



## A COMPARATIVE STUDY OF SINGLE LAYER CONTINUOUS GASTROINTESTINAL ANASTOMOSIS VERSUS SINGLE LAYER INTERRUPTED GASTROINTESTINAL ANASTOMOSIS

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### ABSTRACT

**Aim:** A comparative study of single layer continuous gastrointestinal anastomosis versus single layer interrupted gastrointestinal anastomosis.

**Material and Methods:** The comparative study was done on patients presenting to Department of Surgery, M.L.B. Medical College & Hospital, Jhansi, either in emergency or elective undergoing resection anastomosis of bowel from August 2017 to September 2019. A total of 100 patients would be included in each group.

**Result:** Patients presenting to Department of surgery, MLB Medical College Jhansi either in emergency or elective undergoing resection and anastomosis of bowel from 2017-2019 were maximally between 20-50 years of age showing male predominance. The number of patients presenting as an emergency (43.5%) were slightly less than the number of patients presenting with chronic conditions (56.5%) Maximum number of anastomosis were performed at entero-enteric level, followed by entero-colic level and colo-colic level and least at gastro-jejunosotomy site. Single layer sero muscular continuous anastomosis can be done in shorter time as compared to single layer sero muscular interrupted anastomosis. Length of post-operative hospital stay in both the techniques for anastomosis was found to be similar. Wound infection rates were found to be similar in both the groups. Rate of anastomotic dehiscence was twice in interrupted group when compared to continuous group which was statistically insignificant. Mortality observed in continuous group was found to be double of the interrupted group but none related to the outcome of anastomoses. Increased rates of complications like wound infection and anastomotic leak were observed in emergency situations when compared to elective surgeries.

**Conclusion:** Thus, we conclude that single layer seromuscular continuous anastomosis is easy to learn and can be done in shorter time as compared to single layer seromuscular interrupted anastomosis. At the same time it gives comparable mortality and morbidity figures. Thus single layer seromuscular continuous anastomosis can be taken up by all gastrointestinal surgeons depending upon their individual preference. The study needs further larger series of patients to arrive at a final conclusion.

**KEYWORDS :** Intestinal anastomosis, Single layer continuous seromuscular, single layer interrupted seromuscular

### INTRODUCTION

For over 150 years, intestinal anastomosis has been successfully performed using a variety of techniques and suture materials. The method that has stood the test in most situations and in the hands of most surgeons has been the double-layered anastomosis using interrupted silk sutures for an outer seromuscular layer and a running absorbable suture for a transmural inner layer. The potential shortcoming of the double-layered technique is the risk of anastomotic stricture formation. Several reports have appeared mentioning the construction to be tedious and time-consuming to perform.

Single-layered anastomosis requires less time to fashion. It costs less than the double-layered method and has no increased risk of leakage and of stricture formation.

Due to these prominent advantages, it is hypothesized that the single-layered anastomosis technique can be performed with no increased risk of complications and that it can be constructed in less time and at lesser cost than the double-layered technique<sup>[1]</sup>.

Intestinal anastomosis is an operative procedure that is of central importance in the practice of surgery. Intestinal anastomosis after resection of bowel may be of various types and techniques. The anastomotic technique depends upon site of anastomosis, bowel caliber, quality and underlying disease process but one important factor in making decision to perform a particular anastomosis, however, remains individual surgical experience and personal preference<sup>[2]</sup>.

Various complications following bowel anastomosis are anastomotic leak resulting into peritonitis, abscess, fistula, necrosis, stricture. Unfortunately, however, despite the "perfect patient", healthy bowel and meticulous technique some anastomoses continue to leak resulting in significant morbidity and mortality. The frequency of anastomotic leakage ranges from 1 to 24%. To minimize the risk of potential complications, it is imperative to adhere to several well-established

principles. The main ones relate to the creation of a tension-free join with good apposition of the bowel edges in the presence of an excellent blood supply<sup>[3]</sup>.

Single layer anastomosis causes least damage to submucosal vascular plexus, least chances of narrowing of lumen, incorporates strongest submucosal layer and accurate tissue apposition<sup>[4-5]</sup>.

### AIM AND OBJECTIVES

A comparative study of single layer continuous gastrointestinal anastomosis versus single layer interrupted gastrointestinal anastomosis.

### MATERIAL AND METHODS

The comparative study was done on patients presenting to Department of Surgery, M.L.B. Medical College & Hospital, Jhansi, either in emergency or elective undergoing resection anastomosis of bowel from August 2017 to September 2019.

