Prevalence and Factors Associated with Post-operative Strictures in Anorectal Malformations

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ABSTRACT

Objective: Rectal strictures are a serious complication following operation for anorectal malformations (ARM). The purpose of this study was to determine the factors affecting rectal strictures following surgical treatments for ARM.

Materials and Methods: Retrospective chart reviews of 204 patients with ARM who underwent surgical treatment at Siriraj Hospital between January 2003 and December 2019 were carried out.

Results: Overall, the prevalence of post-operative rectal stricture was 19.6% (40/204). The higher types of ARM had higher rectal stricture rates. In low type ARM, the stricture rate following surgery for perineal fistula, vestibular fistula was 4.1% and 14.7%, respectively. Recto-bulbar urethral fistula and recto-prostatic urethral fistula had stricture rates of 19.2% and 26.7%, respectively, but in higher types, the stricture rates were above 70%. Complications such as wound infection, dehiscence, retraction, colonic necrosis and recurrent fistula all affected the post-operative stricture rate ($p = 0.029$, $p = 0.01$, $p = 0.01$, $p = 0.042$ and $p = 0.002$, respectively). The operation for low type ARM using local tissue flap, such as YV and cutback anoplasty, had low complications. More complicated operations were performed for higher type ARM. The higher the complication rate, the higher the post-operative rectal stricture. Routine rectal dilatation by parents seemed to prevent rectal strictures ($p = 0.056$). The surgical treatments for rectal strictures composed of 57.5% anoplasty, 17.5% PSARP, 15% abdo-assisted pull-through and 10% abdo-assisted PSARP.

Conclusion: Post-operative rectal stricture occurred because of complications following complicated operations for high type ARM. A meticulous operative technique is crucial.

Keywords: Stricture; stenosis; complication; anorectal malformation; ARM (Siriraj Med J 2023; 75: 513-521)

INTRODUCTION

Postoperative stricture of the rectum is a serious complication following operation for anorectal malformations (ARM). The prevalence of postoperative stricture ranges from 3%-35%.[1-4]

Stricture of the neo-rectum is caused by many factors, such as:

1. Rectum devascularization during mobilization of the rectum[3] caused dehiscence, retraction and serious infection.

2. Types of surgery. Each operation for anorectal malformations has different rates of stricture. Anal transposition[5] has a 11% stricture rate, whereas posterior sagittal anorectoplasty (PSARP), which is the standard operation[6,7] performed for non-low types anorectal malformation, have a 6% stricture rate.[4] Meanwhile, internal sphincter-saving posterior sagittal anorectoplasty (ISSA) has a 30% chance of severe rectal stricture.[4]

3. Type of anorectal malformation. Even within the same type of operation, such as posterior sagittal anorectoplasty, the rates of rectal strictures are different. Rectal strictures are more common in recto-bulbar urethral fistula, recto-bladder neck fistula, and cloacal malformation.[2]

4. Non-strict adherence to rectal dilatation protocols.[1,3,8]

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Two weeks after surgical treatment for anorectal malformation, dilatation of the reconstructed anus with a Hegar dilator is commenced. *Peña A*.[6-8] a world authority on anorectal malformations, recommends dilation of the anus with a series of Hegar dilators following the protocol.[1] *Peña A*. believes that rectal strictures are caused by non-strict adherence to the rectal dilatation protocol.[1] However, a study reported that daily dilatation of the rectum is not necessary, but rectum size could be calibrated every week by the surgeon.[9]

Post-operative dilatation is routinely done to avoid rectal stricture. The initial remedy of rectal stricture is treatment by dilating the rectum. If treatment by dilating the rectum does not improve symptoms, subsequent treatment is an operation. The method to correct these rectal strictures include redo-anoplasty, redo-PSARP, redo pull-through, etc.[3,4] Rectal stricture is cited in up to 40% of children who require re-operation for anorectal malformations or Hirschsprung's disease.[1,3]

In this study, rectal stricture was defined as: 1) patients who underwent any type of surgical correction as a result of rectal stricture following surgical treatment for anorectal malformations, or 2) severely constipated patients due to a rectal stricture, resulting in a megacolon which required a subsequent megacolon resection.

