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Original research article

Single-layer extra mucosal versus conventional double layer anastomosis of intestines in elective and emergency laparotomy: A comparative study

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Abstract

Background: The intestinal anastomosis is a surgical procedure to restore intestinal continuity, one of the most commonly performed surgical procedures for benign or malignant lesions of the gastrointestinal tract.The present study aimed to compare single-layer extra mucosal versus conventional double-layer anastomosis of intestines in elective and emergency laparotomy at a tertiary hospital.

Material and Methods: This study was a prospective, comparative, interventionalconducted in patients19-60 years of age who underwent resection and anastomosis of the small or large intestine for various indications either in elective or emergency laparotomy, willing to participate in the study.

Results:82 patients underwent extra-mucosal single-layer anastomosis (group A, n=41) and the other with conventional double-layer anastomosis (group B, n=41). Less length of suture used (21.44 ± 7.75 cms vs. 40.27 ± 11.02 cms) & less time taken for anastomosis (20.37 ± 5.81 minutes vs. 34.64 ± 6.45 minutes) in extra-mucosal single-layer anastomosis as compared to conventional double layer anastomosis & difference was statistically significant ($p<0.001$). Other factors such as the return of bowel sounds (days), resuming flatus (days), the day on which oral intake >1 liter, drain removal (days), postoperative hospital stay (days) &ICU days were comparable in a single layer &double layer groups, the difference was not significant statistically.Postoperative Complications were common in the double-layer group (3 cases of Anastomotic leak, two patients required re-intervention, three instances of Surgical site infection & 1 Mortality) as compared to the single-layer group (1 case of Anastomotic leak, one patient required re-interventions, two instances of Surgical site infection & 1 Mortality). The difference was not significant statistically.

Conclusion: Considering the duration of the anastomosis procedure and medical expenses, the single-layer intestinal anastomosis may prove the choice of procedure for most surgeons.

Keywords: Two-layer anastomosis, intestinal anastomosis, single-layer anastomosis, postoperative leak, medical expenses

Introduction

Intestinal anastomosis is a surgical procedure to restore intestinal continuity, one of the most commonly performed surgical procedures for benign or malignant lesions of the gastrointestinal tract.

Intestinal anastomosis has been successfully performed for over 150 years using various techniques, materials, and devices. Hand-sewnanastomosis of the intestine is the most commonly used technique worldwide because of the availability and affordability of suture materials and familiarity with the procedure. The decision to perform a particular anastomosis remains an individual's surgical experience and personal preference.[1]

The anastomosis can be achieved using sutures, staplers and even compression rings, metal wires, and magnets.[2]The procedure's success depends on sufficient alignment, good vascularity, spaced sutures, devoid of tension, and absence of obstruction.[3] Historically, two-layered anastomoses consisting of an inner transmural layer of continuous sutures and an outer seromuscular layer of interrupted sutures have been performed by most surgeons.

However, many studies have advocated the use of the single-layer anastomosis method for anastomosis because of the lower rate of leak, time, and cost effectiveness.[4] Present study was aimed to compare single-layer extra mucosal versus conventional double-layer anastomosis of intestines in elective and emergency laparotomy at a tertiary hospital.

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Material and Methods

The present study was a prospective, comparative, interventional study conducted in the department of general surgery, Department of General Surgery, Swami Ramanand Tirth Rural Medical College, Ambajogai, India. The study duration was two years (January 2020 to December 2021). The study was conducted after permission from the institutional ethics committee for biomedical research.

Inclusion criteria

- Patients19-60 years of age who underwent resection and anastomosis of the small or large intestine for various indications either in elective or emergency laparotomy are willing to participate in the study.

Exclusion criteria

- Pregnant females.
- Patients with uncontrolled diabetes, h/o steroid intake, severe anemia, immune-compromised.
- Patients in whom anastomoses are preceded bydiverting stoma as dehiscence and obstruction may not be clinically manifested.
- Death due to medical reasons during the period of study.
- Oesophageal and rectal anastomoses.
- Radiation enteritis is complicated with bleeding, stricture, or perforation post-chemotherapy.

The study was conducted after permission from the institutional ethics committee for biomedical research. Patient-related information (age, gender, relevant history, physical status, clinical examination findings), hematological investigations, ECG & radiological investigations were noted & anesthetic fitness was taken.

Eighty-two patients were grouped into two groups before surgery, one who had undergone extra-mucosal single-layer anastomosis (group A) and the other with conventional double-layer anastomosis (group B). All surgeries were performed by a surgeon with a minimum of 5 years of experience.

In group A (single layer anastomosis group), anastomoses were performed with 3-0 polydioxanone in a continuous fashion, including all layers of the bowel wall except the mucosa (i.e., serosa, muscular propria, submucosa). Each bite will include 3 mm of the serosubmucosal wall. Each successive suture was taken approx. 3 mm ahead of the last suture.

