

## A Comparative Study between Single Layer Mucosa Sparing Versus Double Layer Intestinal Anastomosis

Kushaldeep Kaur<sup>1</sup>, Harnam Singh Rekhi<sup>2</sup>, Arshdeep Singh Rekhi<sup>3</sup>, Sushil Kumar Mittal<sup>4</sup>, Gurjot Singh<sup>5</sup>

<sup>1</sup>Junior Resident, Dept. of General Surgery, Govt. Medical College & Rajindra Hospital, Patiala

<sup>2</sup>Professor, Dept. of General Surgery, Govt. Medical College & Rajindra Hospital, Patiala

<sup>3</sup>Junior Resident, Dept. of Surgery, Dayanand Medical College & Hospital, Ludhiana

<sup>4</sup>Professor, Dept. of General Surgery, Govt. Medical College & Rajindra Hospital, Patiala

<sup>5</sup>Senior Resident, Dept. of General Surgery, Govt. Medical College & Rajindra Hospital, Patiala

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Corresponding Author: Dr. Gurjot Singh

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### Abstract:

**Introduction:** Gastro-intestinal anastomosis is one of the most commonly performed procedures in both the elective and emergency surgical theatres worldwide and such procedures are commonly performed to restore the gut continuity after resection of primary pathology or at times to bypass the same. A thorough knowledge of the principles of a good anastomotic technique is a pre-requisite to achieve good surgical outcomes for any surgeon dealing with abdominal surgeries.

**Material and Methods:** 100 patients who required intestinal anastomosis were included in the study. These patients were divided into two groups- A and B with 50 patients each. In group A, intestinal anastomosis was done using single layer mucosa sparing technique. In group B, anastomosis was done using the conventional double layer technique. A comparison was made between both the groups in terms of per-operative and post-operative outcomes i.e., time taken for anastomosis, incidence of anastomotic leak, intra-abdominal abscess, sepsis, paralytic ileus, wound infection, mortality and duration of hospital stay.

**Results:** Mean duration required for single layer mucosa sparing anastomosis was found to be significantly lesser than double layer technique (18.76+1.60 mins vs 28.88 + 2.02 mins). In terms of postoperative leak and other complications, double layer intestinal anastomosis offered no definite advantage of single layer mucosa sparing anastomosis with similar outcomes observed.

**Conclusion:** Considering the duration of procedure and ease of completion, single layer mucosa sparing intestinal anastomosis may prove the optimal choice in most gastro-surgical situations.

**Keywords:** Anastomosis, Single Layer, Double Layer.

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### Introduction

Gastrointestinal anastomosis is an ever evolving and a very exciting procedure commonly performed in the routine surgical practice. It aims to make a good alignment of bowel through which the contents can pass in as early and as easily as possible. Gastro-intestinal surgery and its origin dates back to ancient times and it have been described as a modality to treat life threatening injuries to the gut. Common surgical procedures followed were aimed at restoring the intestinal continuity which was done by re-approximation of the severed bowel by various methods of intestinal suturing, description of which could be found in the writings of Hippocrates (460BCE) and Celsus (30 BCE- 30 CE). [1] With times, gastrointestinal surgery has undergone a sea of change. In today's day and age, bowel resection and anastomosis is being done for various causes

like benign and malignant tumors of small and large bowel, bowel obstruction, incarcerated hernias/strangulated hernias, inflammatory conditions of bowel, intestinal perforation and restoration of bowel continuity in enterostoma cases. Bowel anastomosis after resection of the diseased segment may be carried out in either of the three common orientations that is as an end to end, side to side or end to side anastomosis depending upon the pathology, present condition and the operating surgeon's choice, comfort and expertise. Furthermore, in any chosen orientation, different techniques of intestinal anastomosis may be utilized in form of the classical hand sewn methods (single layer closure in interrupted or continuous fashion & the double layer closure), staples [2], fibrin glue and laser welding [3]. Due to the cost factor and issues of universal

availability and surgeon's familiarity involved in some of the newer techniques, the traditional hand-sewn techniques of bowel anastomosis continue to be utilized by the surgeon's worldwide especially in resource austere settings.

