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The efficacy of retrograde and antegrade enemas in the management of low anterior resection syndrome in patients undergoing rectal resection: a systematic review and meta-analysis

Yuan Yuan[2], Qi Gao[2] and Hui Yang[1*]

Abstract

Background Rectal resection could potentially cause low anterior resection syndrome (LARS). Although recent studies have reported the efficacy of enema against LARS, no systematic review and meta-analysis has been conducted.

Methods A systematic search was conducted in PubMed, EMBASE, MEDLINE, CINAHL Complete, Cochrane library and Web of Science. Eligible studies that quantified the effect of enema vs. other approaches on LARS following rectal resection were selected. Meta-analysis was conducted by using RevMan 5.4 software and StataMP 17. Where meta-analysis was not possible, vote counting was performed.

Results This study comprised five RCTs with 159 participants and meta-analysis was performed in 4 studies. Compared with the control group, enema reduced LARS score with mean differences of -10.84 (95% CI: -16.71 to -4.98, $P=0.0003$). Subgroup analysis based on the type of enema were performed, with three European studies using retrograde enema and one Asian study using antegrade enema, with mean differences of -13.77 (95% CI: -17.97 to -9.57, $P<0.00001$) and -4.86 (95% CI: -9.26 to -0.46, $P=0.03$), respectively. According to follow-up period, two trials reported short-term effects and the other two investigated medium/long-term effects with mean differences of -14.22 (95% CI: -20.05 to -8.38, $P=0.23$) and -7.59 (95% CI: -14.47 to -0.71, $P=0.13$), respectively. One study that used antegrade enema was key contributor to the substantial interstudy heterogeneity by the leave-one-out sensitivity analysis. After exclusion of this study, no heterogeneity was found ($t^2=0.00$; $\chi^2=1.63$, df = 2, $p=0.44$; $I^2=0\%$). Vote counting also showed positive effects of enema on LARS.

Conclusions Enema, particularly retrograde enema, is effective in managing LARS. However, the effectiveness of antegrade enema deserves further investigation. The short-term effects of enema are more pronounced compared to long-term outcomes. Due to the limited number of included studies, these findings should be taken cautiously. More RCTs on other continents are needed to validate the impact of enema on LARS, as well as to develop standardised protocols to facilitate clinical practice.

PROSPERO Registration CRD42024539973.

Keywords Enema, Rectal resection, Low anterior resection syndrome, Meta-analysis

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Introduction

According to updated estimates from the International Agency for Research on Cancer (IARC), the incidence and mortality rates for colorectal cancer are 9.6% and 9.3%, respectively, ranking third and second in the world [1]. Of these, the proportion of rectal cancer increased to 31% [2]. With advancements in surgical techniques, rectal resection has become the preferred sphincter-preserving approach [3], particularly for mid and low rectal cancers, often following chemoradiation therapy and accompanied by a temporary protective ileostomy [4]. Although the anal sphincter is preserved, a high rate of patients suffer from defecatory dysfunction [5], including emptying difficulties, urgency of stool, incontinence, soiling and repeated painful stools. These symptoms were commonly referred to as low anterior resection syndrome (LARS), profoundly impacting quality of life (QoL) [6], leading to distress, low spirits, isolation and social dysfunction [7].

The LARS score has been commonly utilized as a clinical assessment tool for screening patients with LARS [8, 9]. LARS can be classified according to the severity of symptoms as no LARS (score 0–20), minor LARS (score 21–29) and major LARS (score 30–42). The incidence of LARS in different studies varies. The meta-analysis by Croese et al. found that the prevalence of LARS ranged from 17.8% to 56% [10], with another study revealing a 44% incidence of major LARS [11].

The pathophysiologic mechanism of LARS is unknown, but several hypotheses have been proposed, including internal anal sphincter dysfunction, decreased anal canal sensation, loss of recto-anal inhibitory reflexes, interference with anus-neorectum reflexes, and decreased rectal fluid storage capacity and compliance [12, 13]. Additionally, diverting stoma, time to stoma closure, radiotherapy history and low anastomosis height are also risk factors for the development of LARS [10, 14, 15].

Several methods have been proposed to manage LARS, including enema, pelvic floor rehabilitation (PFR), medication, sacral neuromodulation (SNM), percutaneous tibial nerve stimulation (PTNS) [16–18]. However, there are no established gold-standard methods for the prevention and management of LARS [19]. PFR may not be effective if exercise parameters and behaviour are not met and needs to be performed by a professional physiotherapist using a standardised protocol [20]. While ramosetron has been proposed, the safety and feasibility of it in female patients is still unclear [21]. In addition, loperamide can have side effects, such as aggravating constipation, especially inpatients with LARS who have emptying disorders [22]. SNM requires the implantation of an electronic device, with the risk of infection, pain, and damage to the device at the site of implantation [23]. Furthermore, PTNS requires patients to make frequent trips to hospitals for specialised neurostimulation, which can be inconvenient [24]. Enema is easy, long-lasting and can be administered at home, lowering costs while assuring treatment continuity [25]. Although studies have been reported in recent years that both retrograde enema and antegrade enema have positive effects on the management of LARS, no systematic review and meta-analysis has been conducted.

The primary objective of this systematic review and meta-analysis was to evaluate the efficacy of enema administration in managing bowel dysfunction symptoms among adults with LARS following rectal resection, and to synthesize existing clinical evidence on this intervention.

Methods

Literature search and screening

This systematic review and meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines [26]. The protocol was preregistered in the International Prospective Register of Systematic Reviews (PROSPERO registration No. CRD42024539973). A comprehensive literature search was conducted across PubMed, EMBASE, MEDLINE via EBSCOhost, CINAHL Complete via EBSCOhost, Cochrane library and Web of Science from their inception to March 31, 2024. The following Mesh and search terms ('low anterior rectal resection', 'Dixon operation', 'low anterior resection', 'low anterior resection of rectum', 'anterior resection of rectum', 'rectum anterior resection', 'anterior resection', 'anterior rectal resection', 'anterior rectum resection', 'intersphincteric resection', 'intersphincteric excision', 'Low Anterior Resection Syndrome', 'LAR Syndrome', 'LARS', 'anterior rectal resection syndrome', 'anterior rectal excision syndrome', 'anterior resection syndrome') were used alone and retrieved in the above database using a combination of Boolean operators. Furthermore, the references from the retrieved reviews and meta-analysis were manually searched to discover additional relevant studies. To check for new research publications, we updated our search for articles published between April 1, 2024 and March 31, 2025 using the same methodology.

