ORIGINAL RESEARCH PAPER
Volume-8 | Issue-11 | November - 2019 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY OF SINGLE LAYER V/S TWO-LAYER INTESTINAL ANASTOMOSIS

General Surgery

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ABSTRACT

During intestinal anastomosis, although the single layered technique is supposed to be associated with a lower incidence of leakage, the double layer technique is still widely practiced by many surgeons. We present our study of comparison of the two anastomotic techniques. It is a prospective comparative study carried out in a tertiary health care centre from January 2018 to July 2019. Sixty patients were studied and divided into 2 groups, A and B requiring single and double layer anastomosis respectively comprising of 30 patients in each group. Single layer anastomosis took lesser time, was more cost effective and had faster post operative bowel recovery than double layer technique. No statistical difference was noted in anastmotic leak and other complications, hospital stay and mortality. Considering the simplicity of the single layer intestinal anastomosis technique, it may be reliably incorporated in surgical training & can be recommended as method of choice for intestinal anastomosis in both elective and emergency operations.

KEYWORDS

intestine, anastomosis, single layer, double layer

INTRODUCTION

Intestinal anastomosis has excited interest in our day to day surgical practice since its beginning[1]. Double layer intestinal anastomosis(DGIA) has been the preferred technique until the late seventies of the last century[2].The potential shortcomings of the DGIA are its inherent risk of anastomostic stricture formation, longer duration required to construct and more expensive as compared to the single layer intestinal anastomosis (SGIA)[3].

As an alternative, single layer gastrointestinal anastomosis (SGIA) technique was introduced in early eighties of the 20th century[2]. It is a contemporary innovation first described by Hautefeuille in 1976[4]. The purported advantages include shorter time for construction, lower cost, and perhaps a lower rate of anastomotic leakage[5]. However, complications associated with SGIA like anastomotic dehiscence and luminal narrowing have also been mentioned in the literature[6-9].

This comparative study endeavours to compare outcome of single layer versus double layer intestinal anastomosis in small and large bowel in terms of duration required to perform intestinal anastomosis, post- operative recovery and complications like anastomotic leak, and cost effectiveness.

Aim and objective

To study the outcome of the two anastomotic techniques applied during the study period.

MATERIALS

Duration Of Study : One and a half year, (1st Jan 2018 to 1st July 2019)
Type of Study : Hospital based prospective study
Sample Size : A total of 60 patients were studied and divided into 2 groups, A and B requiring SGIA and DGIA respectively, comprising of 30 patients in each group.

SELECTION OF CASES:

Inclusion Criteria:

All the patients above the age of 12 years, requiring intestinal anastomosis in both emergency and elective procedures.

Exclusion Criteria:

(1) Those requiring anastomosis to the stomach, or to the duodenum, rectum were excluded
(2) Those patients requiring stapled intestinal anastomosis were excluded from this study.

METHODS:

All the patients with various intestinal pathologies were closely observed and followed from the time of admission till 2 months after their discharge from the hospital. Patients in the paediatric age group (<12 years) were excluded since single layer intestinal anastomosis is routinely performed in this group and therefore not suitable for this comparative study.

The diagnosis of the primary intestinal pathology was made on the basis of a detailed history, clinical examination, laboratory investigations, wherever applicable. The diagnosis was confirmed during the operation and those patients requiring an intestinal anastomosis were included. Both emergency and elective operations requiring intestinal anastomosis were included in this study.

The patients were alternatively allotted into two groups; group A requiring single-layered intestinal anastomosis, while group B requiring double-layered anastomosis. Informed written consent was obtained and the procedure and its outcome were well explained.

The time recorded for construction of the anastomosis began with the placement of the first stitch and ended with cutting the excess material from the last stitch. Abdominal tube drain, one each, was placed in Morrison's pouch and pelvis. Post-operatively results were assessed by clinical evaluation, stressing upon the return of gut function assessed by the day of return of bowel sounds, flatus and the day on which oral intake exceeded one litre over 24 hours.

