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ORIGINAL SCIENTIFIC REPORT

Taeniectomy Versus Transverse Coloplasty as Neorectum After Low Rectal Resection

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Abstract

Purpose Restorative surgery for rectal cancer is usually criticized by its functional outcomes. The aim of this study is to assess the efficacy "taeniectomy" pouch in comparison with transverse coloplasty pouch.

Study design This was a prospective controlled study. Most patients who were candidate for low rectal resection presented to colorectal unit at Cairo university hospitals during the period from February 2013 to August 2016 were divided into two groups. The total number of patients enrolled in the study was 180 patients. Ninety patients were subjected to low rectal resection with the transverse coloplasty pouch, and 90 patients were subjected to low rectal resection with the newly described taeniectomy pouch. Safety and feasibility of both techniques were assessed about leakage, operative time, difficulty in evacuation, incontinence, number of daily motions and postoperative urgency. Both groups were assessed clinically, by means of defecography and anorectal manometry.

Results There was no significant statistical difference between taeniectomy and transverse coloplasty regarding postoperative leakage (P value = 0.988), postoperative mortality (P value = 0.99) and functional outcomes including number of motions per day (P value was 0.403 at 3 months and 0.361 at 12 months), urgency (P value was 0.688), continence grade (P value was 0.320 and 0.683 in 3 and 12 months, respectively) and manometric findings. However, taeniectomy is statistically significant better in terms of operative time (P value = 0.001).

Conclusions Taeniectomy is a newly described, technically easier technique for pouch formation after low rectal resection that can be used as a safe and effective alternative for the widely used transverse coloplasty.

Introduction

Restorative surgery for rectal cancer is criticized by concerns about the functional outcomes as incontinence and high stool frequency, especially when ultra-low colorectal anastomoses are required [1, 2]. After Park and colleagues introduced their ileal J-pouch–anal anastomosis in 1978 [3], Lazorthes et al. [4] described colonic pouch anastomosis.

Although colonic J-pouch anastomosis can overcome some of the functional problems of the straight colo-anal anastomosis, it is technically difficult and the pouch cannot be evacuated easily [5]. Later on, transverse coloplasty has been developed to avoid some of drawbacks of J-pouch [6, 7].

More recently, a sutureless technique has been described by Farag et al. [8] in 2016 to avoid unfavorable functional effects of J-pouch and coloplasty "taeniectomy". The newly described taeniectomy pouch is performed by excision of 20 cm of the antimesenteric tenia coli aiming at increasing the volume of the remaining colon [8]. The expected benefits of taeniectomy in comparison with the already described pouches are mainly the absence of

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anastomosis and sutures. Theoretically, this may decrease the operative time, incidence of leakage and the overall cost [8].

Aim of work

In this study, the "taeniectomy pouch" was compared to the transverse coloplasty after low anterior rectal resection of the rectum. Functional outcomes of both techniques were compared about frequency of bowel motions, urgency, incontinence and difficulty of evacuation.

Patients and methods

Type of study

This was a prospective comparative clinical study. Patients who were candidate for low anterior rectal resection presented to colorectal unit at Cairo university hospitals during the period from February 2013 to August 2016 were divided into two groups. The total number of patients enrolled in the study was 180 patients. Ninety patients were subjected to low rectal resection with the transverse coloplasty pouch, and 90 patients were subjected to low rectal resection with the newly described taeniectomy pouch. The taeniectomy arm runs in the period from February 2013 to February 2015, and then the transverse coloplasty arm runs in the period from March 2015 to August 2016. Follow-up completed on September 2017. All cases are done by a single surgeon.

Information and consent

All patients signed a written informed consent for the operation with different pouches. The study was approved by the Research Ethics Committee of Cairo University. It ended up with 180 patients in which 90 patients were subjected to low anterior resection with the traditional transverse coloplasty pouch (68 laparoscopic and 22 open surgeries) and 90 patients were subjected to low anterior resection with the newly described taeniectomy pouch (70 laparoscopic and 20 open surgeries).