When two areas of skin are joined together, there is a strong evolutionary incentive to achieve rapid healing in order to prevent infection of the tissue underneath. However, joining two segments of bowel and also restoring intestinal function while preventing leakage of intestinal contents is a relatively difficult and complicated task. Failure of anastomosis and consequent leakage is still a common & dreaded surgical complication, despite the recent advances made in this field and carries significant morbidity and mortality, thus adversely affecting the surgical outcomes and patient's quality of life. The principles to be followed to ensure successful anastomosis are well established and include the presence of well vascularized tissues, a tension free anastomosis, no distal obstruction, absence of faecal contamination, adequate exposure and excess, meticulous technique and a well-nourished patient with no systemic illness.

In 1887, William Halsted discovered that it is the submucosa which provides the gastrointestinal tract with the majority of its tensile strength. [4] The bulk of collagen along with blood vessels, lymphatics and the nerve fibers are contained within this layer. The muscularis propria layer consists of the smooth muscle cells (longitudinal and circular fibres) which are interspersed with a dense network of collagen. The collagen content in this layer increases significantly in response to chronic obstruction. The outermost layer is the serosa which is a thin layer of connective tissue covering the muscularis propria. It is widely proposed that during creation of an anastomosis, direct apposition of this layer minimizes the risk of anastomotic leak. Historically, the hand sewn double layer anastomosis which uses an outer inverted seromuscular layer and a running transmural inner layer has been the standard technique for most of the situations. In this technique, a posterior inner layer is formed with full thickness continuous suture whilst the anterior inner layer is formed with Connell sutures. Both anterior and posterior outer layers are formed with continuous or interrupted Lembert sutures. The double layer anastomosis has been noted for producing mucosal inversion and serosal apposition. The inner layer is believed to be hemostatic but there may be damage to submucosal vascular plexus which may result in strangulation of mucosa. Currently, the single layer intestinal anastomosis is preferred more as it probably causes less luminal narrowing or tissue necrosis and also requires less time and cost without any additional risk of leakage. In the single layer technique, only seromuscular layer of gut wall is approximated by interrupted or continuous sero-submucosal sutures. This technique

incorporates the strongest layer (submucosa) of gut and causes minimal damage to the submucosal vascular plexus, thus maintaining the anatomy with less chances of mucosal necrosis. This comparative study attempts to compare single layer mucosa sparing versus double layer intestinal anastomosis in terms of time required to perform bowel anastomosis, peri-operative outcomes and post-operative complications in each sub-group with the primary aim of arriving at the potential superiority, if any, of the one technique over the other.

### Material and Methods

The comparative study was conducted in the Department of General Surgery, Government Medical College and Rajindra Hospital Patiala. A total of 100 patients who required intestinal anastomosis in any form were included in the study. These patients were randomly divided into two groups- A and B. Each group consisted of 50 patients each. Before commencing with the study, an institutional ethical committee clearance was obtained with respect to the study design and plan. A duly informed and written consent about the procedural details and the study design was taken from each patient. In group A, intestinal anastomosis was done using single layer mucosa sparing technique. All anastomoses were done using exclusively a non-absorbable suture (silk 2-0/3-0 in interrupted manner). In group B, the anastomosis was done using the double layer technique, in which an inner layer was sutured using continuous absorbable suture (Polyglactin 910 in 3-0/2-0) and an external layer was sutured using interrupted 3-0/2-0 silk suture (Lembert's stitch). Anastomosis was done using hand sewn method and all the surgeries were performed by same team of experienced surgeons. A comparison was made between both the groups in terms of per-operative and post-operative outcomes i.e., time taken for anastomosis, rates of anastomotic leak, intra-abdominal abscess, sepsis, paralytic ileus, wound infection, duration of hospital stay and mortality, if any.

### Inclusion Criteria

- Patients who gave written consent for participation in the study.
- Patients who required bowel anastomosis for various causes at our hospital.

### Exclusion Criteria

- Patients who refused to give written consent for the participation in study.
- Associated co-morbid conditions like known cardiovascular disease, chronic renal disease, chronic liver disease and uncontrolled diabetes.

In patients admitted in emergency ward, preoperative resuscitation was undertaken first. I.V fluids were given through a wide bore cannula and

dys-electrolytemia, if any, was corrected. A close watch on vitals and urine output was kept. Patient was kept NPO and Ryle's Tube was inserted. Per-urethral catheterization was done under all aseptic conditions. Appropriate analgesics and an empirical antibiotic cover was given. Once the patient was stabilized, he or she was taken for emergency laparotomy without any further delay. In elective surgeries, bowel preparation was done one day prior to the day of surgery. Patient was kept NPO, I.V fluids were given during night, and serum electrolytes were checked in the morning before surgery. Prophylactic intravenous and/or oral antibiotics (colorectal cases) were given prior to the surgery as per standard protocols.

