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ORIGINAL RESEARCH

To compare the effectiveness of single-layered and double-layered intestinal anastomosis

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Abstract

Background: Intestinal anastomosis is a fundamental surgical procedure performed in various gastrointestinal surgeries, where two ends of the intestine are joined together after a resection.

Aim: To compare the effectiveness of single-layered and double-layered intestinal anastomosis.

Materials and Methods: A prospective, single-centre, double-blind, randomized controlled study was conducted within the Department of General Surgery to compare the outcomes of two different techniques for intestinal resection and anastomosis. The study included both emergency and elective procedures involving jejuno-jejunal, jejuno-ileal, ileo-ileal, ileo-colic, and colo-colic anastomoses, as well as stoma closures. A total of 100 eligible patients who underwent intestinal resection and anastomosis were randomly assigned to one of two groups. The participants were then randomly allocated to undergo either a single-layer extramucosal intestinal anastomosis (Group A) or a double-layer intestinal anastomosis (Group B).

Results: The duration for which the nasogastric tube remained in place was shorter in Group A (2.3 ± 0.7 days) compared to Group B (3.1 ± 0.8 days), with a p-value of <0.001. The time for the return of bowel sounds postoperatively was also faster in Group A (2.5 ± 0.6 days) compared to Group B (3.4 ± 0.9 days), with a p-value of <0.001. Similarly, the first postoperative bowel movement occurred earlier in Group A (3.1 ± 0.8 days) than in Group B (4.2 ± 1.0 days), with a p-value of <0.001. On average, patients in Group A were discharged after 7.8 ± 1.4 days, whereas those in Group B required 10.2 ± 1.6 days of hospitalization (p<0.001).

Conclusion: We concluded that the single-layer anastomosis technique is superior to the double-layer technique in terms of operative time, suture material usage, and cost efficiency, without compromising patient safety.

Keywords: Single-layered, Double-layered, Intestinal anastomosis

Introduction

Today's anastomosis is one of the most common surgical procedures. Over a million anastomoses are performed in the United States each year for visceral indications such as gastrointestinal, urological, and gynaecological surgeries.[1] Out of these surgeries, intestinal anastomosis is the most common. Intestinal anastomosis is required in patients suffering with

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intestinal malignancy, inflammation, infection like TB with stricture, obstruction, congenital conditions like intestinal atresia, Hirschsprung syndrome, or injuries leading to malfunctioning of the area affected.[2] The most common purpose of anastomosis is to restore the continuity of the affected intestinal portion. With the advent of modern surgical tools, suturing materials, and medications, anastomosis is becoming more effective and safer surgery with fewer incidences of associated complexities. Intestinal anastomoses are common procedures in both elective and emergency general surgery, and the technique selected is determined by the site of the anastomosis, bowel caliber and quality, and underlying disease process.[3] The development of stapling instruments added a new dimension to intestinal surgery with the advantage of a short learning curve. Based on the technique used, anastomosis is categorized as hand-sewn, stapled, and laparoscopic anastomosis.[4]

As intestinal anastomosis is commonly employed in both elective and emergency surgical procedures, it is imperative that practicing surgeons and residents become familiar with and skilled in the technique of safe bowel anastomosis. The location of the anastomosis, the condition of the colon, the underlying cause of the disease and the general condition of the patient all affect the anastomosis procedure.[5]

The impact of the anastomosis technique on patient outcomes is also a critical area of research. Key outcomes of interest include the rate of anastomotic leaks, the incidence of postoperative complications such as infections or bowel obstructions, the time to recovery of normal bowel function, the length of hospital stay, and overall patient survival. Understanding how the choice of anastomosis technique influences these outcomes is essential for improving surgical practices and patient care.

Aim and objectives

To compare the effectiveness of single-layered and double-layered intestinal anastomosis.

Materials and methods

A prospective, single-centre, double-blind, randomized controlled study was conducted to compare the outcomes of two different techniques for intestinal resection and anastomosis at the Department of General Surgery, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, India, for a period of two years (September 2016- March 2017). The Institutional Ethics Committee gave the study its approval. Patients' consent was obtained before starting the study.

Adult patients aged between 18 to 70 years, of either gender, who required intestinal resection and anastomosis were evaluated for eligibility upon admission to the surgical ward. Eligibility was determined through a combination of physical examination, routine blood tests, and imaging studies (either ultrasonography or computed tomography of the abdomen), as appropriate.

