A Comparative Study of Hand Sewn Small Intestinal Anastomosis; End to End Versus Side to Side Anastomosis

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ABSTRACT

Introduction: *Bowel anastomosis can be classified depending on the site of anastomosis; enteroenteric, colocolic, ileocolic, colorectal, ileorectal, ileoanal, or coloanal, stapled or hand sewn or combined, single or double layered, interrupted or continuous and end to end or side to side.* ***Aim of the study:*** *To assess safety of end to end and side to side hand sewn small intestinal anastomosis.* ***Patients and Methods:*** *A prospective controlled study was conducted in the period from April 2014 to February 2016 consisting of 60 patients who underwent small intestinal resection and anastomosis in Ain Shams University hospitals. Patients were divided in 2 groups according to the type of the anastomosis; group A had 30 patients who underwent end to end anastomosis and group B had 30 patients who underwent side to side anastomosis.*
Results: *anastomotic operative time was statistically significant to be higher in side to side anastomosis than end to end anastomosis after small intestinal resection, yet the overall operative time was statistically non significant. Anastomotic leakage although not statistically significant had higher incidence in hand sewn end to end anastomosis than side to side intestinal anastomosis after small intestinal resection. Other operative and postoperative results were insignificant.* ***Conclusion:*** *hand sewn side to side small intestinal anastomosis is safe, feasible and has lower anastomotic leakage rate than end to end anastomosis after small intestinal resection.*
Keywords: *anastomosis, end to end, side to side, small bowel*

INTRODUCTION

Bowel anastomoses are common procedures in both elective and emergency general surgery. One important factor in the decision to perform a particular anastomosis remains individual surgical experience and personal preference.[1]

The theory behind creating a safe, healthy bowel anastomosis remains constant, irrespective of the technique chosen.[1,2] Creating a safe and reliable anastomosis depends on meticulous technique, avoidance of tension at the anastomosis, maintenance of good tissue vascularity, perioperative nutritional optimization, avoidance of concomitant systemic illnesses, perioperative optimization of medical comorbidities, and avoidance of certain drugs such as steroids and vasopressors.[3]

The choice of anastomotic technique may be influenced by the diameter of the bowel ends, oedema, accessibility, site of anastomosis, contamination, available time and equipment and underlying pathology.[1]

Anastomoses can be classified as sutured and stapled. Sutured anastomosis may be: (1) interrupted or continuous;(2) single or 2-layer; (3) end-to-end or side-to-side (or combination); (4) various suture materials; (5) extramucosal or full-thickness sutures; and (6) size of and spacing between each suture; and stapled anastomosis may be : (1)side-to-side or end-to-end (or combination); (2) staple lines oversewn, buried or not; and (3) Various stapling devices.[1]

Undoubtedly, two of the most significant complications related to intestinal anastomosis remain dehiscence and leakage. Indeed, breakdown of an anastomosis is associated with considerable perioperative morbidity and mortality.[3]

PATIENT AND METHODS

A prospective non randomized controlled study was conducted in the period from April 2014 to February 2016 consisting of 60 patients who underwent small intestinal resection and

anastomosis. Patients were divided in 2 groups; group A which included 30 patients in the study for whom an end to end anastomosis was done and those were almost done in the 1st year and group B which included 30 patients for whom side to side anastomosis were done and those patients were done in the 2nd year of the study.

All cases requiring small intestinal resection anastomosis were included either emergency or elective. Those included patients with strangulated paraumbilical and inguinal hernias, patients undergoing exploration for intestinal obstruction, blunt and sharp abdominal traumas and those who underwent appendectomy and a meckel's diverticulum was discovered.

Patients undergoing other procedures in addition to a single small intestinal anastomosis were excluded.

Steps:

All patients had general anesthesia. The type of incision was determined according to the type of operation either a hernia or exploratory incision.

