Single Layered Intestinal Anastomosis: A Safe and Economic Technique

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Abstract The objective of the study was to compare single-layered intestinal anastomosis and double-layered intestinal anastomosis in terms of safety and cost-effectiveness. A comparative prospective study was conducted in the Department of General Surgery, SSG Hospital, Baroda, from May 2007 to November 2009. All the patients above the age of 12 years, requiring intestinal anastomosis in emergency or electively, were randomly assigned either of the group. Those requiring anastomosis to the stomach, or to the duodenum, or to the rectum were excluded. Single-layered anastomoses were constructed with a continuous 3–0 polypropylene suture. Double-layered anastomoses were constructed using interrupted 3–0 silk Lembert sutures for the outer layer and a continuous 3–0 polyglactin suture for the inner layer. Comparison was made in terms of time required for anastomosis, anastomotic leak and other complications, and the cost incurred. Seventy-three single-layered and 72 double-layered anastomoses were performed. Age and sex difference was not significant. The mean time required to construct single-layered anastomosis was 9.5 min and that for double-layered anastomosis was 19.3 min. Anastomotic leak and other complications were similar in both the groups. The length of hospital stay was also comparable. The expenditure for the procedure was significantly different (₹ 298 for single-layered anastomosis, whereas ₹ 390 for double-layered anastomosis). Single-layered

intestinal anastomosis does not carry any increased risk of anastomotic leak when compared with the conventional double-layered technique, can be constructed in shorter time and at a lower cost.

Keywords Single-layered intestinal anastomosis • Anastomotic leak

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.

Material and Methods

The present study was conducted in the Department of General Surgery, SSG hospital, Baroda, between May

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Table 1 Underlying pathology

	Single layered (73)	Double layered (72)
Trauma	35	34
Enteric perforation	17	16
Tuberculosis	14	14
Carcinoma	7	8

2007 and November 2009. A total of 145 patients were included in the study. All the patients above the age of 12 years, requiring intestinal anastomosis on emergency or electively, were included in the study. Those requiring anastomosis involving the stomach, duodenum, or the rectum were excluded. The patients were alternatively allotted single-layered intestinal anastomosis group and double-layered group. Informed written consent was obtained and the procedure and its outcome were well explained.

Technique

All the anastomoses were performed by the same consultant surgeon.

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 anastomoses constructed were end-to-end type of anastomoses.

Double-Layered Anastomosis

The inner transmural layer was constructed in a continuous manner using 3–0 polyglactin suture. The outer seromuscular Lembert [1] sutures were taken in an interrupted manner, inverting the inner layer using 3–0 silk suture.

Single-Layered Anastomosis-

All the single-layered intestinal anastomoses were performed using a continuous 3–0 polypropylene double-needled suture that began at the mesenteric border, incorporating all the layers except the mucosa. Each bite included 4–6 mm of the wall from the edge and about 5 mm from each other. The larger bites were 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

Table 2 Site of repair

Site of anastomosis	Single layered (73)	Double layered (72)
Enteroenterostomy	46	46
Enterocolostomy	15	16
Colocolostomy	12	10

Table 3 Suture material and cost

Suture material (no.)	Single layered (73)	Double layered (72)
3-0 polypropylene (mean)	01	–
3-0 polyglactin (mean)	–	01
3-0 silk (mean)	–	01.5
Cost(₹)	298	390

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.

Abdominal tube drains number 32, one each was placed in Morrison's pouch and pelvis.

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.

Intra-abdominal abscess without visible discharge was seen in patients as fever, persistent abdominal pain, tachycardia, and raised leucocyte count and was confirmed on ultrasound of the abdomen.

Drains were removed once the output was minimal (10 ml). Suture removal was done between the 8th and 12th postoperative day after confirming adequate wound healing.

Histopathological diagnoses were confirmed and patients were advised necessary treatment at the time of discharge.

On discharge, the patients were followed up at twice monthly basis for the first 2 months and on 3 monthly basis thereafter. The patients were evaluated for gastrointestinal complaints and other complaints, if any.

Result and Analysis

Seventy-three patients had a single-layered anastomosis, whereas 72 had a double-layered anastomosis. In both the groups 60 % of the patients were male and the mean age for both the groups was 33 years. The most common underlying pathology for which the anastomosis was required was trauma in both the groups followed by enteric perforation, tuberculosis, and carcinoma (Table 1). The most common site of repair for both the groups was enteroenteric followed by enterocolic and colocolic (Table 2).

The time required for construction of the anastomosis was recorded, beginning with the placement of the first

Table 4 Complications

Complications	Single layered (73)	Double layered (72)
Anastomotic leak	04	03
Intra-abdominal abscess	03	03

Table 5 Statistical significance

	Single layered (73)	Double layered (72)	<i>P</i> value
Complications (no. of patients)	7	6	0.57*
The mean time of construction (minutes)	9.5	19.3	<0.0001^
Sutures used (no.)	1	2.5	<0.0001^
Cost of sutures used	₹ 298	₹ 390	<0.0001

*chi square test ^Student's *t* test

stitch till cutting the excess material from the last stitch. The mean time required for single-layered anastomosis was significantly lesser (9.5 min) than for double-layered (19.3 min). The mean number of suture material used in the construction of single-layered anastomosis was 1 pack of 3–0 polypropylene, whereas in double-layered construction, it was 1 pack of 3–0 polyglactin and 1.5 pack of 3–0 silk suture material. In the single-layered group the expenditure was about ₹ 298, whereas in the double-layered group it was ₹ 390 (Table 3).

Both the groups had a mean hospital stay of 12 days. The complication rate that included anastomotic leak and abdominal abscess was not significantly different for both the groups (Table 4).