The patients selected for this study were those admitted with various gastrointestinal clinical conditions requiring resection and anastomosis of small or large bowel. Based on detailed history, thorough clinical examinations, radiological examinations and ultrasound of abdomen, the diagnosis was made. Those requiring anastomosis involving the esophagus were excluded. Informed written consent was obtained and the procedure and its probable outcome was well explained to patients.

Patients were assigned into two groups, study group and control group. Selection of patients was made on random basis after matching for age, sex and disease. The study group comprised of patients undergoing single layer continuous seromuscular gastrointestinal anastomosis while control group included patients undergoing single layer interrupted seromuscular gastrointestinal anastomosis.

A total of 100 patients would be included in each group .

All the anastomoses were done by single operating surgeon.

**INCLUSION CRITERIA:**

1. All patients undergoing resection and anastomoses of small bowel and large bowel at our hospital in emergency or as elective procedure for causes like intestinal obstructions due to bowel ischemia, strangulated hernia, traumatic bowel injury, bowel tumours etc.

**EXCLUSION CRITERIA:**

1. Esophageal anastomosis.
2. Distal rectal anastomosis.

Based on duration of symptoms, the groups were categorized into Acute and Chronic disease groups. Patients presenting with acute symptoms were operated in emergency setting and patients presenting with chronic symptoms were operated as an elective procedure.

**Technique:**

The affected segment of bowel was resected as per the standard technique. The bowel ends were cleaned with 5% povidone iodine swab and approximated.

All the single layered intestinal anastomoses will be performed using a 3-0 polyglecaprone 25 that began at the mesenteric border, incorporating all the layers except the mucosa. Each bite included 4-6 mm of the seromuscular wall and each stitch was about 5 mm from each other. The larger bites will be used at the mesenteric border to ensure an adequate seal. Only enough pressure was applied to the suture to avoid ischemia of the anastomosis. The edges of the mesentery were closed to prevent any internal herniation. The patency of the anastomosed segment was confirmed by gently palpating the anastomosis between the thumb and the index finger.

**Variables to be studied:**

- Operative time
- Return of bowel activity
- Anastomosis leak
- SSI(surgical site infection)

The duration of anastomosis began with placement of first stitch on the bowel and ended when the last stitch was cut. All single layer anastomoses will be done with polyglecaprone 3-0 pack which had a suture material of 90 cm length.

Day of return of bowel activity was considered to be the post operative day when the patient first appreciated passing flatus.

Anastomotic leak was defined as fecal discharge in the drain or from the wound or a visible disruption of the suture line during re-exploration. Histopathological diagnoses will be confirmed and patients will be advised necessary treatment at the time of discharge.

On discharge, the patients will be followed up at 1st week, 3rd week and on 3rd month basis thereafter. The patients will be evaluated for gastrointestinal complaints and other complaints, if any.

A pretested performa used to collect relevant information (patient data, clinical findings, laboratory investigations, follow up events etc.) from all the selected patients. Data collected and compared with percentage/rate of parameter as sample size is small.



Figure 1a and 1b: Right hemicolectomy specimen

**RESULT**

**Table 1: Age wise distribution of cases in study groups**

Age (yrs)	SLC	Percentage (%)	SLI	Percentage (%)
<10	08	08.00%	07	07.00%
10-19	07	07.00%	06	06.00%
20-29	18	18.00%	24	24.00%
30-39	21	21.00%	15	15.00%
40-49	19	19.00%	20	20.00%
50-59	14	14.00%	10	10.00%
>60	13	13.00%	18	18.00%
Total	100	100%	100	100%

**TABLE 2: Mean Age SLC Vs SLI**

Parameter	SLC	SLI	P value
	Mean ± SD (n=100)	Mean ± SD (n=100)	
Age(yrs)	37.21+18.281	38.1+18.442	0.7322

**Table: 3 Gender distribution of cases in study groups**

Sex	SLC	Percentage (%)	SLI	Percentage (%)
Male	66	66.00%	73	73.00%
Female	34	34.00%	27	27.00%
Total	100	100%	100	100%

**Table 4: Duration of symptoms in study groups**

Duration of symptoms	SLC	Percentage	SLI	Percentage
Acute	38	38.00%	49	49.00%
Chronic	62	62.00%	51	51.00%
Total	100	100%	100	100%

**Table 5: Diagnosis distribution of cases in study groups**

Diagnosis	SLC	Percentage	SLI	Percentage
Acute intestinal obstruction (AIO)	23	23.00%	33	33.00%
SAIO	62	62.00%	51	51.00%
Peritonitis	15	15.00%	16	16.00%
Total	100	100%	100	100%

