Early Surgical Complications Following Transanal Endorectal Pull-through for Hirschsprung's Disease

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ABSTRACT

Objective: The purpose of this study was to examine factors affecting early complications following transanal endorectal pull-through (TERPT) in patients with Hirschprung's disease.

Materials and Methods: Retrospective chart reviews of patients with Hirschsprung's disease who underwent TERPT/ abdominal assisted TERPT at Siriraj Hospital between January 2009 and December 2019 was carried out.

Results: The overall complication rate was 26% (43/163). The complications were as follows: 14 cases of anastomotic strictures (32.6%), five cases of abscess at anastomosis (11.6%), and three cases of anastomotic leakages (7.0%). In regards to preoperative bowel preparation, when comparing those with and those without post-operative complications, the amount of NSS for rectal irrigation (ml/Kg), duration required (days), and duration of changed diet (days) were the same. Colostomy prior to a pull-through operation could not prevent post-operative complications following endorectal pull-through (p = 1.000). The incidences of early complications following TERPT and abdominal assisted TERPT was the same (p = 0.344). Abdominal assisted TERPT had a higher incidence (4%) of anastomotic leakages whereas TERPT had a higher rate of anastomosis strictures (12%) compared to o abdominal assisted TERPT (5%). The higher the transitional zone, the higher the complication rate. Anastomotic leakages, the most serious complication, rarely occurred following TERPT in the low transitional zone.

Conclusion: There was no significant risk factor associated with early surgical complications following TERPT. Abdominal assisted TERPT should be selected properly according to the level of transitional zone. The complications correlate with whether a perfect pull-through operation could be performed or not.

Keywords: Hirschsprung; endorectal pullthrough; complications; anastomosis; bowel preparation (Siriraj Med J 2023; 75: 445-453)

INTRODUCTION

Hirschsprung's disease (HD) is caused by the absence of ganglion cells in the myenteric and submucosal plexus of the colon, resulting in a lack of propagation of the peristaltic wave of the colon. The incidence of HD is approximately 1 in 5,000 live births.[1] Effective surgical treatment includes resection of the aganglionic portion of the bowel and identification of normally ganglionated proximal bowel with a leveled coloanal anastomosis. Many operative approaches to correct HD are derived from original concepts by Swenson, Duhamel, and Soave-Boley.[2-4] The standard Soave-Boley endorectal pull-through procedure uses both the abdominal and transanal approach[3,4] and was popularized after the introduction of the laparoscopic pull-through.

The Soave-Boley endorectal pull-through procedure was transformed into a solely transanal approach named "transanal endorectal pull-through (TERPT)" by L De la Torre and J A Ortega in 1988.[5-7] If the transanal approach cannot be performed perfectly, a combination of abdominal and transanal approaches, named "abdominal assisted transanal endorectal pull-through," (abdo + TERPT) is used.

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During the transanal endorectal pull through procedure, a submucosal dissection of the rectum after a circumferential incision of the rectal mucosa is performed. Following a submucosal dissection, a seromuscular layer of the rectum is incised circumferentially. A mucosectomy of the rectum, leaving a muscular cuff is also performed. The ganglionated colon is pulled through the aganglionic rectal cuff, and a coloanal anastomosis is performed.[5-7]

When the transition zone is proximal to the mid-sigmoid colon, abdominal assisted transanal endorectal pull-through is considered.[6] A pedicled colon flap must be developed to provide adequate length for colon pull-through. In this situation, it might be necessary to ligate and divide either the inferior mesenteric artery just distal to its origin from the aorta or the left colic artery just after it rises from the inferior mesenteric artery. By ligating these vessels at these sites, the arterial supply through the marginal artery should not be compromised.[6]

The primary pull-through method for HD has been in use since 1980.[7,8] A single-stage procedure avoids the complications associated with a colostomy and the need for another operation to close the colostomy. A primary single-stage pull-through is appropriate for most infants and children diagnosed with HD. Contraindications to primary pull-through include severe enterocolitis[7-9], massive proximal dilatation[7-9], an inability to determine the transition zone[7,8], life-threatening comorbidities[7,8] and colonic perforation[9]

Early postoperative complications include anastomotic leaks and cuff abscess, bowel obstruction, perineal excoriation, stoma complications, and wound infection. On the other hand, late complications include bowel obstruction, constipation, enterocolitis, incontinence, and stricture. In this study, complications that happened in less than or equal to 30 days post-operatively were included.

