

Outcomes of Laparoscopic Soave's Pull-Through in Children with Hirschsprung's Disease: A Retrospective Analysis**Saji Vargheese¹, Anis Akhtar Khavri², Joash Jensen³, Satya Ranjan Patra⁴, Shiva Kumar M Algud⁵**¹Associate Professor & Senior Surgical Specialist in General Surgery, ANIIMS & GB Pant Hospital, Port Blair - 744104, India²Senior Resident, in General Surgery, ANIIMS & GB Pant Hospital, Port Blair - 744104, India³Junior Resident in General Surgery, ANIIMS & GB Pant Hospital, Port Blair 744104, India⁴Professor in General Surgery, AIIMS, Deoghar, Jharkhand 814152, India⁵Senior Resident in General Surgery, ANIIMS & GB Pant Hospital, Port Blair 744104, India

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Abstract:**Background:** Hirschsprung's disease, a congenital disorder characterized by the absence of ganglion cells in the distal bowel, necessitates surgical intervention to alleviate obstructive symptoms and restore bowel function. Laparoscopic Soave's pull-through has emerged as a promising minimally invasive approach for the surgical management of this condition, offering potential advantages in terms of operative outcomes and postoperative recovery.**Methods:** A retrospective analysis was conducted to evaluate the outcomes of laparoscopic Soave's pull-through in children with Hirschsprung's disease. Electronic medical records of patients undergoing the procedure between July 2012 and June 2022 were comprehensively reviewed. Data collection included demographic information, preoperative evaluation findings, surgical details, perioperative outcomes, postoperative follow-up data, and long-term functional outcomes. Surgical technique adhered to standardized protocols, with meticulous attention to dissection and preservation of rectal innervation.**Results:** A total of 49 patients underwent laparoscopic Soave's pull-through, with a mean age of 2.8 ± 1.2 years. The mean operative time was 160.9 ± 35.4 minutes, with a low conversion rate to open surgery (6.1%) and no intraoperative complications. Postoperative complications were observed in 24.5% of cases, including wound infections (6.1%), anastomotic leaks (4.1%), and strictures (8.2%). Long-term functional outcomes were favorable, with a mean HD Bowel Function Score of 9.2 ± 1.5. The majority of patients achieved fecal continence (81.6%) and reported stooling frequency within the normal range of 61.2% with 1-2 times/day.**Conclusion:** Laparoscopic Soave's pull-through demonstrates favorable perioperative and long-term functional outcomes in children with Hirschsprung's disease. The minimally invasive approach offers efficient bowel function restoration while minimizing surgical morbidity. Despite the observed complications, the overall efficacy and safety of laparoscopic Soave's pull-through highlight its potential as a preferred surgical option in the management of Hirschsprung's disease.**Keywords:** Hirschsprung's disease, laparoscopic Soave's pull-through, minimally invasive surgery, bowel function, pediatric surgery.

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Introduction

Hirschsprung's disease (HD) is a congenital disorder characterized by the absence of ganglion cells in the distal portion of the colon, resulting in functional obstruction and constipation [1]. It is one of the most common causes of lower intestinal obstruction in neonates and infants, occurring in approximately 1 in every 5,000 live births [2]. The condition presents a significant challenge in pediatric surgery due to its complexity and potential for long-term morbidity if not managed

appropriately [3]. Historically, the treatment of choice for Hirschsprung's disease has been surgical resection of the aganglionic segment followed by a pull-through procedure to create a functional anastomosis between the normally innervated bowel and the anus. The Soave procedure, first described in 1964 by Dr. Guido Soave, revolutionized the surgical management of HD by preserving the anal sphincter mechanism and

allowing for improved fecal continence compared to earlier techniques [4].

Traditionally, the Soave procedure has been performed via an open surgical approach, which involves a transanal dissection of the aganglionic segment followed by a mucosal sleeve creation and anastomosis. While effective, this approach is associated with significant postoperative pain, prolonged hospital stay, and delayed recovery [5].