The purpose of this study was to determine factors affecting rectal stricture after surgical treatments for anorectal malformation. These factors included complications following surgery such as dehiscence, retraction, wound infection, type of anorectal malformation, type of surgery, and the practice of dilating the anus according to the protocol.[8] Moreover, this study also elucidates on surgical treatments for rectal stricture. When factors affecting rectal strictures are clarified, it can be reduced or prevented.

MATERIALS AND METHODS

Following approval from the Siriraj Institutional Review Board, (COA. No Si 377/2020), a retrospective study was conducted in children with anorectal malformations who underwent surgical corrections for anorectal malformations at Siriraj Hospital between January 2003 and December 2019, regardless of the hospital where the patient had a colostomy. Children with cloacal exstrophy, Hirschsprungs's disease, major chromosomal anomalies incompatible with life, incomplete medical records, and those who failed to follow-up at Siriraj Hospital were excluded from this study.

Demographic data, presence of colostomy, type of ARM and operation, operative records, post-operative complications, the practice of dilating the anus according to the protocol, and operative treatments for stricture correction were analyzed. Types of ARM and operation were compared between those with rectal strictures and those without stricture. Complications including wound infection, wound dehiscence, wound retraction, colonic necrosis, recurrent fistula, mucosal prolapse and anastomosis leakage, were also compared between those with rectal strictures and those without stricture. The practice of anal dilatation according to the protocol by parents was recorded and compared. Operative treatments for rectal stricture correction were analyzed. A Chi square test or Fisher's exact test was used to compare proportions between the groups for qualitative evaluation, including type of anorectal malformation, type of surgical treatment, complications such as dehiscence, retraction, infection, etc. Data was analyzed using the PASW Statistics program (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 as number and percentage. All data was analyzed in two-way and a p-value of <0.05 indicated statistical significance.

RESULTS

Between January 2003 and December 2019, 204 patients with anorectal malformations underwent surgical correction at the Division of Pediatric Surgery, Department of Surgery, Siriraj Hospital, Mahidol University, Thailand. Demographic data of all patients was compared, and the results of those without post-operative stricture and those with post-operative stricture are shown in Table 1.

In this study, the definition of rectal stricture was either: 1) patients who underwent any form of surgical correction as a result of rectal stricture or 2) severely constipated patients with a megacolon and subsequent megacolon resection.

One hundred and twenty-eight patients (62.7%) were male and 76 patients (37.3%) were female. Gender had no impact on post-operative stricture ($p = 0.609$). The median age at surgery for anorectal malformation in those without rectal stricture and those with rectal stricture was 3.9 months and 7.5 months, respectively ($p < 0.008$).

Overall, the prevalence of post-operative rectal stricture was 19.6% (40/204). The prevalence of post-operative stricture in each type of anorectal malformation is demonstrated in Table 2. Each type of ARM has a different stricture formation rate. Higher types of anorectal malformation have higher rectal stricture rates. In low type anorectal malformations, stricture formation following surgery for perineal fistula, and vestibular fistula occurred in 4.1% and 14.7% of patients, respectively. In high type

TABLE 1. Demographic data of all patients comparing between those without post-operative stricture and those with post-operative stricture was shown.

Characteristics	Non - stricture (n = 164)	Stricture (n = 40)	Total (n = 204)	P - valve
Gender, n (%)				
Male	101 (61.6%)	27 (67.5%)	128 (62.7%)	0.609
Female	63 (38.4%)	13 (32.5%)	76 (37.3%)	
Age at definite operation (months); median ± IQR	3.9 ± 8.1	7.5 ± 6.3	4.6 ± 8.8	0.008
Age at follow up (years); median ± IQR	4.2 ± 4.9	5.6 ± 4.7	4.5 ± 4.9	0.054
Duration of treatment(months); median ± IQR	67.6 ± 54.8	50.1 ± 54.6	54.0 ± 55.4	0.054

TABLE 2. Prevalence of post-operative stricture in each type of anorectal malformation.