Major complications mostly occur at coloanal anastomosis. Anastomotic leaks have been reported in 5% to 10% of cases, while cuff abscess is seen in about 5% of cases.[10-12] Factors increasing the risk of these complications include tension on the anastomosis or ischemia of the pull-through segment.[10-12]

Factors affecting anastomotic leakage include:

1. Levels of transitional zone. When the transition zone is located too high, abdominal assisted transanal endorectal pull-through is considered. The levels of transitional zone required for an abdominal assisted transanal endorectal pull-through instead of an isolated transanal endorectal pull-through is still controversial.

2. Preoperative bowel preparation. The Division of Pediatric Surgery, Faculty of Medicine, Siriraj Hospital uses a preoperative bowel preparation regimen with rectal NSS irrigation of 30-50 ml/Kg/, twice a day. This amount of NSS is not proven to be efficient nor is known to be enough to do rectal NSS irrigation. A reduction of stool production by changing the diet was also done pre-operatively. At Siriraj Hospital, a low residual diet was introduced on the third day before operation. On the second day before operation, a liquid diet was prescribed, and on the day before operation, patients were given only a clear liquid diet. The question of how many days is required to change the diet regimen remains.

3. Malnutrition. Whether malnutrition caused more complications was questioned.

4. Colostomy. Whether colostomy proximal to coloanal anastomosis would prevent anastomotic complications remains debatable.

An anastomotic stricture after the pull-through procedure is another important postoperative complication. The risk factors include anastomotic ischemia, cuff ischemia, anastomotic leak, and small circular anastomosis.[13]

If all factors affecting early anastomosis complications are clarified, there would be a reduction of early complications following transanal endorectal pull-through.

MATERIALS AND METHODS

Following approval by the Siriraj Institutional Review Board, (COA no. Si 276/2020), a retrospective study was carried out in children with Hirschsprung's disease who underwent either a transanal endorectal pull-through or abdominal assisted transanal endorectal pull-through at Siriraj Hospital between January 2009 and December 2019. Children with another diagnosis (rectal stenosis, meconium plug syndrome), those who underwent other pull-through operations, and incomplete medical information, were excluded from the study.

Patients' demographic data, nutritional status, transitional zone level, colostomy, bowel preparation before surgery, types of operation, complications following either transanal endorectal pull-through or abdominal assisted transanal endorectal pull-through was collected. Complications, including anastomotic leakage, abscess at anastomosis, intraabdominal collection, anastomotic stricture, rectal cuff stricture, were also recorded. The collected data was analyzed using SPSS software version 18 (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc). Continuous data was expressed as median and IQR and categorical data was expressed as numbers and percentages. A Chi square test or Fisher's exact test was used to compare the without post-operative complications and post-operative complication groups. A p-value of <0.05 indicated statistical significance.

RESULTS

Of the 222 patients whose medical records were reviewed, 59 were excluded (41 had other pull-through operations, and 18 had incomplete medical information). One hundred and sixty-three patients were included in this study. Complications were found in 43 patients or 26% (43/163). Post-operative complications are demonstrated in Table 1. Anastomotic strictures were the most common complication (32.6%). Other complications included five cases (11.6%) of abscess at anastomosis, and three cases (7.0%) of anastomotic leakages.

Demographic data and location of the transitional zone in the non-complication (n=120) and complication group (n = 43) is shown in Table 2. The median age of the non-complication group was 3.8 months, and the median age of the complication group was 5.4 months. However, the difference in age and weight of patients in both groups during the operation was not statistically significant.

