ORIGINAL RESEARCH

Effect of Laparoscopic Soave Combined with Deloyers Turnover on the Efficacy and Prognosis of Children with Congenital Hirschsprung's Disease

Daliu Chen, PhD; Yongchun Du, PhD

ABSTRACT

Objective • To analyze the effect of laparoscopic Soave combined with Deloyers turnover on the efficacy and prognosis of children with congenital Hirschsprung's disease, and to explore an effective and safe operation, so as to provide a reference for clinical development of treatment plan and promote the faster recovery of children.

Methods • A total of 80 children with Hirschsprung's disease admitted to our hospital from July 2021 to June 2022 were selected and included in the traditional group and minimally invasive group according to different surgical procedures, with 40 cases in each group. The traditional group was treated with open Soave, and the minimally invasive group was treated with laparoscopic Soave combined with Deloyers reversal. Compared two groups in terms of operation indicators (operation time, intraoperative blood loss, fasting time, intestinal function recovery time, and hospital stay), the stress response (serum cortisol, heart sodium, plasma epinephrine, and norepinephrine), intestinal flora (*Bifidobacterium*, *Lactobacillus*, *Escherichia coli*, and *Enterococcus faecalis*), anal function, recent complications (urinary retention, hematochezia, anus week dermatitis, incision infection, and abdominal bleeding), long-term complications (constipation, anastomotic stenosis, enterocolitis, and dirty feces).

Results • The operation time, intraoperative blood loss, fasting time, intestinal function recovery time, and hospital stay in the minimally invasive group were significantly shorter than those in the traditional group ($P < .05$). The levels of serum cortisol, atrial natriuretic peptide, plasma epinephrine, and norepinephrine in the minimally invasive group were lower than those in the traditional group ($P < .05$). The levels of *Bifidobacterium* and *Enterococcus faecalis* in the minimally invasive group were higher than those in the traditional group ($P < .05$). The excellent and good rate of anal function in the minimally invasive group was higher than that in the traditional group ($P < .05$). The incidence of short-term and long-term complications in the minimally invasive group was lower than that in the traditional group ($P < .05$).

Conclusion • Joint Deloyers flip Soave under laparoscopic surgery for children with congenital Hirschsprung disease has a better curative effect, with shorter operation time, less blood loss compared to traditional open surgery.

(*Altern Ther Health Med.* 2023;29(8):570-575).

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INTRODUCTION

Hirschsprung's disease is a common and typical congenital developmental defect requiring pediatric general surgery, with a prevalence of about 2.8/10000 and a male-female ratio of about 4:1.[1] Hirschsprung's disease is a neurocristopathy, caused by defective migration, proliferation, differentiation, and survival of neural crest cells, leading to gut aganglionosis. Pathological changes associated with the disease involve narrow ganglion cells in the distal part of the intestinal wall causing lesion spasms, and incapable of normal peristalsis and proximal normal bowel, thereby restricting normal emptying of the intestine. This causes functional intestinal obstruction, lower therapeutic efficacies, proximal bowel unusual expansion, and thickening, which lead to abnormal changes in the intestine such as its ganglion cells undergoing degeneration and atrophy.[2-3] The main symptoms of this disease are non-excretion or delayed excretion of meconium, abdominal distension, vomiting, constipation, and malnutrition.

At present, radiological examination, anorectal manometry, biopsy, and histological examination are mainly used for diagnosis.[4] Surgery is an important method for the treatment of the disease, which can effectively remove the

ganglion-free intestine. However, there are some differences in the effectiveness and safety of different surgical methods. The traditional surgical method is open surgery, which has large trauma and more complications, and hence is not conducive to postoperative recovery, resulting in limited application.[5] With the development of minimally invasive technology and the application of laparoscopy, laparoscopic-assisted surgery has attracted more attention, and clinical practice has proved that its effectiveness and safety are superior to traditional open surgery, with the advantages of mild trauma, fewer complications, and faster recovery.[6]

This study aims to analyze the efficacy and prognosis of laparoscopic surgery combined with Deloyers procedure in children with congenital Hirschsprung disease to find an effective and safe surgical method and provide a reference for clinicians to make treatment plans. Towards this end, the medical records of 80 cases were analyzed, and the operation index, stress reaction, intestinal flora, anus function, the influence of the recent complications, and long-term complications were noted.

