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ABOUT COVER

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AIMS AND SCOPE

The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS*, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, *etc*.

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SYSTEMATIC REVIEWS

Systematic review and meta-analysis comparing extraperitoneal and transperitoneal routes of colostomy-related complications

Adamu D Isah, Xu Wang, Zakari Shaibu, Xiao Yuan, Sheng-Chun Dang

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Abstract

BACKGROUND

Complications associated with stomas—including parastomal hernia (PSH), prolapse, mucocutaneous separation, and stoma retraction—provide considerable postoperative challenges for colostomy patients. Selecting between extraperitoneal colostomy (EPC) and transperitoneal colostomy (TPC) pathways is therefore essential for mitigating these complications.

AIM

To analyze the existing data regarding the efficacy of EPC compared to TPC in reducing stoma-related complications post-colostomy.

METHODS

PubMed, Google Scholar, EMBASE, MEDLINE, and the Cochrane Library were adopted to uncover pertinent papers in which EPC and TPC approaches were compared. We then conducted a meta-analysis using RevMan 5.4.1.

RESULTS

Both laparoscopic (Lap) and open approaches showed a reduced incidence of PSH in EPC relative to TPC (P < 0.00001 and P = 0.02 respectively). In addition, Lap EPC depicted a lesser incidence of prolapse, mucocutaneous separation, and stoma retraction (P = 0.007, P = 0.03, and P = 0.01, respectively) compared to Lap TPC. However, EPC and TPC did not differ with respect to operation time, blood loss, edema, ischemia, necrosis, or infection after the LAP approach.

CONCLUSION

The extraperitoneal approach may provide benefits in minimizing some stoma-related problems such as PSH, prolapse, mucocutaneous separation, and stoma retraction after colostomy surgery.

Key Words: Colostomy; Extraperitoneal; Transperitoneal; Parastomal hernia; Abdominoperineal resection

Core Tip: The study provides an inclusive meta-analysis comparing extraperitoneal (EPC) and transperitoneal (TPC) routes in colostomy surgery, emphasizing significant reductions in parastomal hernia, prolapse, stoma retraction, and mucocutaneous separation with the EPC approach. Despite previous studies suggesting benefits, newer evidence from 1973 patients highlights methodological improvements and the inclusion of previously overlooked cohort studies. Findings indicate comparable operative outcomes between EPC and TPC routes, challenging previous assertions. The study underscores EPC's potential to enhance postoperative quality of life by minimizing specific complications.

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INTRODUCTION

Colorectal cancer constitutes approximately 10% of newly diagnosed malignancies and cancer-related fatalities globally each year, and ranks as the third most prevalent cancer in men and the second most prevalent in women worldwide[1,2]. Conventional surgical techniques, including abdominoperineal resection (APR) and sigmoidectomy, are regarded as safe and effective interventions for these individuals[3,4]. However, even with the progress in surgical instrumentation and methodologies, some patients with low rectal cancer still require sigmoidostomy, which entails a significant risk of complications[4-6].

A colostomy requires creating a hole in the large intestine by pulling the healthy segment through an incision in the abdominal wall, thus establishing an alternate route for waste excretion[7]. This aperture, along with the connected stoma, offers an additional route for waste expulsion from the body[8], and a permanent stoma is conventionally established *via* a transperitoneal colostomy (TPC). In 1958, Goligher created an extraperitoneal colostomy (EPC) methodology, which has subsequently gained widespread acceptance. This approach conserves lateral space reduces the possibility of blockage and provides enhanced coverage *via* a lateral peritoneal flap.

Regarding the prolonged use of these techniques, a consensus on the efficacy of permanent sigmoidostomy in avoiding parastomal hernia (PSH) remains unclear. The European Hernia Society contends that there are inadequate data to demonstrate the advantage of EPC over TPC in decreasing the incidence of PSH[7]. However, prior meta-analyses of open surgical techniques indicate that colostomies formed by the EPC route show a reduced incidence of PSH relative to those constructed *via* the TPC route[9]. Although studies on laparoscopic APR have revealed that the laparoscopic EPC approach reduces the rate of PSH[10], performing an EPC colostomy during laparoscopic APR is more challenging due to the technical complexities[11]. Deciding whether to pursue an open or laparoscopic extraperitoneal or transperitoneal route for a permanent stoma placement remains a point of perplexity for many surgeons. It is thus crucial to carefully consider the feasibility of each approach based on the specific patient’s condition, anatomy, and potential risks and benefits associated with the procedure. We herein assessed the impact of open and laparoscopic EPC *vs* TPC routes on colostomy-related complications.

MATERIALS AND METHODS

In this meta-analysis we evaluated the EPC and TPC approaches using randomized controlled trials (RCTs) and retrospective studies (RS). Our analysis was executed in accordance with the Recommended Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards[12]. Ethical authorization and patient consent were unnecessary, since the analysis used previously published research.

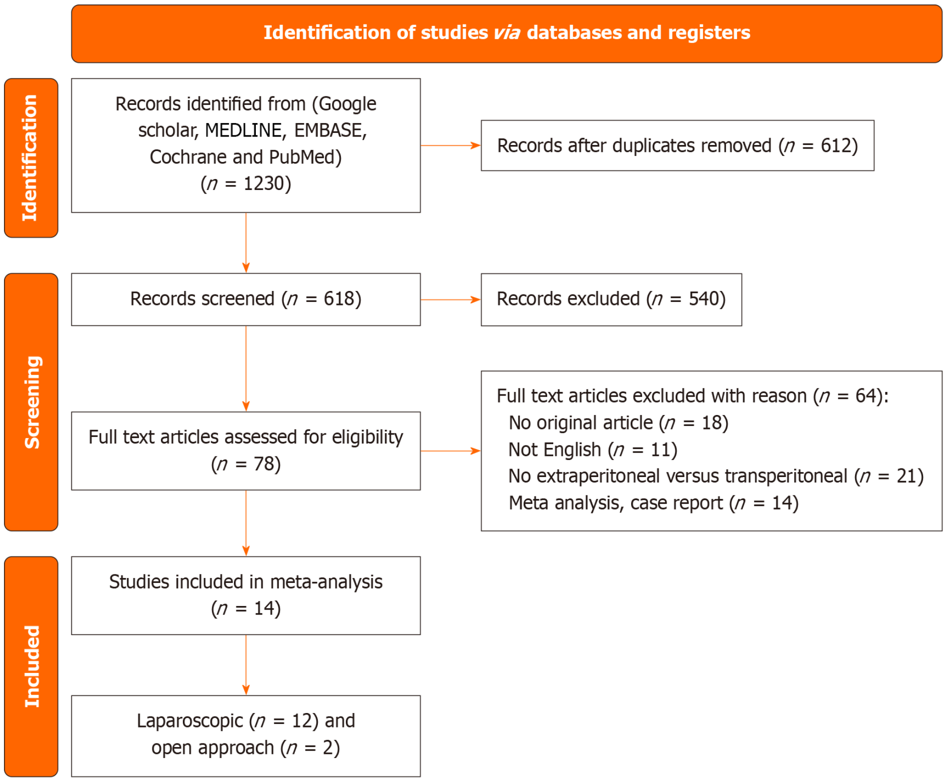

Figure 1 Literature screening process.