The most common location of the transitional zone in this study was the rectosigmoid colon (46.3%). Comparing levels of the transitional zone in patients in the non-complication and complication group revealed no statistical significance (p = 0.403).

Whether nutritional status affected post-operative complications was also studied. Nutritional parameters, such as percentile of body weight according to the WHO Growth Chart, total lymphocyte count, Hct, albumin and globulin were collected and compared between those without complications and those with complications. The effect of nutritional status on post-operative complications is demonstrated in Table 3. Nutritional status seemed to have no impact on the complication rate following endorectal pull-through.

TABLE 1. Post-operative complications.

Complication	n	Percent
Anastomotic stricture	14	32.6
Abscess at anastomosis	5	11.6
GI obstruction	4	9.3
Retained aganglionosis bowel	4	9.3
Anastomotic leakage	3	7.0
Rectal cuff stricture	3	7.0
Injury to other organs	1	2.3
Bowel perforation	1	2.3
Other complications	8	18.6
Total	43	100.0

TABLE 2. Demographic data and location of transitional zone compared between the non-complication group (n =120) and complication group (n = 43)

	No complications (n = 120)	Complications (n = 43)	Total (n = 163)	P value
Gender, n(%)				1.000
Male	89 (74.2%)	32 (74.4%)	121 (74.2%)	
Female	31 (25.8%)	11 (25.6%)	42 (25.8%)	
Age (months)				0.657
Median ± IQR	3.8 ± 14.4	5.4 ± 34.8	4.0 ± 14.8	
Body weight (Kg)				0.935
Median ± IQR	5.8 ± 5.9	5.3 ± 6.8	5.6 ± 6.4	
Underlying disease, n(%)				0.209
No underlying disease	116 (96.7%)	39 (90.7%)	155 (95.1%)	
With underlying disease	4 (3.3%)	4 (9.3%)	8 (4.9%)	
Level of transitional zone				0.403
Rectum	33 (27.7%)	9 (22.0%)	42 (26.3%)	
Rectosigmoid colon	55 (46.2%)	19 (46.3%)	74 (46.3%)	
Descending colon	10 (8.4%)	5 (12.2%)	15 (9.4%)	
Transverse colon	14 (11.8%)	6 (14.6%)	20 (12.5%)	
Ascending colon	2 (1.7%)	1 (2.4%)	3 (1.9%)	
Total colonic aganglionosis	5 (4.2%)	1 (2.4%)	6 (3.8%)	

TABLE 3. Effects of nutritional status on post-operative complications.

	No complications (n = 120)	Complications (n = 43)	Total (n = 163)	P value
Age (months)				0.657
Median ± IQR	3.8 ± 14.4	5.4 ± 34.8	4.0 ±14.8	
Body weight (Kg)				0.935
Median ± IQR	5.8 ± 5.9	5.3 ± 6.8	5.6 ± 6.4	
Percentile, n(%)				0.935
P<2536 (30%)	13 (30.2%)	49(30%)		
P25-5023 (19.2%)	10 (23.3%)	33(20.2%)		
P50-7538 (31.7%)	13 (30.2%)	51(31.3%)		
P>9523 (19.2%)	7 (16.3%)	30(18.4%)		
Laboratory				
Total lymphocyte count (cells/mm^3)				
(Median ± IQR)	5611 ± 4338	4889 ± 3703	5155 ± 3886	0.191
Hct (%) (Mean ± SD)	36.1 ± 0.5	35.2 ± 1.2	35.8 ± 6.5	0.436
Albumin (mg/L) (Mean ± SD)	3.9 ± 0.1	3.9 ± 0.2	3.8 ± 0.1	0.594
Globulin (mg/L) (Mean ± SD)	1.8 ± 0.1	1.9 ± 0.1	1.9 ± 0.1	0.644

Pre-operative risk factors for post-operative complications include pre-operative bowel preparation, previous history of Hirschsprung's associated enterocolitis, and colostomy prior to pull-through operation. All pre-operative risk factors for post-operative complications were compared between those without complications and those with complications and are demonstrated in Table 4.