Types of anorectal malformation	Total N = 204	Stricture n (%)
Perineal Fistula	49	2 (4.1%)
Vestibular Fistula	34	5 (14.7%)
Imperforate Anus Without Fistula	31	0 (0%)
Recto-bulbar Urethral Fistula	26	5 (19.2%)
Recto-prostatic Urethral Fistula	30	8 (26.7%)
Recto-bladder Neck Fistula	17	12 (70.6%)
Persistent Cloaca < 3 Cm	15	6 (40.0%)
Persistent Cloaca ≥ 3 Cm	1	1 (100.0%)
Rectal Atresia	1	1 (100.0%)

anorectal malformations, recto-bladder neck fistula had a stricture rate of 70.6%. Meanwhile, persistent cloaca (>3 cm) and rectal atresia had a 100% rectal stricture rate. Anorectal malformations in these two groups, such as recto-bulbar urethral fistula and recto-prostatic urethral fistula, had stricture rates 19.2% and 26.7%, respectively.

A comparison of the type of anorectal malformations in those without and those with postoperative strictures of the rectum is shown in Table 3. Recto-bladder neck fistula had a statistically significant high percentage of strictures ($p < 0.001$). The types of anorectal malformation which had a statistically significant low percentage of stricture were perineal fistula ($P = 0.003$) and imperforated anus without fistula ($p = 0.006$). A higher ARM type meant more post-operative rectal strictures than the low type.

In non-low type anorectal malformations managed by colostomy, the rate of post-operative rectal strictures is revealed in Table 4. In this group, 129 patients underwent colostomy, with the most common type being loop colostomy (123/129) (95.3%). Divided colostomy was also performed in five patients (3.9%) and other types of colostomy in 0.8% of patients. Sigmoid colostomy is the preferred type and was performed in 120/129 (93%) patients. However, colostomy was performed as an initial operation for non-low type anorectal malformation only. Patients who had undergone a colostomy had

TABLE 3. Types of anorectal malformation: comparison between those without and with postoperative stricture of the rectum.

Types of Anorectal malformation	Non - stricture (n = 164)	Stricture (n = 40)	Total (n = 204)	P - valve
Perineal Fistula	47 (28.7%)	2 (5%)	49 (24%)	0.003
Vestibular Fistula	29 (17.7%)	5 (12.5%)	34 (16.7%)	0.581
Imperforated Anus Without Fistula	31 (18.9%)	0 (0)	31 (15.2%)	0.006
Recto-bulbar Urethral Fistula	21 (12.8%)	5 (12.5%)	26 (12.7%)	1
Recto-prostatic Urethral Fistula	22 (13.4%)	8 (20.0%)	30 (14.7%)	0.421
Recto-bladder Neck Fistula	5 (3%)	12 (30%)	17 (8.3%)	<0.001
Persistent Cloaca < 3 Cm	9 (5.5%)	6 (15%)	15 (7.4%)	0.082
Persistent Cloaca ≥ 3 Cm	0	1 (2.5%)	1 (0.5%)	0.443
Rectal Atresia	0	1 (2.5%)	1 (0.5%)	0.443

TABLE 4. Post-operative rectal stricture in non-low type anorectal malformations patients managed by colostomy before, were revealed.

Operation type	Non-stricture (n=164)	Stricture (n=40)	Total (n=204)	P - value
Colostomy	96 (58.5%)	33 (82.5%)	129 (63.2)	0.008
Non colostomy	68 (41.5%)	7 (17.5%)	75 (36.8)	

more rectal stricture formation than one who had never had a colostomy (82.5% vs 17.5%), and this result had a statistically significant difference. (p = 0.008).

The type of operative treatment for anorectal malformation, and a comparison between those without and those with postoperative strictures of the rectum are shown in Table 5. Each operative technique had a different incidence of stricture. Posterior sagittal anorectoplasty (PSARP), which was the most common procedure, had a stricture rate of 18.5% (15/81 patients) whereas, abdominal assisted PSARP and posterior sagittal anorectovaginourethroplasty (PSAVUP) had a rectal stricture incidence of 55.6% (10/18 patients) and 50% (7/14) patients, respectively. The procedure for high or complex anorectal malformation, such as abdominal assisted PSARP and PSARVUP, had a high rate of rectal stricture with significant statistical difference (P < 0.001 and P = 0.009, respectively). The operations for low type anorectal malformation, which used local tissue flaps such as YV anoplasty and cutback anoplasty, had low incidences of rectal stricture (0% and 5% (1/20)), respectively. Using statistical analysis, this difference between those without and those with strictures in YV anoplasty and cutback anoplasty had a p-value of 0.025 and 0.151, respectively. Anal transposition which complete mobilization of rectum into the proper position had to be performed, had rectal stricture in 6/37 (16.2%) and p value was 0.730.

