

RESEARCH ARTICLE

Evaluation of Stapled *versus* Hand-Sewn Techniques for Colo-Rectal Anastomosis after Low Anterior Resection of Mid-Rectal Carcinoma: a Study on 50 Patients

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Abstract

Aim: To evaluate the outcome of stapled versus sutured colo-rectal anastomosis after low anterior resection of mid-rectal carcinoma. **Patients and Methods:** A prospective study of fifty patients who underwent colo-rectal anastomosis following low anterior resection (LAR) of T2 mid-rectal cancers at the Egyptian National Cancer Institute during the time period from June 2010 to June 2013 was conducted. Classification was into two groups; a stapled anastomosis group I (25 patients) and a hand-sewn anastomosis group II (25 patients). All operations are evaluated regarding intra-operative complications such as anastomotic line bleeding, visceral injuries or major blood loss. The anastomotic time and operative time are documented for each operation. All patients are evaluated post-operatively for anastomotic leakage (AL), wound infection and ileus. **Results:** The distance of the tumor from the anal verge was 9.6 ± 2.0 cm in group I and 9.9 ± 2.4 cm in group II. The mean operative time was 191.5 ± 16.2 min in the stapled group and 208 ± 18.6 min in the sutured group ($p=0.002$). The mean anastomotic times were 9.0 ± 1.9 min and 19.7 ± 12.2 min ($p=0.001$). Anastomotic leakage developed in three (12.0%) patients in the stapled group and in four (16.0%) patients in the sutured group ($p=1.000$). Post-operative ileus was observed in 3 patients in group I and one patient in group II. Wound infection developed in three (12.0%) patients in the stapled group and four (16.0%) patients in the sutured group ($p=1.000$). **Conclusion:** Colo-rectal anastomosis after low anterior resection for mid rectal carcinoma can be conducted safely either by stapling or hand-sewn techniques; however the stapling technique showed shorter anastomotic and operative times with no significant advantages regarding intra- or post-operative complications or hospital stay.

Keywords: Stapled - hand-sewn - colo-rectal anastomosis - rectal cancer

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Introduction

Following resections of the parts of the gut for any benign or malignant condition, anastomosis is necessary to restore the continuity of the gut. Intestinal anastomosis can be performed in a variety of ways Goulder (2012).

Currently, the two most commonly used anastomotic techniques are: (A) hand-sewn sutured anastomosis and (B) stapled anastomosis. Although both are well established, they are not without their faults. Neither provides an immediately "sealed" anastomosis and both are prone to uncommon but serious complications such as anastomotic bleeding, infection or leaks. However, controversy remains regarding which of the two methods of creating an anastomosis yields better clinical outcomes (Buchberg et al., 2011).

The theory behind creating a safe, healthy bowel anastomosis remains constant, irrespective of the technique chosen. Unfortunately, however, despite the "perfect patient", healthy bowel and meticulous technique some anastomoses continue to leak resulting in significant

morbidity and mortality (Phillips and Steele, 2009).

Prospective, randomized trials have not demonstrated any differences between stapled and hand-sewn anastomosis in terms of leakage rates, length of hospital stay, or overall morbidity (Docherty et al., 1995; Chen, 2012). Comparing local recurrence, 3 - and 5-year survival rates after anal preserving surgery and abdominoperineal resection of Miles for rectal cancer, it showed no statistically significant difference ($p>0.05$) (Yu et al., 2012).

After colorectal resection, the incidence of anastomotic leak ranges from 2.9% to 15.3%. These complications may require further surgical intervention and can lead to significant morbidity and mortality (Buchberg et al., 2011; Yang et al., 2014). In colorectal surgery, the advantages of the stapled technique are said to be a lower percentage of complications, such as leaks, better blood supply, reduced tissue manipulation, less edema, uniformity of sutures and shorter hospital stay and operation time Korolija (2008).

Meta-analysis was performed to compare the safety and effectiveness of stapled versus hand-sewn colorectal

anastomosis surgery. Outcome measures were mortality, anastomotic bleeding, leak, wound infection, anastomotic duration (time taken to perform the anastomosis) and hospital stay. No significant statistical differences were found except that time taken to perform the anastomosis was longer with handsewn techniques ($p < 0.05$) (Neutzling et al., 2012).

