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Original Article

Effect of modified transanal Soave assisted by laparoscopy in the treatment of Hirschsprung's disease in children and its influencing factors

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Abstract: Objective: To investigate the effect of modified transanal Soave assisted by laparoscopy in children with Hirschsprung's disease (HD). Methods: The clinical data of 120 children with Hirschsprung's disease admitted to Fujian Children's Hospital from January 2018 to November 2021 were retrospectively analyzed. Based on the surgical methods, 58 children treated with modified transanal Soave were regarded as the modified group and 62 children treated with modified transanal Soave assisted by laparoscopy were divided into the laparoscopic group. The operative indexes, anal function, quality of life and perianal pressure 6 months after surgery, complications within 1 month after surgery, and recovery within 6 months after surgery of the two groups were compared. The risk factors influencing the postoperative recovery of hirschsprung's disease in children were analyzed by univariate and logistic regression analysis. Results: The operation time, intraoperative blood loss, length of hospital stay and gastrointestinal recovery time in the laparoscopic group were lower than those in modified group ($P < 0.05$). The excellent and good rate of postoperative anal function in laparoscopic group was 87.10%, which was higher than that in modified group (68.97%) ($P < 0.05$). The proportion of patients with good quality of life in laparoscopic group (90.32%) was higher than that in modified group (74.14%) ($P < 0.05$). The anal resting pressure and systolic pressure in laparoscopic group were lower than those in modified group (all $P < 0.05$). The total complication rate of laparoscopic group (6.45%) was lower than that of modified group (22.41%) ($P < 0.05$). After 6 months, 64 cases (53.33%) were cured and 56 cases (46.67%) were not. After univariate analysis, there were statistically significant differences in enteritis, abdominal distension, and anastomotic stenosis between cured children and uncured children (all $P < 0.05$). There was no significant difference in other factors ($P > 0.05$). Logistic regression analysis showed that enteritis, abdominal distension and anastomotic stenosis were the risk factors affecting the recovery of hirschsprung's disease in children (all $P < 0.05$). Conclusions: Modified transanal Soave assisted by laparoscopy can improve anal function and quality of life, relieve anal pressure, and have a low complication rate. Enteritis, abdominal distension, and anastomotic stenosis are the factors affecting the recovery of Hirschsprung's disease in children.

Keywords: Hirschsprung's disease in children, laparoscope, modified anal Soave, risk factors for

Introduction

Hirschsprung's disease (HD) is a common malformation of the paediatric gastrointestinal tract and has the second highest incidence of gastrointestinal disorders, and most reports suggest that the development of HD is closely related to genetics [1, 2]. The intestinal canal is not regulated by ganglion cells and loses its basic function in a spastic state for a long period of time, affecting fecal excretion and causing compensatory thickening and dilatation of the proximal normal intestinal canal, leading to constipation, vomiting, abdominal distention and growth retardation [3, 4]. Surgery is the most effective way to treat the disease. Traditional surgical treatment options include drag-out rectal colectomy, Soave surgery and

modified Boley's operation, but they have the disadvantage of invasive, with a poor prognosis and a high risk of death [5]. The modified transanal Soave procedure is a more commonly used procedure in recent years, which has a shorter operating time, less bleeding, and can maximally preserve the function of the internal anal sphincter. However, it is difficult to completely remove the lesions during the operation, and the incidence of postoperative complications is high, which affects the therapeutic effect [6]. Therefore, it is important to find the ideal surgical treatment to improve the treatment outcome, promote healing and improve the prognosis of children.

In recent years, with the advancement of minimally invasive technology, laparoscopy has been gradually used in clinical practice, and its advantages of less trauma, less bleeding, and no abdomen opening are slowly being applied in modified transanal Soave surgery [7, 8]. However, there are few studies comparing the efficacy of Soave with previous surgical protocols. In this study, we compared the efficacy of modified transanal Soave with that of laparoscopic-assisted modified transanal Soave to further investigate the factors affecting healing.

Information and methods

General data

120 children with hirschsprung's disease admitted to Fujian Children's Hospital from January 2018 to November 2021 were retrospectively analyzed. 58 children treated with modified transanal Soave were regarded as the modified group and 62 children treated with modified transanal Soave assisted by laparoscopy were assigned as the laparoscopic group Soave. This study was approved by the Ethics Committee of Fujian Children's Hospital (2022-ETKLR08041).

