Single-layer versus double-layer intestinal anastomosis: A comparative study

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Abstract

Background: Intestinal anastomosis is essential to maintain the continuity after resection. There has been constant controversy due to various repair options. Adequate apposition can be achieved by either single- or double-layer anastomosis which may affect the post-operative outcome. **Objective:** To compare the outcome of single-layer versus double-layer anastomosis of small and large intestine. **Method:** This prospective comparative study was conducted over a period of 16 months, and included 78 patients who underwent intestinal anastomosis (without diverting stoma) after fulfilling inclusion and exclusion criteria. They were randomized into double-layer and single-layer intestinal anastomosis groups by a computer generated series. Double layer anastomosis was constructed using inner continuous Polyglactin 3-0 and outer interrupted Silk 3-0, while single layer anastomosis was done with interrupted PDS 2-0. **Result:** The mean age was 39.79±17.78 years. A total of 59% were operated in emergency room while 41% in elective setting. Overall mean time for anastomosis was 31.81±6.03 (21-50) minutes. In double- and single-layer intestinal anastomosis mean time was 34.35±5.80 (26-50) and 29.13±5.08 (21-45) minutes respectively, which was statistically significant (p value < 0.05). Single-layer was completed 5 minutes earlier than double layer anastomosis in average. Clinical anastomotic leak was seen in six (7.7%) patients, three in each group. Eight (10.3%) patients had surgical site infection: 3 in double-layer and 5 in single-layer groups. One (1.3%) mortality was seen, from single-layer anastomosis group. **Conclusion:** Single-layer anastomosis can be constructed in significantly shorter time with similar complication rate when compared to double-layer anastomosis.

Keywords: Anastomosis, double-layer, single-layer.

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Introduction

The ideal anastomotic technique and the suture material to be used is still an area of conflict for intestinal anastomosis after reaction. An ideal anastomosis should be easy to construct, reproducible, easy to teach, should not leak or obstruct and should regain the normal bowel function within a few days of its reconstruction.

Adequate apposition, adequate alignment, good local blood supply, tension free and equally spaced stitches can affect gastrointestinal anastomosis positively, while malnutrition, abdominal sepsis, generalized sepsis, and immune suppression can negatively affect the anastomosis.[8] So, we can say that anastomotic integrity is an important determinant of immediate outcome in gastrointestinal surgery and the anastomotic technique to be an important aspect for its healing.

The various techniques included for repair of the intestinal tract are double layer inverted technique, double layer everted technique, single layer sero-submucosal technique, and single layer full thickness technique. It can also be repaired by the use of staplers, compression rings, metal wires and magnets.[1-4] A Cochrane review done in 2012 concluded that single layer anastomosis is comparable to double layer anastomosis in terms of anastomotic leak, peri-operative complications, death rate and hospital stay; and consumes shorter operative time as compared to double layer.[5]

In this study we have compared two methods of anastomosis, the single layer and the double layer anastomosis of the intestine and seen outcome and feasibility.

Methods

This study was conducted in the department of General Surgery at BPKIHS, Nepal from March 2012 to June 2013. This study was approved by the Institute's Ethical Review Board. Seventy- eight patients were enrolled using the Epi Info software with an alpha error of 0.05% and study power of 0.8. All patients requiring resection and anastomosis of the intestine or stoma closure were enrolled in this study and were divided in two parallel randomized groups using a random computer generated series. The patients were included in the study after fulfilling the criteria and an informed written consent was taken from them. Inclusion criteria included patients requiring bowel resection and single-site end-to-end anastomosis, or stoma closure. The patient excluded were those with polytrauma, multiple intestinal anastomosis, other associated visceral or head injury, anastomosis involving the esophagus, stomach, duodenum, pancreatico-hepato-biliary system, anastomosis with a diverting stoma and those who refused consent.

All anastomosis in both groups was performed by three senior surgeons in the institute who had a minimum of 5 years of experience. Mechanical bowel preparation was done for all patients being operated in elective setting with polyethylene glycol solution given the night before the operation.