Intra-operatively, after resection of the diseased segment, the bowel ends were cleaned with 5% povidone iodine swab and approximated. In group A, anastomosis was done with interrupted non-absorbable suture beginning at mesenteric border, incorporating all the layers except mucosa.

In group B, inner transmural layer was sutured in a continuous manner using the absorbable polyglactin 910 suture (3-0/2-0) and the outer seromuscular layer was sutured in an interrupted manner, inverting the inner layer using silk 2-0/3-0 suture. The time of anastomosis began with the placement of first stitch and ended when the last stitch was cut. Abdominal drain(s) of adequate bore size were

placed based on the surgery needs and were removed once the output was minimal and the contents clear. Post-operative complications in the form of formation of intra-abdominal collection/ abscess, anastomotic leak, development of paralytic ileus, surgical site infection/ dehiscence and sepsis were duly noted. Suture removal was done after about 10 days confirming adequate wound healing. The duration of hospital stay was noted in days and mortality, if any, recorded.

### Statistical analysis

Results were expressed as mean and standard deviation for continuous data and frequency as number and percentage. Unpaired t test was used to compare mean levels between two groups. Categorical data was analyzed by Chi square test and Fischer's exact test. A value of 0.05 or less was considered for statistical significance.

### Results

The mean age of patients in group A & B was  $45.32 \pm 2.6$  &  $43.04 \pm 2.1$  years respectively with majority of the patients falling in the 41-50 years age group. 76% (n = 38) & 82% (n = 41) of the patients were males in Group A and B respectively. Furthermore, Table 1 illustrates that in both groups ileocaecal tuberculosis was diagnosed in maximum number of patients i.e., a total of 28 (28%) cases.

**Table 1: Disease Groups & Patients**

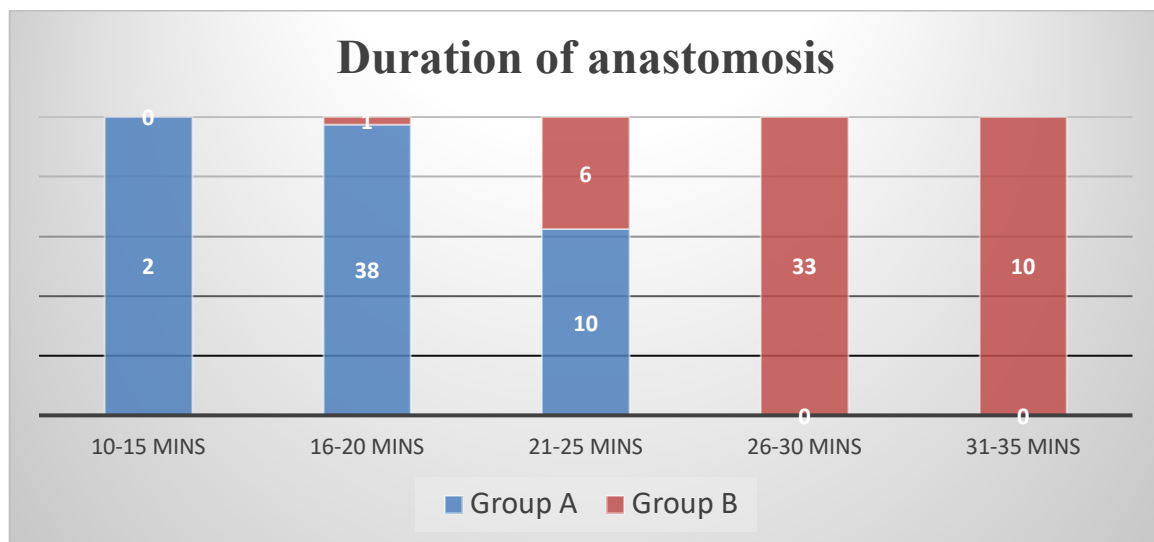
Disease group	No. of cases (n)	% age
Carcinoma colon	18	18%
Sigmoid stricture	2	2%
Caecal GIST	1	1%
Traumatic small bowel perforation	19	19%
Ileocaecal TB	28	28%
Ileal stricture of other causes	16	16%
Ileo-ileal intussusception	4	4%
Strangulated ventral or groin hernia	8	8%
Mesenteric ischemia small bowel	4	4%