DATA AND METHODS

General Information

A total of 80 children aged 0-12 years with Hirschsprung's disease admitted to our hospital from July 2021 to June 2022 were enrolled in the traditional group and minimally invasive group according to different surgical procedures, with 40 cases in each group. In traditional group, there were 31 males and 9 females. The average age was (10.63 ± 3.20) months (range, 3 months to 2 years). Body mass index (BMI) ranged from 4 to 12 kg/m^2, with an average of (8.24 ± 2.35) kg. There were 3 cases of short segment type, 31 cases of common type, and 6 cases of long segment type. ASA classification: 19 cases of grade I and 21 cases of grade II. In the minimally invasive group, there were 30 males and 10 females. The average age was (10.68 ± 3.17) months (range, 3 months to 2 years). The average body mass index was (8.26 ± 2.33) kg (range, 4-12 kg). There were 3 cases of short segment type, 30 cases of common type and 7 cases of long segment type. ASA classification: 20 cases of grade I and 20 cases of grade II. The general data of the two groups were compared. This study was approved by the ethics of the hospital.

Inclusion and exclusion criteria

Inclusion criteria. (1) complete medical records; (2) confirmed by radiological examination, rectal and anal manometry, biopsy, and histological examination that the patients met the diagnostic requirements of Hirschsprung's disease. Abdominal distension, intractable constipation, vomiting, delayed fecal discharge time, malnutrition, and other symptoms occurred in all patients; (3) in accordance with the surgical indications, ASA grade I to II; (4) informed and consented to the study by family members.

Exclusion criteria. (1) history of abdominal surgery; (2) reissuing the second operation; (3) serious diseases of other organs; (4) diseases of blood system; (5) coagulation dysfunction; (6) malignant tumor; (7) immune dysfunction; (8) mental illness and unconsciousness.

Methods

History of preoperative systematic understanding of the health of children was noted, along with three conventional, liver and kidney function, blood coagulation function, barium enema examination such as residual barium radiography and 24 h, if necessary, the anorectal pressure and rectal submucosal tissue clamps biopsy examination, water electrolyte disorder, malnutrition, hypoalbuminemia, colonics 7 d, preoperative 3 d taking metronidazole tablets. The surgical procedures were performed by the same surgical team.

The conventional group was treated with open Soave. Children position in bladder cut stone, surgery under general anesthesia operation, seam traction line pull the anus, dentate line and submucosal injection adequate adrenal physiological saline, the dentate line 0.5 ~ 1 cm of the rectal mucosa on circular incision mucosa (low) after high, rectal mucosa GuanShun rectal mucous membrane separation up about 7 cm, to peritoneal reflex, cut rectal muscular layer, mesocolon tube for free after open the abdominal cavity, the transitional period and the period of separation and cut off, after the separation of colon to normal bowel position, cut off lesions insufflate, proximal colon flip mesangial by muscular sheath off the inside, back in rectal muscular sheath shall be fixed, and vertical slit in rectal muscular sheath in the middle of all muscular layer 1 ~ 2 cm, pulling colon cutting edger.

