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Outcomes of laparoscopic-assisted surgery for total colonic aganglionosis using the Duhamel technique at the National Children's Hospital from 2013 to 2018

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ABSTRACT

Objective: This retrospective descriptive study was conducted to evaluate the outcomes of laparoscopic-assisted surgery for total colonic aganglionosis (TCA) using the Duhamel technique at the National Children's Hospital from 2013 to 2018. **Methods:** Medical records of thirty-three patients who underwent laparoscopic surgery for TCA using the Duhamel technique at the National Children's Hospital from January 2013 to December 2018 were collected. Information on the surgical methods and short- and long-term outcomes was also collected. **Results:** The results showed that Laparoscopic-assisted surgery for TCA using the Duhamel technique had a mean surgical time of 148.6 ± 40.9 minutes (80–240 min). The mean resection of anastomosis was 18.7 cm (range, 5–50 cm), with no complications, and no intraoperative mortality was recorded. The mean hospital stay after surgery was 7.8 days (range, 5–7 days), and low rates of postoperative complications were recorded, with only 3% bleeding, 3% wound infection, and no postoperative mortality. The percentage of patients with good postoperative bowel function was 88.5%; only 11.5% had moderate outcomes, and none had poor outcomes. The rate of enteritis after surgery was 61.5%. **Conclusion:** Laparoscopic-assisted surgery for TCA using the Duhamel technique is a safe and highly feasible surgery with a short operative time and without complications or intraoperative mortality.

Keywords: Laparoscopic surgery, total colonic aganglionosis, Duhamel

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INTRODUCTION

Total colonic aganglionosis (TCA) causes the intestine to lose its motility, leading to stool accumulation in the upper part of the bowel and causing significant dilation of the ileum. Historically, diagnosing and treating TCA has been challenging and often requires multiple surgeries in affected children. Over the years, various pediatric surgery centers worldwide have adopted different surgical techniques to treat TCA, including the Martin, Boley, J-pouch, and Duhamel techniques [1], [2]. However, none of these methods has proven to be optimal. Currently, many surgeons prefer the Duhamel technique for treating TCA because of its simplicity and adherence to the principle of removing the entire aganglionic colon while preserving a portion of the rectum, which aids in water absorption

within the gastrointestinal tract. This method can help reduce diarrhea, improve water absorption, thicken stool consistency, and enhance postoperative quality of life in children with TCA [3].

In Vietnam, the National Children's Hospital was the first center to perform laparoscopic-assisted surgery for treating TCA using the Duhamel technique, yielding positive initial results. However, TCA surgery remains a complex procedure that can have lasting impacts on patients, affecting not only their physical health and bowel function but also their quality of life postoperatively [4].To date, some studies in Vietnam have evaluated the treatment outcomes for patients with congenital megacolon (Hirschsprung's disease). However, no comprehensive study has specifically assessed the outcomes of laparoscopic-assisted TCA surgery using the Duhamel technique. This study aimed to evaluate the results of laparoscopic-assisted surgery for TCA using the Duhamel technique at the National Children's Hospital between 2013 and 2018.

PATIENTS AND METHODS

Study Subjects, Duration, and Location

Patients who underwent laparoscopy-assisted surgery for TCA using the Duhamel technique at the National Children's Hospital between January 2013 and December 2018 were included in this study. *The inclusion criteria* were as follows.

1. Patients who underwent first-stage ileostomy with biopsy results showed an absence of ganglion cells throughout the colon.

2. Patients were aged ≥ 12 months at the time of the second-stage surgery, which was performed using the Duhamel technique with laparoscopic assistance.

3. The patients were operated upon by the same surgical team.

4. Patients with a minimum follow-up period of 6 months postoperatively.

The exclusion criteria were as follows.

1. Patients who underwent second-stage surgery before the age of 12 months.

2. Patients who had failed surgeries at other hospitals.

3. Patients who were not adequately followed up.

Study Design, Sample Size, and Sampling Method

This retrospective descriptive study design was used. All surgical records of patients over six years from 2013 to 2018 were reviewed. A total of 33 records met the inclusion and exclusion criteria.

Information and Study Procedure

This study involved a retrospective review of the patient’s medical records based on a standardized research template. The information collected included the following.