Bowel preparation for a pull-through operation at the Division of Pediatric Surgery, Faculty of Medicine, Siriraj Hospital used rectal NSS irrigation of 30-50 ml/Kg/ twice a day. Comparing those without and those with post-operative complications, the amount of NSS for rectal irrigation (ml/Kg), duration required for rectal NSS irrigation (days), and duration of changing diet (days) were the same (p = 0.961, p = 0.553 and p = 0.296, respectively), The minimum NSS volume for rectal irrigation without any complications in this study was just 10 ml/kg. A previous history of Hirschsprung's associated enterocolitis may increase post-operative complications (p = 0.072).

Colostomy prior to a pull-through operation could not prevent post-operative complications following endorectal pull-through (p = 1.000).

The intra-operative risk factors for post-operative complications were compared between those without complications and those with complications and are shown in Table 5.

When the transition zone was proximal to the mid-sigmoid colon, an abdominal assisted transanal endorectal pull-through (abdo + TERPT) was considered. Early complications following endorectal pull through, whether transanal endorectal pull through or abdominal assisted transanal endorectal pull-through, were the same (p = 0.344). In abdominal assisted transanal endorectal pull-through, division of the inferior mesenteric artery (IMA) to create a pedicled colon flap with adequate length for endorectal pull-through was considered. By ligating the inferior mesenteric artery, there was concern of the compromised arterial supply. In this study, inferior mesenteric artery ligation did not affect complications following abdominal assisted transanal endorectal pull-through (p = 1.000).

Two types of coloanal anastomosis for endorectal pull-through were described. The standard technique was two-layer anastomosis. The first layer sutured the seromuscular layer of the pull-through colon to the rectal cuff, and then the second layer sutured full thickness of the pull-through colon to the rectal mucosa and lower rectal cuff at 0.5 cm above the dentate line. There were only a few patients who received one layer of coloanal anastomosis by suturing full thickness of the pull-through

TABLE 4. Pre-operative risk factors for post-operative complications compared between those without complications and those with complications.

	No complication (n = 120)	Complication (n = 43)	Total (n = 163)	P value
Pre-operative bowel preparation				
Amount of rectal irrigated NSS (ml/kg/dose) (Mean ± SD)	30.3 ± 1.1	30.3 ± 1.9	30.3 ± 1.0	0.961
Duration of rectal NSS irrigation (Days) (Mean ± SD)	6.3 ± 0.5	6.4 ± 0.7	6.4 ± 0.4	0.553
Duration of changing diet (Days) (Means ± SD)	2.1 ± 1	2.2 ± 0.8	2.0 ± 0.9	0.296
Hirschsprung's associated enterocolitis				0.072
No 101 (84.2%)	30 (69.8%)	131 (80.4%)		
Yes19 (15.8%)	13 (30.2%)	32 (19.6%)		
Colostomy prior to pull-through				1.000
No 85 (70.8%)	30 (69.8%)	115 (70.6%)		
yes 35 (29.7%)	13 (30.7%)	48 (29.4%)		

TABLE 5. The intra-operative risk factors of post-operative complications compared between those without complication and those with complications.

	No complication (n = 120)	Complication (n = 43)	Total (n =163)	P value
Type of operations				0.344
TERPT	65 (54.2%)	19 (44.2%)	84 (51.5%)	
Abdo + TERPT	55 (45.8%)	24 (55.8%)	79 (48.5%)	
IMA (in Addo + TERPT only)				1.000
Divided IMA	41 (80.4%)	15 (83.3%)	56 (81.2%)	
Not divided IMA	10 (19.6%)	3 (16.7%)	13 (18.8%)	
Coloanal anastomosis				0.713
2 layers (Seromuscular + all colonic layers	98 (83.8%)	36 (87.8%)	134 (84.8%)	
1 layer (all colonic layers)	19 (16.2%)	5 (12.2%)	24 (15.2%)	

colon to the rectal mucosa and lower rectal cuff 0.5 cm above the dentate line. In our study, both types of coloanal anastomosis had no difference in complication rates (p = 0.713).