Comparison of post-operative complications between the group without and with post-operative strictures is shown in Table 6. All complications such as wound infection, wound dehiscence, wound retraction, colonic necrosis and recurrent fistula affected post-operative stricture (p = 0.029, p = 0.01, p = 0.01, p = 0.042 and p = 0.002, respectively).

Complications following an operation, including wound infection, wound dehiscence, wound retraction, colonic necrosis, recurrent fistula, were compared for the type of operation and the results are shown in Table 7. The operations for low type anorectal malformation, which

TABLE 5. Types of operative treatment for anorectal malformation: comparison between those without and those with postoperative stricture of the rectum were demonstrated.

Operation type	Non-stricture (n=164)	Stricture (n=40)	Total (n=204)	P - value
YV anoplasty	23 (14%)	0	23 (11.3%)	0.025
Cutback anoplasty	19 (11.6%)	1 (2.5%)	20 (9.8%)	0.151
Anal transposition	31 (18.9%)	6 (15%)	37 (18.1%)	0.730
Mini-PSARP	3 (1.8%)	0	3 (1.5%)	0.897
PSARP	69 (42.1%)	15 (37.5%)	81 (41.2%)	0.728
Abd assist PSARP	8 (4.9%)	10 (25%)	18 (8.8%)	<0.001
Lap assist PSARP	3 (1.8%)	1 (2.5%)	4 (2.0%)	1.000
PSARVUP	7 (4.3%)	7 (17.5%)	14 (6.9%)	0.009

TABLE 6. Comparison of post-operative complications between groups with and without post-operative stricture.

Complication	Non-stricture (n=164)	Stricture (n=40)	Total (n=204)	P - valve
Wound infection	14 (8.5%)	9 (22.5%)	23	0.029
Wound dehiscence	5 (3.0%)	10 (0.3%)	15	0.01
Retraction	2 (4.2%)	8 (0.3%)	10	0.01
Colonic necrosis	0	2 (0.1%)	2	0.042
Recurrent fistula	0	4 (0.1%)	4	0.002
Mucosal prolapse	29 (17.6%)	11 (0.3%)	40	0.362

TABLE 7. Complications following definite operations including wound infection, wound dehiscence, wound retraction, colonic necrosis, recurrent fistula, were compared among the types of the operation.

Operation	n	Wound infection	Wound dehiscence	Wound retraction	Colonic necrosis	Recurrent fistula
YV anoplasty	23	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Cutback anoplasty	20	0 (0%)	1 (5.0%)	0 (0%)	0 (0%)	0 (0%)
Anal transposition	37	2 (5.4%)	0 (0%)	3 (8.1%)	0(0%)	1 (2.7%)
PSARP	85	9 (10.6%)	2 (2.4%)	3 (3.6%)	0 (0%)	1 (1.2%)
Abd assist PSARP	18	1 (5.6%)	4 (22.2%)	1 (5.6%)	0 (0%)	0 (0%)
PSARVUP	14	4 (28.6%)	3 (21.4%)	(14.3%)	2 (14.3%)	1 (7.1%)

used local tissue flap transfer such as YV anoplasty and cutback anoplasty, had a very low incidence of complication. Anal transposition, which was mostly used for vestibular anus and required mobilization of the rectum into a new position in the center of the sphincter of the anus, had a higher incidence of wound retraction (8.1%) and recurrence of fistula (2.7%) than any other procedure for low type anorectal malformation. Complications following PSARP included wound infection in 10.6% of cases, wound dehiscence in 2.4% of cases, and recurrent fistula in 1.2% of cases. Abdominal assisted PSARP had more complications than PSARP, with wound infection in 5.6% of cases, wound dehiscence in 22.2% of cases, and retraction in 5.6% of cases. PSARVUP had the highest rate of complications overall.