Minimally invasive group: laparoscopic Soave combined with Deloyers turnover. The child was placed in a supine position. The skin was cut 0.5-1cm from the upper edge of the umbilicus with a diameter of about 0.2 cm, and the Veress needle was punctured to establish CO_2 pneumoperitoneum. The abdominal pressure was maintained at about 12 mmHg, and the flow rate was 2 L/minute. The Veress needle was withdrawn, a 5 mm Trocar was placed along the pneumoperitoneum hole, and the laparoscope was placed at 30° to explore the intraperitoneal conditions. A 5 mm Trocar was placed 2 cm to the left of the center connecting the lateral side of the right inferior epigastric artery with the umbilicus and the symphysis pubis. The foot was slightly raised and tilted to the right about 15° to explore the spasm, transition, and expansion sites, and the intestinal plasmacytomomycosis layer was taken at the segmented point for examination. The sigmoid colon was lifted with non-injury-free grasp forceps, and the mesentery and blood vessels were exposed. The mesentery and blood vessels were coagulated with ultrasonic knife at the secondary mesentery blood vessels. The sigmoid wall was attached to the distal rectum and peritoneum, and the proximal colon was separated. The bowel was observed for active bleeding and abdominal organ damage, and the transposed intestinal segment was checked for homeopathy, mesangial traction. and compression. If not, pneumoperitoneum was removed, perineal surgery was performed, and the body position was changed to double lower limb suspension lithotomy position, and traction wire was sutured around the hilum hepatis. The anorectal mucosa was pulled and exposed, and the rectal mucosa was cut at 5 mm of the dentate line. The

proximal rectal mucosal traction line was sutured and pulled downward. The mucosa was separated from the rectal mucosa from the bottom to the rectoperitoneal fold, and the muscle sheath of the rectum was cut annular, and the separated colorectal was pulled out. The diseased intestine was observed under direct vision and removed. After confirming that there was no twist in the intestinal canal, the posterior rectal muscle sheath was removed in a wedge at 3-9 o 'clock, and the proximal intestinal plasmic muscle layer, dentate line submucosal tissue, and anterior wall muscle sheath were sutured to fix the intestinal canal. Each layer of the intestinal canal and the anal canal incision margin were sutured continuously. The anal anastomosis was compressed and fixed through the anus with oil yarn. CO_2 pneumoperitoneum was established again, and the intestinal tube was detected for torsion and active bleeding. If not, pneumoperitoneum and Trocar were withdrawn, and the puncture hole was bonded with skin adhesive.

The vital signs of the two groups were monitored after operation. On the first day after operation, the urinary tube and gastric tube were withdrawn, and the family members were instructed to let the child into liquid diet, and the child was slowly restored to the normal diet according to the recovery situation. Antibiotics were used to prevent infection 1 to 2 days after operation. The oiling yarn was removed on the 2nd day after the operation to ensure cleanliness and clean skin near the anus.

Observation Indicators

The surgical indicators, stress response, intestinal microbiota, anal function, short-term complications, and long-term complications were compared between the two groups. (1) Operation indicators: operation time, intraoperative blood loss, fasting time, intestinal function recovery time, hospital stay. (2) Stress response: including serum cortisol, atrial natriuretic peptide, plasma epinephrine, and norepinephrine. Venous blood samples were collected before and 1 day after operation, respectively. Non-equilibrium radioimmunoassay was used to detect cortisol and atrial natriuretic peptide, and modified fluorescence method was used to detect epinephrine and norepinephrine. (3) Intestinal flora: *Bifidobacterium*, *Lactobacillus*, *Escherichia coli*, and *Enterococcus faecalis* were included. Fresh fecal samples (2 g) were collected before and 1 day after surgery for bacterial culture. (4) Anal function: evaluated after operation, according to Wingspread score standard, and divided into (i) excellent: no constipation and controlled defecation; (ii) good: no dirty feces but mild constipation which can be relieved with the use of relevant drug treatment; (iii) can: intermittent feces and uncontrolled defecation; (iv) poor: continuous occurrence of sewage. Excellent and good rate = (excellent + good) cases/total cases ×100%.[7] (5) Recent complications: including urinary retention, hematochezia, perianal dermatitis, incision infection, abdominal hemorrhage, and the total incidence was calculated. (6) Long-term complications: including constipation, anastomotic stenosis, enterocolitis, fecal fouling, and the total incidence was calculated.