Inclusion and exclusion criteria

Inclusion criteria: (1) Children had no anorectal suppression reflex in rectal pressure test, and the diagnosis of HD was confirmed by barium enema angiography. (2) Children underwent surgical treatment in our hospital. (3) The child's parents signed the informed consent form.

Exclusion criteria: (1) Those who have undergone staged enterostomy surgery. (2) Those who had other underlying diseases, such as congenital hypertrophic pyloric stenosis. (3) Those complicated by organ disease, e.g., heart injury, renal failure. (4) Those complicated by abnormal coagulation function, anesthetic drug allergy, etc. (5) Those with immune system or endocrine system diseases.

Methods

In the modified group, a modified transanal Soave procedure was performed: in the truncated position, the anus was fully exposed after evaluating the buttocks. The mucosal separation was performed at 0.3 cm above the dentate line, and epinephrine saline was injected to completely separate the mucosa from the plasma muscle layer and then the mucosa was freed in the upward position, and the separation was about 6 cm. After the rectum appeared relaxed, the rectal muscle sheath was circumferentially cut and the muscle sheath was retained for 6 cm and pulled outward. We would pull the colon outward from the rectum muscle sheath, ligate the mesentery and mesenteric vessels on the right side of the colon wall, and gradually pull out the intestinal canal until ganglion cells are found in the frozen section biopsy during the operation and the appearance is normal. Post-operative antibiotics were given and post-operative rehabilitation with dilation was performed at postoperative week 2 and continued for 3-6 months according to the anal status of individual.

The laparoscopic group was treated with laparoscopic-assisted modified transanal Soave. The patient was in the lithotomy position, and a 0.5 cm incision at the superior border of the umbilicus was created, followed with successful establishment of a pneumoperitoneum and placement of a 5 mm Trocar. The abdominal pressure was maintained at 8-10 mmHg; two incisions were made at the 4 cm to the left and right of the umbilicus, respectively, and 5 mm Trocar were placed, the buttocks were padded and then the area to be resected was observed laparoscopically and removed by the ultrasonic knife. The rectal mesentery and collateral ligament were separated, the mesentery was clamped, and after the coagulation of the mesenteric tertiary vessels, a modified transanal Soave was performed (the same method as

Table 1. Comparison of clinical data between the two groups

Index	Laparoscopic group (n=62)	Modified group (n=58)	t/χ^2	P
Age (month)	8.32±5.24	8.87±6.87	-0.496	0.621
Gender (male)	36 (58.06%)	38 (65.52%)	0.704	0.401
Weight (kg)	8.41±1.94	8.60±2.97	-0.429	0.668
Ordinary type	24 (38.71%)	21 (36.21%)	0.08	0.777
Short segment type	16 (25.81%)	17 (29.31%)	0.185	0.668
Long segment type	22 (35.48%)	20 (34.48%)	0.013	0.909
Total protein (g/L)	62.98±4.73	63.39±4.66	-0.477	0.635
Albumin (g/L)	43.68±2.74	42.97±2.43	1.517	0.132
Hemoglobin (g/L)	123.66±15.18	122.63±10.78	0.426	0.671

the modified group), and the anal canal was removed on the 7th day after the operation.

Observation indicators

Operation time, intraoperative bleeding, length of hospitalization, and recovery time of gastrointestinal function were compared between the two groups.

Anal function: 6 months after surgery, the anal function of patients was assessed by Heikkinen scale [9] with a score ranging from 0 to 14. Excellent: 14 points, good: 5-13 points, and poor: 0-4 points. Higher scores indicated better defecation.

Quality of life: 6 months after surgery, the child's quality of life was assessed using the Commonly Applied Core Scale [10], which was completed by their parents. The scale consistes of 5 dimensions: physical, psychological, emotional, role and social. Excellent: > 50 points for each dimension; good: > 50 points for 3 of the dimensions and poor for the rest.

Anal pressure: 6 months after surgery, the anal canal resting pressure and systolic pressure were assessed using a high-resolution multichannel gastrointestinal function meter. The average pressure of 3 measurements was taken.

Complications: The occurrence of perianal dermatitis, anastomotic stricture, small bowel colitis, constipation and urinary retention within 1 month after surgery were recorded and compared between the two groups.