The inclusion criteria were as follows: (1) Population: Adults (≥ 18 years) who have undergone rectal resection. (2) Intervention: Administration of enema via the rectum or the formation of a protective stoma. (3) Outcome: improvement in LARS assessed by a change in LARS score. (4) Study Design: Experimental studies including randomized control trials (RCTs) and non-randomized controlled trial (non-RCTs). (5) language: in English.

The exclusion criteria were defined as studies that: (1) Do not report the primary outcomes. (2) Duplicate publications (those based on the same primary study). (3) Cannot be obtained in full text from the database or by contacting the author. (4) Include retrospective or observational studies, reviews, opinions, letters to editors, case reports, theses, dissertations, study protocols, conference abstracts, and grey literature. (5) Lack sufficient data or relevant outcomes.

Study selection and data extraction

We performed a comprehensive title screening by importing all search results into EndNote 20 software. Duplicates and studies not aligned with our research question were excluded. The final EndNote database was shared for abstract screening, during which two independent reviewers (Yuan and Gao) conducted parallel data extraction from relevant search engines. Both reviewers applied the inclusion and exclusion criteria to identify relevant literature for further evaluation. Potentially relevant studies were assessed in full text for final inclusion or exclusion. Any disagreements between the reviewers during the selection process were resolved through discussion or by consulting a third reviewer (Yang).

A pre-determined data extraction table was designed to capture all key study characteristics, including the following information: (1) title, (2) author, (3) publication year, (4) country of publication, (5) study design, (6) study population (age, gender, sample size, type of cancer), (7) surgical procedure, (8) compared group, (9) follow-up time point, (10) outcome measures. Furthermore, the following data about the intervention groups were extracted from the original articles: (1) the type of enema, (2) irrigation system used, (3) frequency, (4) the type of solution, (5) starting time, (6) volume (7) duration. Where information regarding data was unclear, we contacted the author of the original trial report for further details.

Study quality assessment

Quality assessment was undertaken by two independent reviewers using the Risk of Bias 2 (ROB2) tool for assessing RCTs [27] and a summary of findings table was generated using GRADEpro GDT (GRADEpro Guideline Development Tool [Software]. McMaster University, 2015 (developed by Evidence Prime, Inc)).

Statistical analysis

The meta-analysis of comparable data was performed using Review Manager 5.4 and stataMP 17. The mean difference and 95% confidence intervals (95% CIs) were used to evaluate continuous variables. Continuous variables reported as median (range) or median (95% CIs) in the original publications were transformed to mean (standard deviation) [28, 29]. Vote-counting method was applied based on the direction of the effect where meta-analysis was not appropriate [30]. The mean difference (MD) were pooled with the random-effects model. Weighted averages are used to express scores on the same metric across multiple studies. Heterogeneity among studies was evaluated using the Cochrane's Q-test and the I-Square (I^2) index [31]. To explore the underlying causes of heterogeneity, subgroup and sensitivity analysis were performed. Subgroup analysis was conducted based on the type of enema and follow-up period to assess their effects on the LARS score. Short-term follow-up was defined as up to 3 months after baseline, and medium/long-term follow-up was defined as over 3 months after baseline [32]. Sensitivity analysis was performed in the form of leave-one-out to assess whether excluding any individual study significantly altered the outcomes. Finally, publication bias was assessed by visual inspection of the funnel plot generated by Review Manager 5.4 and the Egger test using StataMP 17. The statistical difference was determined when the *P*-value was less than 0.05.

Results

Literature search and study characteristics

In a database search conducted in April 2024, we identified 5338 relevant publications in the initial search. Of these studies, 3335 remained after removing 2003 duplicates. A total of 35 studies were subjected to full-text review and five studies were included in the final analysis. An updated search yielded 632 additional records. After deduplication, 297 articles were screened. Five potentially eligible studies underwent full-text review: one was excluded due to lack of a comparative group, and four were ongoing trials. Consequently, no study from the update was eventually included. Finally, we included 5 studies [33–37]. The flow chart of the search and selection of studies is shown in Fig. 1.

All five studies were RCTs involving a total of 159 participants, published between 2019 and 2023. The sample size ranged across the trials between 23 and 39, and the follow-up period ranged from 1 week to 12 months. Two of the studies were single-center studies conducted in Iran [33] and Spain [37], respectively. Of the remaining three studies, one involved seven centers across Switzerland, France and Denmark [34], while the other two were multicenter studies in Austria, Vienna, Germany [36] and Sweden [35]. The experimental group in one study utilized antegrade enema before stoma closure [33], with manual administration method. This study reported the initial intraoperative enema details and the duration of enema. For remaining four studies using retrograde enema after ileostomy

