

A COMPARATIVE STUDY BETWEEN SINGLE LAYERED CONTINEUOUS AND DOUBLE LAYERED CONTINEUOUS INTESTINAL ANASTOMOSIS

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ABSTRACT

Background - The history of intestinal anastomosis dates back to the time of Hippocrates. From earlier times to as late as the 19th century, most of the anastomoses were primarily performed for traumatic injuries of the gastrointestinal tract. The art of intestinal anastomosis has evolved over the last 150 years and especially after the advent of anesthesia in the late 19th century. Within the past 150 years, intestinal anastomosis has been transformed from a life threatening venture to a safe and routinely performed procedure¹. There are various methods and materials for intestinal anastomosis which have been a topic of much discussion and debate. With the advent of various other techniques like sutureless anastomosis and stapled anastomosis, confusion exists about the best option. However the conventional sutured anastomosis still stands out as the gold standard procedure being practiced throughout the world. **Materials and Methods** - The present study focuses on comparison between the classical double layered method of intestinal anastomosis and the single layered extramucosal continuous method of anastomosis. The present study was carried out in the Department of General Surgery, S.C.B. Medical College, Cuttack during the time period September 2021 to September 2022. A total of 97 patients were included in the study and were randomized into the two study groups. Group 1 underwent single layered extramucosal intestinal anastomosis, while group 2 was treated with the conventional double layered method. The intra operative and post-operative data collected were subsequently analyzed and observations made. The two groups were compared using the standard tests of significance and conclusions were drawn. **Results** - Time taken for anastomosis (mean) , Ryle's tube removed on POD (mean) , Return of bowel sounds on POD (mean) , Passage of motion on POD (mean) , Complications recorded (Anastomotic leaks , Wound infection , Abdominal distension, Mortality) , and Mean duration of hospital stay are less in single layered extra-mucosal continuous anastomosis on comparison to double layered continuous intestinal anastomosis . But reverse is seen in case of cost of suture material used. **Conclusion** – a single layered extramucosal continuous anastomosis is much safer and cost effective than the conventional double layered method.

Keywords - Anastomosis , Dyselectrolytemia, Total Parenteral Nutrition,

INTRODUCTION

Intestinal anastomosis is a common procedure both in elective and emergency surgeries and hence it is imperative for both practicing surgeons and residents to be familiar with and to master the art of safe bowel anastomosis. Higher costs, limited availability and less familiarity with the operating surgeons are the main drawbacks of the stapling devices. Less commonly used suture less techniques of anastomosis like biofragmentable compression rings, tissue adhesive glues and laser welding etc. never gained desired popularity due to mixed results of success [1].

Whatever be the method of anastomosis, it has been stated that “the key to a successful anastomosis is the accurate reunion of two viable bowel ends with complete avoidance of tension” [2,3]. Thus the most important factors in the creation of a bowel anastomosis can be summarized as:

1. Meticulous technique.
2. Adequate apposition of bowel ends.
3. Good blood supply.
4. No tension.

Moreover, it is advocated that double layer anastomosis incorporates a large amount of ischemic tissue into the suture line leading to tension and increased chances of leakage and luminal narrowing while a single layer anastomosis causes minimal damage to vascular plexus and bowel lumen. Several published works have highlighted the risks associated with double layered intestinal anastomosis [4,5,6,7,8,9,10,11,12,13]. A double layered anastomosis is technically difficult to perform because it requires accurate identification of all the layers of the bowel wall and then incorporate each layer individually into the stitch making the suture tension harder to maintain. Higher demand of technical skill reduces the margin of error. Secondly, more tissue handling as compared to a single layered anastomosis gives rise to more tissue edema and ischemia leading to difficulty in holding of sutures in the bowel wall. It also reduces the lumen of the involved segment of gut.