The time taken to perform the anastomosis may, when analyzed in isolation, have some importance. It may influence the total length of the operative procedure or hospitalization of the patient. The other variables analyzed did not demonstrate any advantage of one technique over the other (Neutzling et al., 2012).

This study aims to re-evaluate the outcome of stapled versus sutured colo-rectal anastomosis after low anterior resection of mid-rectal carcinoma.

Patients and Methods

This is a prospective study of fifty patients who underwent colo-rectal anastomosis following low anterior resection (LAR) of T2 mid-rectal cancer at the Egyptian National Cancer Institute during the time period from June 2010 to June 2013, classified into two groups; the stapled anastomosis group I (25 patients) and Hand-sewn anastomosis group II (25 patients). No neoadjuvant chemoradiation was given to any of the patients in the study and no diverting colostomies were done intra-operatively. All patients had either normal or corrected to near normal laboratory investigations pre-operatively (eg. serum albumin $> 3 \text{ gm/dl}$, hemoglobin $> 11 \text{ gm/dl}$, well controlled diabetes....etc.) and thorough metastatic work-up was free. Colonoscopy was performed to all patients to rule out synchronous lesions, to localize the lesion and for tissue sampling for histopathology and assess distance of the tumor from the anal verge.

Pre-operative preparation

All patients had received mechanical bowel preparation. Two days before surgery: metronidazole 500mg, two tablets of neomycin 500mg and rectal enema every eight hours, castor oil extract orally at night or picolax 15 drops every eight hours and in addition only oral fluids. The day before surgery: the same regimen + NPO plus daily parental fluids requirements and if tolerated, 200cc mannitol orally.

Preoperative antibiotic prophylaxis on the induction of anesthesia. Each patient received a single dose of cephalosporin 2 g. for prophylaxis. Antibiotics were continued for three to five days postoperatively in addition to Metronidazole 500 mg bid. for three days postoperatively was also used.

Intra-operative evaluation and technique

All operations are evaluated regarding intra-operative complications as anastomotic line bleeding, visceral injuries or major blood loss. The anastomotic time and operative time are documented in each operation.

End-to-end hand-sewn colo-rectal anastomosis

The two bowel ends with right-angled clamps in

situ were brought close by applying lateral two corner seromuscular traction sutures using Vicryl 3-0; Each was then tied and tagged with a straight clamp. The needle and suture is transected distal to the clamps. Anastomosis was performed in a double layer using Vicryl 3-0. Posterior interrupted sero-muscular sutures were taken from the distal rectum to the proximal sigmoid colon (Five to seven interrupted Lembert stitches were placed between the corner sutures). Sutures were not tied but were held long with artery forceps. This ensures accurate placement of full-thickness (seromuscular) sutures. The sutures are then tied (three knots) so that the knots will be "outside" the anastomosis. After completing the posterior layer, sutures were tied in order (three knots) so that the knots will be "outside" the anastomosis starting from one corner. While tying one suture, the next suture had been held taut by an assistant to ensure that there was no abnormal gap between two sutures. All except the two corner sutures are then cut, leaving the tied corner sutures tagged with straight clamps. The inner posterior layer was performed starting in the middle, two continuous sutures were started to form the inner layer of the anastomosis. Each suture goes towards each corner incorporating the mucosal and submucosal layers of each lumen. We used a Connell stitch to invert the corner, which allows inversion of the bowel edges. The Connell stitch was achieved by passing the suture from the outside in, then inside out, on one end in the form of a continuous U-shape. In a similar fashion, the second stitch was taken in the opposite direction and a Connell stitch inserted into the opposite corner. On the anterior surface over-and-over stitches was done. The inner anterior layer; the continuous suture is continued around the corners, one after the other, coming together in the middle and tying the two ends after cutting the needles of each. After the inner layer of the anastomosis has been completed, the non-crushing bowel clamps are removed. Next, the anterior interrupted layer; seromuscular interrupted anterior-layer sutures were taken as the posterior layer (seromuscular) Lembert sutures are placed. Sutures were then tied at the end (3 knots) and cut 5 mm. distal to the knots to complete the anastomosis.