The technique:

After resection of the diseased segment anastomosis was done by either technique:

- End-to-end anastomosis (figure1):
  1) Both ends were approximated
  2) Mesenteric and antimesentric borders were facing each other
  3) Anastomosis was done through a single layer extra mucosal interrupted sutures by vicryl 2-0
- Side-to-side anastomosis (figure 2):
  1) Each end was closed by a single continuous layer of vicryl 2-0.
  2) Both ends were crossed for 6-7cm and the antimesenteric borders were hold toward one another.
  3) 2 stay sutures held the antimesentric borders, these sutures were 1-2 cm away from the blind end of each side
  4) A hole is made in both loops by the electrocautery, 3-4 incision was done by the scissors in the anti mesenteric border
  5) Anastomosis was done through a single layer extra mucosal interrupted sutures by vicryl 2-0

Mesenteric window was closed in all patients. A large tube drain was put in the pelvis in all patients.

Fig. 1: End to end anastomosis

Fig. 2: Side to side anastomosis

Postoperative

Enhanced recovery program was followed in all patients.

Follow-up was conducted weekly for the first month and once per month for the next 6months in the outpatient clinic.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation and analyzed with the Student t test. Categorical ones were expressed as percent value and analyzed with Fischer test or Chi-square test, where appropriate. $P < 0.05$ was considered statistically significant.

RESULTS

Demographics, patients' related data and indication of resection are shown in table 1. There was no significant difference in term of age, sex, BMI, ASA score and the indication of resection.

The commonest indication for resection in both groups was strangulated hernia (20 cases; 9 in group A and 11 in group B), the second common indication for resection was adhesive intestinal obstruction with gangrenous small bowel (12 cases; 7 in group A and 5 in group B). There were 4 cases of adhesive intestinal obstruction with constriction band causing complete obstruction; 2 in each group. There were 5 cases of mesenteric vascular occlusion, 3in group A and 2 in group B, one of them was mesenteric arterial occlusion (in group A) and the rest were mesenteric venous occlusion. There were 5 cases of intestinal injury due to sharp intestinal trauma through stab wounds; 3 in group A and 2 in group B. 3 cases of meckel's diverticulum underwent resection, 2 in group A; 1 patient had acute divertculitis diagnosed primarily as acute appendicitis and the other patient had meckel's diverticulum discovered accidentally during appendectomy resection was done because it had a narrow base and only 1 patient in group B underwent resection because of meckel's diverticutum, the patient presented to us as a case of intestinal obstruction, exploration was done and fibrous band from the tip of a meckel's diverticulum was the cause of obstruction, a wide but thick base with a mass like lesion was felt and the postoperative pathology revealed heterotropic pancreatic tissue in a Meckel's diverticulum. Other indications for resection included Gastrointestinal stromal tumor; 2 cases in group B, blunt abdominal trauma; 1 case in group A and mesenteric telangectasia; 1 case in group B.

Table 1: Demographics and patients' related data

Variables	***Group A***	***Group B***	***P value***
Number of patients	30	30	
Age (mean $\pm$ SD)	35.63$\pm$12.02	38.5$\pm$13.8	0.394441
Sex F:M	12:18	16:14	0.300623
BMI	30.73$\pm$6.43	29.27$\pm$5.19	0.33
ASA score			
I	5 (16.67%)	4 (13.33%)	0.717688
II	9 (30%)	9 (30%)	1
III	15 (50%)	16 (53.33%)	0.796143
IV	1 (3.33%)	1 (3.33%)	1
V	0 (0%)	0 (0%)	
Indication for resection			
Strangulated hernia	9 (30%)	11(36.67%)	0.583882
Adhesive intestinal obstruction with gangrenous loop	7 (23.33%)	5(16.67%)	0.518605
Adhesive intestinal obstruction with constriction band	2 (6.67%)	2 (6.67%)	1
Sharp intestinal trauma	3 (10%)	5 (16.67%)	0.447521
Mesenteric vascular occlusion	3 (10%)	2 (6.67%)	0.640429
Closure of ileostomy	3 (10%)	1 (3.33%)	0.300623
Complicated meckel's diverticulum	2 (6.67%)	1 (3.33%)	0.553617
Gastrointestinal stromal tumor	0 (0%)	2 (6.67%)	0.150323
Blunt abdominal trauma	1 (3.33%)	0 (0%)	0.313244
Mesenteric telangectasia	0 (0%)	1 (3.33%)	0.313244

Operative data

Operative data included the overall operative time from the first skin incision till the last skin suture taken, the anastomotic operative time, symmetry of the bowel loops and the length of the loop resected (table 2). Regarding operative data, there was no statistical difference between the two groups as regard the overall operative time symmetery of the bowel loops, the length of the loop resected and the distance of the anastomosis from the duodenojejunal (DJ) junction. The mean anastomotic operative time was significantly higher in group B.