Inclusion criteria were limited to hemodynamically stable patients with haemoglobin levels greater than 8 g/dL and no signs of peritoneal contamination. The study included both emergency and elective procedures involving jejuno-jejunal, jejuno-ileal, ileo-ileal, ileo-colic, and colo-colic anastomoses, as well as stoma closures.

Exclusion criteria were applied to patients undergoing gastric, duodenal, or rectal anastomosis, or those requiring proximal diversion. Additionally, patients with expected delayed recovery—such as those with septicaemia, hypovolemic shock, significant intraoperative or postoperative bleeding (>1 litre), severe cachexia requiring total parenteral nutrition, cases requiring re-exploration, patients necessitating postoperative intensive care, those with severe systemic organ dysfunction (chronic liver, renal, or heart diseases, or diabetes mellitus), extensive small intestine resections, and immunocompromised individuals—were excluded from the study.

ISSN: 0975-3583,0976-2833 VOL 08, ISSUE 04, 2017

A total of 100 eligible patients who underwent intestinal resection and anastomosis were randomly assigned to one of two groups. Written informed consent was obtained from all participants after explaining the study's purpose and procedures.

The participants were then randomly allocated to undergo either a single-layer extra-mucosal intestinal anastomosis (Group A) or a double-layer intestinal anastomosis (Group B). Randomization was carried out by drawing sealed opaque envelopes in the operating room immediately before surgery, ensuring that the assignment remained concealed until the procedure began. The study design ensured that both the participants and the postoperative care providers remained blinded to the type of anastomosis performed.

The primary outcome measures for the study included the average time taken to complete the anastomosis (measured in minutes), the incidence of postoperative complications (such as anastomotic leaks, intra-abdominal abscesses, pelvic collections, persistent vomiting, and abdominal distension), the mean duration of hospital stay, and the cost of the suture material used. Secondary outcome measures focused on the return of bowel function, which included the duration that a nasogastric tube remained in place (measured in days), the time taken for bowel sounds to return postoperatively (average in days), and the day of the first postoperative bowel movement (average in days).

All surgical procedures were performed by the same surgical team to ensure consistency. The affected bowel segment was resected according to standard surgical protocols, and all anastomoses were of the end-to-end type. For the single-layer anastomoses (Group A), continuous 3-0 polydioxanone sutures were used, starting at the mesenteric border, ensuring that all layers of the bowel wall, except the mucosa, were included in each bite. The double-layer anastomoses (Group B) were performed using interrupted 3-0 silk Lembert sutures for the outer layer and continuous 3-0 polyglycolic acid sutures for the inner layer. In both techniques, stitch advancement was approximately 5 mm, with each bite encompassing 4 to 6 mm of the seromuscular layer. Additional care was taken at the mesenteric border to ensure a secure seal while avoiding ischemia by applying only the necessary pressure to achieve a watertight anastomosis.

Intraoperative parameters such as hemodynamic, complications, the quantity, and cost of suture materials were meticulously recorded. The time taken to complete the anastomosis was measured from the placement of the first stitch to the cutting of the final suture. Nasogastric tubes were not routinely used preoperatively in patients undergoing stoma closure; instead, their postoperative use was determined based on individual clinical progress.

All patients received standardized postoperative care, including antibiotics (Ceftriaxone and Metronidazole) and appropriate supportive care. They were monitored for two weeks post-surgery, with a focus on the time required for the return of bowel function and the occurrence of any immediate or delayed complications. Anastomotic leaks were defined by radiographic evidence of fistula formation or non-absorbable material draining from a wound following oral administration, or by the visible disruption of the suture line during re-exploration. Intra-abdominal abscesses were suspected in patients presenting with fever, persistent abdominal pain, tachycardia, and leukocytosis, and were confirmed through abdominal ultrasonography. The total length of hospital stay was calculated from the day of surgery.

Statistical Analysis

The data were analyzed on an intention-to-treat basis. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software, version 25.0.

