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ORIGINAL ARTICLE

Extraperitoneal vs. intraperitoneal route for permanent colostomy: a meta-analysis of 1,071 patients

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Abstract
Background Parastomal hernia is a common complication after colostomy construction. Whether an extraperitoneal route for colostomy creation can reduce the risk of parastomal hernia remains controversial.
Objective A meta-analysis was performed to evaluate the value of extraperitoneal route in the prevention of parastomal hernia and other postoperative complications related to colostomy.
Data sources A literature search of Medline, Embase, Ovid, and Cochrane databases from the years 1966 to 2010 was performed.
Study selection Studies comparing extraperitoneal colostomy with intraperitoneal colostomy were identified.
Intervention Extraperitoneal colostomy was performed to prevent colostomy-related complications.
Main outcome measures Data on the following outcomes were sought: incidence of postoperative colostomy complications including parastomal hernia, prolapse, and bowel obstruction.
Results Seven retrospective studies with a combined total of 1,071 patients (250 extraperitoneal colostomy and 821 intraperitoneal colostomy) were identified. There was a significantly lower rate of parastomal hernia (odds ratio, 0.41; 95% confidence interval, 0.23–0.73, p=0.002) in the extraperitoneal colostomy group. However, the occurrences of bowel obstruction and prolapse were not significantly different between the two groups.
Limitations A limitation of the study lies on the meta-analysis of observational studies.
Conclusion Extraperitoneal colostomy is associated with a lower rate of postoperative parastomal hernia as compared to intraperitoneal colostomy. Prospective randomized controlled trial is warranted to further determine the role of extraperitoneal route in the prevention of parastomal hernia.

Keywords Parastomal hernia · Extraperitoneal colostomy · Intraperitoneal colostomy · Rectal cancer · Colostomy-related complications · Meta-analysis

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Introduction

Despite improved surgical techniques and the rapid advancement in multimodality management for rectal cancer, abdominoperineal resection with a permanent colostomy is still required in 24–38% of patients with low rectal cancers to achieve oncological clearance [1–3]. Parastomal hernia is one of the most common long-term colostomy-related complications leading to stoma revision in patients with a permanent stoma. The incidence ranges from 4.0% to 48.1% [4–10]. Some degree of parastomal hernia is even considered to be inevitable after colostomy [11]. Although most parastomal hernias are asymptomatic, patients may suffer from parastomal discomfort requiring revisional surgery, and it may progress to strangulation and other life-threatening complications without proper managements. To prevent the development of parastomal hernia, techniques have been used including mesh placement or creation of colostomy via extraperitoneal route [4, 12–14].

Traditionally, the colostomy is created by bringing the colon through the peritoneum. This has been reported to be associated with parastomal hernia in up to 48.1% of the time [6, 8, 10]. An alternative approach, as first described by Goligher [14] in 1958, is to tunnel the colostomy to the hole in the abdominal wall via an extraperitoneal route. It is conceivable that owing to the oblique passage of the bowel through a tunnel, extraperitoneal colostomy eliminated the lateral space without using a suture. A recent case report has described the feasibility of colostomy construction via extraperitoneal route using a laparoscopic approach [15].

However, after the first introduction, subsequent studies have been published with inconsistent results, although in the majority an extraperitoneal route was associated with a lower rate of parastomal hernia [7–9]. Furthermore, the description and discussion of extraperitoneal colostomy have been constantly made in many surgical textbooks however with conflicting opinions [16–18]. The role of extraperitoneal route for colostomy remains uncertain for decades because high-level evidence such as results from multicenter randomized controlled trial (RCT) is lacking to make any sound statement.

It is therefore unclear based on published data as to whether an extraperitoneal or an intraperitoneal route is the better choice in this regard. Meta-analysis can evaluate the literature in a quantitative way by comparing and integrating the results of different studies. It also delineates heterogeneity in the estimates of the outcomes of interest between studies comparing the two techniques. Therefore, the aim of this study was to compare extraperitoneal and intraperitoneal as the technique for colostomy creation with respect to postoperative colostomy complications using the method of meta-analysis.

Methods

Literature search

A literature search of the Medline, Embase, Ovid, and Cochrane databases from the years 1966 to 2010 was performed to identify articles comparing extraperitoneal versus intraperitoneal route for patients undergoing permanent colostomy for cancer or other disease. The following search terms and their combinations were used: (extraperitoneal or retroperitoneal), (intraperitoneal or transperitoneal), (colostomy or sigmoidostomy or stoma*). Both free text search and Mesh search headings for keywords were employed. The "related articles" function was used to broaden the search, and relevant articles referenced in the publications were also searched for additional studies for potential inclusion. No language restriction was used. The date of the most recent search was Jan 22, 2011.