Table 2: Operative data

Variables	*Group A*	*Group B*	*P value*
Operative time (minutes)	108.53±27.78	121.87±26.91	0.064004
Anastomotic operative time (minutes)	12.9±1.67	22.1±1.71	< 0.00001 significant
Symmetry of the bowel loops (symmetrical: asymmetrical)	13:17	16:14	0.438323
Length of the resected loop	45.47±31.51	44.97±27.94	0.948373053
Distance of the anastomosis from the DJ (cm)	208.83±147.35	184.87±137.78	0.517805

Postoperative data

Postoperative data are summarized in table 3. Postoperative data included timing of passage of 1st flatus, length of hospital stay, time of drain removal, postoperative complications, reoperation and readmission. There was no significant difference between both groups in the postoperative data. Postoperative complications (Figure 3) included in our study were intestinal leakage and wound infection. 3patients in group A underwent reoperation for leakage. No cases of readmission

Table 3: Postoperative data

Variables	*Group A*	*Group B*	*P value*
Timing of passage of 1st flatus (days)	2.93±0.87	3.03±0.96	0.674522
Length of hospital stay (LOS) (days)	5.37±1.96	4.7±1.62	0.156108
Postoperative complications			
Leakage	4 (13.33%)	0 (0%)	0.038434 significant
Wound infection	7 (23.33%)	9 (30%)	0.559305
Reoperation	4 (13.33%)	0 (0%)	0.075561
readmission	1 (3.33%)	0 (0%)	0.313244

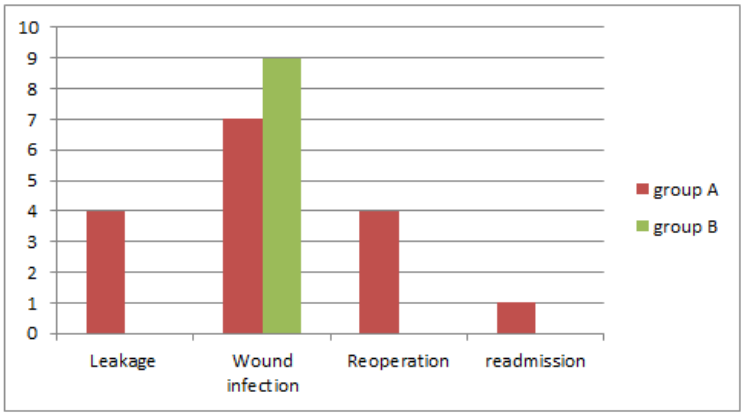

Fig. 3: Postoperative complications

DISCUSSION

Side to side anastomosis was done leaving long blind end in each of the afferent and efferent loops, this resulted in severe and dramatic complications from this type of anastomosis. It would appear that the length of the inverted proximal loop distal to the anastomosis is highly significant, although some pouches have been observed following near flush inversion with the stoma.[4]

In 1906, Cannon and Murphy[5] called attention to poorly functioning stoma, obstructive symptoms and pouch formations following side-

to-side intestinal anastomosis.[4] According to Cannon and Murphy, this method of anastomosis may interfere with normal peristaisis as a result of interruption of the circular muscle fibers. Thus, propulsion of the normal peristaltic contractions is disrupted, since the two opposed loops do not act properly to propel food in an antegrade fashion. Food may accumulate in the blind end of the intestine, gradually causing dilatation and eventual blind pouch formation.[5, 6]

In 1933, Holm produced similar blind loops in dogs and observed their progressive and predictable sequelae.[7]