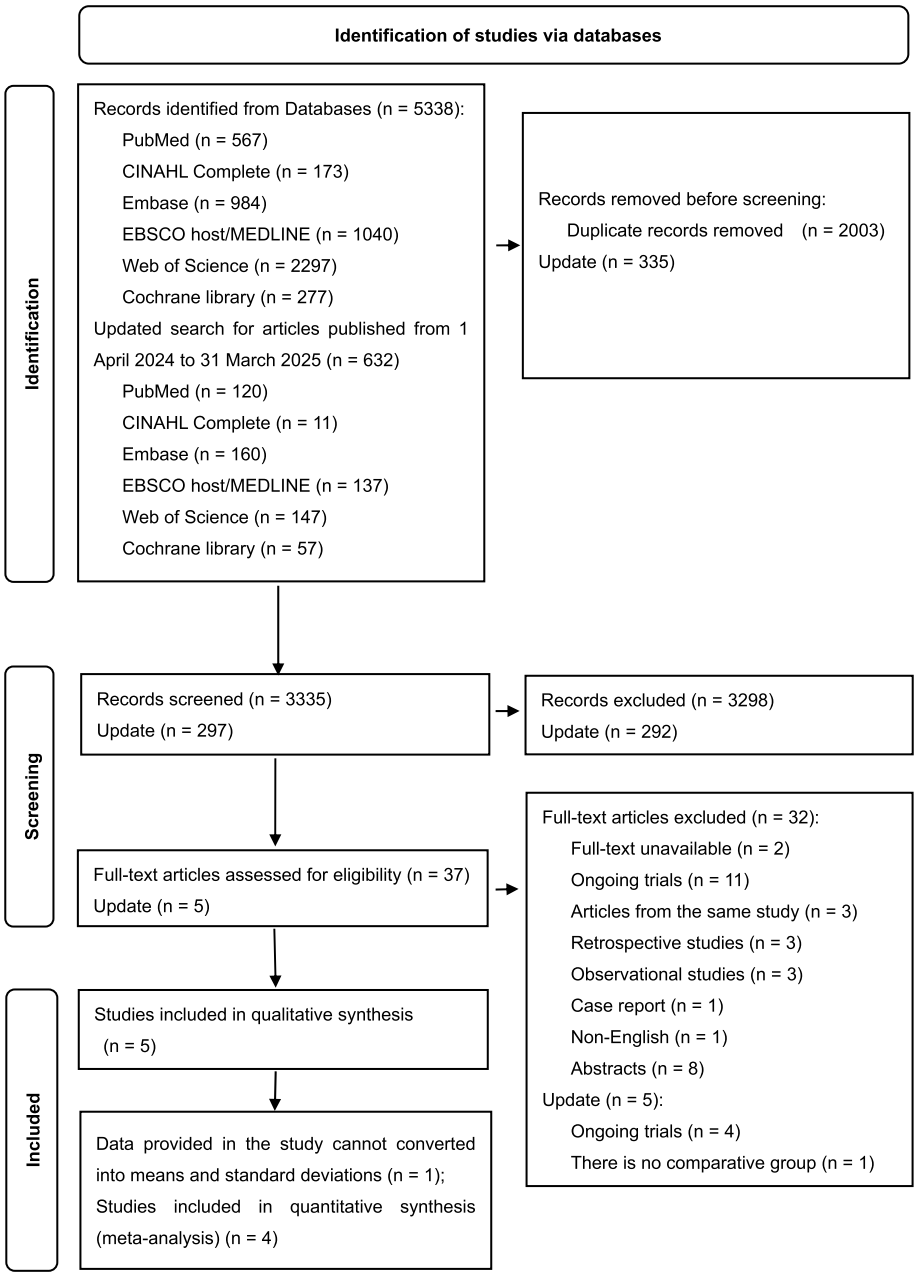


Fig. 1 Flow chart of literature search. **A** Overall forest plot of LARS scores. **B** Subgroup analysis of LARS scores based on the type of enema. **C** Subgroup analysis of LARS scores based on the follow-up period

closure to manage LARS, device-based administration method and tap water were choices, duration, frequency, and volume of enema varied [34–37]. Among the five studies, two reported complications [34, 35], two explicitly documented no adverse events [36, 37], and one did not report relevant safety data [33]. The main characteristics of the 5 included studies and specific implementation details for all experimental groups are summarized in Table 1.

Assessment of quality and bias

Two of the included studies were at high risk of bias, one had a low risk of bias and two had some concerns of bias. Among the 5 included RCTs, only one study was a single-blind RCT [33], in which the observer who filled out the questionnaire and the data analyst were unfamiliar with the groups, while the remaining four studies were all open-label which introduce risk of biases [34–37]. Most RCTs did not demonstrate significant attrition and

Table 1 Study characteristics: baseline participant characteristics of included randomized controlled trials

Study (Year)	Study design	Country	Sample size (n)	Age (years)	Type of surgery	Control group	Experimental group	Discontinuation in experimental group	Outcome	Adverse event (n)	Follow-up duration	Risk of bias
Alvandipour et al. (2022) [33]	Unicenter, Single-Blind, RCT	Iran	30	E: 58 (7.45)[a] C: 55.53 (11)[a]	ISR	SOC	**Type of enema:** antegrade enema **Administration Method:** manual, with a small catheter **Timing:** before stoma closure **Frequency:** NA **Duration:** one week **Solution:** water **Volume:** 1 L **Education:** The necessary care and method of using appendicostomy was given to patients before discharge	no patient discontinued	LARS score; Wexner score; QoL	NA	12 months	Low
Meurette et al. (2023) [34]	Multicenter, Open-Label, RCT	Switzerland France Denmark	30	E: 63.3 (12.9)[a] C: 62.9 (10.1)[a]	TME	SOC	**Type of enema:** retrograde enema **Administration Method:** device-based, with the Peristeen® system **Timing:** after ileostomy closure **Frequency:** every 24 h **Duration:** NA **Solution:** water **Volume:** start with a maximum 1 L **Education:** Specific education and training was undertaken by a dedicated nurse or the treating physician in a consultation dedicated to patient education	1 patient discontinued: deferred performing the enema	LARS score; Wexner score; Frequency of bowel; QoL	A total of 16 adverse events occurred in 14 patients (none severe): irrigation pain at the anus: 2 (14%) abdominal spasms and transit disturbance during irrigation: 5 (36%) water leakage: 2 (14%) immediate reuse of cone: 3 (21%) low water flow/pressure:4 (29%)	3 months	Some concern

Table 1 (continued)

Study (Year)	Study design	Country	Sample size (n)	Age (years)	Type of surgery		Control group	Experimental group	Discontinuation in experimental group	Outcome	Adverse event (n)	Follow-up duration	Risk of bias
Pieniowski et al. (2023) [35]	Multicenter, Open-Label, RCT	Sweden	39	E: 65(10)[a] C: 64(13)[a]	LAR with TME		CT	**Type of enema:** retrograde enema **Administration Method:** device-based, with the Peristeen® system **Timing:** after ileostomy closure **Frequency:** every 24 h **Duration:** 2 weeks **Solution:** water **Volume:** the initial amount of water is 500 ml, then gradually increased to a maximum of 1 L **Education:**All patients randomized to the TAI group received a prescription for the Peristeen devices and were trained to perform TAI by the urotherapist or stoma nurse at the outpatient clinic	6 patients discontinued: 3 dropped out (reason not resulted), 2 dropped out due to COVID-19 pandemic, 1 dropped out due to sudden death	LARS score; CCFFIS; Frequency of bowel; QoL	bleeding at irrigation: 1(6%) Contact with health care (acute): 1(6%) Pain at irrigation: 4(26%) Difficulties inflating water: 8(50%) Difficulties to keep the catheter in place: 12(75%)	6, 12 months	Some concern
Rosen et al. (2019) [36]	Multicenter, Open-Label, RCT	Germany; Austria; Vienna	37	E: 58.5 (52–70)[b] C: 58 (42–80)[b]		ultra-LAR	ST	**Type of enema:** retrograde enema **Administration Method:** device-based, with the Peristeen® system **Timing:** after ileostomy closure **Frequency:** every 24 h **Duration:** up to 3 months **Solution:** tap water **Volume:** 1 L **Education:**Patients randomized to the TAI group received intensive counselling and training in use of the Peristeen® device, and started the first irrigation under the guidance of a specially trained stoma/incontinence therapist once passage of the first stool had been documented	1 patient discontinued: refuse TAI	LARS score; Wexner score; Frequency of bowel;	0	1 week, 1 month, 3 months	High