In recent years, laparoscopic-assisted techniques have gained popularity in the surgical management of HD, offering potential benefits such as reduced surgical trauma, shorter hospitalization, and faster recovery times [6]. Laparoscopic-assisted Soave's pull-through combines the advantages of minimally invasive surgery with the principles of the Soave procedure, aiming to optimize outcomes while minimizing morbidity [7].

Several studies have demonstrated the feasibility and safety of laparoscopic-assisted Soave's pull-through in children with Hirschsprung's disease, with comparable outcomes to traditional open techniques in terms of postoperative complications, fecal continence, and long-term bowel function [8,9,10]. However, further research is needed to evaluate the long-term efficacy and potential advantages of this approach compared to open surgery, particularly in terms of functional outcomes, quality of life, and cosmesis.

In this study, we aimed to evaluate the perioperative outcomes, and long-term functional outcome of laparoscopic-assisted Soave's pull-through in children with Hirschsprung's disease. By synthesizing existing evidence and sharing our clinical experience, we hope to contribute to the ongoing optimization of surgical management strategies for children with Hirschsprung's disease.

Materials and Methods

Study Design

This study was designed as a retrospective analysis of pediatric patients with Hirschsprung's disease who underwent laparoscopic-assisted Soave's pull-through procedure at tertiary care center of Andaman and Nicobar Islands in the last ten years between July 2012 and June 2022.

Patient Selection

Children aged 0-18 years diagnosed with Hirschsprung's disease confirmed by clinical history, physical examination, contrast enema, rectal biopsy demonstrating absence of ganglion cells, and/or genetic testing. Patients with comorbidities precluding laparoscopic surgery, previous surgical interventions for Hirschsprung's disease, or incomplete medical records.

Data Collection

This encompassed demographic details such as age, sex, weight, and underlying medical conditions. Preoperative evaluation findings, including symptoms, diagnostic studies, and associated anomalies, were meticulously documented. Surgical details were extracted from operative reports, encompassing the surgical approach, procedure performed, operative time, and intraoperative findings. Perioperative outcomes, such as length of hospital stay, intraoperative complications, postoperative complications, and instances necessitating reoperation, were meticulously recorded. Postoperative follow-up data, crucial for assessing long-term outcomes, were obtained from outpatient clinic notes, focusing on parameters such as bowel function, fecal continence, stooling frequency, and quality of life. Surgical notes, pathology reports, and outpatient clinic records were extensively utilized for comprehensive data extraction, ensuring a thorough understanding of patient profiles and outcomes throughout the study period.

Surgical Technique

The laparoscopic-assisted Soave's pull-through was conducted by a multidisciplinary team of experienced pediatric surgeons specialized in minimally invasive surgery techniques, with each surgeon having performed a minimum of 10 procedures. A standardized surgical approach, adapted from established protocols [11], guided the procedure. Patients were positioned supine with legs apart and secured to the operating table to facilitate optimal access and patient stability throughout the surgery. Pneumoperitoneum was established by carbon dioxide insufflation, maintaining intra-abdominal pressure at approximately 12 mmHg, which was continuously monitored to ensure stability during the procedure and minimize the risk of gas embolism. Trocars were strategically placed (usually 3 or 4) under direct vision to provide adequate access to the abdominal cavity while minimizing trauma to surrounding structures. The aganglionic segment was meticulously mobilized, with the transition zone confirmed via frozen section biopsy to ensure precise identification of the resection margins. Rectal dissection was performed transanally using open instruments, including graspers, dissectors, and energy devices, under direct vision provided by the laparoscope. Care was taken to avoid injury to surrounding structures, such as the pelvic nerves and blood vessels. The creation of the mucosal sleeve was accomplished utilizing energy-based devices or staplers to ensure precise dissection and minimize mucosal trauma. Anastomosis between the ganglionic pull through bowel and rectum 1 cm proximal to the dentate line was performed transanally. In cases where laparoscopic assistance was utilized, careful dissection and handling of

tissues were maintained to minimize the risk of injury and ensure optimal anastomotic alignment. Attention to detail was given to defect and port site closure using absorbable sutures and skin closure devices to minimize the risk of hernias or wound complications. Drain placement was determined based on surgeon discretion, with the decision guided by factors such as intraoperative bleeding, extent of dissection, and individual patient characteristics. Intraoperative complications, if encountered, were meticulously documented and managed promptly and appropriately to ensure optimal patient outcomes and minimize the risk of postoperative complications.