Population of study and sample

Inclusion criteria

Any patient who was candidate for low anterior resection (LAR) could be included in that study, with no age or gender specifications. All cancers in both groups were rectal cancers, i.e., 4 to 15 cm from the anal verge.

Exclusion criteria

1. Patients with irresectable cancers were excluded from the study.
2. Patients with R1 or R2 resections were excluded from the study.
3. Patients with poor-quality TME (total mesorectal excision) or breached circumferential tumor margins CME were excluded from the study.
4. Patients with ASA grade more than 3, i.e., we exclude all the factors which may lead to undesirable postoperative events that may affect the results.

Endpoints (outcome parameters) and how obtained

Primary endpoints were comparison between both techniques regarding operative time, leakage rate and postoperative mortality.

Secondary endpoints were comparison between both techniques regarding functional outcomes including daily frequency of motions, presence of urgency and Wexner score of continence [9]. These were obtained at three and 12 months postrestoration of bowel continuity. We usually restore bowel continuity after 3 months of the resection. Intra-pouch and anal pressures were obtained by manometry 6 months after restoration of bowel continuity. Defecography was done to assess any difficulty in evacuation. Manometry and defecography were done for all patients.

Surgical technique

The standard rectal dissection including high ligation of the inferior mesenteric vessels with preservation of the autonomic nervous plexus, total mesorectal excision and mobilization of the splenic flexure was performed in both groups. A double-stapled technique was performed using GIA straight stapler for resection followed by circular GI stapler for colo-anal anastomosis the pouches then were constructed with descending colon, and for both it was fashioned starting 4 cm from the distal cut end. The level of anastomosis in all cases was about 4 to 6 cm from the anal verge as the whole rectum was resected. We use circular staplers of diameter 29 or 31 mm according to the availability and diameter of the colon.

Technique of transverse coloplasty

After completion of low anterior resection, the full thickness of the colon was incised 4 cm proximal to its distal cut end. The incision was fashioned in longitudinal manner, 8 cm in length between the tenia coli on the antimesenteric

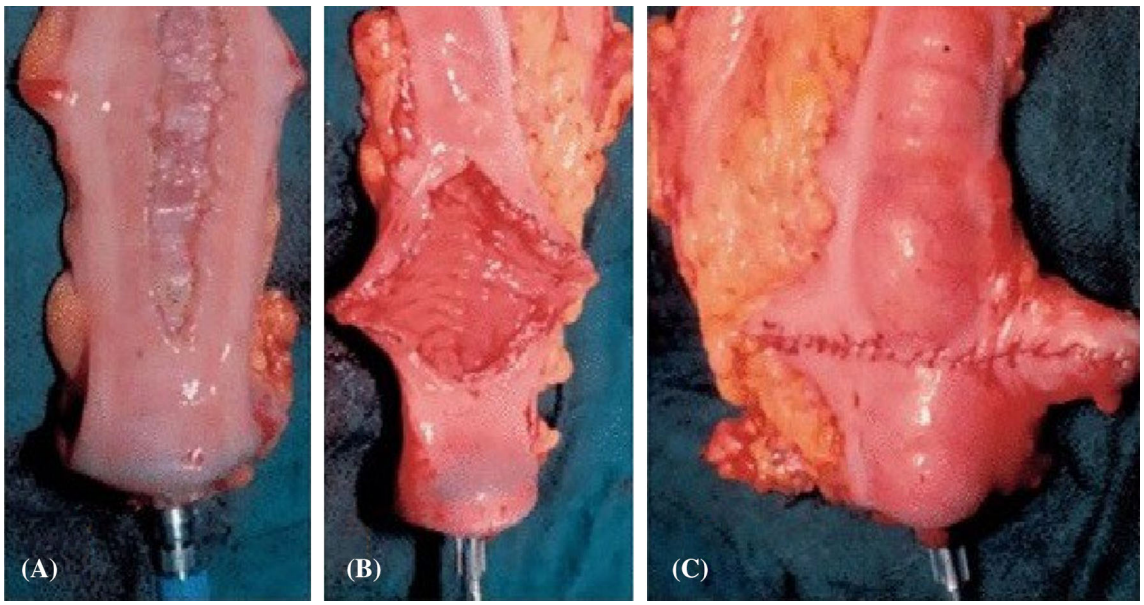

Fig. 1 Technique of coloplasty;**a** about 8 cm incision in the antimesentric border of left colon 4 cm from the cut edge,**b** the colon is opened in the full thickness manner,**c** closure of the incision in transverse manner forming the pouch