Table 1 (continued)

Study (Year)	Study design	Country	Sample size (n)	Age (years)	Type of surgery	Control group	Experimental group	Discontinuation in experimental group	Outcome	Adverse event (n)	Follow-up duration	Risk of bias
Enriquez-Navascues et al. (2020) [37]	Unicenter, Open-Label, RCT	Spain	23	E: 68 (48–71)[c] C: 68 (56–76)[c]	LAR with TME	PTNS	**Type of enema:** retrograde enema **Administration Method:** device-based, with the Peristeen® system **Timing:** after ileostomy closure **Frequency:** initially once a day then 3–4 times a week **Duration:** up to 6 months **Solution:** tap water (36–38℃) **Volume:** 1 L **Education:** Before using the system at home, patients were taught how to use it and supervised for 3–4 weeks by trained gastroenterology nurses	3 patients discontinued: no acceptability of TAI	LARS score; QoL	0	6 months	High

E experimental group, *C* control group, *ISR* intersphincteric resection, *LAR* low anterior resection, *TME* total mesorectal excision, *SOC* standard of care, *CT* conservative treatment, *ST* supportive treatment, *PTNS* percutaneous tibial nerve stimulation, *CCFFIS* Cleveland Clinic Florida Fecal Incontinence Score, *NA* Not Available

[a] Values are mean (standard deviation)

[b] Values are median (range)

[c] Values are mean(range)

reporting bias. The details of the risk of bias assessment can be obtained for all studies in Supplementary Table S1. The certainty of study for primary outcome was rated as moderate. A summary of findings with GRADE evidence is shown in Supplementary Table S2.

Results of vote-counting

All 5 studies supported a positive effect of enema on LARS score, regardless of effect size. The findings from vote counting by direction of effect are shown in Supplementary Table S3.

Results of meta-analysis

In one study [35], we were unable to convert the data provided by the authors into means and standard deviations. Therefore, four articles (n = 120 patients) were included in the meta analysis [33, 34, 36, 37]. Three studies reported single time-point assessments [33, 34, 37], and one study reported multiple follow-up intervals [36]. Only the last follow-up time point in this study was consistent and reproducible with other studies. Therefore, we extracted the terminal follow-up data from the study as the representative values for effect size combination in the meta-analysis.

LARS score

The meta-analysis showed that LARS scores were significantly lower in the experimental group than in the control group (MD = −10.84, 95% CI: −16.71 to −4.98, P = 0.0003). Substantial heterogeneity was found (t^2 = 24.38; χ^2 = 9.87, df = 3, p = 0.02; I^2 = 70%; Fig. 2A).

Subgroup analysis

Type of enema

One Asian study performed manual antegrade enema prior to stoma closure [33], whereas three European studies utilized retrograde enema with device-based administration methods following ileostomy closure [34, 36, 37]. Results from both subgroups indicated that the experimental group had lower LARS scores than the control group (Fig. 2B).

Follow-up period

Two studies reported short-term effects [34, 36], and the other two investigated medium/long-term effects [33, 37]. Results from both subgroups indicated that the experimental group had lower LARS scores than the control group, but for long-term effects, the magnitude of between-group differences was attenuated compared to short-term outcomes (Fig. 2C).

Sensitive analysis

In the meta-analysis of LARS score, the study that used antegrade enema technique was key contributor to the substantial interstudy heterogeneity by the leave-one-out sensitivity analysis [33]. After exclusion of this study, no heterogeneity was found (t^2 = 0.00; χ^2 = 1.63, df = 2, p = 0.44; I^2 = 0%). The result did not change after removing that study (MD = −13.77, 95% CI: −17.97 to −9.57, P < 0.00001). The sensitivity analysis was shown in Fig. 3.

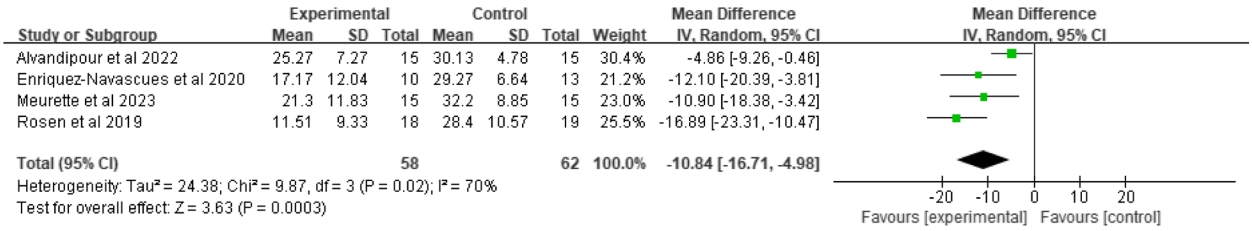
Publication bias

Visual inspection of the funnel plot (Fig. 4) and Egger test showed no evidence of publication bias for any of the designated variables of all included studies (P > 0.05).