Stapled colo-rectal anastomosis

Utilizing the contour and ILS circular curved stapling devices for anastomosis in LAR of the rectum was performed in an end-to-end double-stapled colorectal anastomosis. Laparotomy was performed through a low midline incision with the patient in Supine position. The rectum and sigmoid colon was mobilized and inferior mesenteric vessels ligated and divided. Total mesorectal excision was performed. After mobilization of the splenic flexure, proximal division of colon was performed at the junction of the sigmoid and descending colon. Bowel division had been performed by using a 55-mm linear transverse anastomosis stapler or cutting with a knife after applying a bowel clamp. After complete mobilization of the rectum, a right-angled clamp was applied distal to the tumor and the distal rectum was divided using a 45-mm contour device applied distal to the right-angled clamp (Figure 1). An adequate distal mural margin (2 cm) was necessary to prevent recurrence. The distal rectal stumps



Figure 1. Inset of Contour Stapler to Divide the Rectum



Figure 2. Fixation of the Anvil by Applying Full-thickness Polypropylene Purse-string Stitches

had been washed with saline or dilute povidone-iodine to destroy exfoliated tumor cells shed in the distal rectum before applying a clamp or stapler. After division of the distal rectum, the bowel ends were prepared for double-stapled anastomosis using a circular stapler (31-mm or 33-mm end-to-end anastomosis stapler). The proximal bowel was prepared by applying full-thickness purse-string stitches using polypropylene 3-0 after introducing a well-lubricated anvil (Figure 2). The anvil head was placed in the proximal colon and the purse-string suture was tied above the tying notch. After gentle dilatation of anus, the shaft of the circular stapler was advanced through the anal canal and placed close to the staple line with the trocar fully retracted inside. The trocar was then fully extended to pierce the tissue so that the trocar advances through the rectal wall, either anterior or posterior to the staple line. The detachable head assembly had been reattached by sliding the anvil shaft over the trocar and pushing until the detachable head assembly snaps with the trocar into its fully seated position. Both ends of the circular stapler had been closed, with care taken that there was no twist in the mesentery of the proximal colon. The stapler had been tightened completely for twenty seconds, fired, and then gently removed by rotating it counterclockwise for half a turn before removal. The tissue doughnuts were inspected for completeness before being sent for pathologic examination. The integrity of the anastomosis had been checked by filling pelvis with saline, instilling air in the distal rectum, and looking for air bubbles. If doughnuts are not complete, additional sutures had been made.

Post-operative evaluation

All patients are evaluated post-operatively for anastomotic leakage (AL), wound infection and ileus. The International Study Group of Rectal Cancer (ISREC) defines AL as a communication between the intra- and extraluminal compartments due to a defect of the integrity of the intestinal wall at the anastomosis between two parts of the GIT. The extent or severity of AL should be graded according to the impact on clinical management. Grade A does not require active therapeutic intervention; grade B

requires active therapeutic intervention, but is manageable without re-laparotomy; and grade C requires re-laparotomy (Morks et al., 2011). Hospital stay is documented. All specimens are evaluated histopathologically.

Statistical methods

Data was analyzed using IBM SPSS advanced statistics version 20 (SPSS Inc., Chicago, IL). Numerical data were expressed as mean and standard deviation or median and range as appropriate. Qualitative data were expressed as frequency and percentage. Chi-square test (Fisher's exact test) was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using Mann-Whitney test (non-parametric t-test). A p -value < 0.05 was considered significant.

Results

In this study there were 33 (66.0%) male and 17 (34.0%) female patients. Group I included 17 M and 8 F patients with a mean age of 53.3 ± 12.5 years while Group II included 16 male and 9 female patients with a mean age of 50.8 ± 13.0 years, while ($p=1.000$ for sex and $p=0.495$ for age) (Table 1).

The distance of the tumor from the anal verge was 9.6 ± 2.0 cm in group I and 9.9 ± 2.4 cm in group II.

The mean operation time was 191.5 ± 16.2 min in the Stapled group and 208 ± 18.6 min in the Sutured group ($p=0.002$). The mean anastomotic time was 9.0 ± 1.9 min in the Stapled group and 19.7 ± 12.2 min in the Sutured group ($p=0.001$). The mean hospital stay was 10.2 ± 1.3 days in the Stapled group and 10.1 ± 1.6 days in the Sutured group ($p=0.703$). Intra-operative anastomotic line bleeding was observed in two (8.0%) patients in the Stapled group and in two patients (8.0%) in the Sutured group ($p=1.000$) and was controlled by taking under-running sutures (Table 2).