Study selection and data extraction

The literature search was done by two investigators independently (L.L. and XR.W.). The two reviewers also independently applied the following inclusion criteria: (1) clear hernia subtype differentiation (parastomal vs. incisional), (2) concurrent controls included, (3) adequate data included to determine relative risks and confidence intervals (CIs), and (4) no later publication of identical data. All disagreements were resolved through discussion. Publications were included if they compared extraperitoneal route for colostomy creation to intraperitoneal route in terms of parastomal hernia. Non-comparative studies, case series, and case reports were not included.

Data on the following outcomes were sought: parastomal hernia, prolapse, and bowel obstruction. Studies were included if they provided information on at least one of these outcome measurements. All eligible studies were assessed for quality of methodology and relevance to the objective of the review. Each study was accepted or rejected based on the criteria noted above. Data were then extracted independently and compared. If data were not reported specifically for certain outcomes, the data were regarded as missing. No assumptions were made from these missing data. Diagnosis of each complication (i.e., parastomal hernia, prolapse, and bowel obstruction) was at the discretion of authors in each study. First author, year of publication, study population characteristics, study design, inclusion and exclusion criteria, number of subjects, length of follow-up, and short-term and long-term outcomes were reviewed and recorded.

Statistical analysis

Statistical heterogeneity was tested using χ^2 test. A fixed-effect model was initially performed. In a fixed-effect

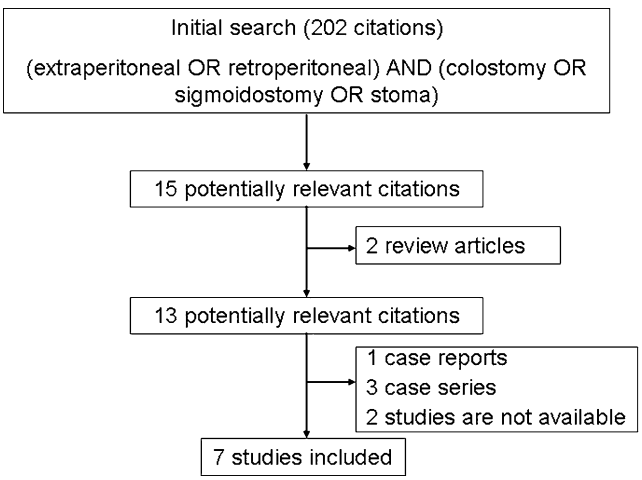

Fig. 1 Search process

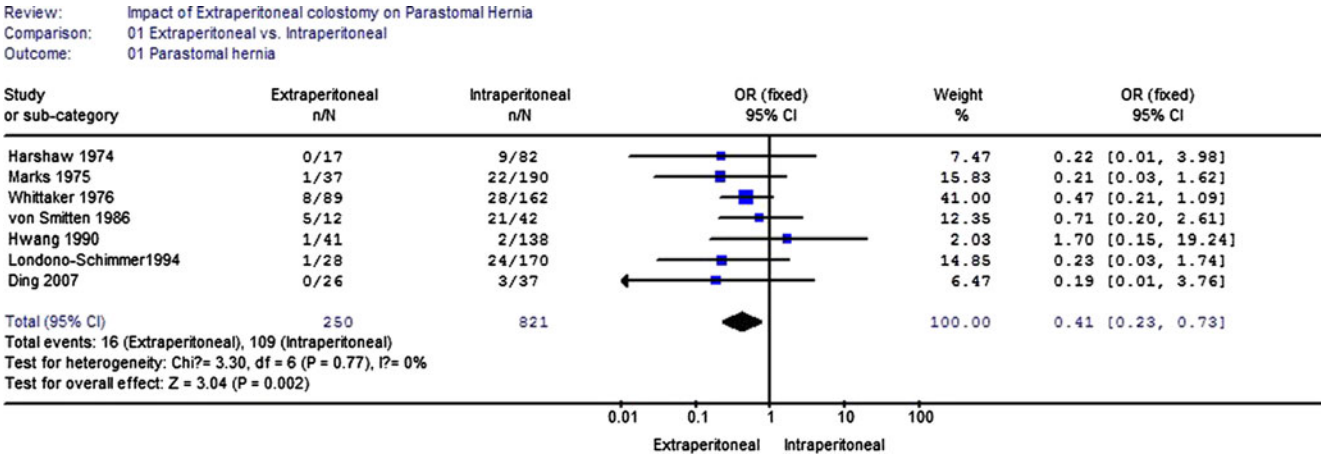

Fig. 2 Forest plot for the occurrence of parastomal hernia between extraperitoneal and intraperitoneal colostomy