Perioperative management

Perioperative care adhered to standardized protocols, beginning with preoperative bowel preparation and administration of antibiotic prophylaxis to mitigate the risk of postoperative infections. Postoperative pain management was tailored to individual patient needs, following institutional guidelines that included the administration of oral analgesics and, when necessary, the provision of patient-controlled analgesia to ensure optimal pain control and comfort. Early enteral feeding was initiated postoperatively, gradually advancing as tolerated by the patient to promote gastrointestinal function and expedite recovery. Throughout the postoperative period, vigilant monitoring for complications such as wound infections, anastomotic leaks, strictures, and ileus was conducted, with prompt intervention and management implemented as needed to optimize patient outcomes and minimize the impact of adverse events on recovery.

Follow up

Following surgery, patients underwent comprehensive follow-up care through scheduled outpatient clinic visits at regular intervals postoperatively, including assessments at 1 week, 1 month, 3 months, 6 months, and annually thereafter. During these visits, a multidisciplinary team monitored patients' progress, evaluating various aspects of their health and surgical outcomes. Long-term follow-up data were collected to assess bowel function, fecal continence, stooling frequency, and overall quality of life using validated scoring systems, such as the Hirschsprung's Disease Bowel Function Score, which provided objective measures to gauge patients' functional outcomes over time [11]. Additionally, complications arising postoperatively, such as anastomotic leaks, strictures, fecal incontinence, and instances

necessitating reoperation, were diligently documented and managed during follow-up visits, ensuring prompt intervention and optimization of patient care to achieve favorable long-term outcomes.

Outcome Measures

Primary outcome measures included intraoperative complications, postoperative complications (classified according to Clavien-Dindo classification), [12], length of hospital stay, time to full enteral feeds, and time to passage of stool. Long-term functional outcomes, including fecal continence, constipation, and bowel function, were assessed through clinical evaluation and patient-reported outcomes during follow-up visits.

Statistical Analysis

Statistical analysis conducted using SPSS, version 20.0. Descriptive statistics were used to summarize patient characteristics and surgical outcomes. Continuous variables were reported as mean \pm standard deviation or median with interquartile range, while categorical variables were presented as frequencies and percentages. Comparative analyses between subgroups were performed using appropriate statistical tests, including t-tests, and chi-square tests, as applicable. Statistical significance was set at $p < 0.05$.

Ethical Considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Institutional Review Board. Patient confidentiality was strictly maintained, and informed consent was obtained from all participants or their legal guardians.

Results

A total of 49 patients underwent the procedure, with a mean age of 2.8 years (± 1.2) and a slightly higher proportion of males (65.3%) than females (34.7%). The mean weight at surgery was 10.6 kg (± 2.3). Associated anomalies were observed in 24.5% of cases, with the most common preoperative symptoms being constipation (57.1%) and abdominal distension (30.6%). Diagnostic studies, including contrast enema and rectal biopsy, were performed in all patients. The mean length of the aganglionic segment was 9.1 cm (± 2.5), with a mean distance from the anal verge of 5.0 cm (± 1.3) and a mean rectal diameter of 3.5 cm (± 0.7). Comorbidities were present in 20.4% of patients, and 8.2% had a history of previous surgeries (Table 1).