A single layer continuous extra-mucosal anastomosis incorporates the strongest sub-mucosal layer and allows accurate tissue approximation and layer to layer attachment leading to better wound healing. A single layered anastomosis significantly reduces the risks associated with double layered anastomosis cited above, but it is not bereft of its own disadvantages. Several authors have suggested that single layer also increases the risk of dehiscence because the suture technique uses the outerpart of the bowel when it is fashioned with a sero-submucosal technique [14,15] or can narrow the intestinal lumen when a full thickness technique is used [16,17].

Our study is aimed to evaluate the safety and cost effectiveness of single layer continuous extra-mucosal intestinal anastomosis as compared to the double layered method.

AIMS AND OBJECTIVES

- To determine cost effectiveness of single layered as compared to double layered intestinal anastomosis
- To assess and compare the treatment outcomes of single layered and double layered intestinal anastomosis.
- To find out and compare the complications of single layered and double layered intestinal anastomosis, if any.

MATERIALS AND METHODS

Design

Hospital Based Randomized Comparative Study

Sample Size

The present study was carried out in the Department of General Surgery, S.C.B. Medical College and attached 97 patients who were admitted through emergency as well as on routine outdoor basis in a single surgical unit and underwent intestinal anastomosis during the time period of September 2021 to September 2022. The data thus obtained were analyzed and the observations made are summarized in the ensuing pages.

Inclusion Criteria-

- Adult age group (18 – 65 years) and either sex were included.
- Hemodynamically stable patients
- Hemoglobin > 8 g/dL
- No peritoneal contamination
- Surgeries – both emergency and elective :
 - a) Jejunum-jejunal, jejunum-ileal and ileo-ileal anastomosis.
 - b) Ileo-colic and colo-colic anastomoses.
 - c) Stoma closure

Exclusion Criteria -

- Patients requiring gastric, duodenal and rectal anastomosis.
- Patients undergoing proximal diversion.
- Patients whose recovery was not expected to be uneventful (septicemic or hypovolemic shock)
- Profuse intra-operative or postoperative bleeding(>1lit)
- Severely cachexic patients requiring simultaneous TPN
- Re exploration cases
- Patients requiring intensive care in post operative period
- Severe systemic organ dysfunction (chronic liver, renal or heart diseases, diabetes mellitus).
- Massive small intestinal resection.
- HIV+ patient and immunosuppressed.

METHODOLOGY

RECORD-

Duration of surgery, quantity and cost of suture material used, preoperative finding, intraoperative complication, intraoperative as well as post-operative condition, pulse, B.P., temperature. nasogastric tube output daily, status of bowel sound, flatus, motion, tolerance of oral feeding, nausea, vomiting, abdominal distension, time of hospital stay, anastomotic leak if any, intra-abdominal abscesses and other possible complications like chest infection, wound infection, burst abdomen.

METHOD OF ANASTOMOSIS-

GROUP 1 (Study Group) (Single Layered Extra-mucosal Anastomosis) - All single layered anastomosis were performed by using continuous synthetic absorbable monofilament 3-0 suture taking all layers of bowel wall except the mucosa into the bite. Stitch advancement was approximately 5mm.

GROUP 2 (Control Group) (Double Layered Continuous Intestinal Anastomosis) - All double layered anastomoses were performed using continuous silk 3-0 Lembert suture for outer layer and continuous running polyglycolic acid (Vicryl) 3-0 suture for inner layer.

Time taken for the anastomosis was recorded beginning with the placement of first stitch and ending with cutting of extra suture material from the last stitch of anastomosis. All patients were given IV fluid and similar antibiotics followed by gradual withdrawal. Any complications arising like anastomotic leaks, fistulae, wound infection, intra-abdominal abscesses were recorded.

STATISTICAL ANALYSIS -

Data was analyzed using SPSS software Version 20.0

- Qualitative data was expressed in the form of proportion.
- Quantitative data was expressed in mean \pm SD (complications)
- Qualitative data was compared by Chi square test
- Unpaired t test was used to infer the difference in means.

For significance, following at the level of “p” value were taken

1. P > 0.05 = Not significant
2. P = 0.05 = Just significant
3. P < 0.05 = Significant
4. P < 0.001 = Highly significant.