model, it is assumed that there is no heterogeneity in treatment effect between studies, whereas in a random-effect model, it is assumed that there is variation between studies, and the calculated odds ratios (ORs) therefore have a more conservative value. Use of the random-effect model is preferable and advisable when meta-analysis is used to analyze data in retrospective surgical research because each surgical technique at each center has its own selection criteria for patients, and these patients have different risk parameters. $P \leq 0.05$ was considered statistically significant. For categorical variables, the ORs were combined with the Mantel–Haenszel $\chi 2$ method using a random-effect meta-analytical technique.

A funnel plot was used to assess the publication bias. This is a scatter plot of the treatment effects estimated from individual studies plotted on the horizontal axis (OR) against a measure of outcome shown on the vertical axis (SE[log OR]). The overall effect estimate is indicated by the vertical dotted line, and the 95% CI for the overall effect is shown by the diagonal dotted lines, forming an inverted funnel shape around the overall estimate. The effect of each study is marked by a dot on the graph. Publication bias is indicated when studies are not evenly distributed within the inverse funnel shape around the total line (as indicated by the 95% lines). All analyses were conducted using Review Manager version 4.2 (Update Software, Oxford, UK).

Results

Seven observational studies [6–10, 19, 20] comparing extraperitoneal colostomy and intraperitoneal colostomy were identified using the predefined search strategy, and they were included in the meta-analysis containing 1,071 patients. Search process is detailed in Fig. 1. There were no randomized controlled trials published. Samples size of

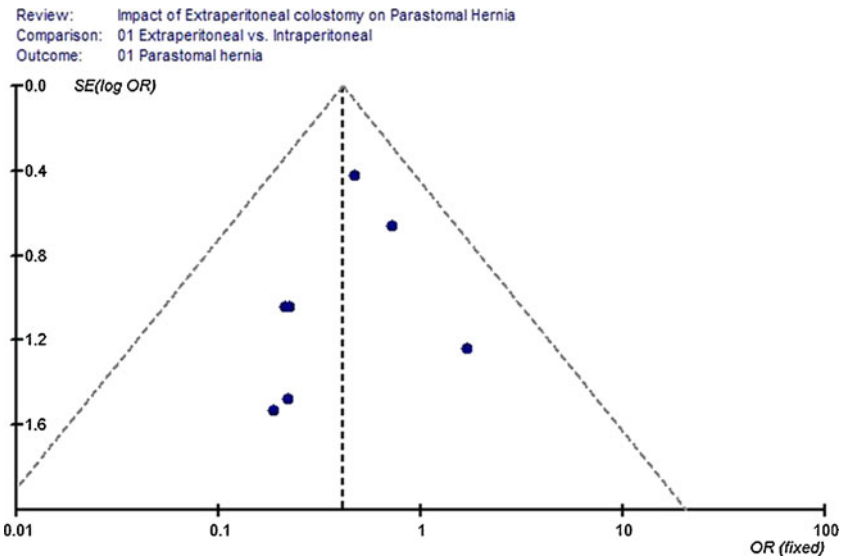

Fig. 3 Funnel plot for the occurrence of parastomal hernia between extraperitoneal and intraperitoneal colostomy