In group A (double layer anastomosis), anastomoses were constructed with a 3-0 polydioxanone suture incorporating transmural (full-thickness involving all layers) continuous sutures for the inner layer and 3-0 silk Lambert (seromuscular means partial-thickness incorporating only serosa and muscularis propria) interrupted sutures for the outer layer. Each suture bite was taken to include 3 mm of the bowel wall. Each successive suture bite was taken approximately 3 mm ahead of the last bite.

Outcome parameters assessed were length of suture material used, time taken for anastomosis, time taken for surgery, postoperative return of peristalsis and passage of flatus, postoperative complications like paralytic ileus, bowel obstruction, anastomotic dehiscence diagnosed by the presence of enteric contents like bile or feces in the drain or wound or diagnosed on radiological imaging like CT scans, postoperative ICU and hospital stay.

Data was collected and compiled using Microsoft Excel and analyzed using SPSS 23.0. Frequency, percentage, means, and standard deviations (SD) were calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. The difference of proportions between qualitative variables was tested using the chi-square test or Fisher exact test. P-value less than 0.5 was considered statistically significant.

Results

Eighty-two patients were grouped into two groups who had undergone extra-mucosal single-layer anastomosis (group A, n=41) and the other with conventional double layer anastomosis (group B, n=41). Both groups were comparable in terms of age, gender & co-morbidities. The difference was not significant statistically (p> 0.05).

Table 1: General characteristics

General characteristics	Single-layer (n=41)		Double-layer (n=41)		p-value
	No. of cases	Percentage	No. of cases	Percentage	
Age (in years)					0.38
19-30	9	21.95%	8	19.51%	
31-40	14	34.15%	16	39.02%	
41-50	11	26.83%	11	26.83%	
51-60	7	17.07%	6	14.63%	
Mean ± SD	37.07±13.21		35.16±11.95		

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Gender					0.53
Male	25	60.98%	23	56.10%	
Female	16	39.02%	18	43.90%	
Co-morbidities					0.65
Alcoholism	11	26.83%	8	19.51%	
Hypertension	8	19.51%	7	17.07%	
Diabetes	6	14.63%	5	12.20%	
Smoking	5	12.20%	4	9.76%	

In the present study, we noted less length of suture used (21.44 ± 7.75 cms vs. 40.27 ± 11.02 cms) & less time taken for anastomosis (20.37 ± 5.81 minutes vs. 34.64 ± 6.45 minutes) in extra-mucosal single-layer anastomosis as compared to conventional double layer anastomosis & difference was statistically significant (p<0.001). Other factors such as the return of bowel sounds (days), pod resuming flatus (days), the day on which oral intake >1 liter, drain removal (days), post-operative hospital stay (days) &ICU days were comparable in a single layer &double layer groups, the difference was not significant statistically.

Table 2: Comparison of per-operative parameters and recovery outcomes

Outcome factors	Single-layer (n=41) (mean ± SD)	Double-layer (n=41) (mean ± SD)	p-value
Length of suture used (cms)	21.44 ± 7.75	40.27 ± 11.02	<0.001
Time taken for anastomosis (minutes)	20.37 ± 5.81	34.64 ± 6.45	<0.001
Return Of bowel sounds (days)	4.1 ± 1.2	5.5 ± 0.62	0.53
POD resuming flatus (days)	5.1 ± 1.8	5.2 ± 1.2	0.51
Day on which oral intake >1 liter	9.3 ± 1.7	9 ± 2.8	0.78
Drain removal (days)	7.6 ± 1.8	6.9 ± 1.7	0.47
Postoperative hospital stay (days)	13.9 ± 5.4	14 ± 4.5	0.36
ICU days	3.1 ± 1.9	3.6 ± 1.6	0.47

Postoperative Complications were common in the double-layer group (3 cases of Anastomotic leak, 2 cases required re-interventions, three instances of Surgical site infection & 1 Mortality) as compared to the single-layer group (1 case of Anastomotic leak, 1 case required re-interventions, two instances of Surgical site infection & 1 Mortality), the difference was not significant statistically.

Table 3: Post-operative Complications

Post-operative Complications	Single-layer (n=41)		Double-layer (n=41)		p-value
	No. of cases	%	No. of cases	%	
Anastomotic leak	1	2.44%	3	7.32%	0.069
Re-interventions	1	2.44%	2	4.88%	0.064
Surgical site infection	2	4.88%	3	7.32%	0.057
Mortality	1	2.44%	1	2.44%	--

Discussion

The process of intestinal anastomotic healing mimics wound healing elsewhere in the body. It can be classified into an acute inflammatory (lag) phase, a proliferative phase, and a remodeling maturation phase.[5] Bowel anastomoses after resection of the bowel may be either end-to-end anastomoses, side or side-to-end anastomoses, depending on the surgery and the operating surgeon. Different techniques of intestinal anastomosis are single, double-layered closure, staples, glue, and laser welding.[6]

Failure of an anastomosis with fecal fistula,leakage of intestinal contents is one of the most dreaded surgical complications. Anastomotic leak is a major complication of gastrointestinal anastomosis and may lead to peritonitis, intra-abdominal abscess, fistula, necrosis, and stricture. A fecal fistula adds the morbidity and even deaths related to the surgery; it can prolong the days of the hospital stay and increase the mortality by threefold.