OBSERVATIONS AND RESULTS

Table 1 - Distribution of cases according to age group in relation to sex

| Age group (Years) | Sex | | | | Total | |
|-------------------|------|--------|--------|-------|-------|-------|
| | Male | | Female | | No | % |
| | No | % | No | % | | |
| 11 -20 | 07 | 7.21 | 02 | 2.06 | 09 | 9.27 |
| 21-30 | 18 | 18.55 | 06 | 6.18 | 24 | 24.74 |
| 31-40 | 06 | 6.18 | 10 | 10.30 | 16 | 16.49 |
| 41-50 | 07 | 7.21 | 04 | 4.12 | 11 | 11.34 |
| 51-60 | 09 | 9.27 | 10 | 10.30 | 19 | 19.58 |
| 61-70 | 11 | 11.34 | 04 | 4.12 | 15 | 15.46 |
| >70 | 03 | 0.0349 | 00 | 00 | 03 | 3.09 |
| Total | 61 | 62.88 | 36 | 37.11 | 97 | 100 |

A total of 97 patients were included in the study out of which 61 were males and 36 females. The mean age was 42.84 years with males having a mean age of 42.26 years and females 43.83 years. The male to female ratio was approximately 1.7:1.

Table 2 - Distribution of cases according to the method of anastomoses

| Type of anastomoses | Sex | | | | Total | |
|---------------------|------|-------|--------|-------|-------|-------|
| | Male | | Female | | No | % |
| | No | % | No | % | | |
| Single layered | 33 | 34.02 | 17 | 17.52 | 50 | 51.54 |
| Double layered | 28 | 28.86 | 19 | 19.58 | 47 | 48.48 |
| Total | 61 | 62.88 | 36 | 37.11 | 97 | 100 |

A total of 50 patients underwent single layered extra-mucosal continuous anastomosis, out of which 33 were in males and 17 in females. 47 patients underwent double layered anastomosis out of which 28 were males and 19 females. The mean age of patients undergoing single layered anastomosis was 42.96 years while that of the second group i.e. those undergoing double layered anastomosis was 42.72 years.

Table 3 - Distribution of cases according to the site of anastomoses in relation to sex

| Site of Anastomoses | Sex | | | | Total | |
|---------------------|------|-------|--------|-------|-------|-------|
| | Male | | Female | | No | % |
| | No | % | No | % | | |
| Jejuno-jejunal | 03 | 3.09 | 03 | 03 | 06 | 6.18 |
| Ileo-ileal | 13 | 13.40 | 09 | 9.27 | 22 | 22.6 |
| Ileo-ascending | 03 | 3.09 | 02 | 2.06 | 05 | 5.15 |
| Ileo-transverse | 09 | 9.27 | 04 | 4.12 | 13 | 13.40 |
| Colo-colic | 08 | 8.24 | 05 | 5.15 | 13 | 13.40 |
| Ileostomy closure | 21 | 21.64 | 10 | 10.30 | 31 | 31.90 |
| Colostomy closure | 04 | 4.12 | 03 | 3.09 | 07 | 7.21 |
| Total | 61 | 62.88 | 36 | 37.11 | 97 | 100 |

A total of 59 end to end anastomosis and 38 stoma closures were performed. Ileoileal anastomosis was the most common site of end to end anastomosis in 22 patients whereas ileostomy closure was the most common form of stoma closure (31 patients). Ileoileal anastomosis was followed in frequency by ileo ascending and ileo transverse anastomosis, 13 cases each.