border. This incision was then closed transversely with a continuous single layer of seromuscular polyglactin 2/0 on a rounded tip needle. The coloplasty pouch is then anastomosed to the anorectal stump by circular stapler, with the coloplasty facing anteriorly (Fig. 1). Integrity of the anastomosis and the neorectum was checked by injecting methylene blue dye through the anal canal.

Technique of taeniectomy

Four centimeters proximal to the distal cut end of the colon, the antimesenteric tenia coli was identified. The submucosal plane of the chosen teniae coli was infiltrated with 20 ml of adrenaline in saline solution (1:100,000) for 20 cm (Fig. 2).

Dissection of the antimesenteric tenia from the submucosal plane was done using scissors for 20 cm. Careful dissection prevents breaching the submucosa and leaving it intact (Fig 3).

The integrity of the mucosa was confirmed by visually inspecting the mucosa from outside, during gentle finger palpation from inside and by injecting 100 ml of methylene blue-colored saline into the pouch (Fig. 4).

The pouch was then anastomosed to the distal anorectal stump end by circular stapler. Integrity of the anastomosis was checked using methylene blue dye.

After completion of both techniques, diverting loop ileostomy was fashioned, and this was reversed 3 months later or after completion of postoperative chemoradiotherapy after checking the integrity of the distal anastomosis by Gastrograffin enema.

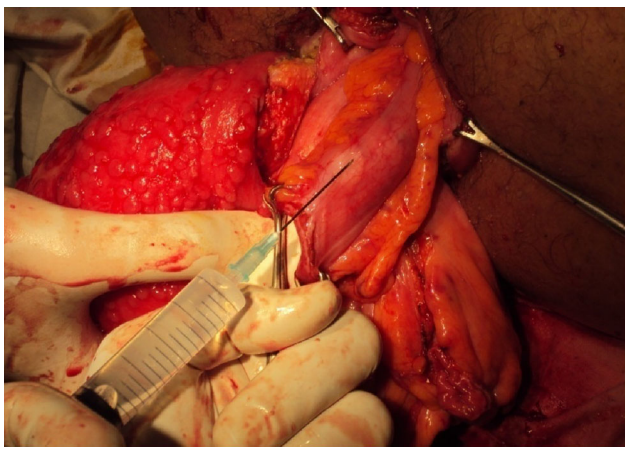

Fig. 2 Infiltration of the subserosal plane with diluted adrenaline

Statistical analysis

Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student t test for independent samples. For comparing categorical data, Chi-square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows.