• General patient information

• Intraoperative details: location, duration of trocar placement, CO2 insufflation rate and pressure, total surgery time, duration of the laparoscopic stage, duration of the transanal stage, length of resected aganglionic ileum, intraoperative complications

• Early postoperative outcomes: time to bowel movement resumption, time to oral intake postoperative, length of hospital stay postoperative, early postoperative complications such as intra-abdominal bleeding, anastomotic leakage, anastomotic fistula, anastomotic dehiscence, perirectal

abscess, postoperative bowel obstruction, early enteritis, and other complications

• Long-term postoperative outcomes: Evaluation of bowel function at the time of follow-up. Bowel function outcomes were assessed according to criteria proposed by Wildhaber et al. (2005) [5], which included factors such as recurrent abdominal distension, daily bowel movement frequency, stool consistency, fecal incontinence, rectal sensation, diaper use, prolonged medication use, and dietary restrictions

Data Processing and Analysis

Data were collected and processed using SPSS 22.0 software. Descriptive statistics were applied, including mean, standard deviation, frequency, and percentage.

RESULTS

There were 33 children with TCA met the inclusion and exclusion criteria. The mean age was 14.7 ± 3.1 months, with a male-to-female ratio of 1.7:1. All 33 patients underwent placement of 4 trocars using an open technique, including 3 trocars of 5 mm and 1 trocar of 12 mm. All three 5 mm trocars were sutured to the abdominal wall. The 12 mm trocar was placed at the site of the ileostomy drainage. Regarding the trocar insertion site for the endoscope, 13 patients (39.4%) had a trocar placed through the umbilicus, whereas 20 patients (60.6%) had a trocar placed approximately 2 cm above the umbilicus. The mean time for placing the 3 trocars of 5 mm was 14 ± 2.1 minutes (range, 10–20 min). The mean CO_2 insufflation pressure was 10.3 ± 0.7 mmHg (ranging from 9 to 11 mmHg). The initial CO_2 flow rate was 1 L/min and was maintained at 2 – 2.5 liters per minute. No complications related to CO_2 insufflation were observed.

Table 1 shows that the shortest length of the resected ileal segment was 5 cm, and the longest was 50 cm, with a mean length of 18.7 ± 11.3 cm. The majority of the resected ileal segments ranged from 10 to 20 cm, accounting for 48.5%. The mean duration of surgery was 148.6 ± 40.9 minutes, ranging from 80 to 240 min. Among these, surgery lasting ≤ 120 min constituted 27.3% had surgery lasting between 121 and 180 min constituted 48.5%, and 24.2% had surgery lasting > 180 min.

Table 1. *Length of Resection of Ileal Segment and Duration of Surgery*

Characteristic		**Amount**	**%**
Length of Resection of Ileal Segment	< 10 cm	6	18,2
	10 - 20 cm	16	48,5
	21 - 30 cm	5	15,1
	> 30 cm	6	18,2
Duration	≤ 120 minutes	9	27,3
	121-180 minutes	16	48,5
	181-240 minutes	8	24,2
	Total	33	100

The mean time for bowel movement recovery was 8.8 ± 3.2 hours (ranging from 5 to 18 hours). Eleven patients (33.3%) had bowel movement recovery ≤ 6 h after surgery, 19 patients (57.6%) recovered within 7–12 h, and only three patients (9.1%) recovered more than 12 h postoperatively. Three patients (9.1%) experienced vomiting within the first 12 hours post-surgery. Table 2 shows that the time to bowel movement recovery did not differ between age

groups (≤ 18 months and > 18 months) or between groups with different resected ileal segment lengths (p > 0.05). The time to bowel movement recovery for the group with surgery duration ≤ 120 minutes was 6.4 ± 0.8 hours, for the group with surgery duration between 121 - 180 minutes was 8.6 ± 2.5 hours, and for the group with surgery duration ≥ 180 minutes was 11.8 ± 3.8 minutes. The difference was statistically significant (p < 0.05). (Table 2)

Table 2. *Bowel Movement Recovery Time by Various Characteristics*

Characteristic		**Time to Bowel Movement Recovery**			**p**
		Mean ± SD	**Earliest**	**Latest**	
Age at Surgery	≤ 18 months	8,4 ± 2,7	5	15	0,11
	> 18 months	11,2 ± 5,7	6	18	
Length of Resection of Ileal Segment	< 10 cm	7,5 ± 2,3	6	12	0,42
	10 - 20 cm	8,5 ± 2,6	5	12	
	21 - 30 cm	9,4 ± 3,8	5	14	
	> 30 cm	10,5 ± 4,8	6	18	
Duration	≤ 120 minutes	6,4 ± 0,8	5	8	0,001
	121-180 minutes	8,6 ± 2,5	5	12	
	181-240 minutes	11,8 ± 3,8	6	18	

Table 3 shows that the mean time to start feeding after surgery was 4.5 ± 0.7 days, with the earliest being 4 days (57.6%) and the latest being 7 days (3.0%). Feeding on the 5th day postoperative accounted for 30.3%, and on the 6th day, 9.1%. The mean length of postoperative hospital stay was 7.8 ± 3.1 days, with the shortest being 5 days and the longest being 17 days. Seven patients (21.2%) had a hospital stay of ≤ 5 days, 20 (60.6%) had a hospital stay of 6–10 days, and 6 (18.2%) had a hospital stay of > 10 days. Regarding early complications, 31 patients (94.0%) had no early complications, 1 patient (3.0%) experienced postoperative bleeding, underwent laparoscopic reoperation for hemostasis, and was discharged on the 9th postoperative day. One patient (3.0%) had an infection at the surgical site, which responded well to local wound care, and was discharged on the 15th postoperative day.