Table 4 - Distribution of cases according to site of anastomosis and method of anastomosis

| Site of Anastomoses | Method of anastomoses | | | | Total | |
|---------------------|-----------------------|-------|----------------|-------|-------|-------|
| | Single layered | | Double layered | | No | % |
| | No | % | No | % | | |
| Jejuno-jejunal | 03 | 3.09 | 03 | 3.09 | 06 | 6.18 |
| Ileo-ileal | 10 | 10.30 | 12 | 12.37 | 22 | 22.6 |
| Ileo-ascending | 02 | 2.06 | 03 | 3.09 | 05 | 5.15 |
| Ileo-transverse | 05 | 5.15 | 08 | 8.24 | 13 | 13.40 |
| Colo-colic | 04 | 4.12 | 09 | 9.27 | 13 | 13.40 |
| Ileostomy closure | 21 | 21.64 | 10 | 10.30 | 31 | 31.90 |
| Colostomy closure | 05 | 5.15 | 02 | 2.06 | 07 | 7.21 |
| Total | 50 | 51.54 | 47 | 48.40 | 97 | 100 |

Out of the 50 anastomosis performed using the single layered method, the most common was ileostomy closure (21 cases, 21.64%) followed by ileo ileal anastomosis (10 cases, 10.30%). The double layered anastomosis was most commonly performed for ileo ileal anastomosis (12 cases, 12.37%) followed by ileostomy closure (10 cases, 10.30%). Thus, ileostomy closure and ileo ileal end to end anastomosis were the two most commonly performed operations in this study.

Table 5 - Characteristics of patients undergoing Single Layered extra-mucosal anastomosis

| Observed Parameter | Study group characteristic |
|--|---|
| * Time taken for anastomosis (mean) ----- | 9.12 min |
| * Ryle's tube removed on POD (mean) ----- | 1.91 days |
| * Return of bowel sounds on POD (mean) ----- | 2.32 days |
| * Passage of motion on POD (mean) ----- | 4.18 days |
| * Complications recorded ----- | Anastomotic leaks - nil Wound infection - 1 case Abdominal distension - 3 cases Mortality - 1 case |
| * Mean duration of hospital stay ----- | 5.9 days |
| * Cost of suture material used ----- | INR 564 |

The average time taken for the anastomosis was 9.12 min. 23 out of 50 patients undergoing anastomosis had a nasogastric tube in place, the output of which was recorded daily. Nasogastric tube was not used in any of the patients undergoing stoma closure pre-operatively with selective insertion of the nasogastric tube being done post operatively depending on the patient's clinical course. Nasogastric tube was removed after an average duration of 1.91 days. The mean time taken for return of bowel sounds in this study group was 2.32 days. The patients included in this group passed motion after a mean duration of 4.18 days post operatively. Out of 50 cases, 5 complications were recorded. There was 1 mortality, which was not related to surgical procedure and was due to pulmonary complications. 3 patients suffered from abdominal distension post operatively while 1 patient had minor wound infection which subsided subsequently with aseptic dressings. The average duration of hospital stay after the surgery in this study group was 5.9 days.

Table 6 - Characteristics of patients undergoing double layered anastomosis

| Observed Parameter | Study group characteristic |
|--|----------------------------|
| Time taken for anastomosis (mean) ----- | 13.38 min |
| Ryle's tube removed on POD (mean) ----- | 2.32 days |
| Return of bowel sounds on POD (mean) ----- | 3 days |

| | | |
|---------------------------------|-------|---|
| Passage of motion on POD (mean) | ----- | 4.85 days |
| Complications recorded | ----- | Anastomotic leaks - 1 Wound infection - 2 cases Abdominal distension - 12 Persistent vomiting - 5 Pelvic collection - 1 Mortality - 1 case |
| Mean duration of hospital stay | ----- | 7.29 days |
| Cost of suture material used | ----- | INR 480 |