Search strategy

We conducted an extensive search of the PubMed, MEDLINE, Google Scholar, Cochrane Library, and Web of Science databases for publications published between 1976 and 2024. This investigation focused on research that compared the EPC and TPC approaches for individuals having an end colostomy due to cancer or other ailments. A search was implemented using the following key terms: Extraperitoneal; abdominoperineal resection; transperitoneal; colostomy; and PSH. Two separate evaluators assessed the selected studies by reviewing their entire texts (Figure 1 illustrates the outcomes of the search approach).

Inclusion criteria

The following criteria were considered for inclusion.

Participants: Adult patients undergoing colonic surgery that comprised either an end colostomy or APR.

Interventions: EPC and TPC.

Comparison: EPC *vs* TPC.

Outcomes: PSH, prolapse, necrosis, infections, retraction, ischemia, and mucocutaneous separation.

Exclusion criteria

The following criteria were considered for exclusion. Studies that lacked specifically targeted data. Incomplete papers. Case reports and meta-analyses. Non-English language papers

Data acquisition

Two reviewers individually assessed the search results, and all concerns regarding inclusiveness were addressed *via* dialogue. Publications were included using standardized forms that recorded data from studies, including study design, EPC or TPC colostomy, author, country, year of publication, surgical method (whether open or laparoscopic), period of follow-up, and patient number as outlined in Table 1.

Postoperative outcomes—including operation time and blood loss—were included. Additionally, problems associated with colostomy (such as PSH, prolapse, edema, mucocutaneous separation, infection, necrosis, ischemia, and stoma retraction) were documented as shown in Table 2.

Statistical analysis

We conducted our analysis using Review Manager (RevMan) version 5.4.1, applying the Mantel-Haenszel method for statistical evaluation. Both dichotomous and continuous data were assessed to calculate odds ratios (ORs) with 95%CI,

Table 1 Characteristics of included studies, median (25th-75th percentiles)

Ref.	Country	Year	Approach (open/lap)	Study design	Group EPC/TPC	Number of patients EPC/TPC	Follow-up month
Heiying *et al*[13]	China	2014	Lap	RCTs	EPC/TPC	18/18	17 (12-24)
Whittaker *et al* [14]	England	1976	Open	RS	EPC/TPC	89/162	-
Madoka *et al*[15]	Japan	2012	Lap	RS	EPC/TPC	22/15	23/14
Leroy *et al*[16]	Taiwan	2012	Lap	RS	EPC/TPC	12/10	22.25/36.3
Hino *et al*[17]	Japan	2017	Lap	RS	EPC/TPC	30/29	21 (2-95)
Xiao *et al*[18]	China	2023	Both	RS	EPC/TPC	103/202	17-46
Zhang *et al*[19]	China	2024	Lap	RS	EPC/TPC	37/37	36
Ota *et al*[20]	Japan	2022	Lap	RS	EPC/TPC	105/222	38.0/45.5
Xiao *et al*[21]	China	2022	Lap	RS	EPC/TPC	83/50	6
Wang *et al*[22]	China	2018	Lap	RS	EPC/TPC	108/123	24
Yao *et al*[23]	China	2023	Lap	RS	EPC/TPC	30/30	6
Wang *et al*[24]	China	2024	Lap	RS	EPC/TPC	37/46	32/28
Dong *et al*[25]	China	2012	Lap	RCTs	EPC/TPC	66/62	6-60
Marks *et al*[26]	United States	2005	Open	RS	EPC/TPC	37/190	60

Lap: Laparoscopic; RCTs: Randomized controlled trials; EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

which provided insights into the statistical differences between the outcomes of EPC and TPC colostomies. Our findings are presented through forest plots. Statistical heterogeneity was evaluated using the I^2 statistic, with heterogeneity categorized as follows: 0%–30% (low), 30%–60% (moderate), 50%–90% (substantial), and 75%–100% (considerable). A significance threshold of $P < 0.05$ was employed for all models.

RESULTS

Our initial search identified 1230 articles, with 612 remaining after duplicate removal. Following the screening process, 78 articles were selected for full-text review. Of these, 14 studies met the inclusion criteria and were included in the final analysis: 12 focused on laparoscopic procedures, and 2 examined open procedures, as shown in Figure 1.

Characteristics of included studies

The included studies consisted of two RCT and 12 RS that involved a total of 1973 patients. Of these, 1495 patients underwent laparoscopic procedures (651 with EPC and 844 with TPC), and 478 patients underwent open procedures (126 with EPC and 352 with TPC).

The studies represented a geographically diverse sample, including data from Asia, Europe, and the United States; and offered a comprehensive perspective on the topic (detailed characteristics of the included studies are summarized in Table 1).

Laparoscopic outcome after EPC vs TPC approaches

Several studies[13-25] collectively encompassed 1362 patients, comprising 568 patients in the EPC and 794 patients in the TPC groups. The analysis of operation time, as depicted in Figure 2A, indicated no statistically significant difference between the two groups. The mean difference was −4.02 (95%CI: −9.51-1.47), with an I^2 of 93% and $P = 0.15$.

Six studies[15,17,18,20,22,24] collectively comprised 1042 patients, with 405 patients in the EPC group and 637 patients in the TPC group. The analysis of blood loss, as depicted in Figure 2B, indicated no statistically significant difference between the two groups. The mean difference was −3.00 (95%CI: −16.10–10.10), with an I^2 of 0% and $P = 0.65$.