Anastomotic leakage developed in three (12.0%) patients in the Stapled group and in four (16.0%) patients in the Sutured group ($p=1.000$). Two patients with leakage in the Stapled group and three patients in the Sutured group ($p=1.000$) were minor leakages (Grade B) treated conservatively by NPO, antibiotics and intravenous fluid therapy, whereas one patient (4.0%) in the Stapled group

Table 1. Clinicopathological Features (n=25)

Demographic data	Stapled	Suture	p value
Age (years)	53.3 ± 12.5	50.8 ± 13.0	0.495
Gender			1
Male	17 (68.0%)	16 (64.0%)	
Female	8 (32%)	9 (36.0%)	
Comorbidity			
Diabetes mellitus	3 (12.0%)	1 (4%)	0.609
Hypertension	4 (16.0%)	1 (4%)	0.349
Liver disease	2 (8.0%)	3 (12.0%)	0.49
Laboratory investigation			
Hb (g/dl)*	11.4 ± 1.1	11.8 ± 1.0	0.173
Albumin (g/dl)*	3.6 ± 0.3	3.4 ± 0.6	0.8
Tumor size (median)	4	3.5	0.381
Resection margin			
R0 (Negative margin)	24 (96.0%)	24 (96.0%)	
R1 (microscopic residual)	1 (4.0%)	1 (4.0%)	
Distance from anal verge (cm)*	9.6 ± 2.0	9.9 ± 2.4	0.225

*Values are presented as mean \pm standard deviation

Table 2. Intra and Post-operative Outcomes (n=25)

Variable	Stapled	Suture	p value
Time			
Operative time (min)*	191.5±16.2	208±18.6	0.002
Anastomotic time (min)*	9.0±1.9	19.7±12.2	0.001
Hospital stay (day)*	10.2±1.3	10.1±1.6	0.703
Intra-operative complications			
Anastomotic line bleeding	2 (8.0%)	2 (8.0 %)	1.000
Postoperative complications			
Leakage	3 (12.0%)	4 (16.0%)	1.000
Wound infection	3 (12.0%)	4 (16.0%)	1.000
Ileus	3 (12.0%)	1 (4.0%)	0.609
Fistula (>500cc)	1 (4.0%)	1 (4.0%)	1.000

*Values are presented as mean±standard deviation

on the 6th post-operative day and another patient in the sutured group on the 8th post-operative day developed a high-output fistula (Grade C), those two patients were re-operated and underwent a proximal defunctioning transverse colostomy.

Post-operative ileus was observed in 3 patients in group I and one patient in group II; all patients were treated conservatively without any remarkable complications.

Wound infection developed in three (12.0%) patients in the Stapled group and four (16.0%) patients in the Sutured group ($p=1.000$) between the 4th and 7th post-operative days. All were superficial minor infections and were treated successfully by conservative measures in the form of drainage, frequent dressings and proper antibiotics.

All specimens were examined histopathologically revealing microscopic infiltration of the distal safety margin by malignant cells in one specimen of the stapled group and another one in the sutured group. All other specimens revealed negative safety margins (distal, proximal and circumferential) for tumor infiltration (Table 1).

Discussion

The interest in the results from comparisons between hand-sewing and stapling has been progressively growing. However, the majority of the results come from studies of inadequate methodological quality. Looking only at the conclusions from randomized studies, it can be seen that the results are not uniform (Angelca et al., 2002). This study was designed to re-evaluate and compare the results of both techniques in a non-biased manner.

Inspite Choy et al. (2011) stated that anastomotic bleeding, anastomotic time, mortality, intra-abdominal abscess, wound infection, length of stay, showed no significant difference between Stapled and hand sewn anastomoses, this study showed a significant shorter anastomotic and operative time with the stapled group.