In both the groups, resection of the ileum with ileo-ileal anastomosis was performed in maximum number of patients i.e., 28 (56%) in Group A and 26 (52%) in Group B as shown in Table 2. The maximum number of anastomoses in both groups were performed at entero-enteric site (56%; n = 28 each in both the groups) followed by entero-colic site (36%; n = 18 in Group A and 40%; n = 20 in Group B) and least at colo-colic site (four & two cases in Group A & B respectively). The mean duration of anastomosis from starting of first stitch to last stitch in Group A (single layer mucosa sparing) was 18.76 minutes ranging from 14 – 22 min and in Group B (double layer) was 28.88 minutes ranging from 24 – 35 min which is highly

significant ( $P < 0.001$ ) as shown in Figure – 1 & Table - 3. It was seen that anastomotic leak occurred in two (4%) cases in Group A in comparison to three (6%) such cases in Group B. However, the difference was not found to be statistically significant ( $P$  value 0.363). The incidence of other complications was also comparable between the two groups and the complication rate was not found to be statistically significant. It was also observed that the mean duration of hospital stay in Group A was 10 days and in Group B was 10.16 days with the statistically insignificant ( $P$  value 0.302) difference of 0.16 days. Two patients in Group A and one patient in Group B succumbed to their illness. (Figure – 2; post-operative outcomes)

**Table 2: Type of Procedure in Each Group**

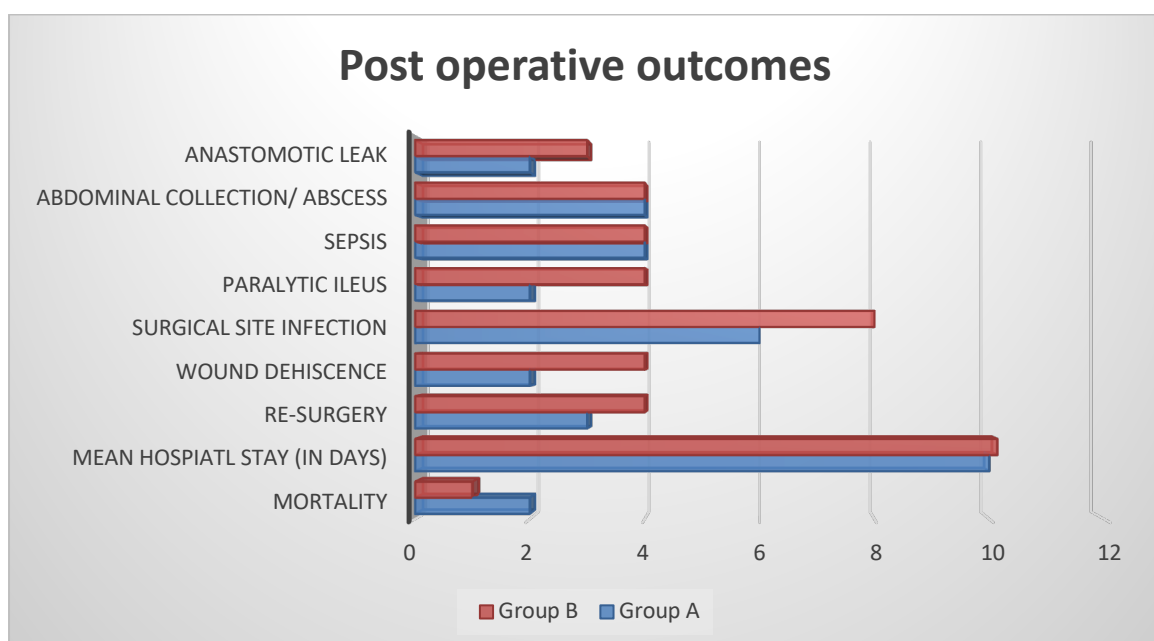
Procedure	Group A		Group B	
	No of cases	% age	No of cases	% age
Resection of terminal ileum & caecum with ileo-colic anastomosis	8	16%	10	20%
Resection of ileum with ileo-ileal anastomosis	28	56%	26	52%
Right hemicolectomy with ileo-transverse anastomosis	10	20%	10	20%
Jejunal resection with end to end anastomosis	0	0	1	2%
Sigmoid resection with end to end anastomosis	1	2%	1	2%
Left hemicolectomy with colorectal anastomosis	3	6%	2	4%