For double layer anastomosis polyglactin 2-0, on a round body needle, was used for the full thickness inner layer continuous anastomosis. Over and over suture was used to anastomose the bowel at 0.5 cm from the cut edge and 0.5 cm from each other. The second interrupted outer sero-muscular layer was constructed using silk 2-0. The suture was introduced 0.5 cm on either side of the first anastomotic layer and 0.5 cm from each other. This was done circumferentially around the inner continuous layer burying it inside. For single layer anastomosis Polysioxanone Suture (PDS) 2-0 on a round body needle was used. Full thickness bites were taken 0.5 cm deep from the cut end and 0.5 cm away from each other. If one of the bowel lumen was smaller than the other, anastomosis was facilitated by making an anti-mesenteric slit (Cheat ling) to enlarge the smaller bowel lumen. A closed system soft tube abdominal drain was put in the pelvis.

The emergence of luminal contents either through the wound or from the abdominal drain, or a presence of collection near the anastomosis, causing fever, abscess, septicemia, metabolic disturbance and/or multiple-organ failure were labeled as an anastomotic leak.

Data was analyzed using the student t-test. The Fisher exact test and the Pearson chi-square test were used to analyze categorical data. P value of less than 0.05 was considered as statistically significant.

Results

This study included 78 patients who underwent intestinal anastomosis (without diverting stoma). They were randomized into double-layer and single-layer intestinal anastomosis by a computer generated series. Forty patients were enrolled in double-layer and 38 patients were enrolled in the single-layer anastomosis group.

Study Population (n= 98)