The type of intestinal anastomosis one performs depends on personnel preference but irrespective to the technique used, principles that ensure a successful outcome include: good vascular supply to segments being approximated, no distal obstruction and a tension free repair. Ideally the cut edges of the bowel segments should bleed freely. Dusky, cyanosed, bowel ends indicate an inadequate arterial supply and the affected Segment should be sacrificed. Adequate mobilization is particularly important for anastomosis and stoma formation involving

the large bowel (Joyce et al., 2002; Goulder et al., 2012). In this study, all the preceding factors for anastomotic integrity were considered and applied by the surgeon intra-operatively, and since irradiated bowel or previous chemotherapy are contributing factors in anastomotic failure and leakage (Trencheva et al., 2013; Yang et al., 2013), all patients in this study didn't receive neoadjuvant chemoradiation regarding the early stage (T2) and relatively the high distance from the anal verge 9.6 ± 2.0 cm in group I and 9.9 ± 2.4 cm in group II.

In general, complications can be divided into intra-operative and post-operative complications. Occurrence of intra-operative complications such as bleeding, bowel injury, ureteral injuries and bladder injuries are caused by intra-abdominal adhesions, anatomic problems, the experience of the surgeon and many other factors. Major post-operative complications include wound infection, anastomotic leakage, ileus and bleeding (Artinyan et al., 2008). In this study, two patients in each group had anastomotic line bleeding detected intra-operatively and controlled safely by under-running sutures. No major wound infections were detected post-operatively, ileus was observed in four patients (8%) and all were managed conservatively by the use of nasogastric decompression and correction of electrolyte imbalances (Kirchhoff et al., 2010).

The frequency of anastomotic leakage (AL) ranges from 1 to 24%. The consequences of postoperative dehiscence are bad and include peritonitis, blood stream infection, further surgery, creation of a defunctioning stoma and different complications (Matthiessen et al., 2007). In this study, anastomotic leakage (Grade B - C) was detected collectively in 7 patients (14%) within the accepted international figures, with no significant difference between the 2 groups studied, and only 2 patients required a diverting colostomy.

In a study by Yang et al., 2013 they reported an AL of 7.6%, inspite that this rate seems lower than in this study, however they included the whole rectum (including upper rectum), they excluded hand-sewn anastomoses and an acquired infection in the postoperative period other than leakage.

Yang et al. (2014) demonstrated an anastomotic leakage in anterior resection with a double stapling technique of 7.6% between the 6th and 12th postoperative days compared to 12% in the stapled group of this study, and this difference may be due the small sample size ($n=25$) in this study compared to ($n=753$), while leakage in this study was diagnosed between the 6th and 8th postoperative days.

In a study done by Singha et al. (2013) to find out whether stapled anastomosis is safer than hand-sewn anastomosis in colon and rectal cancer surgery, they operated 100 patients were selected. 48 patients underwent 'Stapled' and 52 underwent 'Hand-sewn' anastomosis. The outcome variables were 'time required for anastomoses', 'postoperative hospital stay' and early and late 'complications' in postoperative and follow-up period. They found that the time required for anastomosis showed strongly significant difference (18.17 min and 26.85 min; $p=0.000$) in favor of stapling group, almost

similar to this study. The mean anastomotic time was (9.0 ± 1.9 min and 19.7 ± 12.2 min; $p=0.001$) in favor of the stapling group too. No statistical difference was found between the two groups regarding hospital stay ($p=0.821$) as in this study where ($p=0.703$). In spite of the similarity between the two studies, however this study specified only one type of anastomosis (colo-rectal for mid rectal carcinoma); both studies demand statistical strengthening on a large scale patients' number.

Another study by Jeelani, et al. (2013) on 58 patients divided randomly into two groups 29 each showed that anastomotic leak was more in hand sewn technique ($p=0.4227$) which is not highly significant, mean operating time significantly shorter in stapled anastomosis (140 ± 20 min vs 180 ± 20 min, $p=0.0001$) and this is comparable to this study (191.5 ± 16.2 min vs 208 ± 18.6 min in $p=0.002$). No statistical significant difference in mortality and recurrence rate.

In conclusion, Colo-rectal anastomosis after low anterior resection for mid rectal carcinoma can be done safely either by stapling or hand-sewn techniques; however the stapling technique showed shorter anastomotic and operative times with no significant advantages regarding intra-or post-operative complications or hospital stay.

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