**Table 6: Mean anastomosis time in study groups**

Diagnosis	SLC (Mean+SD)	SLI (Mean+SD)	p value
Acute	6.02+1.270	20.70+2.410	0.0001
Chronic	5.57+1.451	20.62+2.513	0.0001
Total	5.747+1.396	20.661+2.451	0.0001

**Table 7: Anastomosis pattern in study groups**

Diagnosis	SLC	Percentage	SLI	Percentage
Gastro-Jejunostomy	09	09.00%	06	06.00%
Small bowel – small bowel	51	51.00%	57	57.00%
Small bowel – large bowel	30	30.00%	27	27.00%
Large bowel – large bowel	10	10.00%	10	10.00%
Total	100	100%	100	100%

**Table 8: Complication in study groups**

Complication	SLC	Percentage	SLI	Percentage	p value
Infection	8	8.00%	7	7.00%	0.78
Anastomotic dehiscence	1	1.00%	2	2.00%	0.56
Mortality	4	4.00%	2	2.00%	0.407

**TABLE 9: Complication in acute causative factor**

Complication	SSI		Anastomotic dehiscence		Mortality	
	SLC	SLI	SLC	SLI	SLC	SLI
Acute	03 (3%)	06 (6%)	00 (0%)	02 (2%)	01 (1%)	00 (0%)

**TABLE 10: Complication in chronic causative factor**

Complication	SSI		Anastomotic dehiscence		Mortality	
	SLC	SLI	SLC	SLI	SLC	SLI
Chronic	05 (5%)	01 (1%)	01 (1%)	00 (0%)	04 (4%)	02 (2%)

**TABLE 11: Bowel activity in study groups**

Parameters	SLC (Mean+SD)	SLI (Mean+SD)	p value
Bowel activity	2.63+0.994	3.04+0.764	0.0013

**Table 12: Hospital stay in study groups**

Parameters	SLC (Mean+SD)	SLI (Mean+SD)	p value
Hospital stay	8+3.303	7.95+2.921	0.9098

**DISCUSSION**

The advantages of a single row of sutures in gastrointestinal anastomosis had been pointed as early as almost 100 years ago by Halstead. The single layer continuous anastomosis was first described by Hautefeuille in 1976<sup>[1]</sup>. Subsequently a number of studies have shown equally good outcome after single layer continuous anastomosis as compared to double layer anastomosis.

Among the methods of single layer suturing, when we compare the results of continuous suturing with the interrupted suturing, the

question of superiority of one over the other is still unresolved due to lack of adequate studies in literature comparing the two.

A continuous suture is less time consuming to place, the suture line is more watertight with better hemostasis. However, the entire suture line is based on a single stitch.

Continuous suturing may also have a disadvantage of later development of stricture because of the suture constriction effect leading to subacute bowel obstruction in future. However, there are no studies to date on post-operative strictures and a reason for stricture not being a common outcome of the single layer continuous suturing has been put forward by Bailey et al<sup>[2]</sup>, who speculated that continuous single layer suture resembles a circular coiled spring and may be able to expand and contract depending on intraluminal forces.

Also, animal studies have shown that blood flow and mean tissue oxygen tension are reduced in both suturing techniques but more so in the continuous group, which result in impaired healing and increased complication rates. However clinical trials have failed to show any difference in the safety of the two suturing techniques.

Our current study was to demonstrate the efficacy of single layer continuous anastomosis with that of single layer interrupted anastomosis in terms of anastomotic time, hospital Stay, return of bowel activity and post surgical complications including Wound infection, Anastomotic leak and mortality.

**Anastomotic time:**

The most common disadvantage of single layer interrupted extra mucosal technique is that it takes comparatively more time for the anastomosis to be constructed by this method. The majority of comparative studies have shown that the time required to complete single layer continuous is lesser as compared to single layer interrupted (Deen et al<sup>[3]</sup>, Hussain et al<sup>[4]</sup>, Mahboob et al<sup>[5]</sup>).

Our study has also shown that mean time taken for creation of anastomosis was 5.74 minutes in single layer continuous anastomosis group (Group A) and 20.66 minutes in single layer interrupted anastomosis (Group B) p-value was 0.0001 and was found significant.

Study	Year	Cases	Anastomotic time	
			SLC	SLI
Deen KI et al <sup>[3]</sup>	1995	53	15	26
Hussain et al <sup>[4]</sup>	2015	50	10.04+1.37	19.2+1.93
Mahboob et al <sup>[5]</sup>	2019	60	12.15+1.40	20.98+1.38
Present study	2019	200	5.74+1.39	20.66+2.45

Deen KI et al<sup>[3]</sup> evaluated 53 cases of colonic anastomosis, which included 26 by single layer continuous anastomosis and 27 by single layer interrupted anastomosis. Anastomotic time was significantly longer in single layer interrupted group.