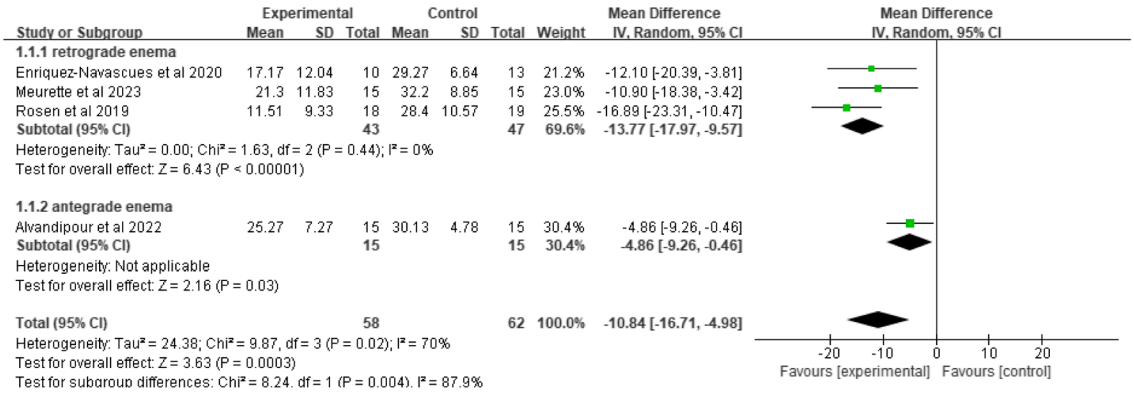
Discussion

Based on the results of this systematic review, it can be concluded that enema is effective in alleviating LARS. In the meta-analysis, all three European studies used retrograde enema after ileostomy closure, showing the positive effects. There was no heterogeneity among these European studies, so the findings were persuasive. From a physiological perspective, the mechanism of retrograde enema is to induce a reflex colorectal voiding by introducing water into the colon and rectum through the anus [38], and retrograde enema may be the option that affects bowel dysmotility, mimicking the rectal pacemaker control to regulate intestinal transport rhythms and motility [39]. Only one study from Asia used antegrade enema prior to stoma closure and considered it effective. The finding may not be representative because just one study was included, and the sample size was small. In an early meta-analysis of 8 studies evaluating the effectiveness of antegrade enema, all studies showed improvements in incontinence and constipation [40]. Antegrade enema works through mechanical intestinal irrigation, potentially in conjunction with stimulating colonic contractions, emptying of the colon at regular intervals [41]. However, these studies paid more attention to the symptom of constipation and fecal incontinence rather than those of LARS, such as urgency and clustering. Few studies have explored the relationship between antegrade enema and LARS. More RCTs are needed in the future to expand sample size and further explore whether antegrade enema before stoma closure inhibits LARS in the future.

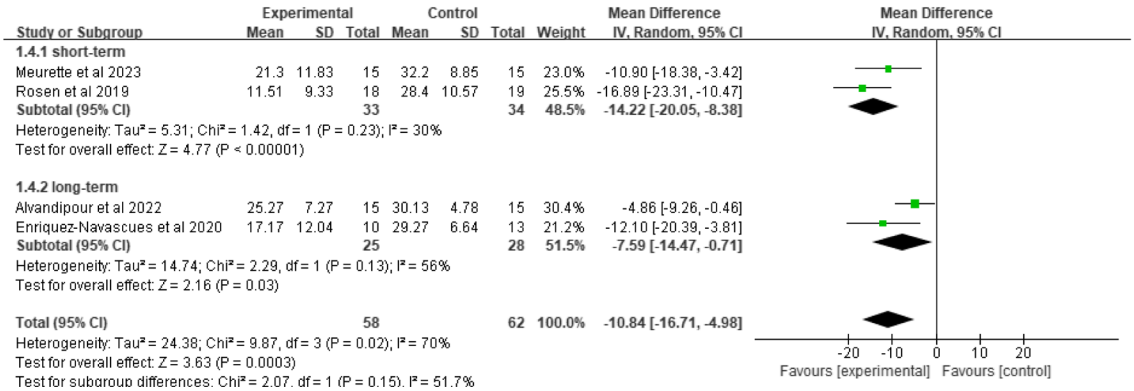
The short-term effects of enema are more pronounced compared to long-term outcomes. A Bayesian network meta-analysis conducted by Yu et al. [42] comparing the effectiveness of different interventions for the treatment of LARS showed that in terms of short-term symptomatic relief, retrograde enema was the most efficacious, followed by PFR. Both TAI and PTNS showed good therapeutic potential in terms of long-term functional improvement, but no significant differences were noted. Time-consuming nature of the enema [43], as well as loss of motivation after



A. Overall forest plot of LARS scores.



B. Subgroup analysis of LARS scores based on the type of enema.



C. subgroup analysis of LARS scores based on the follow-up period.

Fig. 2 Forest plots of the mean difference for the LARS score

experiencing improved bowel function [42], resulted in patients' reduced compliance [44]. Thus, introducing enema in the early stage in the LARS management could be beneficial, particularly for patients with short-term symptoms [42]. Two studies utilizing device-based enema reported adverse events, predominantly operational technical issues [34, 35], potentially attributable to insufficient patient training, suboptimal procedural proficiency, or device design limitations. Also, inserting a catheter into the bowel and administering an enema under pressure increases the danger of a possibly intestinal perforation [45]. A global audit on enema-induced perforation estimated that the weighted average risk of bowel perforation was 6 per million irrigation procedures (1:167,000) [45]. To ensure the safety, all patients are required to undergo rigorous training by a specialist before self-administration [36]. Usually, it takes 6–8 weeks after initial training for patients to become fully proficient in all practical aspects of self-irrigation [46]. It is recommended to conduct following up (phone/email/social media) within 7 days post-training and initial enema, with reinforced instruction at 14 days to ensure correct device use [47]. In our clinical experience, adequate training and continuous support for patients may be crucial for their compliance. However, further studies is warranted to substantiate this

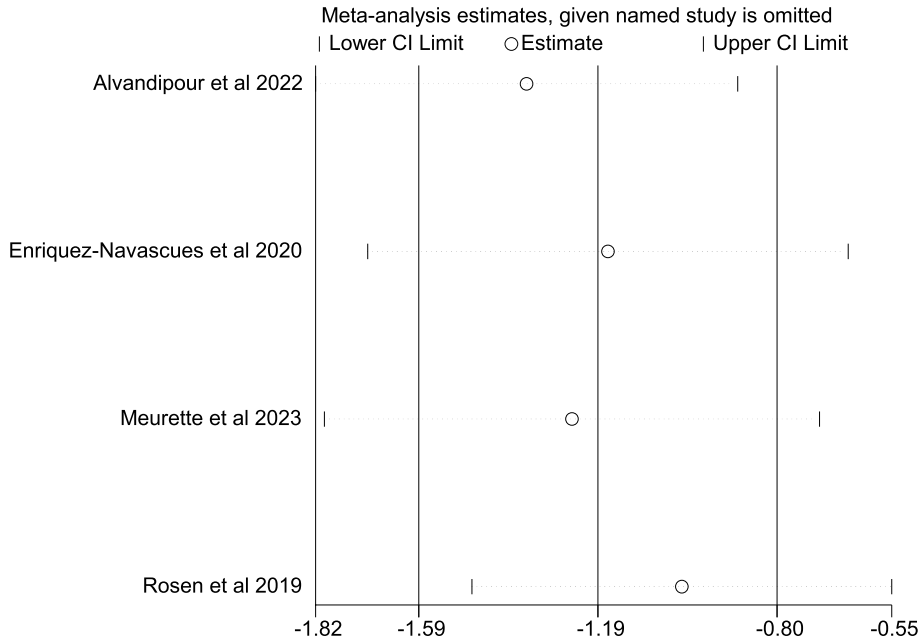


Fig. 3 Sensitivity analysis of LARS score

hypothesis in future. The included studies differ widely in terms of the details of enema, highlighting the necessity of conducting large-scale, well-designed RCTs to determine the ideal timing, frequency, volume and duration of enema. More importantly, despite abundant clinical evidence, most of it has not been effectively implemented in clinical practice due to healthcare professionals' low willingness and insufficient policy support [48]. We need to focus not only on optimizing protocols, but also on developing standardized clinical guidelines to ensure that enema as an intervention can be effectively promoted in clinical practice.