Surgical site infection was defined as a purulent discharge in, or exuding from, the wound, or a painful, spreading erythema indicative of cellulitis irrespective of the bacteriological assessment. Anastomotic leak was defined as faecal discharge in the drain or from the wound or a visible disruption of the suture line during post-operative period or during re-exploration. Intra-abdominal abscess without visible discharge was seen in patients as fever, persistent abdominal pain, tachycardia, and raised leucocyte countand was confirmed on ultrasound of the abdomen.

Removal of the drain was usually done on 4th-5thpostoperative day, depending on the post-operative recovery and amount of collection in the drain (<25ml over 48 hours).Suture removal was done between the 8th and 12th postoperative day after confirming adequate wound healing. Hospital stay was counted from the day of operation as there were a number of patients and hospital related factors which lead to a delay in the operation from the date of admission. To assess mortality, the 30-day in hospital mortality was taken into account. After discharge, the patients were followed up at twice monthly basis for the first 2 months. and were evaluated for gastrointestinal complaints and other complaints, if any.

STATISTICALANALYSES:

Data was analysed based on intention to treat principle. Continuous data were analysed using the student T test. The Fischer exact test and

the Pearson chi square tests were used to analyze the categorical data. P value < 0.05 was considered to indicate statistical significance. All data analyses were performed on an IBM compatible PC using SPSS 10.0 for Windows.

RESULTS

Both groups were evenly matched for age, sex and location of anastomosis as shown below by p value >0.05 in table 1

Table–1 : Age, Sex And Location Of Anastomosis

	Group–A (single Layer)	Group–B (double Layer)	*p value*
Number of Anastomosis	30	30	
Mean Age (years)	42.97 ± 13.68	41 ± 13.06	0.571
Sex (M/F)	19/11	19/11	1
Location of anastomosis			
Enteroenterostomy	11	12	0.636
Enterocolostomy	8	5	
Colocolostomy	11	13	

ALBUMIN LEVELAND ANASTOMOTIC LEAK:

Since albumin is a confounding risk factor of anastomotic leak, their levels were evenly matched to eliminate this factor as shown in Table 2

TABLE–2 : Matching of albumin in both groups

	GROUP–A		GROUP–B		*p value*
	Mean	± S.D.	Mean	± S.D.	
Albumin levels (gm/dl)	3.35	0.23	3.31	0.39	>0.05

3.5 gm% was taken as the cut-off value for normal serum albumin level. The distribution of albumin levels in the 2 groups is shown in table 3.

TABLE–3 : Distribution of albumin levels

SERUM ALBUMIN (gm%)	GROUP–A		GROUP–B	
	n	%	n	%
< 3.5	15	50.00	17	56.67
>/= 3.5	15	50.00	13	43.33
TOTAL	30	100.00	30	100.00

Relation of anastomotic leak with albumin levels is shown in table no. 4 and 5.

TABLE–4 : Relation of anastomotic leak with albumin levels

ALBUMIN	GROUP–A (Anastomotic Leak) (n)	GROUP–B (Anastomotic Leak) (n)	TOTAL (n)
Normal	1	1	2
Below Normal	2	4	6

TABLE–5: Relation of anastomotic leak with albumin levels

	No Anastomotic Leak (n=52)	Anastomotic Leak (n=8)	*p value*
Albumin (mean) (gm/100ml)	3.41 ± 0.18	2.75 ± 0.48	0.01

Thus it is seen that the serum albumin levels correlate with the anastomotic dehiscence rate, p value being less than 0.05 which is statistically significant.

ETIOLOGY:

Large intestinal tumuors were the commonest indication for intestinal anastomosis (25%) followed by blunt abdominal trauma. Other indications were penetrating Trauma abdomen, strangulated inguinal hernia, stoma reversal, pathologies causing intestinal obstruction

ELECTIVE/EMERGENCY SURGERY:

Figure 1 and table 6 show the distribution of emergency and elective surgery and their relation to anastomotic dehiscence in Group–A and Group–B.