Differences between the two groups were evaluated using the Chi-square test (with or without Yates correction) for categorical data and the student’s t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

ISSN: 0975-3583,0976-2833 VOL 08, ISSUE 04, 2017

Results

Table 1: Patient Demographics and Baseline Characteristics

Characteristic	Group A: Single-Layer (n=50)	Group B: Double-Layer (n=50)	p-value
Age (years)	45.3 ± 12.4	46.1 ± 13.1	0.72
Gender (Male/Female)	28/22	26/24	0.67
Haemoglobin (g/dL)	11.5 ± 1.4	11.6 ± 1.5	0.88
Type of Procedure (Emergency/Elective)	22/28	24/26	0.75

Table 1, shows that he demographic characteristics of the patients in both groups were similar, with no statistically significant differences observed. The mean age of the participants was 45.3 ± 12.4 years in the Single-Layer group (Group A) and 46.1 ± 13.1 years in the Double-Layer group (Group B), with a p-value of 0.72, indicating that age was evenly distributed between the two groups. Gender distribution was also comparable, with Group A comprising 28 males and 22 females, and Group B consisting of 26 males and 24 females (p=0.67). Haemoglobin levels were similar between the groups, with Group A averaging 11.5 ± 1.4 g/dL and Group B averaging 11.6 ± 1.5 g/dL (p=0.88). The type of procedure (emergency versus elective) showed no significant difference, with 22 emergency and 28 elective cases in Group A, compared to 24 emergency and 26 elective cases in Group B (p=0.75). These results suggest that the baseline characteristics were well-matched between the two groups, ensuring that any differences in outcomes could be attributed to the surgical technique rather than demographic variables.

Table 2: Intraoperative Outcomes

Outcome	Group A: Single-Layer (n=50)	Group B: Double-Layer (n=50)	p-value
Time for Anastomosis (minutes)	22.5 ± 4.1	35.7 ± 5.6	<0.001
Quantity of Suture Material Used (m)	3.2 ± 0.5	5.8 ± 0.7	<0.001
Cost of Suture Material (USD)	$15 ± 3	$25 ± 4	<0.001

Intraoperative outcomes revealed significant differences between the two groups. The time required to perform the anastomosis was considerably shorter in the Single-Layer group, with an average of 22.5 ± 4.1 minutes compared to 35.7 ± 5.6 minutes in the Double-Layer group (p<0.001). This suggests that the single-layer technique is more time-efficient. Additionally, the quantity of suture material used was significantly less in Group A (3.2 ± 0.5 meters) compared to Group B (5.8 ± 0.7 meters), with a p-value of <0.001, reflecting the simpler and faster nature of the single-layer approach. Consequently, the cost of suture material was lower in Group A ($15 ± 3) compared to Group B ($25 ± 4), with a p-value of <0.001, indicating potential cost savings associated with the single-layer technique.

Table 3: Postoperative Complications

Complication	Group A: Single-Layer (n=50)	Group B: Double-Layer (n=50)	p-value
Anastomotic Leak (%)	2 (4%)	4 (8%)	0.67
Intra-abdominal Abscess (%)	3 (6%)	5 (10%)	0.46
Pelvic Collection (%)	1 (2%)	3 (6%)	0.62
Persistent Vomiting (%)	4 (8%)	5 (10%)	0.73
Abdominal Distension (%)	3 (6%)	4 (8%)	0.79

Table 3 and figure 1 shows that the incidence of postoperative complications was relatively low in both groups, with no statistically significant differences observed. Anastomotic leaks occurred in 4% of patients in Group A and 8% in Group B (p=0.67). Intra-abdominal

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abscesses were noted in 6% of Group A and 10% of Group B (p=0.46). Pelvic collections were observed in 2% of Group A and 6% of Group B (p=0.62). Persistent vomiting was reported in 8% of Group A and 10% of Group B (p=0.73). Finally, abdominal distension was seen in 6% of Group A and 8% of Group B (p=0.79). Although there were slightly higher rates of complications in the Double-Layer group, these differences were not statistically significant, indicating that both techniques have similar safety profiles in terms of postoperative complications.