Data were analysed using the Student's *t* test and the Pearson Chi-square test. $P < 0.05$ was considered to indicate statistical significance (Table 5).

When the data was compared, the number of patients developing complications in the single-layered group was not found to be significant, whereas the mean time required for construction of anastomosis and cost of sutures used was found to be highly significant when compared with the double-layered group.

Discussion

In the early 19th century through the experimental work of Travers [2] and Lembert [1], double-layered intestinal anastomosis was first performed. With the inner layer of anastomosis, the risk of leakage was reduced and better mucosal approximation was achieved. They advocated careful approximation of the serosal surfaces of the bowel and devised a

method of suturing to accomplish this. Since then the technique has remained more or less the same except for the use of different suture material for the inner layer.

The single-layered interrupted anastomosis was first described by Hautefeuille [3] in 1976.

The utility of any technique for intestinal anastomosis depends mainly on its ability to heal without a leakage. This complication has catastrophic consequences on patients' health as well as cost of care. Other predictors of intestinal failure such as diabetes, steroids, method, blood loss, and nutrition have not been so significant in the outcome when technique of anastomosis is concerned.

The present study assessed the efficacy and safety of the single against the double-layered anastomosis after intestinal resection, mainly in terms of anastomotic leak, time required to construct the anastomosis, cost incurred, and length of hospital stay. As it is an easy technique, it can be safely introduced into a surgical training programme without a painful learning curve.

The mean time required in constructing the single-layered anastomosis was 9.5 min, whereas that for two-layered anastomosis was 19.3 min. Hence, the mean time saved by creating the single-layered anastomosis was 10 min, which may seem relatively insignificant. But the time documented in constructing single-layered anastomosis has been 8–10 min and in contrast double-layered method has been no less than 20–25 min, which seemed significant. Samiullah et al. [4] and Khan et al. [5] also experienced the same significant difference between the timings of the anastomosis.

The most significant finding was the considerable difference in the cost of materials for the anastomoses. The total number of suture packs required in double-layered anastomosis was 3, 1 pack of 3–0 polyglactin and 2 packs of 3–0 silk, whereas in single-layer anastomosis, only one pack of 3–0 polypropylene was used. The cost of one pack of 3–0 polyglactin is ₹ 243, whereas that of 3–0 silk is ₹ 98. The cost of one pack of 3–0 polypropylene is ₹ 298. Therefore, the cost incurred for suture material in two-layered anastomosis was about ₹ 439 and that in single-layered anastomosis was ₹ 298. The difference seemed to be highly significant.

The length of hospital stay was comparable in both the groups (mean of 12 days). The complications rate that included anastomotic leak and abdominal abscess were similar to both groups and to the literature available (Table 6). This is

Table 6 Comparison with world literature

Complications		Our study (145)	Burch et al. [7] (132)	Ordorica et al. [8] (86)	Maurya et al. [9] (172)
Anastomotic leak	Single layered	04 (5.3 %)	02 (3.1 %)	02 (4.8 %)	04 (6.6 %)
	Double layered	03 (4 %)	01 (1.5 %)	03 (6.8 %)	20 (17.8 %)
Intra-abdominal abscess	Single layered	03 (4 %)	02 (1.5 %)	04 (9.5 %)	08 (13.3 %)
	Double layered	03 (4 %)	02 (1.5 %)	04 (9 %)	18 (16 %)

further proved by the meta-analysis done by Shikata et al. [6] which is the largest series available in literature presently. It analysed 670 participants showing that the combined risk ratio using DerSimonian-Laird methods was 0.91 (95 % CI 0.49–1.69), and indicated no significant difference between the anastomotic leaks for both the groups.

Single-layered anastomosis may be successful due to several factors. Any anastomosis requires adequate blood supply for it to hold up. In this technique, less mesentery is cleared off of the two cut edges and therefore less compromise of blood supply to the anastomosis. Also, the inner layer of double-layered technique is believed to be hemostatic, but may cause strangulation of the mucosa due to apparent damage to the submucosal vascular plexus. This is avoided in single-layered technique, as suture is taken sparing mucosa, and hence causing lower damage to the submucosal vascular plexus. In the double-layered technique, there may be excessive inversion of the tissue, as there are two layers of anastomosis that may lead to narrowing of the lumen, in the single-layered technique this is prominently avoided, as only one layer of sutures is incorporated. Another factor is use of nonabsorbable monofilament suture material in a continuous fashion. In an anastomosis with interrupted suture line, the tension that may be exerted while suturing may lead to ischemia, which is easily avoided in the continuous technique as speculated by Hautefeuille [3] that in a continuous anastomosis at no point is there a segment of bowel which is completely devoid of blood supply. Bailey et al. [10] describe that a continuous single-layer suture line resembles a circular coiled spring, which may be able to expand and contract depending on the intraluminal forces, which also explains why it is rare to have bowel stenosis.

Considering the fact that most of the patients we operated on were on emergency basis, having some degree of hemodynamical instability, with reduced construction time, the time of anesthesia was also reduced, and hence seemed beneficial to such patients. Also, with the kind of population we serve here in our set-up, the cost factor definitely seems significant.

In our institute, in a 3-year surgical residency protocol, only a third-year resident performs surgeries like resection and anastomosis. But because of the ease of the single-layer technique, even a second-year resident can perform it as satisfactorily.

From our study, it is seen that single-layered intestinal anastomosis technique does not carry any increased risk of complications, whereas it took significantly lesser time for construction and also costs lower than double-layered intestinal anastomosis technique.

Hence, we recommend single-layered intestinal anastomosis as a safe and economic intestinal anastomosis technique as compared with its conventional counterpart and recommend that it can be reliably introduced as a technique of intestinal anastomosis in our current surgical setting due to its easy learning curve.

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