Twelve studies[13,15-25] collectively included 1495 patients, with 651 in the EPC group and 844 in the TPC group. Analysis of PSH rates (shown in Figure 3A) revealed a statistically significant difference favoring the EPC group. The PSH rate was 4.3% in the EPC group (28 of 651 patients) compared to 16.4% in the TPC group (139 of 844 patients). The OR was 0.24 (95%CI: 0.16–0.37), with an I^2 of 35% and $P < 0.00001$.

Nine studies[13,16-19,22-25] were collectively composed of 998 patients, with 441 in the EPC group and 557 in the TPC group. As illustrated in Figure 4A, the analysis of prolapse rates revealed a statistically significant difference that favored the EPC group. The prolapse rate was 1.8% in the EPC group (eight of 441 patients) compared to 5.9% in the TPC group

Table 2 Outcomes of included studies, mean ± SD

Ref.	Operation time	Blood loss	Edema	Necrosis	Ischemia	Stoma retraction	Infection	Prolapse	Mucocutaneous separation	Parastomal hernia
EPC/TPC Lap										
Heiying *et al*[13]	14.7 ± 6.4/25.3 ± 8.5	-	0/6	-	1/1	0/0	-	1/0	-	2/0
Whittaker *et al*[14]	361 ± 64/308 ± 80	182 ± 118/203 ± 254	-	2/0	-	-	4/1	-	2/6	1/5
Madoka *et al*[15]										
Leroy *et al* [16]	320.83 ± 65.84/350 ± 64.8	-		0/2	-	-	0/1	0/0	-	0/4
Hino *et al* [17]	291 ± 120/ 306 ± 102.25	43 ± 172.5/66 ± 203.25	-	-	0/2	0/3	1/0	1/4	0/1	4/12
Xiao *et al* [18]	209.47 ± 24.23/ 210.00 ± 24.42	90.67 ± 116.42/ 84.43 ± 41.92	-	-	-	-	3/7	6/10	0/2	7/31
Zhang *et al* [19]	205± 10.75 /205± 12.5	-	-	0/0	-	0/0	-	0/3	-	6/5
Ota *et al*[20]	289± 156.75/345.5± 192.5	50± 143.75/60 ± 407.5	-	-	-	-	17/46	-	-	2/38
Xiao *et al* [21]	23.1± 6/21.4 ± 4	-	-	-	-	-	-	-	-	0/4
Wang *et al* [22]	168.0 ± 21.2/ 170.2 ± 21.2	167.1 ± 73.7/179.1 ± 76.3	10/5	1/2	-	0/6	1/3	0/6	-	5/22
Yao *et al*[23]	26.64 ± 2.45/24.86 ± 2.78	-	-	-	-	1/1	-	0/2	-	0/4
Wang *et al* [24]	155.8 ± 38.2/158.5 ± 32.4	119.4 ± 81.3/108.7 ± 74.7	13/7	-	0/1	2/4	-	0/6	-	1/9
Dong *et al* [25]	21.3 ± 3.5/30.4 ± 4.2	-	-	1/1	-	1/3	-	0/2	-	0/5
EPC/TPC open										
Marks and Ritchie *et al* [26]	-	-	-		-	-	-	-	-	1/22
Whittaker *et al*[14]	-	-	9/16	-	-	-	11/23	2/10	7/17	8/28

EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

(33 of 557 patients). The calculated OR was 0.39 (95%CI: 0.20–0.77), with an I^2 value of 25% (indicating low heterogeneity), and a significance level of P = 0.007.

In three studies[15,17,18] that totaled 401 patients (155 in the EPC and 246 in the TPC groups), we analyzed the rate of mucocutaneous separation; and as shown in Figure 4B, there was a statistically significant difference in favor of the EPC group. The mucocutaneous separation rate was 1.3% (two of 155) in the EPC group compared to 3.6% (nine of 246) in the TPC group. The OR was 0.21 (95%CI: 0.05–0.84), with an I^2 of 0% and P = 0.03.

Six studies[15-18,20,22] collectively included 981 patients, with 380 in the EPC and 601 in the TPC groups; and our analysis of infection rates (shown in Figure 5A) did not reveal any difference between the groups. The infection rate was 6.8% (26/380) for EPC and 9.6% (58/601) for TPC, with an OR of 0.79 (95%CI: 0.48–1.32), I^2 of 0%, and P = 0.38.

Three studies[13,22,24] consisted of 350 patients, 163 in the EPC and 187 in the TPC groups, and when we analyzed these for edema rates, we uncovered no difference between the groups (Figure 5B). The EPC group possessed an edema