As we see from the table, the average time taken for anastomosis was 13.38 min. Nasogastric tube was kept in situ in 28 out of the 47 cases with neither of the stoma closure patients having the tube placement done preoperatively. The mean duration of nasogastric tube being kept was 2.32 days which was higher than the other group. The average time taken for return of bowel sounds was 3 days which was also higher than the single layered group. Patients included in this group passed motion approximately 5 days after the surgery (4.85 mean). Compared to the single layered anastomosis group, the recorded complications were much more in number. There was 1 recorded case of anastomotic dehiscence which was documented by fecal discharge from the wound and intra peritoneal collection on ultrasonography. The patient ultimately expired and the cause of mortality was anastomotic leak with subsequent dyselectrolytemia and septic shock. 12 patients developed persistent abdominal distension postoperatively which was subsequently relieved after passage of motion. 5 patients had associated bouts of bilious vomiting which were also relieved as the bowel functions returned to normal. One patient had a minor pelvic collection documented sonographically. 2 patients developed wound infections which were managed by aseptic dressings.

Table 7 - Distribution of complications in relation to the method of anastomosis

| Type of Complication | Method of Anastomoses | | | |
|----------------------|-----------------------|------|----------------|---------|
| | Single layered | | Double layered | |
| | No | %* | No | %* |
| Anastomotic leak | 00 | 00 | 01 | 2.12 |
| Abdominal distension | 03 | 06 | 12 | 25.53 |
| Persistent vomiting | 00 | 00 | 05 | 10.63 |
| Wound infection | 01 | 02 | 02 | 4.25 |
| Pelvic Collection | 00 | 00 | 01 | 2.12 |
| Mortality | 01 | 02 | 01 | 2.12 |
| Total | 05 | 10 # | 22 | 34.04 # |

*-percentage of number of cases in the particular study group

#-no. of cases with complications in the particular study group used for calculating percentage

There was 1 anastomotic leak in double layered group. 12 cases of post-operative abdominal distension were recorded in the double layered group as compared to 3 cases in single layered. 5 patients in double layered group had episodes of bilious vomiting post operatively as compared to none in single layered group. 2 patients developed wound sepsis in the double layered group while 1 patient did so in single layered group. There was incidence of minor pelvic collection as depicted on ultrasonography in 1 patient in double layered arm. Both study groups had similar incidence of mortality during the study period i.e. 1 each.

Table 8 - Comparative analysis of the two study groups

| Study Variable | Single Layered (n = 50) | Double Layered (n = 47) | P - Value |
|-------------------------------------|----------------------------|----------------------------|------------|
| Average time taken | 9.12 min | 13.38 min | < 0.0001 * |
| Complications (No. of Cases) | 05 | 16 | < 0.005 @ |
| Duration of hospital stay (mean) | 5.9 days | 7.29 days | 0.0089 * |
| Cost of suture materials | INR 564 | INR 480 | |

*- t-test

@- Chi square test

On comparative analysis of the two groups, the average time required for the single layered anastomosis was 9.12 minutes which was significantly lower than that required for double layered anastomosis, which was 13.38 minutes (p value <0.0001, highly significant). Similarly, the rates of complications were also found to be significantly different between the two groups, with p value < 0.005, highly significant. The mean duration of hospital stay was also found to be significantly reduced in patients undergoing single layered anastomosis, 5.9 vs 7.29 days mean (p value 0.0089, highly significant). However, the cost of suture material used was higher in the single layered group (INR 564) as compared to the double layered group (INR 480).

DISCUSSION

Demographic profile of Study population

A total of 97 patients were included in the study. The patients were admitted through the emergency department of the hospital as well as on routine outdoor basis. The sample included 61 male patients while 36 patients were of the opposite sex. The mean age of the study population was 42.84 years with the mean age for patients in group 1 i.e. single layered anastomosis being 42.96 years while that of patients in group 2 i.e. double layered anastomosis being 42.72 years. This is in accordance with Burch et al [18] who had a similar study population. However, the mean age groups of the study population

of Garude K. et al [19] were somewhat lower with the mean age of both the groups being around 33 years. Both groups were matched according to age and sex characteristics.