Statistical methods

All survey data and experimental data were managed by Excel and SPSS22.0 software. Measurement data were expressed as ($\bar{x} \pm s$), t test was performed, count data were expressed as %, χ^2 test was performed. Adjustments or corrections were made for confounding variables. $P < .05$ was considered statistically significant.

RESULTS

Comparison of surgical indicators between the two groups

The operation time in the minimally invasive group was 93.57 ± 12.59 min, which was significantly shorter than that in the Legacy group (113.44 ± 16.72 min). The intraoperative blood loss in the minimally invasive group was 27.28 ± 8.84 mL, which was significantly less than that in the Legacy group (45.51 ± 10.62 mL). The fasting time in the minimally invasive group was 15.25 ± 5.93 h, which was significantly lower than that in the Legacy group (19.22 ± 6.31 h). The intestinal function recovery time and hospital stay in the minimally invasive group were significantly shorter than those in the traditional group ($P < .05$). See Table 1.

Comparison of stress response between the two groups

The levels of serum cortisol in the minimally invasive group were 70.32 ± 7.04 μmol/L postoperatively, which was significantly lower than that in the Legacy group (78.83 ± 8.76 μmol/L). The atrial natriuretic peptide in the minimally invasive group was 0.29 ± 0.05 nmol/L postoperatively, which was significantly lower than that in the Legacy group (0.35 ± 0.08 nmol/L). Also, the plasma epinephrine and norepinephrine in the minimally invasive group were lower than those in the traditional group ($P < .05$), as shown in Table 2.

Comparison of intestinal flora between the two groups

The levels of *Bifidobacterium* and *Enterococcus faecalis* in the minimally invasive group were higher than those in the traditional group ($P < .05$), as shown in Table 3.

Comparison of anal function between the two groups

The excellent and good rate of anal function in the minimally invasive group was higher than that in the traditional group ($P < .05$). See Table 4.

Comparison of recent complications between the two groups

The incidence of short-term complications in the minimally invasive group was lower than that in the traditional group ($P < .05$), as shown in Table 5.

Comparison of long-term complications between the two groups

The incidence of long-term complications in the minimally invasive group was lower than that in the traditional group ($P < .05$), as shown in Table 6.

Table 1. Comparison of Surgical Indicators Between the Two Groups ($\bar{x} \pm s$)

Grouping	No. of cases	Surgery time (min)	Intraoperative blood loss (mL)	Fasting time (h)	Recovery time of intestinal tract function (h)	Length of hospital stay (d)
Legacy group	40	113.44 ± 16.72	45.51 ± 10.62	19.22 ± 6.31	35.25 ± 9.45	7.35 ± 1.44
Minimally invasive group	40	93.57 ± 12.59	27.28 ± 8.84	15.25 ± 5.93	26.32 ± 8.53	5.68 ± 1.00
t	-	6.004	8.344	2.900	4.436	6.025
P	-	.000	.000	.002	.000	.000[a]

[a]$P < .05$

Table 2. Comparison of Stress Response Between the Two Groups ($\bar{x} \pm s$)

Constituencies	Number of cases	Cortisol (μmol/L)		Natriuretic (nmol/L)		epinephrine (of/L)		Norepinephrine (nmol/L).	
		Preoperatively	Postoperatively	Preoperatively	Postoperatively	Preoperatively	Postoperatively	Preoperatively	Postoperatively
Legacy group	40	63.60 ± 7.58	78.83 ± 8.76	0.26 ± 0.06	0.35 ± 0.08	32.93 ± 3.55	44.17 ± 6.95	3.49 ± 0.59	4.71 ± 0.80
Minimally invasive group	40	63.57 ± 7.71	70.32 ± 7.04	0.27 ± 0.04	0.29 ± 0.05	33.00 ± 3.48	37.42 ± 5.37	3.54 ± 0.64	3.90 ± 0.56
t	-	0.018	4.789	0.877	4.022	0.089	4.861	0.363	5.246
P value	-	0.493	.000	.192	.000	.465	.000	.359	.000