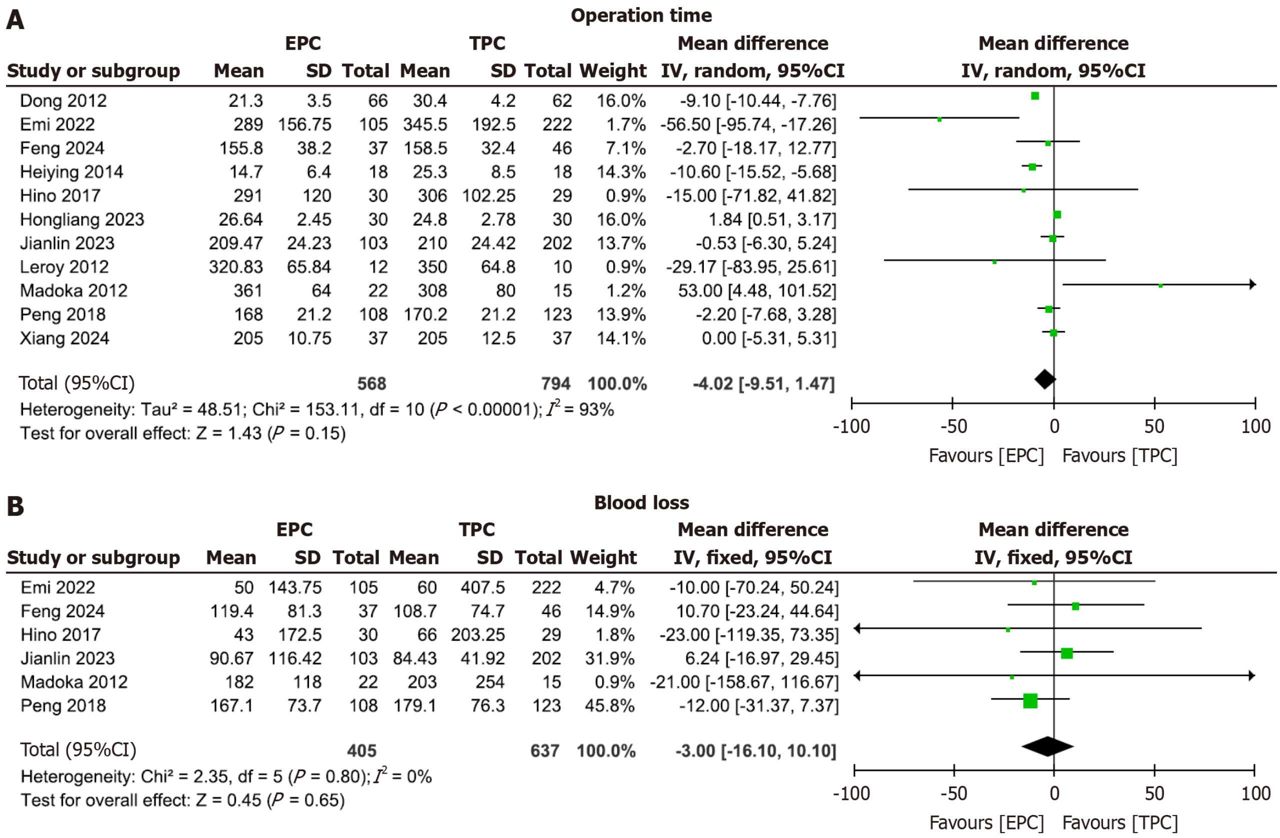

Figure 2 Forest plot of operation time and blood loss. A: Operation time; B: Blood loss after laparoscopic approach. EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

rate of 14.1% (23 of 163) *vs* 9.6% in the TPC group (18 of 187), for an OR of 1.31 (95%CI: 0.26–6.44), with an I^2 of 72% and P = 0.74.

Seven studies[13,17,19,22-25] entailed 671 patients, with 326 in the EPC group and 345 in the TPC group. As shown in Figure 3B, analysis of stoma retraction showed a statistically significant difference that favored the EPC group. The stoma retraction rate was 1.2% (4 of 326 patients) in the EPC group, compared to 4.9% (17 of 345) in the TPC group, for an OR of 0.29 (95%CI: 0.10–0.78), an I^2 of 0%, and P = 0.01.

When we analyzed five studies of 492 patients for necrosis[15,16,19,22,25] (245 in the EPC group and 247 in the TPC group), we found no difference between the two groups (Figure 6A). The necrosis rate was 1.6% (4 of 245) in the EPC group and 2.0% (5 of 247) in the TPC group; the calculated OR was 0.72 (95%CI: 0.21–2.47), with an I^2 value of 0% and P = 0.61.

Three studies[13,17,24] that encompassed a total of 178 patients (85 patients in the EPC group and 93 in the TPC group) were analyzed, and we found that the groups did not differ with respect to ischemia (Figure 6B). The ischemia rate was 1.2% in the EPC group (one case of 85) and 4.3% in the TPC group (four cases of 93), for an OR of 0.40 (95%CI: 0.08–2.15), I^2 value of 0%, and P = 0.29.

Open approach after EPC vs TPC

We analyzed the incidence of PSH in two studies[14,26] that encompassed 478 patients (126 with EPC and 352 with TPC) (Figure 3C), and our results indicated a statistically significant difference favoring the extraperitoneal group. The PSH rate was 7.1% in the EPC (9 of 126 patients) *vs* 14.2% in the TPC (50 of 352 patients), for an OR of 0.40 (95%CI: 0.19–0.86), an I^2 of 0%, and P = 0.02.

Quality evaluation

This study adhered to the guidelines outlined in the Cochrane Handbook for Systematic Reviews of Interventions (version 6.3) to objectively evaluate the quality of the included trials using the risk-of-bias tool. The assessment focused on several key domains: (1) Random sequence generation; (2) Allocation concealment; (3) Blinding; (4) Incomplete outcome data; (5) Selective reporting; and (6) Other relevant biases.

Trials were classified as “high risk” if bias was identified in one or more critical domains, trials with low risk of bias across all critical domains were categorized as “low risk”, and studies that did not clearly fall into either category were designated as “unclear” (the classification outcomes are illustrated in Figure 7). Any discrepancies among researchers were resolved through discussions involving the corresponding author.