After surgical correction for anorectal malformation, postoperative dilatation was performed to prevent rectal stricture. Routine rectal dilatation by parents was done in 160 patients. A comparison of rectal dilatations according to the protocol[1] in those with and without post-operative strictures are shown in Table 8. Rectal strictures were observed in 28/160 (17.5%) of all cases. Routine rectal dilatation by parents seems to prevent rectal strictures, but the incidence between these two groups has no statistical significant difference ($p = 0.056$). Patients with rectal strictures required a prolonged duration of rectal dilatation and higher frequency of rectal dilatations under general anesthesia than those without strictures ($p = 0.123$ and $p < 0.001$ respectively).

The surgical treatments for rectal stricture in this series composed of anoplasty in 23 patients (57.5%), PSARP in seven patients (17.5%), abdominal assisted pull-through in six patients (15%), and abdominal assisted PSARP in four patients (10%). The mean length of stay of these reoperations was 13 days.

DISCUSSION

Among post-operative complications in cases of anorectal malformation, rectal stricture is a serious complication. A wide variety of studies have reported its prevalence, depending on the type of surgery[3], and type of anorectal malformation. The prevalence of post-operative stricture ranges from 3%-35%.[1-4] Overall, the prevalence of post-operative rectal stricture in our series was 19.6% (40/204).

The cause of rectal strictures can be attributed to the following factors:

1. Complications following treatment for anorectal malformation. Devascularization of the rectum during mobilization of the rectum[3] causes dehiscence and retraction. This problem is caused by improper rectum mobilization. Ischemia of the rectum and excessive tension between the rectum and the skin can also cause rectal strictures.[1,3] The rectum normally has a good intramural blood supply, however, during mobilization of the rectum, in order to obtain an adequate length of rectum for anastomosis, the surgeon can cut the fascia located posterior to the rectum. It is important to dissect close to the rectum wall. If the rectum is injured during dissection, it will lack of intramural blood supply, leading to stricture of the rectum.[8] An operation performed in younger age of patient might cause hypothermia which could probably affect post-operative surgical complications similar to adult's anorectal operations.[10] However, the effect of hypothermia was not examined in this study. In our study, the median age at surgery for anorectal malformation in those with rectal stricture was 7.5 months whereas in those without rectal stricture was 3.9 months, but the result probably more depended on the type of anorectal malformation and different operative procedures than hypothermia.

Our study confirmed that complications such as wound infection, wound dehiscence, wound retraction, colonic necrosis and recurrent fistula all affect post-operative strictures ($p = 0.029$, $p = 0.01$, $p = 0.01$, $p = 0.042$ and $p = 0.002$, respectively). The operations for low type anorectal malformations, which use local tissue flap such

TABLE 8. Comparison of rectal dilatation according to Protocol1 between those with and without post-operative stricture.

	Non-stricture	Stricture	P - value
Anal dilatation by parent	132 (81.5%)	28 (66.7%)	0.056
Duration of dilatation (months): median ± IQR	18.8 ± 24.8	34.4 ± 39.7	0.123
Frequency of rectal dilatation under GA: median ± IQR	1 ± 0	3 ± 3	< 0.001

as YV anoplasty and cutback anoplasty, have a very low incidence of complications. Anal transposition, which is mostly used for vestibular anus and requires mobilization of the rectum into a new position at the center of the sphincter of the anus[5], has a higher incidence of wound retractions (8.1%) and recurrence of fistula (2.7%). A colostomy prior to anal transposition has the benefit of reduced complications.[9] Moreover, colostomy prior to anal transpositions can reduce recurrent fistula and rectal strictures.[9] The incidence of recurrent fistula and rectal strictures when comparing between patients with a colostomy and those without a colostomy were 0% vs 9.1%, and 5.6% vs 18.2%, respectively.[9] Complications following PSARP included wound infection in 10.6% of cases, wound dehiscence in 2.4% of cases, retraction in 3.6% of cases, and a recurrent fistula in 1.2% of all cases. Abdominal assisted PSARP had more complications than PSARP, including wound infections in 5.6% of cases, wound dehiscence in 22.2% cases, and retractions in 5.6% of all cases. PSARVUP had the highest number of complications. More complicated operations were performed mostly for high type anorectal malformations. The more complicated the operation, the higher the complication rate, and the higher the complication rate, the higher post-operative rectal stricture.