The reported rate of failure of gastrointestinal anastomosis (GIA) ranges from 1.5% to 2.2%, depending on what type of anastomosis was performed, where the operation was elective or an emergency procedure, general factors such as age, nutritional status, comorbid conditions, and local factors like vascularity, sepsis, and suture technique.[8]

In a study by Dhamnaskar SS *et al*., nine lengths of suture used for a single layer (mean of 15.06 cm) was statistically significantly lesser than that for a double layer (mean 19.90 cm) (p.0.001). Time taken for anastomosis and overall surgical time too was considerably less for the single-layer group (p.0.001 and 0.022, respectively). Complications including anastomotic dehiscence were not significantly different between the two groups. Postoperative recovery of bowel function was earlier in the single-layer group with marginal statistical significance (p=0.048). A single-layer continuous method of intestinal

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anastomosis resulted in a significant reduction in time, suture material length, and cost; without any difference in complications, it marginally hastens the postoperative recovery of bowel function.

In a study by Rahul S *et al*., the ten mean duration of intestinal anastomosis for the double-layer group was 33.06 minutes, whereas, for the single-layer group, it was 23.6 minutes, which was found to be statistically significant. Anastomotic leak was reported in 2 patients in the double-layer group, and three patients in the single-layer group were found to be statistically insignificant. The other complications that included surgical site infection, re-intervention, and mortality were similar in both groups. Single-layered intestinal anastomosis does not carry any increased risk of anastomotic leak and other complications compared to double-layered intestinal anastomosis. It can be constructed in a shorter time.

Adhikari B[11] divided 50 patients into two groups- single and double-layer groups. Times taken for intestinal anastomosis in single and double layers were 18.28±5.08 and 25.27±6.18, respectively, which was statistically significant (p-<0.012). Hospital stay was 10.9±1.43 in a single layer and 11.2±1.87, which was statistically insignificant. Similarly, the anastomosis leak was seen in 2 patients in a single layer and 3 in the double layer, which was statistically insignificant. While comparing the cost-effectiveness single layer technique was cost-effective. Single-layer anastomosis is a preferable, safe, and economical technique compared to conventional double-layered anastomosis. Similar findings were noted in the present study.

Sai KL[12] divided 58 patients into Group A underwent single-layer anastomosis, and Group B underwent double-layer anastomosis. The mean duration required to perform anastomosis in Group A is 21.64±1.60 minutes and in Group B is 29.6±2.02 minutes. The difference between the two groups' mean duration required for anastomosis was statistically significant (p<0.005). The mean duration of hospital stay in Group A was 12.35±1.72 days and in Group B was 12±2.44 days (difference was statistically insignificant), 3 (10%) cases in Group A and 2 (6.8 %) cases in Group B developed an anastomotic leak, and the difference was statistically insignificant. Similar findings were noted in the present study.

Said L *et al*., [13] studied single-layer extra-mucosal anastomosis (Group A, n=32) or double-layer anastomosis (Group B, n=35). The mean time taken for anastomosis was significantly shorter in group A (23.25 ± 1.20 min in group A vs. 36.71 ± 1.93 min in group B; P<0.001). A considerably shorter duration of hospital stay was seen in group A (7.00 ± 1.778 days in group A vs. 9.74 ± 1.990 days in group B; P<0.001). The detection of bowel sound was substantially quicker in group A compared to group B (4.56 ± 0.50 days in group A vs. 6.46±0.50 days in group B; P<0.001). There was no significant discrepancy between the two groups regarding anastomotic leak rates (P= 0.543). The mean cost of the double-layer intestinal anastomosis method was significantly higher than that of single-layer anastomosis (P<0.001).

The shortcomings associated with the double-layered technique include the risk of stricture formation, failure to oppose clean serosal surfaces, increased chances of leakage, and excessive inversion, causing narrowing of the lumen. [14] In the single-layer technique, only the seromuscular layer of the gut wall is approximated. This technique incorporates the most substantial layer (submucosa) of the gut. It causes minimal damage to the submucosal vascular plexus, anatomy is maintained and hence fewer chances of necrosis and is superior to double-layered closure. [15]

The present study has certain limitations. Since our conclusion was derived from a smaller number of patients, further clinical trials with large sample sizes are required to establish the significant advantage of single-layered anastomosis over double layer regarding postoperative morbidity, complications, and hospital stay. Moreover, long-term follow-up is needed to evaluate the late complications of intestinal anastomosis, including bowel stenosis, stricture, or obstruction.

Conclusion

Two-layer anastomosis for intestinal anastomosis offers no definite advantage over single-layer anastomosis in terms of the postoperative leak and other complications. Considering the duration of the anastomosis procedure and medical expenses, the single-layer intestinal anastomosis may prove the choice of method for most surgeons.

Conflict of Interest: None to declare.

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