Table 1: Demographic and preoperative characteristics of the study participants (N=49)

Variable	Laparoscopic Soave's Pull-Through (n=49)
	Mean \pm SD or Frequency (%)
Age (years)	2.8 \pm 1.2
Sex	
Male	32 (65.3%)
Female	17 (34.7%)
Weight at Surgery (kg)	10.6 \pm 2.3
Associated Anomalies	12 (24.5%)
Preoperative Symptoms	
Constipation	28 (57.1%)
Abdominal distension	15 (30.6%)
Diagnostic Studies	
Contrast Enema	49 (100%)
Rectal Biopsy	49 (100%)
Length of Aganglionic Segment (cm)	9.1 \pm 2.5
Distance from Anal Verge (cm)	5.0 \pm 1.3
Rectal Diameter (cm)	3.5 \pm 0.7
Comorbidities	10 (20.4%)
Previous Surgeries	4 (8.2%)

The mean operative time was 160.9 minutes (\pm 35.4). Conversion to open surgery was required in 6.1% of cases (n=3), though no intraoperative complications were encountered, indicating a favorable intraoperative course. Drain placement was performed in the majority of cases (81.6%, n=40) to facilitate postoperative drainage and optimize patient recovery. Transition zone localization via frozen section biopsy was successfully achieved in all patients (100%, n=49),

ensuring accurate identification of the aganglionic segment.

The mucosal sleeve creation was predominantly accomplished using energy-based devices (91.8%, n=45), with staplers utilized in a smaller proportion of cases (8.2%, n=4). Regarding the anastomosis technique, transanal anastomosis was utilized in all the cases (Table 2).

Table 2: Intraoperative outcomes of the laparoscopic Soave's pull-through among study participants (N=49)

Variable	Laparoscopic Soave's Pull-Through (n=49)
	Mean \pm SD or Frequency (%)
Operative Time (minutes)	160.9 \pm 35.4
Conversion to Open Surgery	3 (6.1%)
Intraoperative Complications	0 (0.0%)
Drain Placement	40 (81.6%)
Transition Zone Localization (Frozen Section Biopsy)	49 (100.0%)
Mucosal Sleeve Creation Method	
Energy-based Devices	45 (91.8%)
Staplers	4 (8.2%)

The mean length of hospital stay was 7.5 days (\pm 2.4), indicating a relatively short duration of hospitalization postoperatively. Postoperative complications were observed in 24.5% of cases (n=12). These complications included wound infections (6.1%, n=3), anastomotic leaks (4.1%, n=2), strictures (8.2%, n=4), and ileus (6.1%, n=3). Reoperation was required in 4.1% of cases (n=2),

indicating the need for additional surgical intervention in a minority of patients. Bowel function at discharge, as assessed by the Hirschsprung's Disease Bowel Function Score, had a mean score of 8.5 (\pm 2.0), suggesting satisfactory bowel function in the immediate postoperative period (Table 3).

Table 3: Perioperative outcomes following laparoscopic Soave's pull-through among study participants (N=49)

Variable	Laparoscopic Soave's Pull-Through (n=49)
	Mean \pm SD or Frequency (%)
Length of Hostal Stay (days)	7.5 \pm 2.4
Postoperative Complications	12 (24.5%)
Wound Infections	3 (6.1%)
Anastomotic Leaks	2 (4.1%)
Strictures	4 (8.2%)
Ileus	3 (6.1%)
Reoperation	2 (4.1%)
Bowel Function at Discharge (HD Bowel Function Score)	8.5 \pm 2.0

At the assessment follow-up, patients exhibited favorable outcomes, with a mean HD Bowel Function Score of 9.2 (\pm 1.5), indicating satisfactory bowel function. Fecal continence was present in the majority of patients (81.6%, n=40), while a small proportion experienced fecal incontinence (18.4%, n=9).

Stooling frequency was predominantly 1-2 times/day in 61.2% of patients (n=30), with a minority experiencing stooling frequency exceeding twice a day (38.8%, n=19). Quality of life assessments revealed that the majority of

patients reported a good quality of life (87.8%, n=43), although a minority perceived their quality of life as fair/poor (12.2%, n=6).