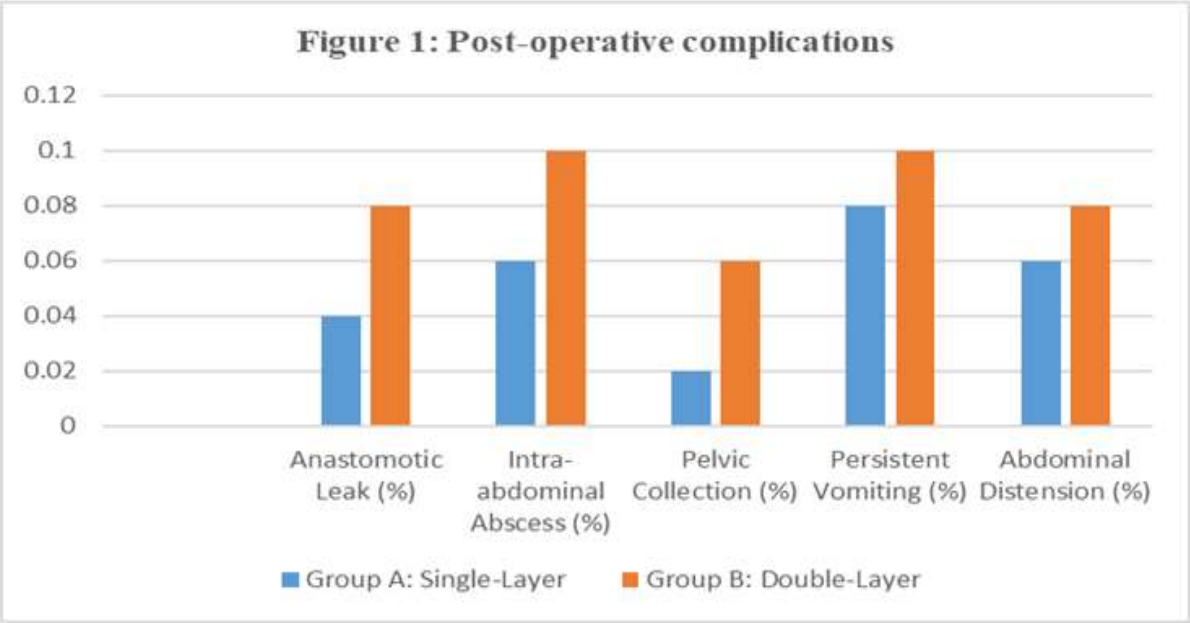

Table 4: Postoperative Recovery and Return of Bowel Function

Outcome	Group A: Single-Layer (n=50)	Group B: Double-Layer (n=50)	p-value
Duration of Nasogastric Tube (days)	2.3 ± 0.7	3.1 ± 0.8	<0.001
Return of Bowel Sounds (days)	2.5 ± 0.6	3.4 ± 0.9	<0.001
First Postoperative Bowel Movement (days)	3.1 ± 0.8	4.2 ± 1.0	<0.001

Postoperative recovery and the return of bowel function were significantly quicker in the Single-Layer group. The duration for which the nasogastric tube remained in place was shorter in Group A (2.3 ± 0.7 days) compared to Group B (3.1 ± 0.8 days), with a p-value of <0.001. The time for the return of bowel sounds postoperatively was also faster in Group A (2.5 ± 0.6 days) compared to Group B (3.4 ± 0.9 days), with a p-value of <0.001. Similarly, the first postoperative bowel movement occurred earlier in Group A (3.1 ± 0.8 days) than in Group B (4.2 ± 1.0 days), with a p-value of <0.001. These findings suggest that the single-layer technique facilitates a quicker recovery of gastrointestinal function, potentially reducing patient discomfort and accelerating discharge.

Table 5: The duration of the Hospital Stay

Outcome	Group A: Single-Layer (n=50)	Group B: Double-Layer (n=50)	p-value
Total Length of Hospital Stay (days)	7.8 ± 1.4	10.2 ± 1.6	<0.001

The total length of hospital stay was significantly shorter for patients in the Single-Layer group. On average, patients in Group A were discharged after 7.8 ± 1.4 days, whereas those in Group B required 10.2 ± 1.6 days of hospitalization (p<0.001). This difference underscores

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the efficiency of the single-layer technique not only in reducing intraoperative time but also in promoting faster overall recovery, which can have important implications for hospital resource utilization and patient satisfaction.

Discussion

The key elements in the formation of a bowel anastomosis include precise technique, delicate tissue manipulation, proper alignment of intestine ends, sufficient blood flow, and the absence of stress or blockage in the distal area. Randomized investigations have shown that there are no discernible differences in rates of leakage, length of hospital stay, and overall morbidity comparing stapled and hand-sewn anastomosis. Continuous sutures provide no benefit over interrupted sutures; nonetheless, this conclusion is based only on retrospective investigations. Burch M. Jon et al. studied on sixty-five single-layer and 67 two-layer anastomoses. 3% of leaks occurred in the single-layer group and 1.5% in the two-layer group. A mean of 20.8 minutes was required to construct a single-layer anastomosis versus 30.7 minutes for the two-layer technique. The mean length of stay was 7.9 days for single-layer patients and 9.9 days for two-layer patients; this difference did not quite reach statistical significance. The cost of materials was $4.61 for the single-layer technique and $35.38 for the two-layer method. Conclusions A single-layer continuous anastomosis can be constructed in significantly less time and with a similar rate of complications compared with the two-layer technique. It also costs less than any other method and can be incorporated into a surgical training program without a significant increase in complications.[6]

The similarity in demographic characteristics between the two groups is crucial as it eliminates potential confounding variables that could influence the outcomes. The mean age, gender distribution, haemoglobin levels, and the type of procedure (emergency vs. elective) were all comparable between the Single-Layer (Group A) and Double-Layer (Group B) groups.