All of these included RCTs are from Europe and Asia. The absence of experimental studies from Africa, the Americas and Oceania in this meta-analysis raises critical concerns regarding health equity and the global generalizability of current evidence on enema for LARS management. Limited access to health-care facilities with high

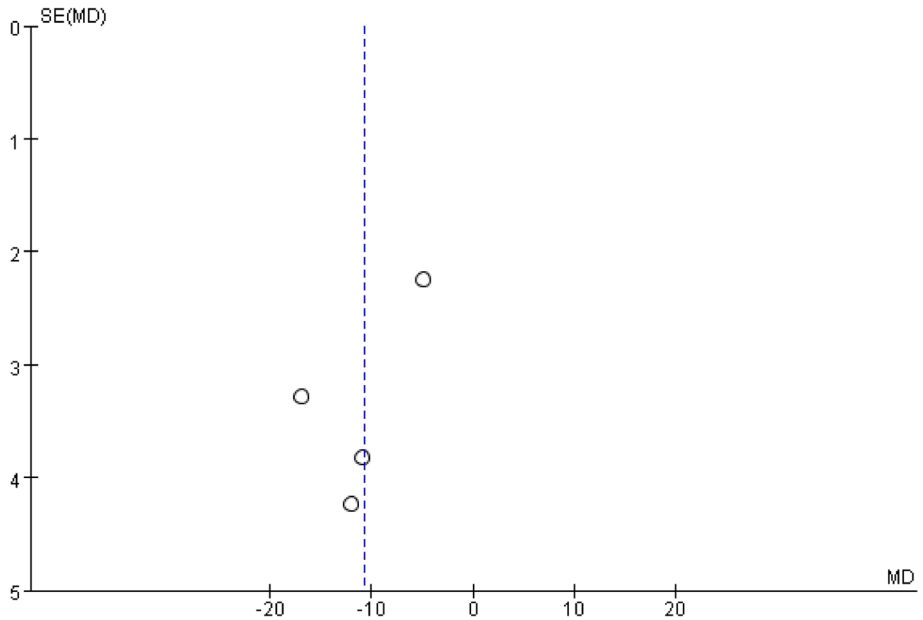


Fig. 4 Funnel plots of the LARS score

costs of care in many African countries, especially in rural areas, poses a major obstacle to bowel management. Research from sub-Saharan Africa shows that low- and middle-income groups in slums are often unable to access needed medical assistance for financial reasons [49, 50]. Limited expertise of healthcare providers and low levels of patient health literacy are barriers to timely treatment [51, 52], increasing the burden of enema training. The generalisability of the findings is further limited by differences in cultural backgrounds and clinical contexts. Cultural backgrounds can influence patients'perceptions of illness and symptoms [53]. Also, religious groups represented by Muslims value physical modesty and privacy in medical settings [54]. Religious prohibitions against, or recommendations for, certain therapeutic decision-making may influence clinical exposure [55]. In addition, recent studies have shown significant geographic and ethnic differences in gut function, with race accounting for more variation in gut microbiota than age, gender, lifestyle, or medical factors [56, 57]. More and larger parallel controlled trials are needed in more continents to validate the efficacy and acceptability of enema in ethnically diverse populations. There is also a need to comprehensively assess the cost-effectiveness and economic impact of enema, taking into account clinical scenarios, the needs and values of ethnically diverse populations, and the professional judgement of healthcare workers, in order to inform the evidence-based management of clinical practice and healthcare policy and ultimately to identify strategies that are most effective in terms of clinical outcomes and resource utilisation [58].

A major strength of this study is the inclusion of only RCTs, which increases the likelihood that we can draw reasonable conclusions. However, this systematic review and meta-analysis should be interpreted with caution due to the limited number of studies, small sample sizes. Moreover, the restricted geographical coverage (only Europe and Asia) and lack of data on protocol adherence may affect the generalizability of the results. In addition, our search for relevant studies was limited to English, potentially overlooking pertinent studies published in other languages. According to the comprehensive systematic search found that some of the ongoing studies involved more regions and countries, in the future we will expand the search time and language for updating systematic review to make up for the above shortcomings, in order to obtain higher quality evidence of clinical applications. Last but not least, inconsistency of experimental group and substantial heterogeneity among the control groups across included studies compromises the comparability of results across studies and complicates the ability to draw definitive, robust conclusions about treatment efficacy. Although subgroup analyses were performed based on enema type and duration of follow-up, heterogeneity remained high in these subgroups. The timing, frequency, volume of enema varied among these included studies. These factors may play a crucial role in determining the efficacy of enema, but they remain a source of uncertainty due to the lack of standardised protocols. Our analysis combined preventive and therapeutic applications due to limited data. Future studies should aim to validate the details of enema to maximize clinical efficacy and reduce heterogeneity, while separately evaluating potential differences between prophylactic and therapeutic applications.

Conclusions

According to our findings, enema, particularly retrograde enema, is effective in managing LARS and can lower the LARS score. However, the effectiveness of antegrade enema before ileostomy closure deserves further investigation. The short-term effects of enema are more pronounced compared to long-term outcomes. However, due to the limited number of included studies, these findings should be taken cautiously. More RCTs on other continents are needed in the future to validate the impact of timing, frequency and duration of enema on LARS, as well as to develop standardised protocols to facilitate clinical practice.

Abbreviations

RCT	Randomized controlled trials
LARS	Low anterior resection syndrome
IARC	The International Agency for Research on Cancer
QoL	Quality of life
PFR	Pelvic floor rehabilitation
SNM	Sacral neuromodulation
PTNS	Percutaneous tibial nerve stimulation
ROB2	Risk of bias
CI	Confidence Interval
MD	Mean Difference
SMD	Standard Mean Difference

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12876-025-03985-x.

Supplementary Material 1.

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Not applicable.

Authors' contributions

Y.Y. was responsible for extracting, analysing and interpreting the data and writing the manuscript. Q.G. was responsible for extracting, analysing the data. H.Y. was responsible for the conceptual design of the study as well as the analysis and interpretation of the data and critical revision of the intellectual content. All authors read and approved the final manuscript.

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Not applicable.