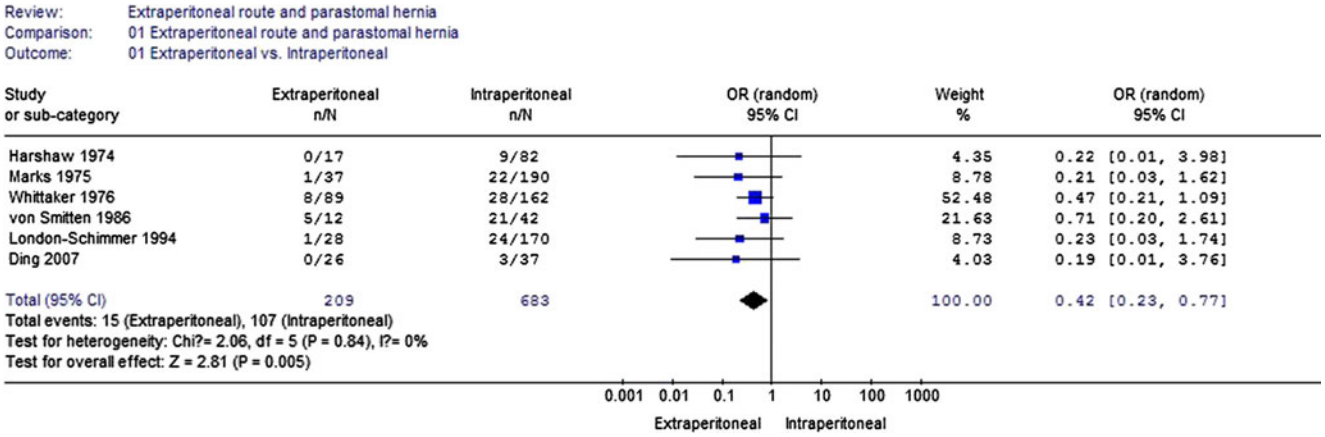

Fig. 4 Pooled data on parastomal hernia rates between extraperitoneal and intraperitoneal colostomy

studies varied from 99 to 251 patients. Review of the data extraction showed 100% agreement between the two reviewers. There were 250 (23.3%) patients in the extraperitoneal group and 821 (76.7%) patients in the intraperitoneal group.

Parastomal hernia

All the seven included studies reported a lower rate of parastomal hernia in the extraperitoneal colostomy group [6–10, 19, 20]. However, the difference was statistically significant in only one study [6]. Overall, parastomal hernia occurred in 16 (6.4%) in the extraperitoneal group and 109 (13.3%) patients in the intraperitoneal group. There was minimal heterogeneity among the four studies, as shown by the heterogeneity test of the trials (χ^2=3.30, p=0.77). Fixed effect and random effect meta-analytical model showed similar results. Overall, among the 1,071 analyzed patients, extraperitoneal colostomy was associated with a lower incidence of parastomal hernia (OR=0.41, 95% CI 0.23 to 0.73, p=0.002) when compared with the traditional intraperitoneal colostomy (Fig. 2).

As shown in Fig. 3, a funnel plot of the studies was used in the meta-analysis of postoperative parastomal hernia between extraperitoneal and intraperitoneal colostomy. None of the studies lay outside the limits of the 95% CI; there was no evidence of publication bias (all studies were equally distributed around the vertical axis).

Parastomal prolapse and bowel obstruction

Two studies [6, 10] reported on colostomy prolapse with an overall reduction from 5.7% to 3.4% in favor of the extraperitoneal group, a difference that did not reach statistical significance (OR, 0.61; (95% CI, 0.20–1.82); p=0.38; Fig. 4). Post-colostomy bowel obstruction was also reported in only two studies [6, 10] with an overall reduction from 4.2% to 2.6% in favor of the extraperitoneal group, a difference that did not reach statistical significance (OR, 0.75; 95% CI, 0.20–2.80); p=0.67; Fig. 5).

A power calculation was performed for the outcome parastomal hernia. The overall incidence of postoperative parastomal hernia was 16 (6.4%) of 250 after extraperitoneal construction compared with 109 (13.3%) of 821 after intraperitoneal colostomy. To rule out a 6.9% absolute risk reduction (from 13.3% to 6.4%) with a 5% significance level and 80% power, a traditional RCT would require 230 patients in each arm.