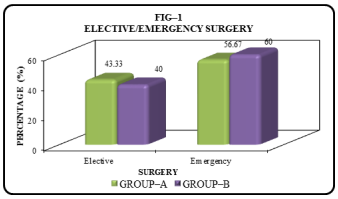


Table 7: Relation of anastomotic leak with type of surgery

Surgery	Total		Anastomotic Dehiscence				*p value*
	Group A	Group B	Group–A		Group–B		
	No.	No.	No.	%	No.	%	>>0.05
Elective	13(43.3%)	12(40%)	1	7.6	1	8.33	
Emergency	17(56.67%)	18(60%)	2	11.7	4	22.22	

Thus we inferred that there is no statistical difference (p>0.05) in anastomotic leak rates with respect to emergency and elective surgeries.

DURATION OF ANASTOMOSIS:

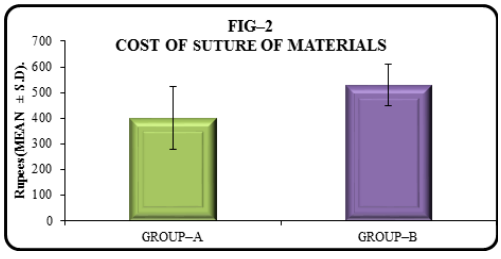
Table–8 : duration Of Anastomosis

	GROUP–A		GROUP–B		p value
	Mean	± S.D.	Mean	± S.D.	
Duration	17.13	2.36	28.60	1.75	<0.001

From table 8 it is clear that single layer anastomosis was performed faster than the two layer anastomosis and was proven statistically significant by p value <0.05.

SUTURE MATERIAL USED AND COST:

On an average 1.15 packs of vicryl were used in single layer amounting to 400.20 rupees ± 122.19 rupees and 1.08 vicryl and 1.47 silk packs were used costing 529 ± 82.58 rupees (p<0.05). Thus there was a significant statistical difference between cost and number of suture materials used.(Figure 2)

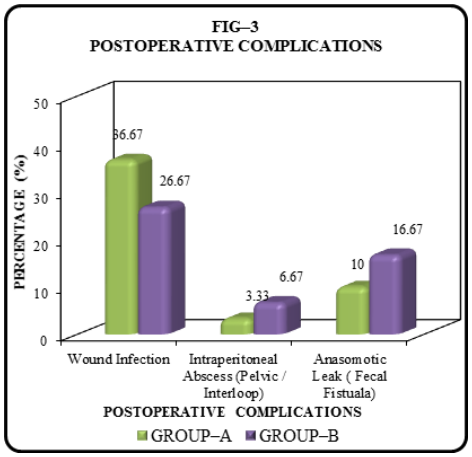


POST OPERATIVE CLINICAL EVALUATION:

Table–9 : Post-operative Recovery

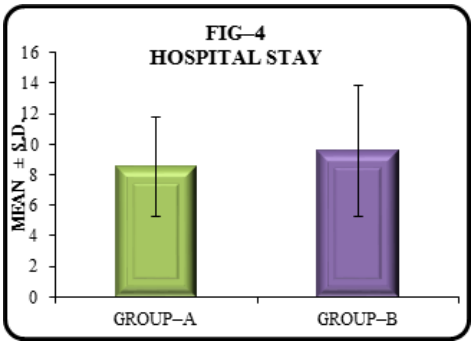
EVENTS	GROUP–A		GROUP–B		*p value*
	Mean	± S.D.	Mean	± S.D.	
Appearance of Bowel Sounds (in hours)	48.67 (2.02 days)	16.74 (0.69 days)	88.27 (3.67 days)	17.98 (0.74 days)	0.0001
Passage of Flatus (in hours)	51.47 (2.14 days)	15.96 (0.66 days)	96.53 (4.02 days)	17.34 (0.72 days)	0.0001
Duration of I.V. Flatus (in days)	4.60	0.62	5.47	1.17	0.007
Tolerates Food Orally (Postoperative Day)	4.43	0.73	4.90	0.96	0.03

Table 9 shows patients in single layer group required a shorter duration of intravenous alimentation and could also tolerate solid food earlier, thus enabling faster post-operative recovery.



POSTOPERATIVE COMPLICATIONS:
Figure 3 shows the post operative complications in both groups. The differences in both groups were statistically insignificant as p value was >0.05. Thus, complication rates were similar in both groups.

HOSPITAL STAY:



As per figure 4, although the hospital stay was longer in the two layer group, it was not statistically significant. (p value > 0.05)

MORTALITY:
Mortality occurred in 2 patients, 1 in each group, (3.33%), a result found to be statistically insignificant.