Table 3. *Postoperative Characteristics*

Characteristic		**Number**	**%**
Time to Start Feeding After Surgery	Day 4	19	57,6
	Day 5	10	30,3
	Day 6	3	9,1
	Day 7	1	3,0
Length of Hospital Stay After Surgery	≤ 5 Days	7	21,2
	6 - 10 Days	20	60,6
	> 10 Days	6	18,2
Early Complications	No early complications	31	94,0
	Bleeding	1	3,0
	Wound Infection	1	3,0
	Death	0	0

Table 4 shows that, out of 26 patients, 19 (73.1%) did not experience abdominal distension, while 6 (26.9%) occasionally had abdominal distension. The percentages of patients with 1-2 bowel movements per day were 30.77% (8 patients); those with 3 - 5 bowel movements was

50.0% (13 patients), and 19.2 % (6 patients) had > 5 bowel movements per day. Four patients (15.4%) had normal stools, 18 (69.2%) had semi-formed stools, and four (15.4%) had loose stools. Eleven patients (42.3%) had no stool incontinence, and 15 (57.7%) had incontinence during straining or diarrhea. Twenty-four patients (92.3%) had normal rectal sensations, and two patients (7.7%) had impaired rectal sensations. Sixteen patients (61.5%) did not require diapers, whereas 10 patients (38.5%) occasionally required diapers. None of the patients required antibiotics or antidiarrheal medications. Twenty patients (76.9%) had a normal diet, while 6 patients (23.1%) were on a restricted diet. Overall, among the 26 patients who were followed up, 23 (88.5%) had good bowel function (11–16 points), 3 (11.5%) had mean bowel function (6–10 points), and no patients had poor bowel function.

Table 4. *Postoperative Bowel Function*

Characteristic		**Amount**	**%**
Recurrent Abdominal Distension	None	19	73,1
	Occasionally	6	23,1
	Frequently	1	3,8
Bowel Movements per Day	1 - 2 times	8	30,8
	3 - 5 times	13	50,0
	> 5 times	5	19,2
Stool Consistency	Normal	4	15,4
	Semi-formed, not well-formed	18	69,2
	Loose	4	15,4
Stool Incontinence	None	11	42,3
	With straining or diarrhea	15	57,7
	Continuous	0	0
Rectal Sensation	Normal	24	92,3
	Impaired	2	7,7
	Loss of Sensation	0	0
Using Diapers	None	16	61,5
	Occasionally	10	38,5
	Frequently	0	0
Long-term Medications	None	26	100
	Antibiotics	0	0
	Antidiarrheal Medications	0	0
Diet	Normal	20	76,9
	Restricted	6	23,1
	Parenteral Nutrition	0	0
Bowel Function (Wildhaber Score)	Good (11-16)	23	88,5
	Mean (6-10)	3	11,5
	Poor (0-5)	0	0

Table 5 shows that, among the 26 patients, 16 (61.5%) occasionally had enteritis that responded well to oral antibiotics and anal dilatation. Among the 26 patients who were followed

up, 8 (30.8%) had perianal skin inflammation, 1 (3.8%) had anastomotic stricture that responded well to anastomotic dilation, and no patients had urinary disorders or penile erection disorders.

***Table 5**. Postoperative Bowel Complications*

Characteristic		**Amount**	**%**
Enteritis	None	10	38,5
	Occasionally	16	61,5
	Frequently	0	0
Other Complications	Perianal Skin Inflammation	8	30,8
	Anastomotic Stricture	1	3,8
	Erectile Dysfunction in Young Male Patients	0	0
	Urinary Disorders	0	0

DISCUSSIONS

Bowel function is the primary criterion for evaluating bowel function recovery in gastrointestinal anastomosis surgery. The advantage of laparoscopic surgery for treating TCA is the earlier recovery of bowel function due to less mechanical impact on the bowel compared with open surgery. In this study, all patients were administered an anal tube through the anastomosis immediately after surgery to reduce the pressure on the anastomosis. Bowel function was measured from the time of surgery until the passage of gas or stool through a tube. The results show that the mean time for bowel function was 8.8 hours (5 ÷ 18 hours). The time to bowel function was not related to the age at surgery and the length of the resected bowel segment but was related to the duration of surgery. Prolonged surgery times require more anesthetics and muscle relaxants, which may contribute to the delayed return of bowel motility.