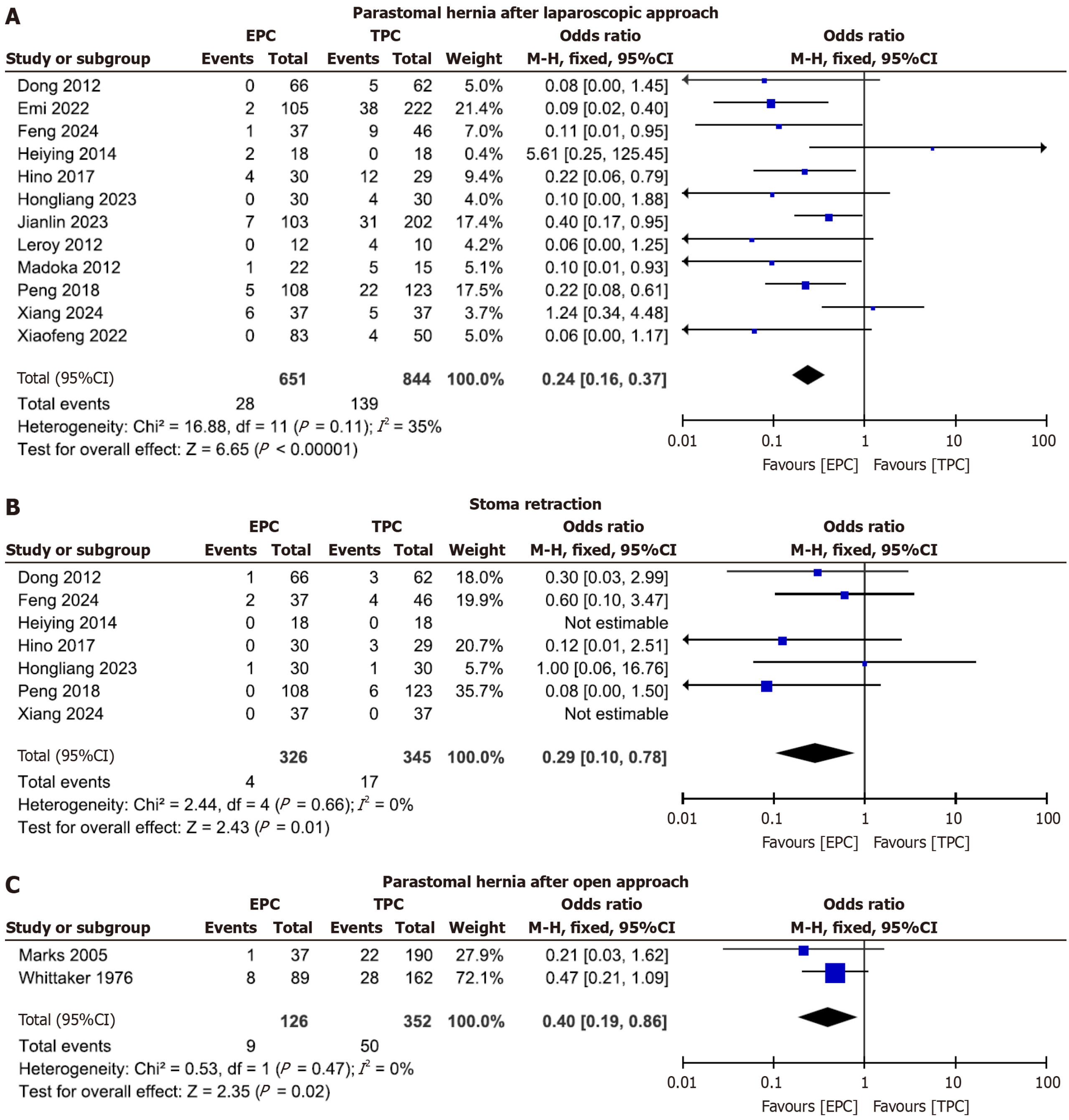

Figure 3 Forest plot of parastomal hernia after laparoscopic approach, stoma retraction, and parastomal hernia after open approach. A: Parastomal hernia after laparoscopic approach; B: Stoma retraction after laparoscopic approach; C: Parastomal hernia after open approach. EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

Publication bias

We detected no evidence of publication bias, as all studies fell within the 95%CI boundaries. The symmetry of the funnel plot was statistically assessed using the Egger test and confirmed the absence of bias. For necrosis, the analysis yielded an OR of 0.72 (95%CI: 0.21–2.47; P = 0.61; I^2 = 0%); while for ischemia, the OR was 0.40 (95%CI: 0.08–2.15; P = 0.29; I^2 = 0%), demonstrating no significant evidence of bias as shown in Figure 8.

DISCUSSION

Colostomy complications include mucocutaneous separation, stoma retraction, infection, ischemia, necrosis, edema, prolapse, and PSH; with the most common of these being PSH. Traditional treatment has been effective for most PSH, but surgical intervention often results in suboptimal outcomes; thus, prevention is considered the best course of action. While previous investigations have shown that extraperitoneal stoma formation exerts beneficial effects[19], evidence-based

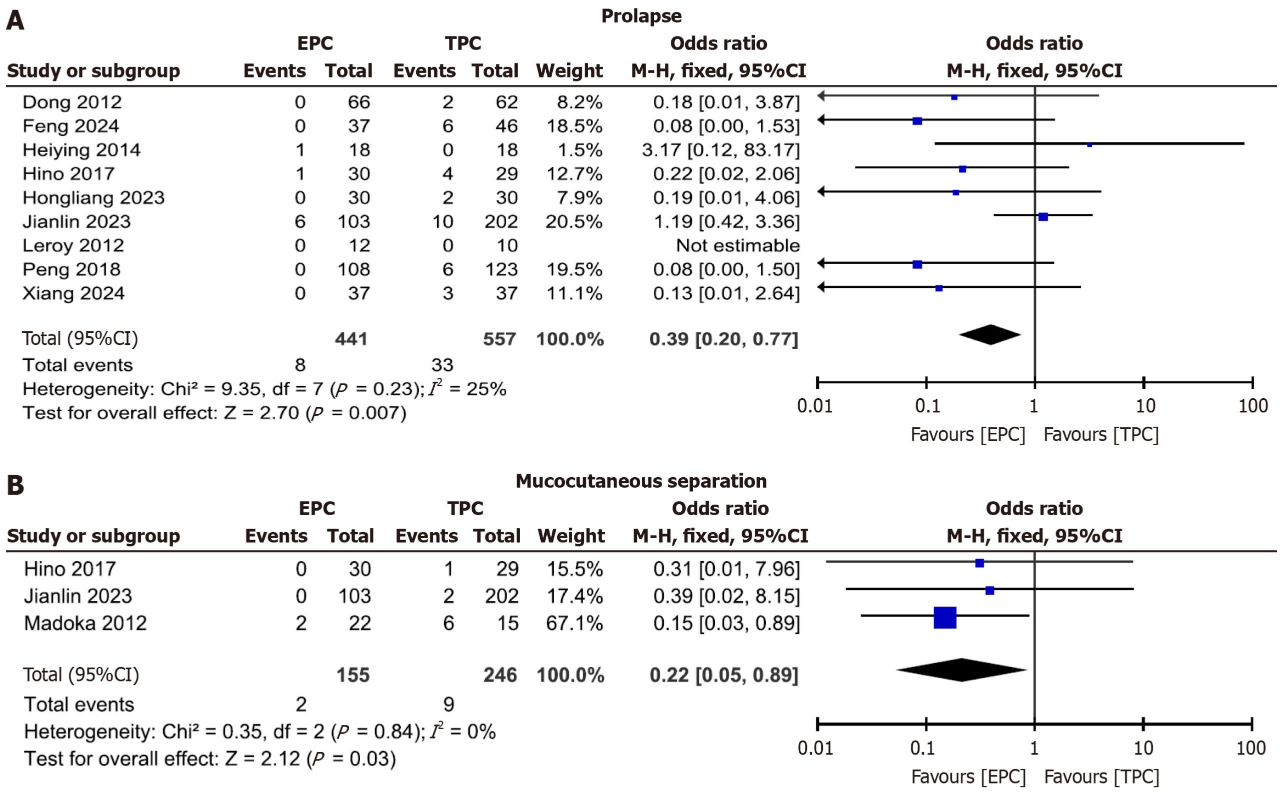

Figure 4 Forest plot of prolapse and mucocutaneous separation. A: Prolapse; B: Mucocutaneous separation after laparoscopic approach. EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

medical data remain limited.