**Figure 1: Duration of Anastomosis**

**Table 3: Duration of Anastomosis**

Groups	Range (Duration in minutes)	Mean + SD	Mean difference	t value	P value
Group A	14 -22 -	18.76+ 1.60	10.12	19.4	<0.001
Group B	24 - 35	28.88 + 2.02			



**Figure 2 : Post Operative Outcomes\***

\* P value >0.5 in all the parameters

## Discussion

In the present study, maximum number of patients in both the groups was in the age group of 41-50 years. The mean age in Group A (single layer) was 45.32 years and in Group B (double layer) was 43.04 years. It was in concordance with the results obtained by previous authors wherein similar findings were also reported by them in their respective studies. Mean age in a study conducted by Burch et al [5] was 44.3 and 44.7 years in single layer group and double layer group respectively. Mean age in a study conducted by Saboo R et al [12] was 49.46(single layer group) and 49.66(double layer group).

The mean duration of anastomosis from starting of the first stitch to last stitch of anastomosis was 18.76 minutes with a range of 14 – 22 minutes in Group A and 28.88 minutes with a range of 24 – 35 minutes in Group B. Our results were in concordance with previous studies. In a study conducted by Burch JM et al the mean duration of anastomosis were 20.8 minutes for single layer group and 30.7 minutes for double layer group. [5] The mean time required for anastomosis was 18.3 minutes and 25.8 minutes in single layer group and double layer group respectively in a study conducted by Mehmood Y et al. [6]

In a study conducted by Pathak A et al the mean duration of anastomosis was 17.59 minutes and 30.16 minutes in single layer group and double layer group respectively. [7] The difference in average time is statistically significant in these studies as well as in present study. Thus, it becomes clear that the use of single layer technique provides the added advantage of reduced anastomotic & thus the overall operative times. As far as the post-operative outcomes are concerned, anastomotic leak occurred in 2 (4%) and 3 (6%) patients in Group A & B respectively which was found to be comparable. Similarly, comparable leak rates were obtained in a study conducted by Shah T et al [8], with leak seen in 3(7.9%) cases in 'single-layer' group and in 3 (7.5%) cases in 'double-layer' group.

Anastomotic leak rates of similar incidence in either technique were also observed by Abdella MR et al. with 2(6.7%) cases in each group suffering this complication [10]. In these studies, as well as in our study this difference was insignificant. In our study, paralytic ileus developed in 2(4%) patients in group A and in 4(8%) patients in group B. These patients were managed conservatively. It was seen in 1(2%) and 2(4.25%) cases in 'single-layer' and 'double-layer' groups respectively in a study conducted by Kar S et al, and in 1(1.5%) patient of 'single-layer' group in a study conducted by Dhamnaskar SS et al. [9,12] These complication rates were found to be similar in both the techniques with no statistically significant difference.

In the present study, the average duration of hospital stay was 10 days in Group A and 10.16 days in Group B which was in concordance with 10.4 days in both the groups in a study conducted by Ordorica et al. [11] In a study conducted by Burch JM et al the average duration of hospital stay was 7.9 days and 9.9 days in single layer group and double layer group respectively. [5] In these studies as well as in present study, it was statistically insignificant.

## Conclusion

There is always a controversy regarding the optimal and ideal hand-sewn technique of intestinal anastomosis following resection. Two main methods that is a single layer closure and double layer closure are adopted worldwide. In the present study, the single layer mucosa sparing technique was compared with the conventional double layer technique. In the single layer technique, full thickness mucosa sparing bites were taken for re-approximation of the cut ends of gut. This ensures incorporating the submucosa, which is the strongest layer of the gut with highest tensile properties and at the same time sparing the mucosa, thus preventing injury to the submucosal vascular plexus thereby avoiding mucosal necrosis. It was concluded that time required to perform such a single layer mucosa sparing interrupted anastomosis is significantly lesser when compared to the conventional double layer technique.

However, as far as the other post-operative outcomes are concerned vis-à-vis anastomotic leak rates, complications like intra-abdominal abscess formation, wound related complications like infection and dehiscence as well as mean hospital stay, no significant difference was observed in both the groups.

Thus, the double layer anastomosis offers no definite advantage over single layer mucosa sparing technique in terms of post-operative anastomotic and surgical outcomes with the latter being easy to perform, less time consuming and simple to teach. However, limited sample size demands further large-scale studies to concretely determine the single layer mucosa sparing intestinal anastomosis as the optimal choice in most surgical situations.

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