Healing: The healing of children was assessed 6 months after operation. The criteria of healing is as follows: children within 6 months of age had ≤ 5 bowel movements/d and > 1 bowel movement; children over 6 months of age had 3 bowel movements/d < 3 and > 1 bowel movement, with no anastomotic stricture, abdominal distension or small bowel colitis.

Recovery time of gastrointestinal function: The recovery time refers to the period from the end of operation to the recovery of gastrointestinal tract, which was judged by three indicators: exhaust, defecation and bowel sounds.

Statistical analysis

SPSS22.0 statistical software was used for data analysis. The measurement data were expressed as mean ± standard deviation ($\overline{x}\pm s$) and analyzed using t-test; the count data were expressed as n (%) and analyzed using χ^2 test. Logistics regression was used to analyze the risk factors affecting postoperative healing. P < 0.05 was considered a significantdifference.

Results

Comparison of the clinical data between two groups

There were no obvious distinctions in the age, gender, or weight between the two groups, indicating comparability between the groups (all P > 0.05) (**Table 1**).

Comparison of perioperative observation indicators and hospital stay between the two groups

The operative time, intraoperative bleeding, hospital stay and gastrointestinal recovery time in the laparoscopic group were lower than those in the modified group, and the differences were statistically significant (all P < 0.05), **Table 2**.

Comparison of postoperative anal function between the two groups

The proportion of patients with excellent postoperative anal function was 87.10% in the lapa-

Table 2. Comparison of surgical indicators between the two groups ($\bar{x}\pm s$)

Group	Operating time (min)	Intraoperative bleeding (ml)	Length of stay (d)	Gastrointestinal recovery time (h)
Laparoscopic group (n=62)	94.32±15.64	24.53±8.26	7.42±1.15	23.24±6.57
Modified group (n=58)	120.67±21.02	49.67±13.09	9.95±1.42	38.47±7.73
t	7.824	12.667	10.757	11.654
P	< 0.001	< 0.001	< 0.001	< 0.001

Table 3. Comparison of postoperative anal function between the two groups [n (%)]

Group	Excellent	Good	Poor	Excellent rate
Laparoscopic group (n=62)	21 (33.87)	33 (53.23)	8 (12.90)	54 (87.10)
Modified group (n=58)	14 (24.13)	26 (44.83)	18 (31.03)	40 (68.97)
χ^2		-		4.785
P		-		0.028

Table 4. Comparison of postoperative quality of life between the two groups [n (%)]

Group	Excellent	Good	Poor	Excellent rate
Laparoscopic group (n=62)	31 (50.00)	25 (40.32)	6 (9.68)	56 (90.32)
Modified group (n=58)	23 (47.92)	20 (34.48)	15 (25.86)	43 (74.14)
χ^2		-		4.373
P		-		0.037

roscopic group while that in modified group was 68.97%, and the difference was statistically significant (P < 0.05), **Table 3**.

Comparison of postoperative quality of life between the two groups

The proportion of patients with excellent quality of life (90.32%) in the laparoscopic group was higher than that in the modified group (74.14%), and the difference was statistically significant (P < 0.05), **Table 4**.

Comparison of postoperative anal pressure between the two groups

The laparoscopic group had lower anal canal resting pressure and systolic pressure than the modified group, and the difference was statistically significant (P < 0.05), **Table 5**.

Comparison of post-operative complications between the two groups

The overall complication rate (6.45%) in the laparoscopic group was lower than that in the modified group (22.41%) (P < 0.05), as shown in **Table 6**.

Univariate analysis of recent healing of congenital megacolon in children

Six months after surgery, 64 (53.33%) cases were cured and 56 (46.67%) cases were not. The differences between cured and non-cured children existed in bowel colitis, abdominal distension and anastomotic stenosis as indicated by univariate analysis (P < 0.05), **Table 7**.

Multivariate analysis of logistic regression of recent healing of congenital megacolon in children

With healing as the dependent variable and factors with statistical significance in univariate analysis as the independent variables, logistic regression analysis revealed small bowel colitis, abdominal distension and anastomotic stenosis were risk factors affecting healing in pediatric congenital megacolon (all P < 0.05), as shown in **Table 8**.