Although authors of previous meta-analyses attempted to address the limitations of small-scale studies and reported findings that differ from those of the current study, our analysis remains crucial. This importance stems from the significant amount of time that has elapsed since the last meta-analyses[9,10,27,28], and the inclusion of several cohort studies in our analysis that were not considered previously. Our meta-analysis notably includes data from 2363 patients, significantly exceeding the sample sizes of earlier studies that encompassed less than half of this number. Furthermore, our analysis emphasizes the reporting of PSH incidence rates based on distinct surgical approaches, thus providing a clearer perspective than previous research that often focused on laparoscopic or combined approaches[9,10,27,28]. By adopting this tailored approach, we offered a more detailed comparison and enhanced our ability to identify variations in outcomes across different surgical techniques.

Laparoscopic colostomy performed *via* the EPC route is often considered more technically demanding compared to the TPC route. However, congruent with findings from previous studies[15,16], our analysis did not reveal any differences in operative time or blood loss between the two approaches during laparoscopic surgery. Similarly, the authors of a separate meta-analysis also reported no notable differences between the techniques[10]. While Heiying *et al*[13] observed that the median operative time for the EPC route was approximately 10 min longer than for the TPC route, this difference was minimal and was deemed to be acceptable. This conclusion may be attributed to advancements in surgical techniques, procedural standardization, optimized patient selection, skilled surgical teams, and adherence to established clinical guidelines.

Recent developments have addressed the technical challenges associated with the EPC approach. For example, studies [29,30] have highlighted the use of a trocar-cannula system to create the extraperitoneal tunnel, simplifying the procedure by improving visualization and allowing for controlled tissue dissection. This technique reduces operative time and facilitates efficient creation of an EPC while maintaining satisfactory outcomes. Improved surgical skills and equipment, along with the selection of suitable patients and adherence to established protocols, likely contribute to the efficient performance of the EPC technique without significantly impacting operative outcomes relative to the TPC approach[29].

In the present study, the incidence of PSH was significantly lower with the EPC route compared to the TPC route in both laparoscopic and open surgical approaches ($P < 0.00001$ and $P = 0.02$, respectively), with our findings consistent with those of previous studies[27,28]. A primary contributing factor to PSH is the insufficient structural density at the junction between the colon and the abdominal wall that can compromise integrity and result in herniation. Supporting these results, a meta-analysis of 1048 patients revealed that the EPC route was associated with a lower incidence of PSH[9], congruent with our findings. However, other investigators reported no significant differences between the two routes[26,31], potentially due to variations in surgical techniques or differences in follow-up durations. The literature presents varying perspectives on the clinical relevance of the EPC. While some authors argued that it exerted minimal impact on PSH incidence[32], others advocated for it as the preferred method for patients who required a permanent iliac colostomy [33]; in a more recent study, the authors continued to consider EPC as a viable option for such cases[34].

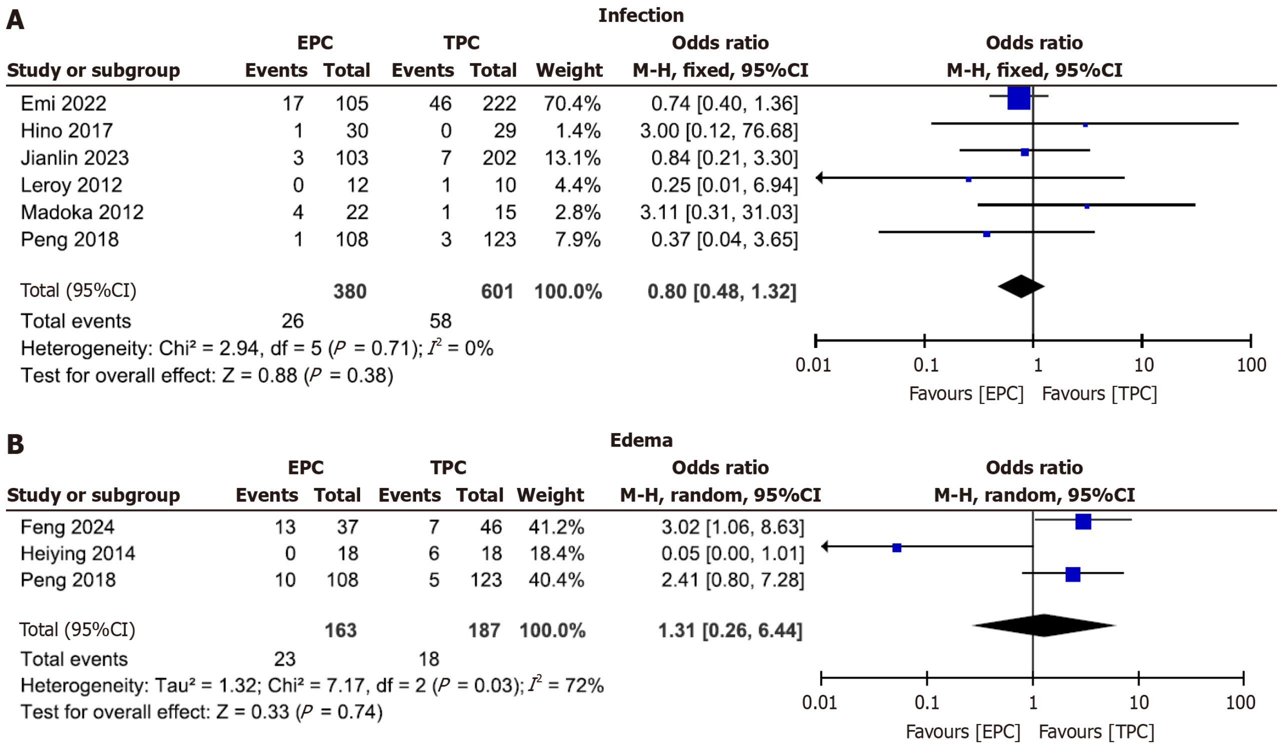

Figure 5 Forest plot of infection and edema. A: Infection; B: Edema after laparoscopic approach. EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