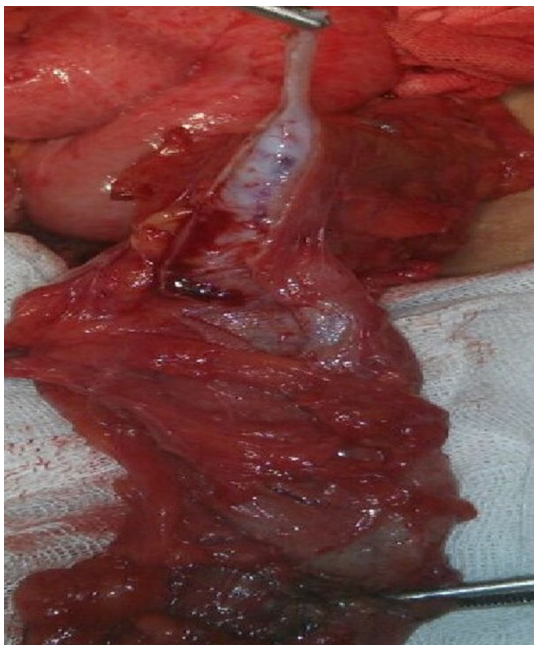

Fig. 3 Dissection of the antimesenteric tenia coli for pouch creation

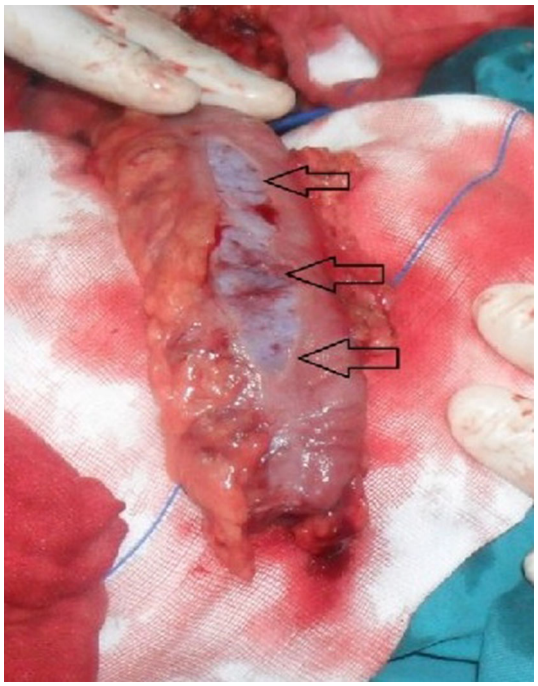

Fig. 4 Checking mucosal integrity after taeniectomy with injection of diluted methylene blue. Arrows point to the taeniectomized segment of the colon

Results

Hundred and twenty patients were included in this study; all of them were candidate for low anterior resection of the rectum. Transverse coloplasty group included 90, and taeniectomy group also included 90 patients.

Patients' characteristics

1. Demographic distribution
   There was no significant statistical difference between the two groups regarding the age, as shown in Table 1.
2. Sex distribution
   Table 1 shows sex distribution between both groups. There was no significant statistical difference between both groups.
3. Body mass index (BMI)
   Also, Table 1 demonstrates the mean BMI in both groups; there was no significant statistical difference between both groups.
4. ASA grade
   All patients from both groups were ASA grade 1–3 as we excluded ASA > 3, mean = 2, and Table 1 shows the difference between both groups with no significant statistical difference.

Tumor characteristics

1. Patients who received preoperative neo-adjuvant radiochemotherapy
   Table 2 shows patients received neo-adjuvant chemoradiotherapy in the both groups; there was no significant statistical different significance.
2. Patients who received postoperative adjuvant therapy
   Also, there was no statistically significant difference between both groups regarding the patients who received adjuvant therapy, as shown in Table 2.
3. Height of the tumors
   Table 2 shows the mean of the height of the tumors in both groups; there was no statistically significant difference.
4. Level of anastomosis in both groups
   Table 2 illustrates the mean of the level of anastomosis in both groups; there was no statistically significant difference between both groups.
5. Diameter of the stapler used
   Table 2 shows the staplers used in both groups. However, we used either 29- or 31-mm-diameter stapler in all patients from both groups.

Operative time

There was no significant statistical difference between the two groups regarding the operative time as shown in Table 3.

Table 1 Comparison between the two groups regarding patient characteristics

	Transverse coloplasty (n = 90)	Taeniectomy (n = 90)	P value
Age (years)			
Mean	51.33	49.6	0.216
SD	8.9	9.8	
Male gender	70 (77%)	66(73%)	0.488
BMI	Mean = 29.3 kg/m^2	Mean = 28.8 kg/m2	0.091
	SD = 1.5	SD= 1.7	
ASA	ASA 1….33 patients, ASA 2…30, ASA 3… 27	ASA 1…30 patients, ASA 2…32, ASA 3..28	1.000