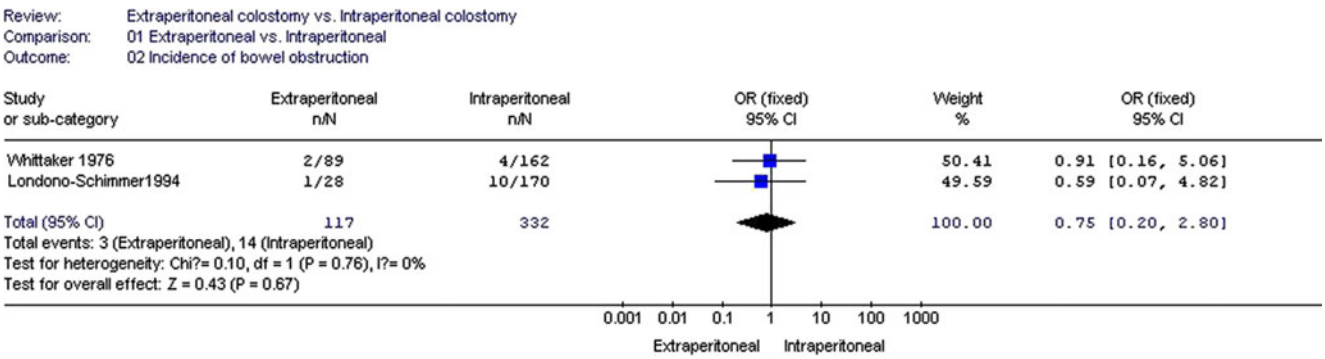

Fig. 5 Pooled data on small bowel obstruction rates between extraperitoneal and intraperitoneal colostomy

Discussion

Post-colostomy complications include hernia, prolapse, and obstruction, with parastomal hernia being the most common one. Though most of the parastomal hernias can be managed conservatively, when surgical intervention is needed, the results are poor. And prevention is in no doubt the best management strategy.

To avoid parastomal hernia, colostomy creation via extraperitoneal route has been attempted, and previous studies reveal promising results. This systematic review is an assessment of the published evidence available on the role of extraperitoneal route in the prevention of postoperative colostomy-related complications. Only seven studies were included, and there have been no published RCTs. In this meta-analysis, seven studies showed homogeneity, and the findings of the present study were that extraperitoneal colostomy was associated with a lower parastomal hernia rate, and that it was not associated with obstruction or prolapse.

Since Golighter [14] reported extraperitoneal colostomy in 1958, surgeons usually believed extraperitoneal colostomy was better than intraperitoneal colostomy with regard to postoperative complications. However, there were few studies comparing the advantages and disadvantages between extraperitoneal and intraperitoneal colostomy. Extraperitoneal colostomy maybe associated with longer operative time and complications. There are different opinions in the literature regarding clinical significance of extraperitoneal route. Some author considered it "had little impact on the incidence of parastomal hernia" [16], while others claimed that it was considered "the method of choice for patients needing a permanent iliac colostomy." [17] However, it was later considered "a good option for patients needing a permanent iliac colostomy" [18], but "much preferred because of fewer complications related to peristomal herniation, prolapse, retraction, and internal herniation." [18] As of now, the adoption of extraperitoneal versus intraperitoneal route for colostomy construction is based on the preference of the surgeon. Conflicting opinions exist even in surgical textbooks. There are few in the literature examining the difference between the two techniques and subject to the drawback of low level of evidence. Thus, a significant gap in the literature remains.

Though obesity, malnutrition, raised intra-abdominal pressure, corticosteroid use, increasing age, and wound infection were believed to be risk factors for parastomal hernia, existence of lateral space was one of the most important reasons [21–26]. It is conceivable that owing to the oblique passage of the bowel through a tunnel, extraperitoneal colostomy eliminated the lateral space without using a suture [14]. This may explain lower parastomal hernia rate after extraperitoneal colostomy.

As to other postoperative complications, Londono-Schimmer et al. [6] reported a cumulative risk of 11.8% and 13.7% at 13 years for prolapse and obstruction, respectively. Although the extraperitoneal colostomy was designed to prevent obstruction, this effect had not been observed by Whittaker et al. [10], and subsequent authors found no impact in this regard. In this meta-analysis, the chance of prolapse was not significantly reduced after extraperitoneal colostomy, so was the chance of bowel obstruction.

However, all studies included in this meta-analysis are observational retrospective investigations and the numbers of patients undergoing extraperitoneal colostomy are small. The length of follow-up was not mentioned in all these articles. Therefore, studies of higher quality, including multicenter randomized controlled trials, with a large number of patients, are needed to further identify whether extraperitoneal colostomy is superior to intraperitoneal colostomy. This is the first meta-analysis comparing extraperitoneal colostomy with intraperitoneal colostomy, and it provides a comprehensive summary for the evaluation of sample size for future RCTs. Other postoperative complications, such as length of operation and blood loss, should also be considered in the trials. Studies related to ileostomy, with a high incidence of postoperative complications as colostomy, which is often performed to prevent the incidence of anastomotic leak, may need to be carried out as well.

In conclusion, based on the existing evidence, creation of permanent colostomy via an extraperitoneal route appears to carry a significantly lower rate of parastomal hernia when compared to intraperitoneal colostomy. Prospective RCT is warranted to further determine the role of extraperitoneal route in the prevention of parastomal hernia.

Disclosures None.

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