In 1934, Pearse[8] created redundant blind segments by side-to-side anastomosis experimentally and noted that the time of onset and severity of symptoms varied with the length of the blind loop. The significance of constant pressure of the peristaltic current on the inverted end of the proximal bowel became apparent.[4]

Apparently there is a rather wide variation in the time required for formation of symptomatic blind pouches in patients following side-to-side anastomosis. The majority of patients probably do not form pouches or, if pouches are formed, they remain small and produce no symptoms.[9] It would appear that the length of the inverted proximal loop distal to the anastomosis is highly significant, although some pouches have been observed following near flush inversion with the stoma.[4]

The usual symptoms and findings recorded are cramping abdominal pain, nausea and vomiting, abdominal distention, palpable mass, a recurring partial or complete intestinal obstruction, melena, recurring episodes of fever and diarrhea, fatigue, anorexia, inability to gain weight, and failure of growth and development in the young.[10-13] There is evidence to suggest that the majority of symptoms are due to stasis and infection in the pouch.[4]

The actual size and weight of the pouch may, in turn, produce mechanical intestinal obstruction.[13] Perforation of the pouch itself or blood loss is related to ulceration secondary to infection.[4]

In 1965, all the dramatic disturbances which may be associated with blind intestinal pouches were reported; treatment of a complicated blind pouch included elimination of the pouch by resection, if feasible, or replacement of the side-to-side with end-to-end anastomosis. Whitake and Shepard stated that these complications were obviously prevented if end-to-end anastomosis was utilized.[4]

Recently, side to side anastomosis is uprising with the blind pouch left at both ends not exceeding 2 cm to avoid blind pouch complication meanwhile gaining the most common benefits of this type of anastomosis; it assures better blood supply and overcomes any discrepancy between the sizes of the 2 bowel loops undergoing anastomosis.

In end to end anastomosis, moderate luminal disparity can be accommodated by using different transection angles. Marked luminal disparity can be corrected by incising longitudinally on the antimesenteric aspect of the segment with the smaller lumen.[14] Yet, the choice of side to side anastomosis in these cases is an easier and reliable choice.

One of the disadvantages of side to side anastomosis is the long anastomotic time. In our study the mean anastomotic operative time was 12.9$\pm$1.67 minutes in group A and 22.1$\pm$1.71 minutes in group B; highly significant. Yet, the overall operative time was 108.53$\pm$27.78 minutes in group A and 121.87$\pm$26.91 minutes in group B; not significant. Since our study was done on isolated single small intestinal anastomosis, so the anastomotic operative time didn't affect the mean operative time in both groups, but in other cases if there are multiple anastomosis or associated injuries or when speed is of very considerable importance as in war surgery, side-to-side anastomosis is therefore seldom done because, while giving a very satisfactory union, it is undoubtedly time-consuming.[15]

In our study, all our patients underwent enhanced recovery program; once they have intestinal sounds, we started a fluid diet. The drain was removed on the day of discharge.

To assure a good bowel anastomosis, the bowel ends must have a good blood supply, be under no tension, and be anastomosed with meticulous technique. There are many factors which affect healing after bowel anastomosis. Personal experience, patient factors and intra-operative findings need to be considered with the available evidence before the final decision regarding anastomotic technique is made by the operating surgeon.[1]

4 (13.33%) patients in group A were complicated by leakage; all of them were

diagnosed at the same hospital stay. Anastomotic leak (AL) is one of the most dreaded complications following colorectal surgery, with reported rates ranging from 3 to 26%.[16-19] The concern over this complication is for good reason as it is associated with a mortality ranging from 6 to 39%.[16, 17, 20, 21]

Although the literature is replete with studies that specify a rate of anastomotic leakage, it is seldom possible to know what constitutes a "leak." Bruce et al performed a systematic review of studies measuring the incidence of anastomotic leaks after gastrointestinal surgery; in the 97 studies reviewed, there were a total of 56 separate definitions of anastomotic leak.[22,] A leak may be defined by the need for reoperation, clinical findings, or radiologic criteria, making comparisons between studies difficult or impossible.[23]

In our study we defined leakage by clinical findings with or without intestinal content in the drain; unexplained tachycardia with or without intestinal content in the drain raised suspicion of leakage