Data availability
Information about the data and analysis performed in the present study is available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
All patient data in the study were obtained from published studies and therefore this work did not require separate ethics approval. All original studies included in our analysis were ethically compliant, with approvals and participant consents obtained as reported in their respective publications (references [33–37]).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–63.
2. Siegel RL, Wagle NS, Cercek A, Smith RA, Jemal A. Colorectal cancer statistics, 2023. CA Cancer J Clin. 2023;73(3):233–54.
3. Toiyama Y, Kusunoki M. Changes in surgical therapies for rectal cancer over the past 100 years: A review. Ann Gastroenterol Surg. 2020;4(4):331–42.
4. Monson JR, Weiser MR, Buie WD, Chang GJ, Rafferty JF, Buie WD, et al. Practice parameters for the management of rectal cancer (revised). Dis Colon Rectum. 2013;56(5):535–50.
5. Rosen H, Sebesta CG, Sebesta C. Management of Low Anterior Resection Syndrome (LARS) Following Resection for Rectal Cancer. Cancers (Basel). 2023; 15(3).
6. Keane C, Fearnhead NS, Bordeianou LG, Christensen P, Basany EE, Laurberg S, et al. International Consensus Definition of Low Anterior Resection Syndrome. Dis Colon Rectum. 2020;63(3):274–84.
7. Ram E, Meyer R, Carter D, Gutman M, Rosin D, Horesh N. The efficacy of sacral neuromodulation in the treatment of low anterior resection syndrome: a systematic review and meta-analysis. Tech Coloproctol. 2020;24(8):803–15.
8. Ribas Y, Aguilar F, Jovell-Fernández E, Cayetano L, Navarro-Luna A, Muñoz-Duyos A. Clinical application of the LARS score: results from a pilot study. Int J Colorectal Dis. 2017;32(3):409–18.
9. Emmertsen KJ, Laurberg S. Low anterior resection syndrome score: development and validation of a symptom-based scoring system for bowel dysfunction after low anterior resection for rectal cancer. Ann Surg. 2012;255(5):922–8.
10. Croese AD, Lonie JM, Trollope AF, Vangaveti VN, Ho YH. A meta-analysis of the prevalence of Low Anterior Resection Syndrome and systematic review of risk factors. Int J Surg. 2018;56:234–41.
11. Sun R, Dai Z, Zhang Y, Lu J, Zhang Y, Xiao Y. The incidence and risk factors of low anterior resection syndrome (LARS) after sphincter-preserving surgery of rectal cancer: a systematic review and meta-analysis. Support Care Cancer. 2021;29(12):7249–58.
12. Pucciani F. A review on functional results of sphincter-saving surgery for rectal cancer: the anterior resection syndrome. Updates Surg. 2013;65(4):257–63.
13. Ridolfi TJ, Berger N, Ludwig KA. Low Anterior Resection Syndrome: Current Management and Future Directions. Clin Colon Rectal Surg. 2016;29(3):239–45.
14. Vogel I, Reeves N, Tanis PJ, Bemelman WA, Torkington J, Hompes R, et al. Impact of a defunctioning ileostomy and time to stoma closure on bowel function after low anterior resection for rectal cancer: a systematic review and meta-analysis. Tech Coloproctol. 2021;25(7):751–60.
15. Erlandsson J, Holm T, Pettersson D, Berglund Å, Cedermark B, Radu C, et al. Optimal fractionation of preoperative radiotherapy and timing to surgery for rectal cancer (Stockholm III): a multicentre, randomised, non-blinded, phase 3, non-inferiority trial. Lancet Oncol. 2017;18(3):336–46.
16. Hernandez MC, Wong P, Melstrom K. Low anterior resection syndrome. J Surg Oncol. 2023;127(8):1271–6.
17. Liapis SC, Baloyiannis I, Perivoliotis K, Lytras D, Theodoropoulos G, Tzovaras G. The Role of Percutaneous Tibial Nerve Stimulation (PTNS) in Low Anterior Resection Syndrome (LARS): A Systematic Review and Meta-analysis. J Gastrointest Cancer. 2023;54(4):1128–39.
18. Nguyen TH, Chokshi RV. Low Anterior Resection Syndrome. Curr Gastroenterol Rep. 2020;22(10):48.
19. Ryoo SB. Low anterior resection syndrome. Ann Gastroenterol Surg. 2023;7(5):719–24.
20. Asnong A, D'Hoore A, Van Kampen M, Wolthuis A, Van Molhem Y, Van Geluwe B, et al. The Role of Pelvic Floor Muscle Training on Low Anterior Resection Syndrome: A Multicenter Randomized Controlled Trial. Ann Surg. 2022;276(5):761–8.
21. Zhang R, Luo W, Qiu Y, Chen F, Luo D, Yang Y, et al. Clinical Management of Low Anterior Resection Syndrome: Review of the Current Diagnosis and Treatment. Cancers (Basel). 2023; 15(20).
22. Markland AD, Burgio KL, Whitehead WE, Richter HE, Wilcox CM, Redden DT, et al. Loperamide Versus Psyllium Fiber for Treatment of Fecal Incontinence: The Fecal Incontinence Prescription (Rx) Management (FIRM) Randomized Clinical Trial. Dis Colon Rectum. 2015;58(10):983–93.
23. Pires M, Severo M, Lopes A, Neves S, Matzel K, Povo A. Sacral neuromodulation for low anterior resection syndrome: current status-a systematic review and meta-analysis. Int J Colorectal Dis. 2023;38(1):189.
24. Zhou L, Zhang Z, Wang L. Treatment of anterior resection syndrome: A systematic review and network meta-analysis. Eur J Surg Oncol. 2024;50(6): 108336.
25. Dulskas A, Smolskas E, Kildusiene I, Samalavicius NE. Treatment possibilities for low anterior resection syndrome: a review of the literature. Int J Colorectal Dis. 2018;33(3):251–60.
26. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372: n71.
27. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366: l4898.
28. Wan X, Wang W, Liu J, Tong T. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. BMC Med Res Methodol. 2014;14:135.
29. Luo D, Wan X, Liu J, Tong T. Optimally estimating the sample mean from the sample size, median, mid-range, and/or mid-quartile range. Stat Methods Med Res. 2018;27(6):1785–805.
30. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. BMJ. 2020;368: l6890.
31. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557–60.
32. Mendonça LM, Leite HR, Zwerver J, Henschke N, Branco G, Oliveira VC. How strong is the evidence that conservative treatment reduces pain and improves function in individuals with patellar tendinopathy? A systematic review of randomised controlled trials including GRADE recommendations. Br J Sports Med. 2020;54(2):87–93.
33. Alvandipour M, Karami MY, Azadfar M, Yazdani CJ. Inter sphincter rectal resection with and without Malone ante grade continence enema in cases with low rectal cancer: A randomized, prospective, single-blind, clinical trial. Caspian J Intern Med. 2022;13(3):546–54.