2. Types of anorectal malformation. The different types of ARM have different stricture formation rates. In our series, the higher type anorectal malformation had the highest rectal stricture rate. In low type anorectal malformations, stricture formation following perineal fistula, vestibular fistula occurred in 4.1% and 14.7% of all cases, respectively. The types of anorectal malformations, which had statistically lower percentages of stricture were perineal fistula ($P = 0.003$) and imperforated anus without fistula ($p = 0.006$). In high type anorectal malformations, such as rectobladder neck fistula, the stricture rate was 70.6% ($p < 0.001$). Intermediate type anorectal malformations, such as rectobulbar urethral fistulas, had a stricture prevalence of 19.2%. Each type of anorectal malformation required a different surgical technique to repair, which was main reason why the stricture rates were so different. Even in the same technique, the difficulty to mobilize the rectum is a factor affecting rectal strictures. In a reported series[2], even with the same posterior sagittal anorectoplasty, the rate of rectal stricture was different. Rectal strictures were found to be more common in rectobulbar urethral fistula, rectobladder neck fistula, cloacal malformation.[2]

3. Type of operative treatment for anorectal malformation. Each operative technique has a different incidence of strictures. Posterior sagittal anorectoplasty (PSARP) is the most common procedure worldwide. This operation cuts the muscle complex in the sagittal line and divides both the anterior and posterior striated muscle complex to create a new anus and brings it into the center of the sphincter and sutures these muscle complexes (both anterior and posterior sphincter) back into the new normal position.[6,7] In our study, PSARP had a stricture rate of 15/81 (18.5%), which was higher than reported in a series by *Holbrook C*[4] which revealed a stricture rate of 6%. Posterior sagittal anorectoplasty was further developed into a new technique named "internal sphincter-saving posterior sagittal anorectoplasty".[4,11] This technique proposed the neo-anus be surgically inserted into the middle of the sphincter without cutting the muscle complex, and using a penetration in the middle of the sphincter instead, called the Internal Sphincter Sparing Approach (ISSA).[4,11] However this new technique had a 30% chance of severe rectal strictures. When laparoscopic pull-through in conjunction with the Internal Sphincter Sparing Approach (ISSA) was done, the stricture rate increased to 50%.[4]

The operative procedure for high or complex anorectal malformations such as abdominal assisted PSARP and PSAVUP had a high rate of rectal strictures with significant statistical difference ($P < 0.001$ and $P = 0.009$, respectively). This high rectal stricture could be the effect of high complication rates. The operation for low type anorectal malformation which use local tissue flap, such as YV anoplasty and cutback anoplasty, had a incidence of rectal strictures (0% and 1/20 (5%), respectively). Anoplasty in the reported series had stricture rate of 11%.[4]

4. Non-strict adherence to rectal dilatation protocols.[1,3,8] *Peña A*, a world authority, believes that rectal strictures are caused by non-dilatation of the anus when following his protocol.[1] Two weeks following surgical treatment of anorectal malformations, dilatation of the reconstructed anus with a Hegar dilator begins. The world authority, *Peña A*.[8] recommends dilation of the anus with a Hegar dilator. For the first dilatation, Hegar dilated the anus tightly. The dilation of the anus was done by parents twice a day. Then, the size of the Hegar dilator was increased by one number each week. The goal of rectal enlargement was relative to the patient's age. The goals for age 1-4 months, 4-12 months and 8-12 months were Hegar dilator number 12, 13, 14, respectively. The goals for ages 1-3 years, 3-12 years and >12 years were a Hegar dilator number of 15, 16, 17, respectively. When dilating the anus reached the goal, it could reduce the frequency of rectal dilatation. This could be reduced to once a day for a month, then every three days for another month,

then twice a week for a month, once a week for another month, and finally once a month. When the patient gets older, the size of the Hegar dilator must increase.