Early diagnosis of an AL is crucial for the prevention of mortality.[16,17,19-21,24,25] The signs and symptoms include the presence of fever, oliguria, ileus, diarrhea, leukocytosis, and peritonitis.[16]

However, a large number of patients ultimately found to have an anastomotic leak develop a more insidious presentation, often with low-grade fever, prolonged ileus, or failure to thrive.[26] In these patients, making the diagnosis may be much more difficult as the clinical course is often similar to other postoperative infectious complications. Radiologic imaging is usually required; even then, the diagnosis may be elusive or at least uncertain.[23]

In our study, the 1st case of leakage was a heavy smoker male patient 33 years old with mesenteric venous occlusion complicated with gangrene, he underwent resection and end to end anastomosis about 50 cm from the DJ flexure, on the 3rd day postoperative the patient started to develop abdominal pain and unexplained tachycardia and fever, there was no wound infection, the patient's abdominal examination showed generalied tendernss and rebound tenderness with grauding allover the abdomen, the drain output was unremarkable, the patient was diagnosed as having leakage and re-exploration was done , about half the anastomosis was disrupted, peritoneal lavage , refashioning of the ends and side to side anastomosis was done. The patient passed uneventful postoperatively except for wound infection which was treated by antibiotics and dressing in the outpatient clinic.

The 2nd case was a female patient 45 years old with neglected strangulated hernia for 5 days, the patient presented to us with septic shock, exploration was done the gangrenous loop was resected, there was marked luminal disparity between both loops, the distal loop was cut in the antimesentric border to fit with the proximal loop and end to end anastomosis was done. Patient was admitted to the ICU for 2 days and discharged, on the 4th day postoperative, the patient became tachycardic and feverish and the drain output contained intestinal fluid, the patient was reexplored complete disruption of the anastomosis was found and refashioning of the ends wth stoma formation was done. The patient passed uneventful postoperatively except for wound infection as the 1st case. The patient was discharged and after one and half month the patient had closure by end to end anastomosis which passed uneventful.

The 3rd case was a female patient 25 years old with adhesive intestinal obstruction after exploration done in her childhood with no follow up document with the patient. After failure of conservative treatment for 48hours, the patient was explored, a band of adhesion was completely constricting the lumen, the proximal loop was markedly distended and the distal loop was collapsed. Resection and end to end anastomosis was done. The 3rd postoperative day the patient passed flatus and oral feeding was started. On the 4th postoperative day the patient developed severe wound infection and tachycardia, wound drainage was done but tachycardia was persistent. The drain output was 100-200ml serosanguinous fluid per day. On postoperative day 7, the drain output became 400ml seropurulent with persistant tachycardia. Exploration was done; half of the anastomosis was disrupted with edema of the edges and discrepancy between the 2 loops, resection of the anastomotic edges was done with side to side anastomosis. The patient passed uneventful after the 2nd operation.

The 4th case of leakage was a male patient 45years old with past history of motor car accident 20 years earlier and splenectomy, he was admitted as case of adhesive intestinal

obstruction, the patient was tachycardic and feverish, a ryle was inserted and 1500ml of altered intestinal fluid was drained by the ryle tube. Exploration was done, a gangrenous loop was found, resection was done, the proximal loop was markedly distended and the distal loop was collapsed. On the 3rd opostoperative day the drain output was 1500ml of intestinal fluid, the patient was explored and almost complete anastomotic disruption was found, refashioning of the edges with closure and side to side anastomosis was done and the postoperative period of the patient passed uneventful.

In conclusion, the good blood supply to the antimesentric border of the bowel can assure a higher healing rate and lower leakage rate especially in cases of edema of the bowel. Side to side anastomosis is better done in cases of intestinal edema and marked discrepancy in bowel loops requiring anastomosis.

CONCLUSION

Hand sewn side to side small intestinal anastomosis is safe, feasible and has lower incidence of anastomotic leakage and is better done in cases of intestinal edema and marked discrepancy in bowel loops requiring anastomosis end to end anastomosis after small intestinal resection.

Limitations:

This study should be done in a larger population so that the results become more reliable.

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