DISCUSSION
Both groups were evenly matched for age like **Rahul *et al* (2015) (10)**. In our study, males(63.33%) predominated over females(36.66%) like **Bronwell*et al* (1967).**[11] Male predominance in the present series is due to the higher incidence of trauma and other emergency operations, that were performed during the study, which were more common in the male population.

SERUM ALBUMIN AND ANASTOMOTIC LEAK:
The albumin levels in both the groups were evenly matched to eliminate the preoperative confounding factor. Out of the total 60 patients in this study, 32 patients (53.33%), i.e majority of them had albumin levels below 3.5gm/dl as maximum patients either required an emergency surgery or were operated for neoplasm. Out of the total 8 anastomotic leaks observed, 6 had serum albumin levels below normal, thus concurring with **Irvin and Goligher (1973)**[12] who stated that patients who had significantly lower plasma albumin values developed anastomotic disruption.(Table10)

TABLE–10 : Serum albumin and anastomotic leak

	Albumin Levels (gm/dl)		
	No anastomotic leak	Anastomotic leak	P value
Present study	3.4 ± 0.18 (N=52)	2.75 ± 0.48 (N=8)	0.01
Irvin and Goligher[12]	3.9 ± 0.52 (n=89)	3.4 ± 0.7 (n=17)	<0.001

Hyspler *et al*[13] in 2015 also had similar conclusion from their studies.

AETIOLOGY:
In this present study, large intestinal tumours were the commonest indication for resection and anastomosis (25%) followed by blunt abdominal trauma (13.33%). **Maurya *et al*[14]** found bowel volvulus leading to gangrene as the leading cause (24.15%) for bowel resection and anastomosis, followed by tubercular bowel lesion. (23.13%)

ELECTIVE/EMERGENCY SURGERY:
The anastomotic dehiscence rate in elective surgery was 8% and that in emergency surgery was 17.14% which was statistically not significant. It matches with **Irvin and Goligher (1973)** [12] who found no difference between emergency and elective operations with respect to anastomotic dehiscence.

DURATION OF ANASTOMOSIS:
Table 11: comparison of mean duration of anastomosis of present study with different studies.

GROUPS	Present Study	Bursch*et al* (2000)[5]	Khan *et al* (2010)[15]	Pravin*et al* (2015)[16]
A (Single Layer)	17.13 Mins	20.8 Mins	20	19.6 Mins
B (Single Layer)	28.60 Mins	30.7 Mins	35 Mins	29.5 Mins

From table 11, it is clear that lesser time (mean 17.13 min) was required to fashion a single layer intestinal anastomosis when compared to the conventional two layer anastomosis (mean 28.60 min), similar to other studies.

COST AND NUMBER OF SUTURE MATERIALS:
Table 12: Sutures used in different studies

(Mode) Number of suture packets used (type of material)				
GROUPS	Present study	Pravin*et al* (2015)[16]	Garude*et al* (2013)[3]	Niyaz et al (2015)[17]
Group A (SGIA)	1 (polyglactin)	1 (silk)	1 (prolene)	1 (PDS)
Group B (DGIA)	2 (1 silk + 1 polyglactin)	2 (silk)	2.5 (1 polyglactin +1.5 silk)	2 (1 silk + 1 polyglactin)

Single layered intestinal anastomosis was found to be more economical compared to double layer bowel anastomosis as the total number of suture packs required in double-layered anastomosis (polyglactin and silk) was 2, whereas in single-layer anastomosis only one pack of polyglactin was used(table 12). Although different suture materials were used in other studies, they also found that double layer anastomosis was costlier than its counterpart. Cost factor regarding the suture materials definitely seems significant in a developing country with poor population.