Table 2 Comparison between both groups regarding tumor characteristics

	Transverse coloplasty (n = 90)	Taeniectomy (n = 90)	P value
Preoperative neo-adjuvant therapy	59 (65%)	65 (72%)	0.334
Postoperative adjuvant therapy	71 (79%)	75 (83%)	0.446
Height of the tumors	Mean = 8.4 cm	Mean = 7 cm	0.063
	SD = 3.3	SD = 3.1	
Level of the anastomosis	Mean = 5.2 cm	Mean = 4.9 cm	0.056
	SD = 0.99	SD = 1.1	
29-mm-diameter staplers used	N = 72	N = 67	0.374

Postoperative mortality

There were two cases of postoperative mortality in taeniectomy group. First of which was a known cardiac 67-year-old male patient who died on the third day postoperatively with extensive myocardial infarction. The other was a 72-year-old woman who died on the ninth postoperative day from a massive pulmonary embolism. There was a single case of mortality in the transverse coloplasty group for a male patient 69-year-old who died also from massive myocardial infarction on day 2 postoperatively. Table 3 compares between both groups regarding postoperative mortality. There was no statistically significant difference between both groups, as shown in Table 3.

Postoperative leakage

There were three cases of leakage in taeniectomy group and four cases of leakage in transverse coloplasty. Most cases were treated conservatively by draining of the pelvic abscesses as all cases had proximal diverting ileostomy. Only one case of leakage in taeniectomy group required exploration and revealed a small opening in the anterior wall of the anastomotic line of the colo-anal anastomosis. Peritoneal lavage and diverting loop ileostomy were done with wide-pored drains inserted. The patient had a smooth postoperative recovery, the bowel continuity was restored 6 weeks later and the patient completed the follow-up.

In transverse coloplasty group, there was also a single case of leakage that requires surgical intervention and reoperation revealed complete disruption of the anastomosis. Reanastomosis was done counting on the diverting ileostomy with massive lavage and wide-pored drains inserted. The patient had a smooth postoperative recovery, and he completed the follow-up.

Comparing the two groups, there was no statistical difference between them about postoperative leakage. This is illustrated in Table 3.

Functional outcomes

There was 2 cases of mortality in the Taeniectomy group and a single case in transverse coloplasty group, this ends up into 88 patients in the Taeniectomy group and 89 in the Transverse coloplasty group who completed the follow up.

Number of motions per day

Table 3 compares between both groups regarding number of motions per day in 3 and 12 months. There was no statistically significant difference between both groups.

Table 3 Comparison functional outcomes of both techniques

	Transverse coloplasty (n = 90)		Taeniectomy (n = 90)		P value
Operative time (minutes)					0.112
Mean	131.67		117.33		
SD	20		13.3		
Post-op mortality					0.99
Number	1 (90)		2 (90)		
Percentage	1.1%		1.8%		
Post-op Leakage					0.988
Number	4 (89)		3 (88)		
Percentage	3.5%		2.6%		
Number of motions/day	3 months (n = 89)	12 months (n = 89)	3 months (n = 88)	12 months (n = 88)	0.403 at 3 months and 0.030 at 12 months
Mean	3.17	1.67	3.04	1.52	
SD	1.1	0.4	0.9	0.4	
Urgency					0.000
Number	3 (89)	3 (88)			
Percentage	3.3%	3.3%			

Degree of continence

Both groups were compared about continence at 3 and 12 months using Wexner scoring system, where 0 is perfect continence and 20 is complete incontinence. There was no significant difference between both groups. This is shown in Table 4.

Difficulty in evacuation

There was no difficulty in evacuation in both groups. All patients in both groups did not report the need of enemas or laxative for pouch evacuation. This was confirmed clinically and by complete evacuation on defecography.

Urgency

There was no significant difference about urge incontinence and inability to defer defecation for 15 min. Three patients in each group complained of urge for the first 3 months then improved markedly within one year (Table 3).

Manometric differences

Resting and squeeze pressures as well as threshold volume were recorded at 6 months' postrestoration of continuity using manometry. This is shown in Table 5.