Table 3. Intestinal Flora Comparison of the Two Groups ($\bar{x} \pm s$)

Constituencies	Number of cases	*Bifidobacterium*		*Lactobacillus*		*Colibacillus*		*Enterococcus faecals*	
		Preoperatively	Postoperatively	Preoperatively	Postoperatively	Preoperatively	Postoperatively	Preoperatively	Postoperatively
Legacy group	40	7.34 ± 1.16	8.50 ± 1.67	7.38 ± 1.25	8.50 ± 1.39	8.05 ± 0.90	7.49 ± 0.72	6.62 ± 0.80	7.34 ± 0.89
Minimally invasive group	40	7.31 ± 1.19	9.78 ± 1.85	7.36 ± 1.28	8.62 ± 1.50	8.09 ± 0.88	7.42 ± 0.75	6.60 ± 0.83	7.69 ± 0.92
t	-	0.114	3.248	0.071	0.371	0.201	0.426	0.110	1.729
P value	-	.455	.001	.472	.356	.421	.336	.456	.044

Table 4. Function Comparison Between the Two Groups [n (%)]

Grouping	Number of cases	Excellent	Good	Can	Difference	Total efficiency
Legacy group	40	10	20	8	2	30(75.00)
Minimally invasive group	40	18	19	3	0	37(92.50)
χ^2 value	-	-	-	-	-	4.501
P value	-	-	-	-	-	.034

Table 5. Comparison of Recent Complications Between the Two Groups [n (%)]

Grouping	Number of cases	Urinary retention	Blood in the stool	Perianal dermatitis	Incision infection	Bleeding from the abdominal cavity	Overall incidence
Legacy group	40	3	2	2	1	1	9(22.50)
Minimally invasive group	40	1	1	0	0	0	2(5.00)
χ^2 value	-	-	-	-	-	-	5.165
P value	-	-	-	-	-	-	.023

Table 6. Comparison of the Long-Term Complications Between the Two Groups [n (%)]

Grouping	Number of cases	constipation	The anastomotic mouth is narrow	Enterocolitis	Feces	Overall incidence
Legacy group	40	2	1	2	2	7(17.50)
Minimally invasive group	40	1	0	0	0	1(2.50)
χ^2 value	-	-	-	-	-	5.000
P value	-	-	-	-	-	.025

DISCUSSION

Hirschsprung's disease is a common developmental disorder in clinical practice, second in prevalence to anorectal malformation in terms of digestive tract malformation.[8] This disease occurs in the neonatal period and is the main cause of neonatal intestinal obstruction. The main pathological basis of this disease is the absence of ganglion cells in the intermuscular and submucosal nerve plexus and the proliferation of nerve fibers in the diseased intestine, which can lead to the involvement of the rectum and sigmoid colon, and in severe cases, the small intestine.[9] The clinical symptoms of the child include abdominal distension, intractable constipation, vomiting, delayed fetal stool discharge time, and malnutrition. High-pressure gas ejection often occurs when the finger sleeve is withdrawn during physical examination. The clinical symptoms of the child can be improved to a certain extent after manual help in defecation, but it is prone to recurrent attacks.[10] Clinically, the disease is mainly divided into short segment type, common type and long segment type according to the involvement degree of the diseased intestine, and the common type is more common in traditional Chinese medicine.[11]

At present, surgery is the main treatment for this disease. The purpose is to remove the spastic intestine without ganglia and drag the normal intestine innervated by ganglion cells in the adjacent part to the anus for anastomosis, so as to reshape the continuity of the digestive tract and restore the normal function of the intestine.[12] Open Soave is a traditional operation, which can obtain certain curative effect, but the incision of this operation is large, resulting in greater trauma and higher incidence of complications, thus resulting in slow postoperative recovery and longer hospital stay.[13]