Although we did not uncover any differences in the rates of necrosis (P = 0.61), ischemia (P = 0.29), edema (P = 0.74), or infection (P = 0.38), the EPC group demonstrated significantly lower incidences of prolapse (P = 0.007), stoma retraction (P = 0.01), and mucocutaneous separation (P = 0.03). Stoma retraction is commonly associated with colostomies and emergency procedures, with reported rates ranging from 1% to 30%[35]. While a previous meta-analysis showed no significant difference in retraction rates between the EPC and TPC approaches (P = 0.08)[28], our findings indicated a significant advantage for the EPC group (P = 0.01). This discrepancy may have been due to the limited number of studies available. Stoma retraction is often caused by inadequate bowel mobilization, resulting in mucocutaneous tension. Preventive measures therefore emphasize the importance of proper bowel mobilization, ensuring adequate blood supply to the stoma conduit; and creating an appropriately sized fascial aperture to facilitate smooth stoma delivery to the skin [35-37]. Stomal prolapse is a frequent late complication following stoma formation, with reported incidence rates in the literature ranging from 1.7% to 25%[38,39]. This condition occurs when increased intra-abdominal pressure (often due to a mobile or redundant intestine) causes the intestine to gradually protrude through the stoma site. The relationship between EPC and the risk of stomal prolapse thus remains a topic of debate. A meta-analysis by Lian *et al*[9] comparing EPC and TPC found no significant difference in prolapse rates (P = 0.38). However, in our study we identified a significantly lower rate of prolapse in the EPC group relative to the TPC group (P = 0.007), aligning with findings from prior research[27,28]. Techniques suggested to minimize stomal prolapse include extraperitoneal tunneling, fixation of the mesentery to the abdominal wall, and reducing the size of the stoma aperture[35]. Mucocutaneous separation, characterized by partial or complete detachment of the stoma mucosa from the peristomal skin, has an incidence rate of 3.7% to 9.7%[40-42], and is a complication that can lead to stoma retraction or stenosis, adversely affecting patient quality of life. To our knowledge, the present meta-analysis is the first-ever to report a significant difference in mucocutaneous separation rates between EPC and TPC groups (P = 0.03), with the EPC group showing a lower incidence. This novel finding underscores the potential advantage of the EPC technique in reducing mucocutaneous separation occurrence.

Impaired blood supply during stoma formation can lead to ischemia and necrosis, complications that are more commonly observed after colostomy compared to ileostomy[43]; and the reported incidence of vascular compromise ranges from 2.3 to 17%[44]. Key factors contributing to inadequate blood supply include high vascular ligation, damage to blood vessels, and a constricted abdominal aperture. Early identification of stomal ischemia is essential, as compromised vascularization may result in delayed complications[45]. We herein did not find any differences in the rates of necrosis (P = 0.61), ischemia (P = 0.29), or edema (P = 0.74), consistent with previous studies[10,28] that also reported no significant differences in ischemia or necrosis rates between EPC and TPC. Regarding other postoperative complications, Hamada *et al*[15] documented an infection rate of 18.2% for the EPC route compared to 6.6% for the TPC route, although this difference was not statistically significant. Variability in infection rates may stem from factors such as differences in anatomical exposure, surgical techniques, patient characteristics, wound care practices, postoperative management, and institutional protocols. Our meta-analysis also did not reveal any significant reduction in stoma infection risk with the EPC route using a laparoscopic approach; there was also no notable difference in the incidence of stoma edema. Although disparities were observed, the absence of statistical significance highlights the need for further research so that we may

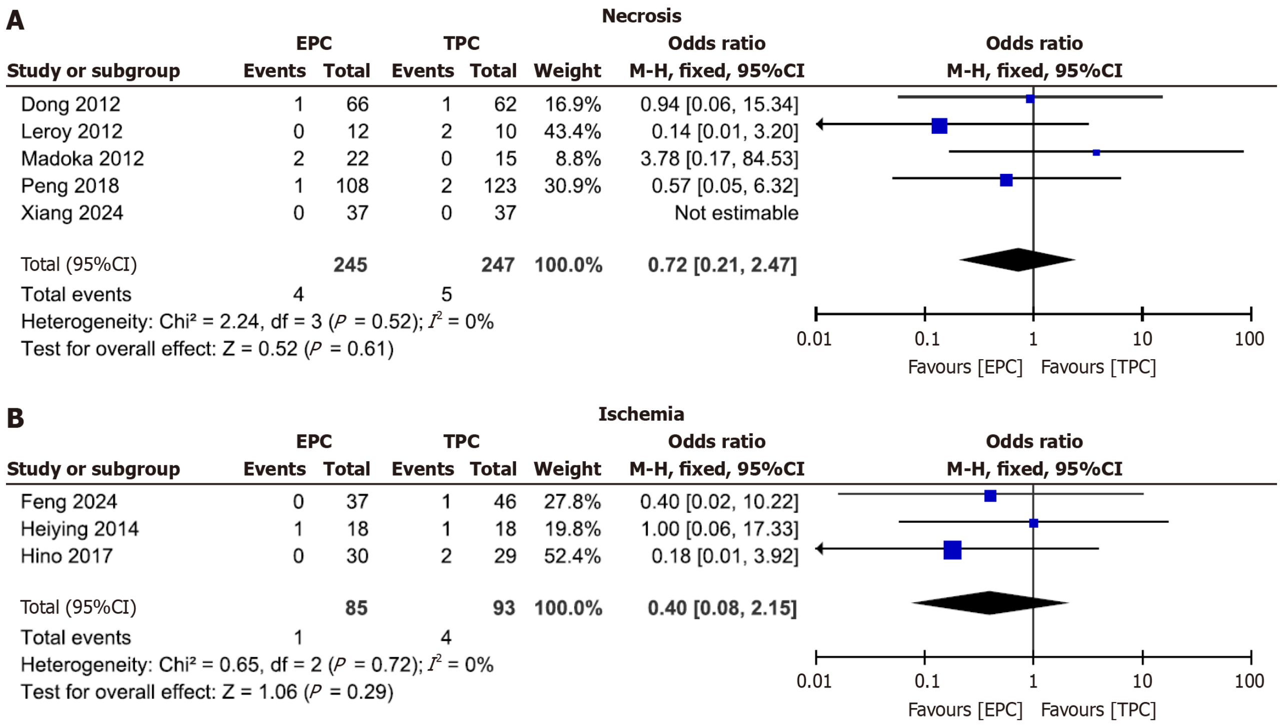

Figure 6 Forest plot of necrosis and ischemia. A: Necrosis; B: Ischemia. EPC: Extraperitoneal colostomy; TPC: Transperitoneal colostomy.