The incidence of post-operative complications when comparing levels of transitional zone are demonstrated in Table 6. The results show a higher transitional zone meant more complications. The complication rates following pull-through for Hirschsprung's disease with transitional zone proximal to sigmoid colon (except total colonic aganglionosis (TCA)) was about 30.0%-33.3% whereas complications in patients with a transitional zone at the rectum and rectosigmoid colon was about 21%-25.6%. The complications after a pull-through operation for classical Hirschsprung's disease were minor. The incidence of anastomotic strictures in patients who had a transitional zone at the rectum and rectosigmoid colon was 16% and 5% respectively. Anastomotic leakage, which was the

TABLE 6. Incidences of post-operative complications comparing levels of transitional zone.

Level of transitional zone	Total complications	Anastomotic complications		
		Anastomotic stricture	Abscess at anastomosis	Anastomotic leakage
Rectum	9/42 (21%)	7/42 (16%)	0/42 (0%)	0/42 (0%)
Rectosigmoid colon	19/74 (25.6%)	4/74 (5%)	4/74 (5%)	1/74 (1%)
Descending colon	5/15 (33.3%)	1/15 (6%)	1/15 (6%)	1/15 (6%)
Transverse colon	6/29 (30%)	0/29 (0%)	0/29 (0%)	1/29 (3%)
Ascending colon	1/3 (33.3%)	0/3 (0%)	0/3 (0%)	0/3 (0%)
Total colonic aganglionosis	1/6 (16.6%)	1/6 (16%)	0/6 (0%)	0/6 (0%)

most serious complication, was found in Hirschsprung patients with a transitional zone at the descending colon and transverse colon. This leakage seldom occurs in classical Hirschsprung's disease.

When the transition zone was proximal to the mid-sigmoid colon, abdominal assisted transanal endorectal pull-through (abdo + TERPT) was considered. A comparison of the incidences and types of complications between the transanal endorectal pull-through and abdominal assisted transanal endorectal pull-through is demonstrated in Table 7.

Abdominal assisted endorectal pull-through had a higher incidence (4%) of anastomotic leakage whereas there were no anastomotic leakages in transanal enorectal pull through. Transanal endorectal pull-through had a higher rate of anastomotic strictures (12%) compared to

TABLE 7. Incidences and types of complications comparing transanal endorectal pull-through (TERPT) and abdominal assisted transanal endorectal pull-through (Abdo + TERPT).

	Complications, n (%)	
	TERPT (n= 84)	Abdo + TERPT (n = 79)
Levels of transitional zone		
Rectum	7 (8%)	2 (3%)
Rectosigmoid colon	11 (13%)	8 (10%)
Descending colon	0 (0%)	5 (6%)
Transverse colon	1 (1%)	5 (6%)
Ascending colon	0 (0%)	1 (1%)
Types of complications		
Anastomotic leakage	0 (0%)	3 (4%)
Abscess at anastomosis	3 (4%)	2 (3%)
Anastomotic stricture	10 (12%)	4 (5%)
GI obstruction	0 (0%)	4 (5%)
Retained aganglionosis	2 (2%)	2 (3%)
Rectal cuff stricture	2 (2%)	1 (1%)
Injury to other organs	0 (0%)	1 (1%)
Other complications	1 (1%)	7 (8%)
Bowel perforation	1 (1%)	0 (0%)

abdominal assisted endorectal pull-through (5%). Those who had a transitional zone located at the descending colon or transverse colon, complications of abdominal assisted endorectal pull-through was around 6%. Although complications following these two techniques of pull-through are comparable, abdominal assisted endorectal pull-through had a higher incidence of leakages. The complications correlate with whether a pull-through operation could be done safely. Moreover, retained aganglionosis colon was observed in 3% of abdominal assisted pull-through, even if exploratory laparotomy was done.