Regarding the need for bowel management, the majority of patients required no additional management (71.4%, n=35), while some relied on medication (16.3%, n=8) or enemas (12.2%, n=6) for bowel management. Additionally, the need for additional surgeries was low, with 85.7% of patients (n=42) not requiring further surgical interventions and 14.3% (n=7) undergoing additional surgeries (Table 4).

Table 4: Long-term functional outcomes and follow-up assessments following laparoscopic Soave's pull-through among study participants (N=49)

Assessment at Follow-Up	Laparoscopic Soave's Pull-Through (n=49)
	Mean \pm SD or Frequency (%)
Bowel Function (HD Bowel Function Score)	9.2 \pm 1.5
Fecal Continence	
Present	40 (81.6%)
Absent	9 (18.4%)
Stooling Frequency	
1-2 times/day	30 (61.2%)
>2 times/day	19 (38.8%)
Quality of Life	
Good	43 (87.8%)
Fair/Poor	6 (12.2%)
Need for Bowel Management	
None	35 (71.4%)
Medication	8 (16.3%)
Enemas	6 (12.2%)
Need for Additional Surgeries	
None	42 (85.7%)
Yes	7 (14.3%)

Among the complications recorded, anastomotic leaks were observed in 2.0% of cases (n=1), while strictures were reported in 4.1% of cases (n=2). Faecal incontinence was documented in 6.1% of cases (n=3), indicating some challenges in bowel control postoperatively. The need for reoperation was noted in 2.0% of cases (n=1), indicating the

necessity for additional surgical intervention in a minority of patients. Additionally, enterocolitis, bowel obstruction, and constipation were each reported in 2.0% of cases (n=1), highlighting a spectrum of postoperative complications encountered during the follow-up period (Table 5).

Table 5: Complications observed during the follow-up period after laparoscopic Soave's pull-through among study participants (N=49)

Complication Type	Laparoscopic Soave's Pull-Through (n=49)
	Number (%)
Anastomotic Leaks	1 (2.0%)
Strictures	2 (4.1%)
Faecal Incontinence	3 (6.1%)
Need for Reoperation	1 (2.0%)
Enterocolitis	1 (2.0%)
Bowel Obstruction	1 (2.0%)
Constipation	4 (8.2%)

Discussion

Hirschsprung's disease poses a significant challenge in pediatric surgery, necessitating effective surgical management to alleviate symptoms and improve long-term outcomes [13]. In this study, we evaluated the efficacy and outcomes of laparoscopic Soave's pull-through in children with Hirschsprung's disease. Our findings demonstrate several key aspects worthy of discussion, including perioperative outcomes, long-term functional results, and comparison with existing literature.

Perioperative Outcomes

The perioperative outcomes observed in our study reflect the safety and feasibility of laparoscopic Soave's pull-through in the pediatric population. The mean operative time of 160.9 minutes aligns with previous studies by Georgeson et al., and Ishikawa et al., highlighting the efficiency of the laparoscopic approach in achieving surgical goals while minimizing procedural duration [14,15].

Notably, the low conversion rate to open surgery (6.1%) underscores the technical feasibility and proficiency of the surgical team in performing laparoscopic procedures in children with Hirschsprung's disease.

Moreover, the absence of intraoperative complications in our study is encouraging and indicative of meticulous surgical technique and patient selection. These findings corroborate previous studies by Ishikawa et al., and Kubota et al., advocating for the safety and efficacy of laparoscopic techniques in the management of Hirschsprung's disease [15,16]. The high rate of successful transition zone localization (100%) further underscores the precision and accuracy afforded by laparoscopic approaches in identifying the aganglionic segment, thereby facilitating optimal surgical management and minimizing the risk of residual disease [16].

Comparison with Other Studies

When compared with existing literature, our findings are consistent with previous studies demonstrating favorable outcomes following

laparoscopic Soave's pull-through. For instance, the mean length of hospital stay in our study (7.5 days) aligns with the reported range of 5-10 days in other studies by Nguyen et al., Zhang et al., and Li et al., reflecting the standardized postoperative care protocols and enhanced recovery pathways implemented in contemporary pediatric surgical practice [17,18,19].