As shown in Table 5, there were no significant differences between the two groups in resting and squeeze pressure.

Discussion

The major drawback of the straight colo-anal anastomosis is the loss of the reservoir functions of the rectum which may lead to evacuatory dysfunctions as incontinence and diarrhea affecting quality of life of those patients although some studies showed long-term improvement of these symptoms [2].

The concept of performing a colonic pouch–anal anastomosis after low anterior resection of the rectum was introduced by Lazorthes [4] and colleagues.

The colonic pouch has the advantage of decreasing frequency, urgency and incontinence in the early postoperative period. J-pouch showed less bowel movements per 24 h (3 months, 2.5 vs. 5.3; 1 year, 2.5 vs. 4.5; and 2 years, 2.0 vs. 3.6, respectively) when compared to straight colo-anal anastomosis [10].

Although J-pouch improves functional outcomes of patients with LAR, it has the drawback of difficulty in evacuation [11]. A coloplasty is similar to a pyloroplasty or stricturoplasty which functions through interrupting antegrade colonic peristalsis. It can be used when the pelvis is too narrow to permit a bulky colonic J-pouch–anal anastomosis [12].

Table 4 Continence by Wexner score

	Transverse coloplasty		Taeniectomy		
	3 months (n = 89)	12 months (n = 89)	3 months (n = 88)	12 months (n = 88)	P value
Continent grade (using Wexner score)					
Minimum	0	0	0	0	0.320 and 0.683 in 3 and 12 months, respectively
Maximum	8	5	9	5	
Mean	3.5	1.25	3.21	1.32	
SD	1.8	1.1	2	1.1	

Table 5 Comparison between both techniques regarding manometric findings

	Resting pressure (mmHg)	Squeeze pressure (mmHg)	Threshold volume (ml)
Transverse coloplasty	Min = 40	Min = 90.0	Min = 65
	Max = 65.1	Max = 152.4	Max = 143
	Mean = 50.5	Mean = 126.99	Mean = 108.17
	SD = 5.6	SD = 13.9	SD = 17.3
Taeniectomy	Min = 38.2	Min = 85.4	Min = 82
	Max = 67.2	Max = 165.2	Max = 160
	Mean = 51.63	Mean = 130.42	Mean = 118.68
	SD = 6.4	SD = 17.7	SD = 17.3
P value	0.156	0.163	0.117

Normal value: resting pressure 59–75 mmHg, squeeze pressure 90–160 mmHg, threshold volume 90–150 mL

According to Pimentel and colleagues, coloplasty and colonic J-pouch were statistically comparable regarding bowel function. However, anastomotic leaks in coloplasty patients were higher though statistical difference was not significant. Leakage was 13.2% in coloplasty and 6.6% in colonic J-pouch [13]. However, more recent studies showed that there is no statistically significant difference regarding anastomotic leak between both techniques [14].

The technique of taeniectomy was fully described in the patients and methods section. Also, in 2017, Farag et al. [8] published a case series study of taeniectomy pouch post-low anterior resection and described its functional outcomes.

In this study, we compared taeniectomy to the widely accepted transverse coloplasty regarding operative time, postoperative leakage and functional outcome.

Operative time

The mean operative time was 131.67 min for transverse coloplasty. This goes with Ho et al. [12] study with mean operative time 110 min for construction of transverse coloplasty and almost with a study done by Yik Hong [15] with a mean operative time of 110 min. In taeniectomy, mean operative time was less than that of transverse coloplasty—mean 117 min; however, it is comparable to transverse coloplasty statistically.

Mortality

In the current study, moralities in the transverse coloplasty group were 1 from 90 patients (1.11%). This goes with Pimentel et al. who conducted their study in 2003 with no mortalities [13]. On the other hand, in Yik Hong study, there was 7% mortality in transverse coloplasty [15]. In the Ho et al. study, mortality rate was 2.27% [12]. Mortality in taeniectomy group was 2 from 90 patients (1.8%) which is statistically comparable to the previous studies.