DISCUSSION

The aim of this study was to identify possible risk factors of postoperative complications within 30 days of transanal endorectal pull-through (TERPT) and/or abdominal assisted transanal endorectal pull-through (abdo + TERPT). The overall complication rate in this study was 26% (43/163), which is comparable to 22% seen in a study by *Hoff N, et al.*[14]

Major complications mostly occurred in coloanal anastomosis. Besides the high incidence of anastomotic strictures in our study, complications at coloanal anastomosis were comparative to other studies. In our study, anastomotic leaks were seen in 7% of cases whereas other studies reported 5% to 10%.[10-12] In our series, anastomotic abscess was present in 11.6% of all cases whereas others reported 5%.[10-12] The risk of leakages and cuff abscess was caused by tension on the anastomosis or ischemia of the pull-through segment.[10-12] In our series, this complication mostly occurred in abdominal assisted transanal endorectal pull-through in a higher transitional zone. This might be the result of ischemia of the pull-through segment.

The most common location of the transitional zone in this study was the rectosigmoid colon (46.3%). In this study, the levels of the transitional zone had no impact on the complication rate following the pull-through operation (p = 0.403). This might be the result of a high percentage of abdominal assisted transanal endorectal pull though performed in our series.

Although, nutritional status in our study seemed to have had no impact on complication rates following endorectal pull-through, complete nutritional status could not be evaluated in many cases. Albumin and globulin levels were not measured in many patients before the operation.

Various bowel preparation regimens using rectal NSS irrigation before a definite pull-through operation were followed. The Royal Children's Hospital, Melbourne[15] as well as the Children's Hospital, Pittsburgh[16] recommend using NSS irrigation of 20 ml/Kg. However, there is no study comparing the efficiency of these regimens. The Division of Pediatric Surgery, Faculty of Medicine, Siriraj Hospital used a bowel preparation regimen using a rectal NSS irrigation amount of 30-50 ml/Kg twice a day. Comparing those without and with post-operative complications, the amount of NSS for rectal irrigation (ml/Kg), duration required to do this rectal NSS irrigation (days) and duration of changing diet (days) were the same (p = 0.961, p = 0.553 and p = 0.296, respectively).

Colostomy before operations were performed in cases where contraindications to primary pull-through were found, and included: severe enterocolitis, massive proximal dilatation, inability to determine the transition zone and life-threatening comorbidities.[17,18] In this multi-step surgical treatment for Hirschsprung's disease, a colostomy helped with bowel preparation before the operation was performed.. In our study, a colostomy prior to a pull-through operation could not prevent post-operative complications following endorectal pull-through (p = 1.000).

When the transition zone was proximal to the mid-sigmoid colon, abdominal assisted transanal endorectal pull-through (abdo+ TERPT) was considered. Early complications following endorectal pull through, whether transanal endorectal pull through or abdominal assisted transanal endorectal pull-through, were the same (p = 0.344). Therefore, the level of transitional zone could not have a direct impact on complications which were linked to whether pull-through operations could be performed safely.

Abdominal assisted endorectal pull-through had an incidence of 4% for anastomotic leakage, while no anastomotic leakages were found in transanal enorectal pull-through. However, transanal endorectal pull-through had higher rate of anastomosis strictures (12%) compared to abdominal assisted endorectal pull-through (5%). In our study, a high incidence of anastomotic stricture could be the result of tight coloanal anastomosis in patients without laparotomy. A minor degree of anastomotic ischemia and stricture was also encountered.