Hussain et al<sup>[4]</sup> also showed that the anastomotic time in continuous group was shorter when compare to interrupted group (SLC-10.04+1.37 min and SLI-19.2+1.93).

Mahboob et al<sup>[5]</sup> evaluation 60 patients which included 30 patients in both continuous and interrupted group. Anastomotic time was found to be 12.15+1.40 in continuous group and 20.98+1.38 in interrupted group with p value=0.000, which is statistically significant.

Our present study (done between 2017-2019) also concurs with the finding of a statistically increased anastomotic time for single layer interrupted anastomosis group (p-value=0.0001)

**Hospital stay:**

The majority of comparative studies have shown that the length of hospital stay in single layer continuous anastomosis is comparable to single layer interrupted anastomosis (Hussain et al<sup>[4]</sup>, Mahboob et al<sup>[5]</sup>). However, a retrospective analysis by Eickoff et al<sup>[6]</sup> showed prolonged postoperative stay in the interrupted group with a difference of 7 days.

Study	Year	Cases	Hospital stay	
			SLC	SLI
Hussain et al <sup>[4]</sup>	2015	50	5.8+2.22	6+2.02
Eickoff et al <sup>[6]</sup>	2019	347	16+11	23+15
Mahboob et al <sup>[5]</sup>	2019	60	6.40+1.32	6.32+0.66
Present study	2019	200	8+3.3	7.95+2.9

In a study by Hussain et al<sup>[4]</sup> 50 cases were evaluated and the length of hospital stay was found to be similar in both interrupted and continuous and was statistically non significant (SLC-5.87+2.22 and SLI-6+2.025).

Eickoff et al<sup>[6]</sup> retrospectively reviewed 347 cases of colonic intestinal resection and anastomosis over 6 year (190 interrupted, 157 continuous). Postoperative stay was longer in the interrupted suture group (23+15 vs 16+11 days; p=0.000)

In a study by Mahboob et al<sup>[5]</sup>, duration of postoperative hospital stay of continuous and interrupted group was 6.40+1.32 days and 6.36+0.66 days. The difference was statistically insignificant (p=0.903)

Our study (done between 2017-2019) is also consistent with the findings of majority of studies and has also shown that mean duration of hospital stay was 8 days in single layer continuous anastomosis group (Group A) and 7.95 days in single layer interrupted anastomosis group (Group B) which is statistically insignificant (p-value=0.90)

**Return of bowel activity:**

Day of return of bowel activity was considered to be the post operative day when the patient first appreciated passing flatus.

In our study, mean duration for passing flatus for single layer continuous anastomosis group was 2.63 days and for single layer interrupted anastomosis group was 3.04 days which is statistically significant (p-value=0.001)

Though there are no studies comparing this parameter between continuous and interrupted group, there are studies which have included this parameter.

In a study by Rahul saboo et al<sup>[7]</sup>, the mean duration of return of bowel sounds in 30 patients undergoing single layer continuous anastomosis was found to be 5.6±0.62 days.

Sibabrata et al<sup>[8]</sup> conducted a study where 50 patients underwent single layer continuous anastomosis and the mean duration of return of bowel sounds was found to be 2.42±1.11. Our data for single layer continuous agrees with the study of Sibabrata et al<sup>[8]</sup>.

**Wound site infection:**

STUDY	YEAR	CASES	WOUND SITE INFECTION	
			SLC	SLI
Hussain et al <sup>[4]</sup>	2015	50	2 (8.3%)	3 (11.5%)
Mahboob et al <sup>[5]</sup>	2019	60	5 (16.7%)	6 (20%)
Present study	2019	200	8(8%)	7(7%)

In the study by Hussain et al<sup>[4]</sup>, both continuous and interrupted groups showed similar wound infection rates.

In the study by Mahmood et al<sup>[5]</sup>, 100 participants were included. Infection of surgical wound was noted as 16.7% in continuous group and 20% in interrupted group. with a non significant p value (p value=0.739)

Our present study also shows similar incidence of postoperative wound complication in the both groups.

