Fig. 2A). Heterogeneity between studies was found to be significant ($I^2 = 67\%$). No definition of stoma prolapse was noted in any of the included studies. A funnel plot of the log odds ratio against the standard error for these eight studies is demonstrated in Fig. 2b; its relative asymmetry suggests possible publication bias.

2.2.2. Urinary tract infection

Five studies evaluated the incidence of urinary tract infection (UTI) after stoma creation [17,20,22,23,25] of which only one study favored divided stoma [23]. The other four studies demonstrated comparable rates of UTI between the two groups. Of note, the authors of the most recently published study in this review [17] performed a risk stratification of the ARM patients based on the presence or absence of a rectourinary fistula. Despite this, they found that the risk of UTI was still independent of the stoma type. Only two studies [17,20] included a definition of UTI which was defined as a combination of suggestive clinical symptoms and a positive urine culture. Data from all the five studies were used for meta-analysis of the pooled cohort (977 patients). Meta-analysis showed no significant difference in the incidence of UTI between the two groups with relatively significant heterogeneity ($I^2 = 85\%$) (Fig. 3).

2.2.3. Skin excoriation

Three studies had data regarding skin excoriation, [17,25,28]. Only one study individually favored loop stoma [28] while the other two showed comparable results. No definition of skin excoriation was presented in any of these three studies and meta-analysis of 340 included patients revealed no difference in the incidence of skin excoriation between the two groups (Fig. 4).

2.2.4. Stoma retraction

Three studies compared the incidence of stoma retraction between loop and divided cohorts. [17,20,25]. All three studies showed comparable