In abdominal assisted transanal endorectal pull-through, a pedicled colon flap must be developed for endorectal pull-through. In this situation, the pull-through colon derives its vascular supply from the marginal artery. Therefore, to mobilize the descending colon and splenic flexure, it might be necessary to ligate and divide either the inferior mesenteric artery just distal to its origin from the aorta or the left colic artery just after it rises from the inferior mesenteric artery. By

ligating these vessels at these sites, the arterial supply through the marginal artery should be preserved.[6] The appropriate length of the pedicle can be determined by pulling the intended site of anastomosis down into the pelvis and allowing a few extra centimeters for a tension-free coloanal anastomosis. However, in our study, patients with abdominal assisted transanal endorectal pull-through with inferior mesenteric artery ligation were not affected by complications following the operation ($p = 1.000$).

Surprisingly, in our study, anastomotic stricture was the most common complication (32.6%). Anastomosis stricture was found frequently in those with a low transitional zone. Sixteen percent of patients with transitional zones located in the rectum had anastomotic stricture. In our series, transanal endorectal pull-through had higher risk (12%) of anastomotic strictures than abdominal-assisted transanal endorectal pull-through (5%). Other studies[13,19] have reported that anastomotic strictures are the result of anastomotic ischemia, cuff ischemia, anastomotic leaks, and small circular anastomosis. In our study, the reason why abdominal assisted transanal endorectal pull-through had a lower rate of anastomotic stricture might be due to less tight coloanal anastomosis and/orlower levels of rectal cuff resection during laparotomy. Some reports[6,20] suggest that the posterior wall of the cuff should be split to the intended point of anastomosis. The rectal cuff should also be inspected to ensure it is straight and does not fold down into the anorectal canal. A short rectal muscular cuff might also decrease the incidence of enterocolitis by reducing obstructions caused by the spastic cuff.[20] Most strictures can be managed by daily home dilatation. Occasionally, a repeat pull-through is needed to ameliorate the problem.

The higher the transitional zone, the higher the complication rate. Excluding total colonic aganglionosis (TCA), complications following pull-through for Hirschsprung's disease with transitional zone proximal to sigmoid colon was about 30%-33%, whereas complications following those with a transitional zone at the rectum and rectosigmoid colon was about 21.0%-25.6%. There were only minor complications of classical Hirschsprung disease. Anastomotic strictures in patients with a transitional zone at the rectum and rectosigmoid colon occurred in 16% and 5%, respectively. Anastomotic leakage, which was the most serious complication, was found in Hirschsprung patients with a transitional zone at the descending colon and transverse colon. These leakages seldom occur in classical Hirschsprung's disease.

Transanal endorectal pull-through might not show the level of the transitional zone as clearly as abdominal assisted transanal endorectal pull-through. During transanal endorectal pull-through, pulling the colon during anorectal surgery might make it more difficult to identify the transitional zone, leading to a retained aganglionosis segment. However, retained aganglionosis was still found in 3% of abdominal assisted pull-through cases, even if laparotomy was done.

Our study did have some limitations.

First, it had a retrospective design which meant some information may be missing. Fifty-nine patients were excluded (41 had other pull through operations, and 18 had incomplete medical information), which meant only 163 patients were included in the study.

Second, the type of operation, whether transanal endorectal pull-through, abdominal assisted transanal endorectal pull-through, or whether pre-operative colostomy should be done, depended on each surgeon's preference.

Third, the generalizability of the results is restricted. The study was conducted in one university hospital, and thus, there may be complications following operation that are not evident elsewhere. This study was conducted in Siriraj Hospital, in which only the traditional surgical techniques were applied. The youngest pediatric surgical staff in here had at least ten-year experience in surgical treatment for Hirschsprung's disease.

CONCLUSION

No significant risk factors were associated with early surgical complications following TERPT. The incidence of early complications following TERPT and abdominal assisted TERPT was the same ($p = 0.344$). Abdominal assisted TERPT had a higher incidence (4%) of anastomotic leakages whereas TERPT had higher rate of anastomosis strictures (12%) compared to abdominal assisted TERPT (5%). The higher the transitional zone, the higher the complication rate was. Abdominal assisted TERPT should be selected properly for higher level of the transitional zone. The complications correlated with whether a perfect pull-through operation could be performed or not.

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