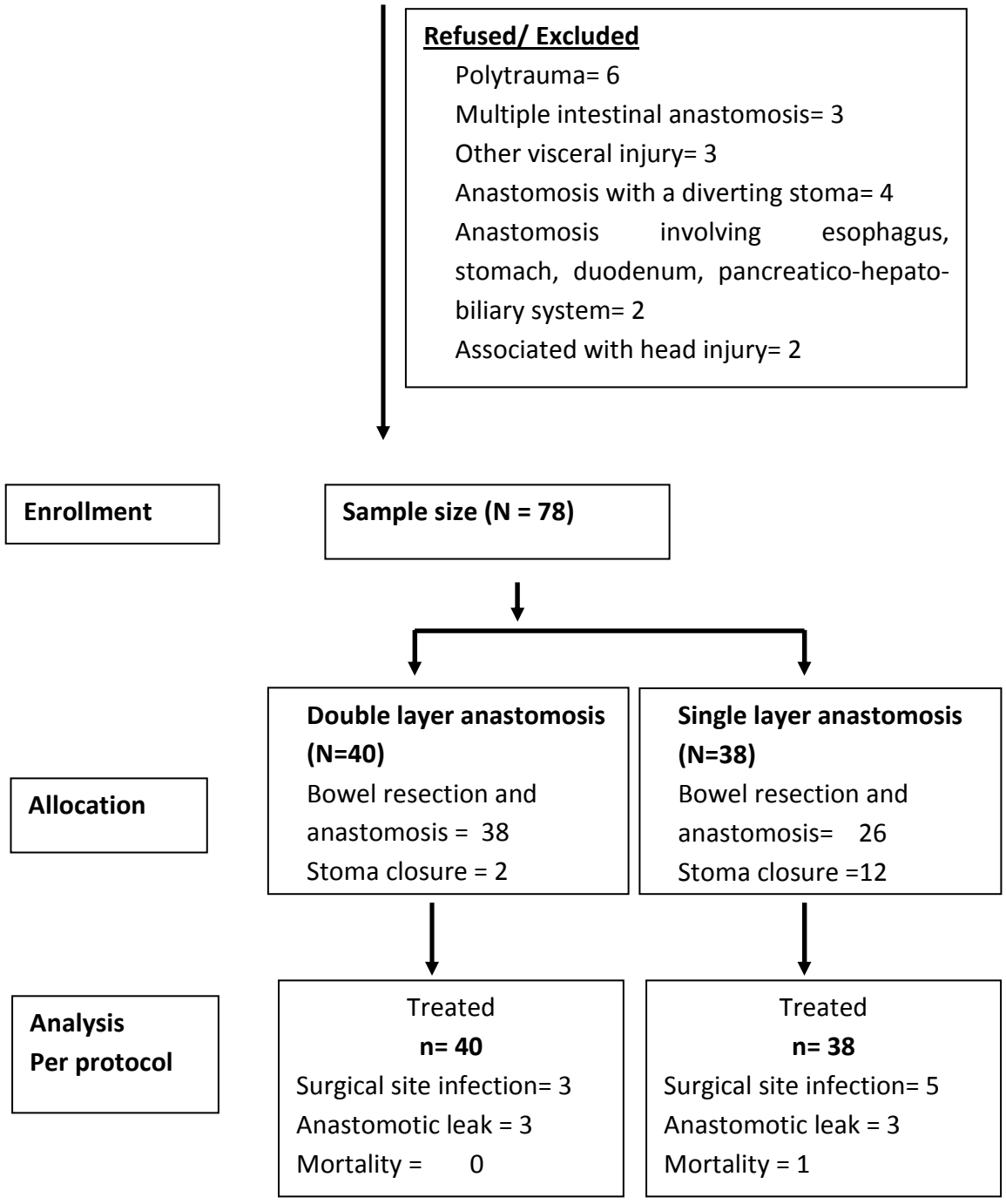

Fig. 1: Flow diagram of the participants in the study

The age, sex, co-morbid conditions, diagnosis, operative setting and site of anastomosis, are shown in Table 1. The outcome variables (length of time required for

anastomosis, anastomotic leak rate, morbidity and mortality rate) are shown in Table 2. The management of the patients with clinical anastomotic leak is shown in Table 3. There was one mortality in single layer anastomosis group who had an ASA 3 score when he presented in the emergency. The patient had an anastomotic leak which was detected on day 7 post-operatively which was later re-explored and a stoma was created on post-operative day 11. He expired on post-operative day 25 due to poor general physical condition. Preoperatively, he had chronic obstructive pulmonary disease (COPD) and was on inhalational medications on a regular basis.

Table 1: Comparison between study groups

	Double layer anastomosis (n=40)	**Single layer anastomosis (n=38)**	**P value**
Age (years)	41.73±17.42	37.76±18.16	0.329
Gender (M/F)	24/16	25/13	0.603
Co-morbid condition (DM, COPD)	3, 1	2, 3	
Diagnosis			
Trauma	7	2	
Malignancy	5	8	
Intussusception	5	5	
Inflammatory	16	7	
Stoma closure	2	12	
Complicated hernias	2	3	
Others	3	1	
Operative setting			
• Elective	8	24	
• Emergency	32	14	
Site of anastomosis			
• small bowel to small bowel	18	18	
• small bowel to large bowel	18	11	
• large bowel to large bowel	4	9	

Table 2: Outcome variables

	Double layer	Single layer	P value
Number of patients	40	38	
Time taken for anastomosis	34.35±5.8 mins	29.13±5.08mins	0.00
Clinical anastomotic leak	3 (7.5%)	3 (7.9%)	0.949
Surgical site infection	3 (7.5%)	5 (13.2%)	0.417
Mortality	0	1 (2.6%)	

Table 3: Comparison of anastomotic leak management

Anastomotic leak management	Double layer	Single layer
Conservative	2	0
Stoma	1	2
Resection and anastomosis	0	1
Total	3	3

Discussion

The outcome of bowel anastomosis is dependent on many important factors, both local and systemic. In a developing country like Nepal, proper technique of hand sewn anastomosis is a very crucial aspect for early healing and recovery. Also, the operative time taken plays a very important role for the early recovery and return to normal activity in the post-operative period. No data till date is available regarding the management of this problem in the eastern Nepal population, to the best of our knowledge, which has compared the safety and feasibility of the single layer anastomosis with the double layer intestinal anastomosis.[6] Keeping all this in mind, we conducted this study to see the feasibility of single layer and double layer hand sewn anastomosis and its outcome.