Leakage

Leakage rate in the concurrent study was 3.59% in transverse coloplasty group. This goes with a study conducted by Pimentel where the leakage rate was 6% [13]; Z'graggen and Büchler reported in a study, which included 41 patients with transverse coloplasty after low anterior resection, an anastomotic leakage rate of 7.3% (3/41 patients) [16]. In taeniectomy group, leakage was 2.46%.

Although numerically lower than that of transverse coloplasty, it was statistically insignificant. When compared to the overall leakage rates in the previous studies, it is comparable or even lower than them.

Functional outcomes

Motions per day

Number of motions per day was assessed in transverse coloplasty group at 3 months and 12 months after restoration of bowel. The mean number of motions in 3 months was 3.17, and after 12 months, the mean was 1.67. This goes with Pimentel results where mean number of motions was 3.12 at 3 months and 2.12 after 12 months [13]. On the contrary, number of bowel motions in a study held by HO et al. was higher, with 4.6 and 3.4 in 6 and 12 months, respectively [12]. In taeniectomy group, there was no statistical significant difference between the numbers of motions when compared to coloplasty group. The mean number of motions was 3.04 after 3 months and 1.52 after 12 months. These results are comparable to the overall number of motions in the previous results.

Grade of continence

The grade of continence in this study was evaluated by Wexner scoring system, in which 0 is perfect continence and 20 is complete loss of continence. For transverse coloplasty group, mean grade of continence was 3.5 after 3 months and 1.25 after 12 months. Pimentel et al. used Wexner scoring system in their study in 2003 where the continence grade was 3.2, 2.9 and 2.7 at 3, 6 and 12 months postoperatively [13]. The results in the current study were better when compared to Ho et al. in 2002 where continence grade was 3.2 in both early 4-month and late 12-month follow-up [12].

In taeniectomy group, the mean continence was 3.21 in 6 months and 1.32 after one year. These numbers come in favor of the concurrent study when compared to the previous studies, however, without statistical difference.

Urgency

In the current study, three patients in each group had urgency that improved markedly by the end of one year. This is comparable to Pimentel who had 10% urgency in his study [13]. This also goes with Z'graggen who reported urgency of 16% of cases after 6 months, to drop to 6% after 12 months [16]. On the contrary, Fazio et al.[17] in 2007 reported persistence of urgency in 23.3% of patients with coloplasty.

In taeniectomy group of the current study, the urgency rate was 3.57% (1/28), which is even better when compared to the transverse coloplasty in the study and the previously mentioned studies.

Manometric results

Manometric findings of transverse coloplasty were also comparable to similar studies. Mean resting and squeeze pressures in this study were 50.57 mmHg and 126.993 mmHg, respectively, and threshold volume was 108.17 ml. These results are consistent with a study by Z'graggen in which median resting pressure after TCP was 49 mm Hg, with mean tolerable volume 123 ml [16]. Pimentel et al. [13] in 2003 reported resting pressure after TCP 43.6 mmHg, squeeze pressure 116.3 mmHg and threshold volume 126.1 ml.

In a study done by Köninger et al. [18] in 2004 also showed similar results, with resting pressure 52 mmHg, threshold volume 110 mL. Squeeze pressure was not measured in that study.

For taeniectomy, the mean resting 51.63 mmHg, squeeze pressure 130.42 mmHg and threshold volume 118.68 ml. These results are comparable to the TCP results in this study and also the previously mentioned studies.

Outcomes and conclusion

Taeniectomy pouch is comparable to the widely accepted transverse coloplasty which can be used as alternative to it being theoretically safer and easier. It was designed with the aim of decreasing number of anastomoses and hence decreasing leakage incidence, added to this being technically not demanding. In this study, taeniectomy showed comparable results to the widely accepted transverse coloplasty. Taeniectomy showed less numerical leakage rates and operative time; however, this was insignificant statistically.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics committee approval The study was approved by the Research Ethics Committee of Cairo University.

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