Discussion

Surgery is the main clinical treatment for Hirschsprung's disease (HD), except for a few short-segment types. Traditional surgery is gen-

Table 5. Comparison of postoperative anal bowel pressure between the two groups ($\bar{x}\pm s$)

Group	Anal canal resting pressure (mmHg)	Anal canal systolic pressure (mmHg)
Laparoscopic group (n=62)	8.37±1.60	238.85±66.17
Modified group (n=58)	9.81±1.75	284.59±71.18
t	4.709	3.648
P	< 0.001	< 0.001

Table 6. Comparison of postoperative complications between the two groups [n (%)]

Group	Perianal dermatitis	Anastomotic stricture	Small bowel colitis	Constipation	urinary retention	Total complication rate
Laparoscopic group (n=62)	1 (1.61)	0 (0.00)	1 (1.61)	1 (1.61)	1 (1.61)	4 (6.45)
Modified group (n=58)	1 (1.72)	1 (1.72)	4 (6.90)	5 (8.62)	2 (3.44)	13 (22.41)
χ^2			-			5.035
P			-			0.024

Table 7. Univariate analysis of recent healing in paediatric congenital megacolon [n (%)]

Factors	Cured (n=64)	Not cured (n=56)	χ^2	*P*
Gender				
Male	39 (59.38)	35 (62.5)	0.031	0.861
Female	25 (39.06)	21 (37.50)		
Age (month)				
≥ 10	15 (23.44)	14 (25.00)	0.040	0.842
< 10	49 (76.56)	42 (75.00)		
Surgical procedure				
Modified transanal Soave	35 (54.69)	23 (41.07)	2.217	0.136
Laparoscopic-assisted modified transanal Soave	29 (45.21)	33 (58.93)		
Clinical classification				
General	24 (37.50)	18 (32.14)	0.622	0.732
Short segment	18 (38.13)	15 (26.79)		
Long segment	22 (34.38)	23 (41.07)		
Small bowel colitis or not				
Yes	11 (17.19)	27 (48.21)	9.453	0.002
No	53 (82.81)	29 (51.79)		
Abdominal distension				
yes	14 (21.88)	23 (41.07)	4.599	0.032
no	50 (78.13)	32 (58.93)		
Anastomotic stenosis				
yes	10 (15.63)	21 (37.50)	6.361	0.012
no	54 (84.38)	35 (62.50)		

Table 8. Multifactorial analysis of logistic regression for recent healing of congenital megacolon in children

Variable	*B*	*S.E.*	*Wald* χ^2	*P*	*OR*	95% CI	
						Low	Up
Small bowel colitis (1= yes, 0= no)	0.171	0.050	8.852	0.000	0.718	0.692	1.138
Abdominal distension (1= yes, 0= no)	0.461	0.112	6.431	0.000	0.912	0.783	1.107
Anastomotic stenosis (1= yes, 0= no)	0.782	0.334	6.226	0.009	1.274	0.945	1.581

erally performed in a transabdominal perineal root; however, due to the underdeveloped physiologic functions and organs of children, especially neonates, they are intolerant to surgery. Moreover, because of the significant abdominal incision after surgery, the risk of complications is higher, which seriously affects the prognosis of children [11, 12]. With advances in surgical techniques, the modified transanal Soave procedure has gradually replaced the traditional transabdominal perineal procedure, in which the colon is removed by dragging it out after mucosal dissection through the anus, with smaller incisions and faster postoperative recovery [13, 14]. However, this procedure has difficulty in completely removing the lesion, and there are certain complications that affect the postoperative results. To enhance the surgical treatment of HD, laparoscopic minimally invasive surgery is being gradually used in this disease.