Similarly, the incidence of postoperative complications (24.5%) observed in our study is within the range reported in the studies by Tang et al., and Deng et al., with wound infections, anastomotic leaks, strictures, and ileus being the most commonly encountered complications [20,21]. The relatively low rate of complications, coupled with the successful preservation of bowel function at discharge (mean HD Bowel Function Score of 8.5), underscores the overall safety and efficacy of laparoscopic Soave's pull-through in achieving favorable short-term outcomes in children with Hirschsprung's disease.

Long-Term Functional Outcomes

Beyond the perioperative period, our study provides valuable insights into the long-term functional outcomes and quality of life following laparoscopic Soave's pull-through. The mean HD Bowel Function Score of 9.2 reflects excellent bowel function and underscores the durable efficacy of the surgical intervention in restoring normal gastrointestinal physiology. Furthermore, the high rate of fecal continence (81.6%) and favorable stooling frequency (1-2 times/day in 61.2% of patients) highlight the sustained functional benefits afforded by laparoscopic Soave's pull-through in promoting continence and regular bowel habits [22,23].

The successful restoration of bowel function following laparoscopic Soave's pull-through can be attributed to the meticulous dissection and preservation of the enteric nervous system during surgery [24].

By excising the aganglionic segment and creating anastomosis between the healthy bowel and rectum, the procedure aims to establish coordinated peristalsis and enhance colonic transit, thereby

alleviating symptoms of constipation and promoting fecal continence [25,26]. Additionally, the minimally invasive nature of the laparoscopic approach minimizes surgical trauma and accelerates postoperative recovery, enabling earlier initiation of enteral feeding and facilitating rapid restoration of bowel function [27].

Conclusion

In conclusion, our study demonstrates the safety, feasibility, and efficacy of laparoscopic Soave's pull-through in children with Hirschsprung's disease. The procedure offers favorable perioperative outcomes, including low rates of complications and preservation of bowel function, while also yielding excellent long-term functional outcomes and quality of life. These findings underscore the importance of laparoscopic techniques in the contemporary management of Hirschsprung's disease and highlight the potential for optimized surgical outcomes and enhanced patient well-being. Further prospective studies and long-term follow-up are warranted to validate our findings and elucidate the enduring benefits of laparoscopic Soave's pull-through in this patient population.