POST OPERATIVE CLINICAL EVALUATION:
TABLE–13: Post operative clinical evaluation

SERIES	***Maurya et al*** [14]		**Present Study**	
	Single Layer	Double Layer	Single Layer	Double Layer
	DAYS			
Appearance of Bowel Sounds	3.10	5.10	2.02	3.67
Passage of Flatus	3.70	5.86	2.14	4.02
Duration of I.V. Alimentation	4.80	6.70	4.60	5.47

Thus, table 13 shows bowel function returned to normal, earlier in patients undergoing single layer intestinal anastomosis. Since DGIA takes longer time to construct than single layer GIA (SGIA), there is excessive tissue handling inflicting significant tissue damage which in turn prolongs the normal bowel function return. Multiple layer closure in DGIA could result in intestinal luminal circumference narrowing, which could be another reason for prolonged post-operative intestinal recovery with this technique. **Rahul *et al* (2015)** showed that the average time for appearance of bowel sounds was 5.6 ± 0.62 days for single layer and 5.5 ± 0.62 days for double layer which was proved statistically insignificant(10).

Although, in the present study, the difference in the post-operative recovery seems to be statistically significant, it could be due to the smaller sample size and may require larger study group to consolidate this finding.

POST-OPERATIVE COMPLICATIONS:
In our study, there were 11 surgical site infections in group A compared to 8 in group B, the difference proved to be statistically insignificant. Our results were compared with other studies like Askarpour *et al(18)* (5 in group A vs 7 in group B); Khair *et al*[19] (4 in group A vs 3 in group B); and Pathak *et al(20)* (6 in group A vs 4 in group B). The rate of wound infection was higher in our series as maximum patients in our study required emergency operations.

Anastomotic leak was less in group A, like in Niyaz *et al* (2015)(17) although, not statistically significant. Similarly, difference in the rate of abcess formation between the 2 groups was also not significant. The post-operative hospital stay was comparable in both groups. Bursch*et al*[5] observed a 2 day difference in the hospital stay in favour of the single layer group. This may be explained by the finding that the single layer has a larger lumen compared to the double layer where excessive inversion of the tissue by the two layers of anastomosis may lead to narrowing of the lumen and thereby delaying the return of bowel movements and tolerance of oral food[2,21]

MORTALITY:
Aslam *et al* (2008) in their study reported no mortality (0%) in the single layer group and in 1 patient (3.8%) in the double layer group

which was statistically insignificant.() In our study, mortality occurred in 2 patients, 1 in each group, (3.33%), thus having no significance statistically.

Both techniques have potential weaknesses that could threaten the anastomosis. Though the two layers might provide adequate strength initially, they increase the inflammatory response in the early stages of healing owing to the extra suture material and the ischaemia of the inverted tissues as it incorporates large amount of tissue in the suture line leading to tension and increases the chance of leakage and lumen narrowing. The inflammatory reactions result in weaker anastomosis as more collagen is broken during the inflammatory phase of healing(). The popularity of single layer intestinal anastomosis has increased in recent years. Every anastomosis will require adequate blood supply for healing. The cut edge of the intestine following resection in single layer is more likely to have an adequate blood supply because less mesentry is cleared. Also, the inner layer in single layer spares the mucosa, causing less damage to submucosal plexus and therefore less strangulation of mucosa. In contrast, the inner layer of double layer which is incorporated to achieve hemostasis may lead to strangulation of mucosa by causing damage to submucosal plexus.()

The properties of a continuous suture line is another factor contributing to the success of single layer. In an anastomosis with interrupted suture line, too much tension exerted on the suture may lead to ischemia which can be easily avoided in a continuous suture line because there would be no segment in the intestinal wall which is completely devoid of blood supply. It has also been speculated that the continuous suture line looks like a coiled spring which could expand and contract depending on intraluminal forces() All these factors establish a superiority of SGIA over DGIA.

CONCLUSION

(1) Duration required to fashion a single layer intestinal anastomosis is significantly lesser as compared to the double layer intestinal anastomosis
(2) Less suture material is required to construct a single layer GIA compared to the two layer GIA, therefore single layer is more cost effective
(3) The postoperative bowel recovery in SGIA takes considerably lesser time when compared to double layer.
(4) Less anastomotic leak was observed in SGIA group, although there was no statistical significance. No statistical difference in other complications like wound infection or abscess formation hospital stay and mortality were noted.
(5) Considering the simplicity of the single layer intestinal anastomosis technique, it may be reliably incorporated in surgical training & can be recommended as method of choice for intestinal anastomosis in both elective and emergency operations.

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