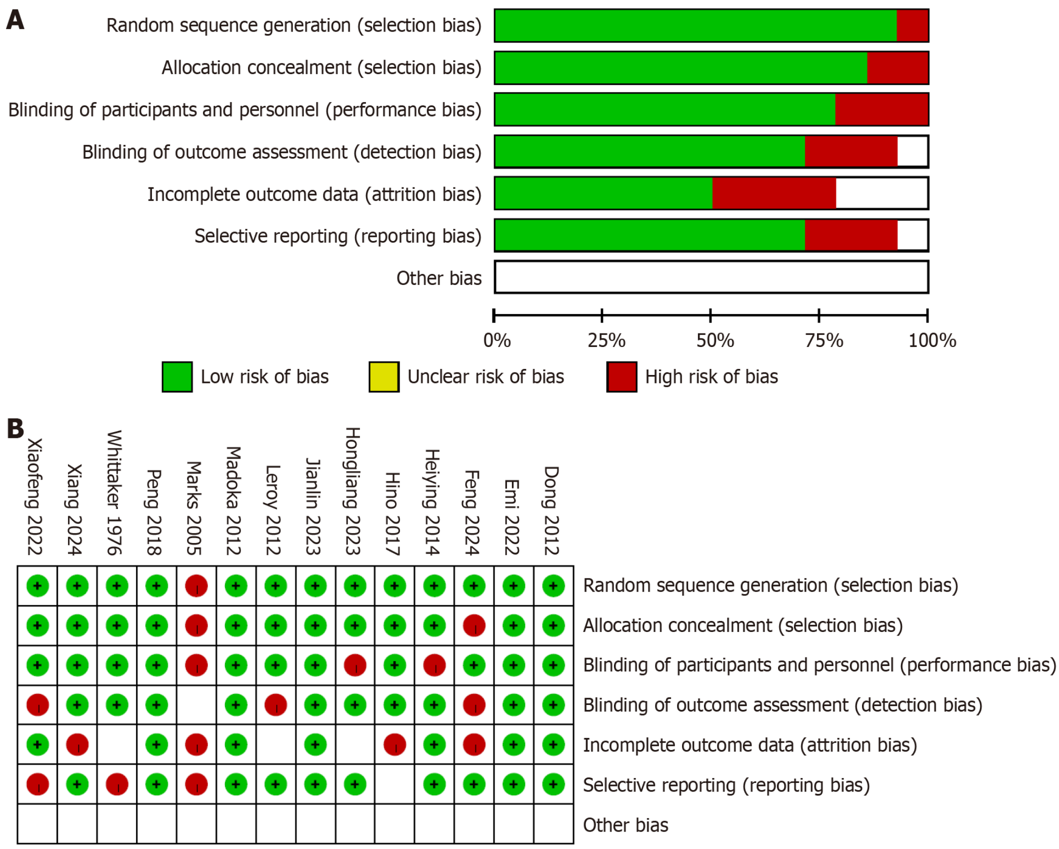

Figure 7 Quality assessment of included studies. A: Graph depicting the risk of bias by presenting the authors’ assessments of each bias item as a percentage across all included studies; B: A summary of the bias assessments, detailing the authors' evaluations of each bias item for each study included in the review.

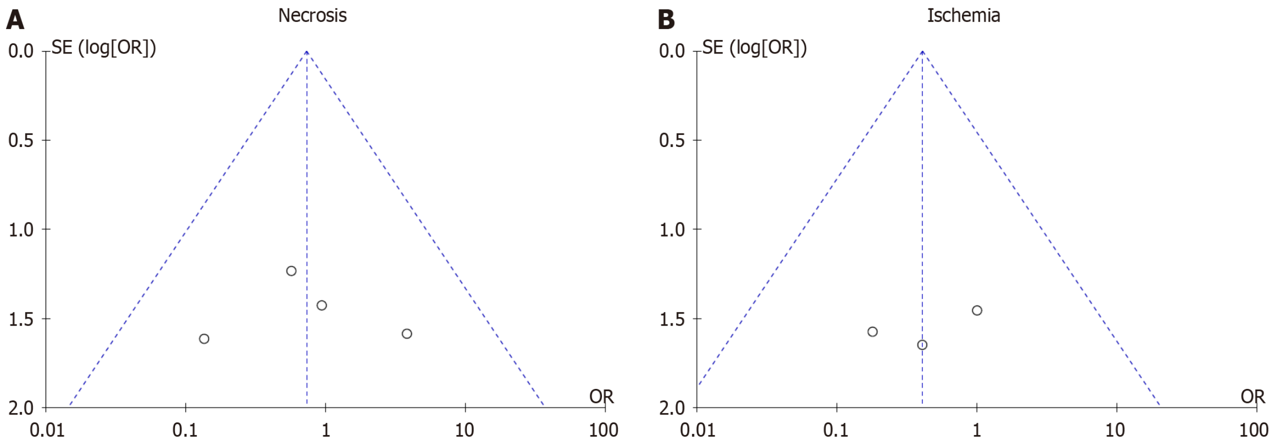

Figure 8 Funnel plot. A: Necrosis; B: Ischemia. OR: Odds ratio.

better understand the factors that influence postoperative infection rates following colostomy procedures.

The limitations we identified in our study include a predominance of RS over RCT, potentially limiting the power to adequately compare complications with low incidence rates. Additionally, there was variability in the selection of colostomy routes based on individual surgeon preferences and surgical contexts. Other limitations that could be considered include the diversity in patient populations across studies, variations in follow-up durations, the potential for publication bias, and differences in defining and reporting colostomy-related complications among included studies. Furthermore, the impact of factors such as post-operative care practices and healthcare settings on complication rates should be considered when interpreting the results.

CONCLUSION

In conclusion, the extraperitoneal route emerges as a promising strategy that can be implemented to mitigate specific stoma-related complications such as PSH and other related complications in colostomy surgery. By considering the extraperitoneal route, healthcare providers may be able to minimize the incidence of these complications, and this will ultimately lead to improved patient outcomes and quality of care. However, further research and ongoing assessment are necessary to confirm and build upon these findings, to improve patient care and treatment outcomes in the area of colostomy management.

FOOTNOTES

Author contributions: Isah AD and Wang X contributed equally as co-first authors. Isah AD, Shaibu Z and Yuan X were responsible for data collection and manuscript preparation; Dang CS and Wang X critically revised the manuscript for significant intellectual content, ensuring the accuracy and integrity of the work. All authors reviewed and approved the final manuscript.

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