**Anastomotic leak:**

Study	Year	Cases	Anastomotic Leak	
			SLC	SLI
Deen KI et al <sup>[3]</sup>	1995	53	1(3.84%)	1(3.7%)
Hussain et al <sup>[4]</sup>	2015	50	1(4.2%)	2(7.7%)
Eickoff et al <sup>[6]</sup>	2019	347	2.5%	16%
Mahboob et al <sup>[5]</sup>	2019	60	2 (6.7%)	4 (13.3%)
Present study	2019	200	1(1%)	2(2%)

The ultimate test of the suitability of a technique for intestinal anastomosis is its ability to heal without leakage. A leaking anastomosis greatly increases morbidity and mortality.

The majority of comparative studies have shown that the rate of anastomotic leak in single layer continuous anastomosis is similar when compared to single layer interrupted anastomosis.

Hussain et al<sup>[4]</sup>, enrolled 50 patients in which 1 patient showed



anastomotic dehiscence in continuous group and 1 patient showed anastomotic dehiscence with non significant p value.

In a study by Deen et al<sup>[5]</sup> anastomotic leak rate was found equal in both groups, 1 continuous and 1 interrupted.

In a retrospective analyses of 347 patients over 6 years by Eickhoff et al<sup>[6]</sup>, overall leakage rate was 9% but strongly dependent on suture technique (interrupted: 16%; continuous: 2.5%; p=0.001)

In a study by Mahboob et al<sup>[5]</sup> dehiscence of anastomosis was observed as 6.7% and 13.3% for continuous and interrupted group respectively, which was statistically significant (p=0.389).

In our study, one patient (1%) showed anastomotic dehiscence among the single layer continuous group while 2 cases (2%) in single layer interrupted group showed leak with insignificant p value which is consistent with findings observed in majority of the studies.

#### Diagnosis distribution: Acute and Chronic:

Based on the duration of symptoms, the groups were categorized into Acute and Chronic disease groups. Patients presenting with acute symptoms were operated in emergency setting and patients presenting with chronic symptoms were operated as an elective procedure. Of the 200 patients in our study, 87 were operated under emergency settings (continuous: 38; interrupted 49). It was observed that the complication rate was more in an acute setting when compared to an elective setting.

With respect to wound infection, 9 patients (10.34%) suffered from surgical site infections in emergency setup which is almost twice when compared to 6 patients (5.3%) in elective group. Out of the 3 patients in the study that showed anastomotic leak, 2 belonged to the acute group.

This is consistent with a study by Gokulnath et al<sup>[5]</sup>, where increased rates of complications like wound infection, fistulae formation and anastomotic leak were observed in emergency situations.

In a study by Golub et al<sup>[6]</sup>, peritonitis and bowel obstruction, that is acute emergency presentations, were found to be significant contributing factors for leakage of intestinal anastomosis.

A study by Shah et al involving 78 patients who underwent intestinal anastomosis, 4 patients showed anastomotic leak in the emergency setting and 2 patients with anastomotic leaks in elective setting.

It would appear that the likelihood of anastomotic dehiscence and wound complication is higher in emergency settings. There could be a number of reasons to it but two variables stand out as obvious causes. Firstly, the edematous bowel tends to hold the single layer of sutures better especially when the sutures are not tightened excessively. Secondly, and more importantly, the hypovolemia and hypotension in a patient undergoing emergency gastrointestinal anastomosis.

Thus the result could make the edges of the sutured bowel more ischemic and thus would be more susceptible for dehiscence. This has been pointed out in a number of studies earlier where the use of vasopressors during surgery has led to increased rate of anastomotic dehiscence.

#### Site of anastomosis:

The site of anastomosis as a contributing factor to anastomotic leak is unclear as there is not enough data is available in current literature.

In our study, of the 3 anastomotic leaks, one was at ileo-colic level and the other two were at entero-enteric level.

In a study by Golub et al<sup>[6]</sup>, no difference was found in rates of leakage among different techniques of anastomosis or among different anastomotic locations.

Earlier it has been pointed out a numbers of times that colonic anastomosis would be served by double layer were extra reinforcement of second layer is required to take care of the relatively ischemic bowel and as compare to small bowel and gastric anastomosis where first layer serves the hemostatic function.

But in our study, 15 gastrojejunal anastomosis non of the patients had

hematemesis or malena and the 20 number of colonic anastomosis done did not result in high rate of anastomotic leak as compare to other parts of the bowel.

#### CONCLUSION

Thus, we conclude that single layer seromuscular continuous anastomosis is easy to learn and can be done in shorter time as compared to single layer seromuscular interrupted anastomosis. At the same time it gives comparable mortality and morbidity figures. Thus single layer seromuscular continuous anastomosis can be taken up by all gastrointestinal surgeons depending upon their individual preference.

The study needs further larger series of patients to arrive at a final conclusion.

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