Our study found that the mean time to start feeding after surgery was 4.5 days (range: 4–7 days). This was earlier than that of some authors, both nationally and internationally. For instance, Tran Thanh Tri reported a mean feeding time of 5.6 days (4–8 days) [6], whereas Miyano reported a mean feeding time of 6.7 days (6–8 days) for open surgery and 5.9 days (5–7 days) for laparoscopic surgery [7]. In our patients, if there was no vomiting and the anal tube produced good stool output by the 2nd or 3rd day postoperative, we removed the anal tube and began oral hydration. By the 4th postoperative day, when the anastomosis was relatively stable, feeding was started, and intravenous fluids were gradually reduced.

The patients were discharged when they could eat entirely by mouth, had normal bowel movements, and showed no abnormal symptoms. The mean length of postoperative hospital stay was 7.8 days (range, 5–17 days), which is considerably shorter than that reported by other authors. Tran Thanh Tri reported an mean stay of 11.2 days (10 ÷ 13 days) [6], Miyano (2017) reported 18.8 days [3], and Xi Zhang (2018) reported 14.1 days (8 ÷ 32 days) [8]. Our shorter surgical time and earlier resumption of feeding contributed to a shorter hospital stay and no complications were noted, allowing for earlier discharge.

Key clinical features of TCA include bowel inflammation, frequent bowel movements, loose stools, fecal incontinence,

and perianal dermatitis. The surgical goal of TCA is to achieve bowel function as close to normal as possible, including parameters such as the frequency of bowel movements per day, fecal incontinence status, and control over bowel movements, aiming to improve the patient's quality of life while minimizing common complications (such as bowel inflammation, perianal dermatitis, anastomotic stricture, fistula, bowel obstruction, and genitourinary dysfunction). These are the primary criteria for assessing the outcomes of TCA surgery.

There are various systems for evaluating bowel function, such as those by Kelly, Peña, Holschneider, Rintala, and Wingspread [9]. Each system has different scoring scales and assessment parameters, which are generally based on factors such as bowel control, frequency of bowel movements per day, fecal incontinence, stool consistency, rectal sensation, diet, medication use, and clinical examination. These systems are designed to evaluate bowel function in patients after surgery for TCA, and are also applicable for assessing bowel function in patients after Hirschsprung's disease surgery. Owing to the many different evaluation methods, comparisons of surgical outcomes among authors are somewhat relative. In this study, we used the classification system developed by Wildhaber et al. 555 to assess postoperative bowel function, which has been used in several recent studies [3], [8], [10].

We assessed bowel function in children after TCA surgery using a scoring system according to Wildhaber's classification [5], and our results were consistent with those of several other authors [8], [10].

In our study, 26 patients were followed up and assessed for bowel function at the end of the study. Of these, 88.5% had good bowel function (11–16 points), 11.5% had good mean bowel function (6 -10 points), and none of the patients had poor bowel function (0-5 points). The proportion of patients with good bowel function after surgery in this study was comparable to that reported in many global studies [5], [8], [10].

Wildhaber et al. conducted a study of 25 patients with TCA over 28 years and found that 83% had good bowel function after surgery, 6% had mean bowel function, and only 11% had poor bowel function with symptoms of fecal incontinence, frequent bowel movements, and recurrent bowel inflammation. The authors also noted that bowel function tends to improve with age [5]. Another larger study by Tsuji et al. on TCA reported similar results [11].

Miyano compared the outcomes of open and laparoscopic surgeries for TCA and found no significant difference in postoperative bowel function between the two groups. However, laparoscopic surgery offers the advantages of better visualization of the entire abdominal cavity, complete removal of the colon, and easier dissection of the pelvic region [3]. Raboei's study on long-term outcomes for TCA concluded that the Duhamel procedure is safe and provides similar, if not better, postoperative bowel function compared to other surgeries [12].

Urinary and erectile dysfunction (in male patients) are potential complications of surgery for Hirschsprung disease and TCA. However, in our study of 26 patients, no cases of urinary dysfunction were reported until the end of the follow-up period. This result is similar to those of studies by Wildhaber and Escobar [5], [13] and better than those of Neuvonen et al., who found that 14% of patients had urinary dysfunction after Hirschsprung's surgery [14]. This suggests that the success of surgical techniques, aside

from thorough resection of the rectum, also minimizes damage to the nerves controlling the bladder function in the pelvic region during surgery.

CONCLUSIONS

Laparoscopic surgery for total colonic aganglionosis using the Duhamel technique is a safe and highly feasible procedure with a short operation time and no complications or mortality during surgery. Surgery is safe, easy, and highly effective.

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