34. Meurette G, Faucheron JL, Cotte E, Denost Q, Portier G, Loriau J, et al. Low anterior resection syndrome after rectal resection management: multicentre randomized clinical trial of transanal irrigation with a dedicated device (cone catheter) versus conservative bowel management. Br J Surg. 2023;110(9):1092–5.
35. Pieniowski EHA, Bergström CM, Nordenvall CAM, Westberg KS, Johar AM, Tumlin Ekelund SF, et al. A Randomized Controlled Clinical Trial of Transanal Irrigation Versus Conservative Treatment in Patients With Low Anterior Resection Syndrome After Rectal Cancer Surgery. Ann Surg. 2023;277(1):30–7.
36. Rosen HR, Kneist W, Fürst A, Krämer G, Hebenstreit J, Schiemer JF. Randomized clinical trial of prophylactic transanal irrigation versus supportive therapy to prevent symptoms of low anterior resection syndrome after rectal resection. BJS Open. 2019;3(4):461–5.
37. Enriquez-Navascues JM, Labaka-Arteaga I, Aguirre-Allende I, Artola-Etxeberria M, Saralegui-Ansorena Y, Elorza-Echaniz G, et al. A randomized trial comparing transanal irrigation and percutaneous tibial nerve stimulation in the management of low anterior resection syndrome. Colorectal Dis. 2020;22(3):303–9.
38. Emmanuel A, Kurze I, Krogh K, Ferreiro Velasco ME, Christensen P, Del Popolo G, et al. An open prospective study on the efficacy of Navina Smart, an electronic system for transanal irrigation, in neurogenic bowel dysfunction. PLoS ONE. 2021;16(1): e0245453.
39. Martellucci J, Sturiale A, Bergamini C, Boni L, Cianchi F, Coratti A, et al. Role of transanal irrigation in the treatment of anterior resection syndrome. Tech Coloproctol. 2018;22(7):519–27.
40. Abildgaard HA, Børgager M, Ellebæk MB, Qvist N. Ileal neoappendicostomy for antegrade colonic enema (ACE) in the treatment of fecal incontinence and chronic constipation: a systematic review. Tech Coloproctol. 2021;25(8):915–21.
41. Vriesman MH, Wang L, Park C, Diefenbach KA, Levitt MA, Wood RJ, et al. Comparison of antegrade continence enema treatment and sacral nerve stimulation for children with severe functional constipation and fecal incontinence. Neurogastroenterol Motil. 2020;32(8): e13809.
42. Yu M, Liu Y, Li N, Xu J, Zhang H, Li F, et al. Optimal interventions for low anterior resection syndrome: Bayesian network meta-analysis of randomized controlled trials. Tech Coloproctol. 2025;29(1):64.
43. Mekhael M, Kristensen H, Larsen HM, Juul T, Emmanuel A, Krogh K, et al. Transanal Irrigation for Neurogenic Bowel Disease, Low Anterior Resection Syndrome, Faecal Incontinence and Chronic Constipation: A Systematic Review. J Clin Med. 2021; 10(4).
44. Brock H, Lambrineas L, Ong HI, Chen WY, Das A, Edsell A, et al. Preventative strategies for low anterior resection syndrome. Tech Coloproctol. 2023;28(1):10.
45. Christensen P, Krogh K, Perrouin-Verbe B, Leder D, Bazzocchi G, Petersen Jakobsen B, et al. Global audit on bowel perforations related to transanal irrigation. Tech Coloproctol. 2016;20(2):109–15.
46. Emmanuel AV, Krogh K, Bazzocchi G, Leroi AM, Bremers A, Leder D, et al. Consensus review of best practice of transanal irrigation in adults. Spinal Cord. 2013;51(10):732–8.
47. Gallo G, Graziani S, Luc AR, Clerico G, Trompetto M. Teaching TransAnal Irrigation (TAI): why it is mandatory. Tech Coloproctol. 2018;22(3):239–41.
48. Gao Y, Gu H. Research on the influence path of the unit environment of medical and health institutions on achievement transformation output. PLoS ONE. 2023;18(12): e0295446.
49. Sharma A, Alatise OI, Adisa AO, Arowolo OA, Olasehinde O, Famurewa OC, et al. Treatment of colorectal cancer in Sub-Saharan Africa: Results from a prospective Nigerian hospital registry. J Surg Oncol. 2020;121(2):342–9.
50. Buigut S, Ettarh R, Amendah DD. Catastrophic health expenditure and its determinants in Kenya slum communities. Int J Equity Health. 2015;14:46.
51. Bosire EN, Blackmon K, Kamau LW, Udeh-Momoh C, Sokhi D, Shah J, et al. Healthcare providers perspectives and perceptions of dementia diagnosis and management at the Aga Khan University Hospital, Nairobi, Kenya. J Alzheimers Dis. 2025:13872877251320411.
52. Aliyu IA, Bala JA, Yusuf I, Amole TG, Musa BM, Yahaya G, et al. Rheumatic Heart Disease Burden in Africa and the Need to Build Robust Infrastructure. JACC Adv. 2024;3(12): 101347.
53. Ware NC, Kleinman A. Culture and somatic experience: the social course of illness in neurasthenia and chronic fatigue syndrome. Psychosom Med. 1992;54(5):546–60.
54. Padela AI, Gunter K, Killawi A, Heisler M. Religious values and healthcare accommodations: voices from the American Muslim community. J Gen Intern Med. 2012;27(6):708–15.
55. Padela AI, Zaidi D. The Islamic tradition and health inequities: A preliminary conceptual model based on a systematic literature review of Muslim health-care disparities. Avicenna J Med. 2018;8(1):1–13.
56. Wilson AS, Koller KR, Ramaboli MC, Nesengani LT, Ocvirk S, Chen C, et al. Diet and the Human Gut Microbiome: An International Review. Dig Dis Sci. 2020;65(3):723–40.
57. Deschasaux M, Bouter KE, Prodan A, Levin E, Groen AK, Herrema H, et al. Depicting the composition of gut microbiota in a population with varied ethnic origins but shared geography. Nat Med. 2018;24(10):1526–31.
58. Zhou X. JBI Evidence Implementation Project Summary. Am J Nurs. 2024;124(12):62–3.

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