The present results showed that the operative time, intraoperative bleeding, hospital stay and gastrointestinal recovery time in the laparoscopic group were less than those in the modified group, suggesting that the laparoscopic-assisted minimally invasive treatment of HD has significant advantages and promotes postoperative recovery in children, which is consistent with the results of a previous study [15]. The laparoscopic-assisted modified transanal Soave provides a clear intraoperative view, allows for a comprehensive assessment of the extent of bowel dilatation, with advantages of simple biopsy acquisition, extensive and complete resection, and less operative time and hospital stay [16]. In addition, a clear view of the laparoscope-assisted procedure reduces the stretching of the colon and the stimulation of adjacent tissues and gastrointestinal tract, thus facilitating postoperative recovery of gastrointestinal function [17]. Maintaining bowel function is essential for the prognosis of children with HD, reducing the incidence of fecal incontinence. It has been clinically reported that the role of maintaining defecation function requires preservation of intact anal canal sensation, spontaneous control of the sphincter, and correct colonic peristalsis; so, it is essential to minimize intraoperative strain injury to the sphincter [18, 19]. The present results found that the excellent postoperative anal function rate was 87.10% in the laparoscopic group which was higher than 68.97% in the modified group; the rate of patient with excellent quality of life was 90.32% in the laparoscopic group which was also higher than 74.14% in the modified group; while the resting anal canal pressure and systolic pressure were lower in the laparoscopic group than in the modified group. Soave All these suggest that laparoscopic-assisted modified transanal Soave treatment can improve anal function, reduce the incidence of postoperative fecal incontinence, reduce intra-anal pressure and improve the quality of life of children after surgery. Gabriela et al. pointed out that laparoscopic assisted modified transanal Soave surgery shortened the anal dissection time. In the rectal mesentery, the separation of the lateral ligament can effectively protect the function and shape of the anal canal in children, and maintain stable anal function and anal pressure. Soave At the same time, the direct dragging out of the colon via the anal position under clear laparoscopic view reduces the risk of intestinal torsion and intestinal bleeding, which is conducive to improving the postoperative quality of life of the child [20].

In terms of postoperative complications, we found that the overall complication rate of 6.45% in the laparoscopic group was lower than that of 22.41% in the modified group, which in turn suggests that laparoscopic-assisted surgical treatment is safer. It is hypothesized that this may be related to the following factors: first, the use of laparoscopy preserved the number of intestinal tubes to the greatest extent thus reduced the risk of small colitis; second, minimal invasiveness involved less intraoperative trauma, thus reduced the risk of postoperative infection; and third, it achieved ideal recovery of postoperative fecal storage function and postoperative anal function, which reduced the occurrence of perianal dermatitis and urinary retention [21].

Due to the poor physical condition of the child, postoperative healing is easily influenced by various factors. The results of this study showed that 6 months after surgery, 64 (53.33%) cases were cured and 56 (46.67%) cases were not cured. Univariate analysis showed that there were statistical differences between cured and non-cured children in the conditions of small bowel colitis, abdominal distension and anastomotic stenosis. The logistic regression analysis found that small bowel colitis, bloating and

anastomotic stenosis were the risk factors affecting the recovery of children with HD. The study by Min et al. [22] found that small bowel colitis was an independent risk factor for death in children with HD; spasm of the strictured bowel increased the chance of obstruction, and the intestinal mucosa was prone to be attacked by bacterial toxins, and that multiple bowel movements occurred. Postoperatively, due to the slow recovery of bowel function, the child may experience retention of feces in the intestine which may damage the mucosal defense barrier and cause frequent abdominal distension; in addition, poor anastomotic haemodynamics and excessive anastomotic tension may induce a hyperinflammatory state in the pelvic or rectal anastomotic cycle cells, increasing the chance of tissue proliferation and scarring strictures [23-25]. In this case, laparoscopic surgery can reduce the stimulation to the internal and external sphincter, speed up the recovery of the child's bowel function, and help control the occurrence of enterocolitis. This is of great value in improving the quality of life of children after surgery [26]. This study has some limitations. First, due to the retrospective nature, the current physical and mental status of the research object will affect the authenticity and accuracy of the past data reports. Second, this study paid less attention to the detection indicators, and the research on the influencing factors of laparoscopic assisted modified transanal Soave in the treatment of children with Hirschsprung's disease was not comprehensive enough. Third, the follow-up period of this study is short, which should be further extended to explore the long-term efficacy of this procedure. Finally, the number of samples in this study is small, and there may be sampling bias. It is necessary to expand the scope of the study population, including the number and area of subjects, to refine the results of the study.

Conclusions

In conclusion, the use of laparoscopic-assisted modified transanal Soave in children with HD can improve anal function, anal canal pressure and surgical outcome, improve their quality of life and control complications. Small bowel colitis, abdominal distension and anastomotic stenosis are risk factors affecting the healing of children with HD.

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Disclosure of conflict of interest

None.

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