The lack of significant differences in these baseline characteristics confirms that the observed differences in outcomes can be confidently attributed to the anastomosis technique rather than patient demographics. One of the most notable findings of the present study was the significantly shorter operative time associated with the single-layer technique. The mean time for anastomosis in Group A was 22.5 ± 4.1 minutes, compared to 35.7 ± 5.6 minutes in Group B ($p<0.001$). Previous studies reported significantly shorter duration of anastomosis for single-layered anastomosis.[7-9]

The reduced quantity of suture material used in the single-layer group (3.2 ± 0.5 meters vs. 5.8 ± 0.7 meters in the double-layer group) further corroborates this, as fewer stitches directly correlate with shorter operative times. Additionally, the cost-effectiveness of the single-layer technique, highlighted by the lower cost of suture material ($15 ± 3 vs. $25 ± 4, $p<0.001$), is a significant consideration, particularly in resource-limited settings. Other studies reported lower costs for the single-layer technique.[6, 8, 10]

The incidence of postoperative complications was relatively low and similar between the two groups, with no statistically significant differences. Anastomotic leaks, intra-abdominal abscesses, pelvic collections, persistent vomiting, and abdominal distension were slightly more common in the double-layer group, but these differences were not statistically significant.

In present study the anastomotic leak in group-A was 4% whereas in group B patients was 8%. In a study by Khan et al.[9], they observed that 6% anastomotic leak was present in group-S and 12% in group-D, while in a study by Ahmed et al.[11], found that 4% anastomotic leak was present in group-S and 8% in group-D.

It has also been attempted to correlate leaking with gender, besides studying the effects of single-layer and double-layer anastomosis approaches on leakage.

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According to Lipska et al.[12], male gender, prior abdominal surgery, and low levels of rectal cancer have been associated with increased incidences of anastomotic leak in a study that included 541 consecutive colon and rectum anastomoses. The risk of leakage and dehiscence in elderly individuals has been studied by Irvin and Goligher.[13]

In comparison to patients under 60, they found that over 50% of the patients were over 60 and that anastomotic breakdown was significantly higher in these patients. The length of hospital stay can be doubled, and the mortality rate may increase threefold as a result of an anastomotic leak, which also increases the morbidity and mortality related to the procedure.[14]

The similar safety profiles of the two techniques suggest that the choice between them can be made based on other factors, such as operative time, cost, and postoperative recovery, without compromising patient safety.

Postoperative recovery, particularly the return of bowel function, was significantly faster in the single-layer group. The shorter duration of nasogastric tube placement, quicker return of bowel sounds, and earlier first bowel movement all favour the single-layer technique.

The accelerated recovery not only improves patient comfort but also reduces the length of hospital stay, which is a critical factor in hospital resource management and patient throughput. The shorter hospital stay observed in the single-layer group (7.8 ± 1.4 days vs. 10.2 ± 1.6 days in the double-layer group, $p<0.001$) is perhaps one of the most significant findings of this study. Shorter hospitalization reduces healthcare costs and the risk of hospital-acquired infections, and it also enhances patient satisfaction.

Consistent with findings from earlier research, the single layer group in our study reported a quicker return to normal postoperative bowel function than the double layer group.[15,16] Furthermore, Maurya SD et al.[15] found that stays in the one-layer arm were shorter than those in the two-layer arm (11.4 days versus 18.6 days, respectively).

This aspect is particularly important in the current healthcare climate, where efficiency and cost-effectiveness are increasingly prioritized. The results of this study are in line with the broader literature on the topic, reinforcing the advantages of single-layer anastomosis in terms of operative efficiency, cost, and recovery times.

Limitation of the study

The shortcoming of the study is small sample size and duration of the study was short.

Conclusion

We concluded that the single-layer anastomosis technique is superior to the double-layer technique in terms of operative time, suture material usage, and cost efficiency, without compromising patient safety. Furthermore, the single-layer technique is associated with faster postoperative recovery and a shorter hospital stay, making it a potentially preferable option for patients undergoing intestinal resection and anastomosis.

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