Method of anastomosis

50 patients underwent single layered extramucosal anastomosis in which the bite included only the outer three layers of the bowel wall leaving behind the mucosa in a continuous fashion. The stitch advancement was 5mm. the suture material used was poly-dioxanone monofilament 3-0 suture. The double layered anastomosis was carried out in the conventional way in 47 patients with inner layer using polyglycolic acid (vicryl) 3-0 and silk 3-0 for outer layer in a continuous fashion. The stitch advancement was kept identically at 5mm. The time taken for the anastomosis was recorded from the placement of the first stitch to the cutting of the thread after the completion of the anastomosis.

Comparison of data

On analysis of our data, it was found that the time required for the construction of single layered anastomosis was significantly lower than the double layered anastomosis with the p value <0.0001 which was highly significant. This is in accordance with data published by both Burch et al [18] and Garude et al [19]. Both of them reported significantly reduced time taken in single layered anastomosis. As far as complications are concerned, there were no anastomotic leaks in the single layered group while 1 patient developed leak in double layered group. The leak rate was thus 0 % in single layered arm while 2.12 % in double layered arm. These were far lower than those reported by Burch et al [18] and Garude et al [19]. (Table 9)

Table 9 - Comparison with published literature

| Complications | | Present Study | Garude et al [48] | Burch et al [46] | Ordorica et al [11] | Maurya et al [10] |
|------------------|----------------|---------------|-------------------|------------------|---------------------|-------------------|
| Anastomotic leak | Single layered | 00 | 04 (5.3%) | 02 (3.1%) | 02 (4.8%) | 04 (6.6%) |
| | Double layered | 01 (0.02%) | 03 (4%) | 01 (1.5%) | 03 (6.8%) | 20 (17.8%) |

Other complications reported like abdominal distension were far higher in the double layered group. Also there was evidence of pelvic collection in one patient undergoing double layered anastomosis. The length of hospital stay was another factor that differed significantly in the two groups with the p value being 0.0089. The mean time of return of bowel function, passage of motion as well as time duration for nasogastric suction had to be done were lower in the single arm group. These data point to the fact that single layered anastomosis was not only easier to perform and took less time but also resulted in reduced post operative mortality and morbidity of the patients. The single death recorded in the single layered arm resulted from pulmonary complications and not from any surgery related causes while there was one death in the double layered arm which resulted from the consequences of anastomotic leak.

Factors contributing to success of extramucosal single layered continuous anastomosis

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 [20] that in a continuous anastomosis at no point is there a segment of bowel which is completely devoid of blood supply. Bailey et al. [21] 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.

CONCLUSION

On the basis of the analysis of the data, the following conclusions can be made.

- I. Single layered extramucosal anastomotic technique is a safe and quick method of bowel anastomosis.
- II. The technique involves lesser tissue handling which gives rise to reduced post operative complications.
- III. A total of 97 patients underwent intestinal anastomosis during the period of study out of which 50 (51.54%) were operated by the single layered method and 47 (48.48%) by the double layered method.
- IV. The mean time taken for a single layered anastomosis was 9.12 minutes which was significantly less than that taken in double layered method (13.38 minutes)
- V. Post operative recovery of patients undergoing single layered anastomosis was quicker with reduced times taken for return of bowel movements and passing of motion.
- VI. Single layered arm patients suffered from reduced number of anastomotic leaks (0 vs 1), reduced post operative abdominal distension (3 vs 12), reduced episodes of bilious vomiting (0 vs 5), reduced evidence of pelvic collections (0 vs 1) and reduced rates of wound infection (1 vs 2)
- VII. Mortality rates were similar in both groups with 1 patient dying in the study period. However the mortality in double layered arm was directly related to surgical technique.
- VIII. The mean duration of hospital stay was significantly less in the single layered arm (5.9 vs. 7.29 days).
- IX. However, the cost of suture material used was slightly more in the single layered group (564 vs. 480 INR) which might be the only factor favoring a double layered anastomosis.

X. Keeping in view the reduced post operative morbidity, lesser hospital stay duration, reduced time taken for anastomosis and reduced rates of complications, it can be concluded that a single layered extramucosal continuous anastomosis is much safer and cost effective than the conventional double layered method.

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