References

- Skaba R. Historic milestones of Hirschsprung's disease (commemorating the 90th anniversary of Professor Harald Hirschsprung's death). *J Pediatr Surg.* 2007; 42: 249–51.
- Langer JC. Laparoscopic and transanal pull-through for Hirschsprung disease. *Semin Pediatr Surg.* 2012;21:283–90.
- Rangel SJ, de Blaauw I. Advances in pediatric colorectal surgical techniques. *Semin Pediatr Surg.* 2010;19:86–95.
- Soave F. Hirschsprung's disease: a new surgical technique. *Arch Dis Child.* 1964; 39: 116–24.
- Giuliani S, Betalli P, Narciso A, et al. Outcome comparison among laparoscopic Duhamel, laparotomic Duhamel, and transanalendorectal pull-through: a single-center, 18-year experience. *J Laparoendosc Adv Surg Tech A.* 2011;21:859–63.
- Singh R, Cameron BH, Walton JM, et al. Postoperative Hirschsprung's enterocolitis after minimally invasive Swenson's procedure. *J Pediatr Surg.* 2007;42:885–9.
- Weidner BC, Waldhausen JH. Swenson revisited: a one-stage, transanal pull-through procedure for Hirschsprung's disease. *J Pediatr Surg.* 2003;38:1208–11.
- Elhalaby EA, Hashish A, Elbarbary MM, et al. Transanal one-stage endorectal pull-through for Hirschsprung's disease: a multicenter study. *J Pediatr Surg.* 2004;39:345–51.
- Kim AC, Langer JC, Pastor AC, et al. Endorectal pull-through for Hirschsprung's disease—a multicenter, long-term comparison of results: transanal vs transabdominal approach. *J Pediatr Surg.* 2010;45:1213–20.
- Liem NT, Hau BD. One-stage operation for Hirschsprung's disease: experience with 192 cases. *Asian J Surg.* 2008;31:216–9.
- Gunadi, Monica Carissa T, Stevie, et al. Long-term functional outcomes of patients with Hirschsprung disease following pull-through. *BMC Pediatr.* 2022;22:246.
- Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004;240:205-13.
- Iacusso C, Leonelli L, Valfre L, et al. Minimally invasive techniques for Hirschsprung disease. *J Laparoendosc Adv Surg Tech A.* 2019;29:1605–8.
- Georgeson KE, Fuenfer MM, Hardin WD. Primary laparoscopic pull-through for Hirschsprung's disease in infants and children. *J Pediatr Surg.* 1995;30:1017–21.
- Ishikawa N, Kubota A, Kawahara H, et al. Transanalmucosectomy for endorectal pull-through in Hirschsprung's disease: comparison of abdominal, extraanal and transanal approaches. *Pediatr Surg Int.* 2008;24:1127–9.
- Kubota A, Kawahara H, Okuyama H, Oue T, Tazuke Y, Okada A. Clinical outcome of laparoscopically assisted endorectal pull-through in Hirschsprung's disease: comparison of abdominal and perineal approaches. *J Pediatr Surg.* 2004;39:1835–7
- Nguyen TL, Bui DH, Tran AQ, Vu TH. Early and late outcomes of primary laparoscopic endorectal colon pull-through leaving a short rectal seromuscular sleeve for Hirschsprung disease. *J Pediatr Surg.* 2009;44:2153–5
- Zhang P, Tian J, Wang XH, et al. Laparoscopy-assisted versus open Soave surgery for Hirschsprung disease in children. *J Laparoscopic Surgery.* 2018;23:298–301.
- Li WH, Ding E, Niu J, et al. Comparative study of effect between transanal soave endorectal pull-through procedure and transabdominal operation for Hirschsprung's disease. *Chin J Curr Adv Gen Surg.* 2014;17:350–60.
- Tang ST, Wang GB, Cao GQ, et al. 10 years of experience with laparoscopic-assisted endorectal Soave pull-through procedure for Hirschsprung's disease in China. *J Laparoendosc Adv Surg Tech A.* 2012; 22: 280–4.
- Deng X, Wu Y, Zeng L, et al. Comparative analysis of modified laparoscopic Swenson and laparoscopic Soave procedure for short-

- segment Hirschsprung disease in children. *Eur J Pediatr Surg.* 2015;25:430–4.
22. Dong Q, Sun WZ, Wang YY, et al. Efficacy evaluation of laparoscopic assisted Soave radical operation in the treatment of children with congenital megacolon. *J Shanghai Jiao Tong University (Med Sci).* 2018;38:841–4.
 23. van de Ven TJ, Sloots CE, Wijnen MH, et al. Transanalendorectal pull-through for classic segment Hirschsprung's disease: with or without laparoscopic mobilization of the rectosigmoid. *J Pediatr Surg.* 2013;48:1914–8.
 24. Goldstein AM, Thapar N, Karunaratne TB, et al. Clinical aspects of neurointestinal disease: pathophysiology, diagnosis, and treatment. *Dev Biol.* 2016;417:217–28.
 25. Burkardt DD, Graham JM, Short SS, et al. Advances in Hirschsprung disease genetics and treatment strategies: an update for the primary care pediatrician. *ClinPediatr (Phila).* 2014; 53: 71–81.
 26. Lin Z, Lin Y, Bai J, et al. Outcomes of preoperative anal dilatation for Hirschsprung disease. *J Pediatr Surg.* 2021;56:483–6.
 27. Langer JC, Rollins MD, Levitt M, et al. Guidelines for the management of postoperative obstructive symptoms in children with Hirschsprung disease. *Pediatr Surg Int.* 2017;33:523–6.