A bulk of our patients were operated in the emergency setting, 59% versus 41% (which were done as an elective procedure). A study by Golub R et al., has mentioned that the likelihood of an anastomotic leak is higher in those patients who are operated in the emergency room.[7] This correlates with our findings of 4 patients with anastomotic leak in the emergency setting and 2 patients with anastomotsic leaks in elective setting. In an emergency operation, the operating team may not always have the opportunity to optimize the patient. Gross bacterial or fecal

contamination poses another hazardous setting and has a poorer outcome.[8]

In the meta-analysis by Shikata S et al., the mean duration of anastomosis procedure in two included studies was 23.4 min vs. 36.9 min (single vs. two-layer).[9]A mean of 20.8 minutes was required to construct a single-layer anastomosis versus 30.7 minutes for the two-layer technique in a study reported by Burch et al. in 2000.[10] Samel et al. reported suturing of a single layer anastomotsic took around 10–25 minutes.[11] A time difference between the two techniques was also seen in our study. The mean time taken in double layer anastomosis was 34.4±5.8 (26-50) minutes and in single layer anastomosis was 29.1±5.1 (21-45) minutes. A significant statistical difference ($p < 0.05$) in the anastomotic time taken between the two groups was noted in our study. The single layer anastomosis was completed at an average of almost 5 minutes earlier than double layer anastomosis.

Various studies have shown the rate of anastomotic leak in the single layer anastomosis group to be between 2- 45% and in the double layer anastomosis group to be between 1.5 to 26%.[12-20] Our results recorded a clinical anastomotic leak of 7.7%; 3 each in double layer and single layer anastomosis groups, which is similar to the result of other reported studies. Of the 6 clinical anastomotic leaks, 2 of them were managed conservatively in double layer, while a re-operative procedure was performed on the remaining 4 patients. It was noted that 4 of the 6 anastomotic leaks occurred in the anastomosis involving the large bowel and the remaining 2 were of small bowel. A stoma was created in 3 patients on re-exploration, one in double layer and 2 in single layer anastomosis group. While in one patient from single layer anastomosis group underwent resection and re-anastomosis which was done in double layer technique. On comparing the anastomotic leak rates between the double layer and the single layer anastomosis groups, it was seen that the difference was statistically insignificant.

In this study, a surgical site infection of 10.3% was noted, 3 in double layer and 5 in single layer anastomosis groups which was managed conservatively. While a study reported the rate of surgical site infection of 1.5 to 7.7%.[21]

The mortality rate recorded in this study was 1.3%. One patient expired in the single layer anastomosis group. This patient was a 78 year male operated for ileo-ileal intussusception in the emergency room. A stoma was created in this patient when a clinical anastomosis leak was noticed. The patient later succumbed to his poor general health condition on postoperative day 25. Various studies have reported a mortality rate

which ranges from 2- 10%.[12,16,21] The table below (Table 4) compares our results with other similar studies.

Table 4: Collected series of single-layer and double layer anastomoses

Author	Year	Single layer/ Double layer				
		Mean age (years)	Males (in %)	Duration of anastomosis (minutes)	Leak (%)	Mortality (%)
Irvin et al.[19]	1973	64.0/57.0	41.4/54.8	NR	17/ 16	10/ 10
Everett et al.[141]	1975	64.0/62.5	43.1/47.0	NR	15/ 25	NR/ NR
Goligher et al.[142]	1977	63.4/63.5	42.0/37.9	NR	45 /26	NR/ NR
Maurya et al.[111]	1984	29.8/31.6	60.0/62.5	NR	7/ 18	NR/ NR
Alves et al.[100]	1999	54/ ND	50.03/ ND	NR	6/ ND	2/ ND
Burch et al.[101]	2000	44.3/44.7	64.6/59.7	20.8/30.7	3.1/ 1.5	NR/ NR
Moriura et al.[112]	2002	65.5/ ND	NR	NR	1.5/ ND	0/ ND
Hussain et al.[133]	2008	56/ ND	54.1/ ND	NR	1.8/ND	0/ ND
Ahmad et al.[136]	2013	NR	80/ ND	NR	8 /ND	8/ ND
Present	2013	37.8/ 41.7	65.8/ 60	29.1/34.4	7.9/ 7.5	2.6/0

NR: not recorded ND: not done

Conclusion

Intestinal anastomosis has always been a crucial surgical skill for a general surgeon. Anastomotic leak has been bothersome to the surgeons in the post-operative period and, whenever present, it has a high morbidity and mortality. Single-layer anastomosis saves valuable intra-operative time with similar complications when compared to double-layer anastomosis.

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