However, some reported series state that dilatation of the rectum by parents was not necessary on an everyday basis, but that it could be calibrated every week by a doctor[12] and the results were not so different. The limitation of this reported study was the small number of patients, as only 65 patients received routine dilatation by parents compared to 30 patients who underwent weekly calibration by surgeons.[12]

A survey of parental behavior in rectal dilatation was conducted in the Federal Republic of Germany.[2] Only 30% of patients strictly followed twice-daily rectal dilatations. In addition, half of the patients got rectal dilatation with a Hegar dilator smaller than the recommended size.[2] In Germany, only about 25% of patients achieved the full recommendation of dilatation of the rectum as per the protocol.[2] In Thailand, there has never been a survey of parental behavior of anal dilatation before.

In our series, 129 patients underwent colostomy. Those with a colostomy had more rectal stricture formation than those who had no colostomy before (82.5% vs 17.5%), with a statistically significant difference ($p = 0.008$). However, colostomy was selected to be performed as an initial operation for non-low type anorectal malformations only. Vestibular fistula was the unique type of anorectal malformation, whether it is regarded as a low or non-low type anorectal malformation. A previous study at Siriraj Hospital reported that colostomy prior to anal transposition could reduce the recurrent fistula and rectal stricture.[9] Besides the vestibular fistula, it could not conclude whether pre-operative colostomy prevented rectal stricture formation due to different populations.

After surgical correction for anorectal malformation, postoperative dilatation was performed to prevent rectal strictures. Routine rectal dilatations by parents was done in 160 patients and rectal stricture was found in 28/160 (17.5%) cases. Routine rectal dilatation by parents seemed to prevent rectal strictures ($p = 0.056$).

The initial remedy for post-operative stricture was treatment by dilating the rectum under general anesthesia. However, it has been argued that general anesthesia followed by forceful dilatation may result in more severe scarring from dilatation.[1] Prolonged rectal dilatation treatment even with general anesthesia may not be the most effective treatment for rectal stricture and 50%-87% of cases still require surgical correction for rectal stricture.[2,4] When treatment by dilating the anus under general anesthesia does not improve the symptoms, the subsequent treatment was surgical treatment. Redo-anoplasty, redo-PSARP, redo pull-through have also been described.[3,4] The surgical treatments for rectal stricture in our series composed of 23 (57.5%) cases of anoplasty, 7 (17.5%) cases of PSARP, 6 (15%) cases of abdominal assisted pull-through and 4 (10%) cases of abdominal assisted PSARP. Some strictures might occur at superficial level which may be corrected with anoplasty. There are several anoplasty techniques to correct anal stenosis, including YV anoplasty[13], Nixon anoplasty, and Heineke-Mikulicz anoplasty.[1] Our study did not have the number of patients required with rectal stricture to determine which surgical techniques would provide the best results. Twenty-six percent of patients who had anoplasty correcting the rectal stricture, still experienced rectal stricture, and another anoplasty was required, while many other patients required megarectum resection.

Our study did have some limitations.

First, the definition of rectal stricture following surgical treatment for anorectal malformation in our study might be different from other studies. In our series, rectal stricture included only patients who had undergone any surgical corrections as a result of rectal stricture following surgical treatment for anorectal malformation.

Second, it had a retrospective design which meant some information may be missing.

Third, the types of operation depended on each surgeon's preference.

Fourth, 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.

CONCLUSION

The higher types of ARM have higher rectal stricture rates. Complications such as wound infection, dehiscence, retraction, colonic necrosis and recurrent fistula all affected the post-operative stricture ($p = 0.029$, $p = 0.01$, $p = 0.01$, $p = 0.042$ and $p = 0.002$ respectively). More complicated operations were mostly performed for higher type ARM. The higher the complication rate, the higher the post-operative rectal stricture rate. Routine rectal dilatation following *Peña A's* protocol by parents seemed to prevent rectal strictures ($p = 0.056$). Post-operative rectal stricture occurred because of complications following complicated operations for high type ARM. Meticulous operative technique was crucial.

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