In recent years, with the deepening of related research, laparoscopic surgery has been well applied in the treatment of this disease and has gradually replaced open surgery.[14] Laparoscopic Soave has the advantages of mild trauma, low complication rate and rapid postoperative recovery, making it the first choice for the clinical treatment of Hirschsprung's disease.[15-18] However, the limitation is that this operation may cause potential damage to the adjacent tissues of the rectum when the whole rectal layer is dissociated in the dentate line. In addition, this operation retains a long rectal muscle sheath, which may lead to postoperative complications such as obstruction and constipation because of the narrow muscle sheath. Intraoperative Deloyers reversal can prevent the occurrence of the above problems to a certain extent, avoid total colon resection, retain ileocecal valve, and then ensure the absorption of nutrients in the ileum,[19] so that the stool becomes thick, which is more consistent with the physiological characteristics of the human body. It should be noted that during the operation, the middle colonic artery should not be too high to avoid injury to the right colonic artery, the mesentery should not be too close to the intestine, and the vascular arch next to the colon should be preserved to ensure collateral circulation, and the ascending branch of the right colonic artery can be cut when the middle segment of the ascending colon is removed.

The results of this study showed that the operation time, intraoperative blood loss, fasting time, intestinal function recovery time, and hospital stay in the minimally invasive group were all less than those in the traditional group, which was basically consistent with domestic related research reports. Whereas, invasive surgery operation can cause non-specific reaction, namely stress reaction to the patient, and strength of the larger or more long time of stress reaction, will pose a certain degree of harm to the body. It can also activate the hypothalamus-pituitary-adrenal cortex system,[20] increasing its excitation, which in turn can elevate the levels of cortisol and noradrenaline. Therefore, the stress response in children should be reduced as much as possible. Interestingly, this study found that stress response along with postoperative serum cortisol, heart sodium, plasma epinephrine, and norepinephrine levels of the minimally invasive group is lower than that of the traditional group. Upon analysis, it appears that the mild stress response in the minimally invasive group undergoing laparoscopic Soave joint Deloyers flip on the body is linked to the small incision and shorter operation duration. In addition, intraoperative exploration and operation through laparoscopic lens can quickly find the diseased intestine, accurately dissociate, cut and provide other treatments, so it can greatly reduce the damage caused to the normal tissue, and reduce the stress response of children. On the contrary, if the intestinal microecological environment is destroyed, as observed in Congenital Megacolon disease in children, the fixed value resistance is reduced. This can easily lead to intestinal flora disorder and increase the risk of bacterial infection. In the analysis results of this paper, the levels of *Bifidobacterium* and *Enterococcus faecalis* in the minimally invasive group were higher than those in the traditional group, suggesting that the minimally invasive surgical method better preserves and can quickly restore the intestinal microecological environment of children, help to improve the number and vitality of normal intestinal microbiota, facilitate the balance of intestinal flora, and then accelerate the recovery of intestinal function as soon as possible. The comparison of anal function showed that the excellent and good rate of the minimally invasive group was higher than that of the traditional group, suggesting that laparoscopic minimally invasive surgery can promote better recovery of anal function in children. In terms of safety, the incidence of short-term and long-term complications was lower in the minimally invasive group, suggesting that laparoscopic Soave combined with Deloyers turnover is safer, which is also the main reason for the rapid postoperative recovery and short hospital stay in the minimally invasive group.

There are certain limitations of this study. No mechanism was explored in the study, and further research is warranted.

CONCLUSION

Joint Deloyers flip Soave under laparoscopic surgery for children with congenital Hirschsprung disease has a better curative effect, with shorter operation time, less blood loss compared to traditional open surgery.

DATA AVAILABILITY

The data used to support this study is available from the corresponding author upon request.

FUNDING

The authors have not received any funding support.

AUTHOR DISCLOSURE STATEMENT

The authors declare that they have no conflicts of interest.

ACKNOWLEDGMENTS

The author would like to thank all those who participated in this study for their outstanding contributions to the study.

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