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Prospective observational comparative study of outcomes between single-layer versus double-layer gastrointestinal anastomosis

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ABSTRACT

Background: In elective gastric surgeries, gastrojejunostomy is the most common anastomosis being done in both benign and malignant conditions. Anastomotic leak, bleeding, wound infection, and anastomotic stricture are important complications associated with intestinal anastomosis. Both double-layer and single-layer anastomosis are well-established techniques for gastrojejunostomy. Till now, there are no definite concluding findings that determine the suitability of either technique. **Aims and Objectives:** To compare the utility of single-layer gastrointestinal anastomosis versus double-layer gastrointestinal anastomosis in terms of post-operative outcome. **Materials and Methods:** A hospital-based prospective comparative study was conducted in the department of general surgery BSMCH with a time frame of about 1/2 years. A total no of 52 patients of the adult age group (18–80 years) admitted in the department of general surgery underwent gastrointestinal anastomosis has been studied. **Results:** Twenty-six (50%) patients underwent single-layer gastrointestinal anastomosis. The rest 26 (50%) underwent double-layer anastomosis. There is no statistically significant difference between these two groups in terms of post-operative nausea vomiting (P = 0.73419), wound infection (P = 0.385332), anastomotic leak (P = 0.552003), and pelvic abscess (P = 0.4924). However, the duration of surgery (P < 0.0001) and hospital stay (P = 0.0179) was significantly less in single-layer gastrointestinal anastomosis. **Conclusion**: Double-layer gastrointestinal anastomosis offers no definite advantage over single-layer anastomosis in terms of post-operative complications. Considering the duration of the anastomosis procedure and hospital stay, single-layer gastrointestinal anastomosis may prove the optimal choice in most surgical situations.

Key words: Gastrojejunostomy; Wound infection; Post-operative nausea and vomiting; Anastomotic leak; Pelvic abscess

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INTRODUCTION

In elective gastric surgeries, gastrojejunostomy is the most common anastomosis being done in both benign and malignant conditions. Intestinal anastomosis operation is a very commonly performed procedure.[1] It has been performed with regularity for more than 100 years.[2] Gastrointestinal anastomosis is conventionally performed using a hand-sewn technique. Matherson from Aberdeen Scotland was in favor of single-layer anastomosis of the intestine because of less-tissue necrosis or luminal narrowing associated with it.

The first successful gastroenterostomy (gastroduodenostomy) was carried out by Billroth in 1881. It was performed in a patient with carcinoma of the stomach following partial gastrectomy.[3] Later that year, Wolfer perform the first successful palliative gastrointestinal anastomosis.[4]

The single-layer anastomosis was first described by Hautefeuille in 1976.[5] Duration of surgery in single-layer technique was less compared to double-layered anastomosis.[6] Single-layer anastomosis costs less than the

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double-layered method and has no increased risk of leakage and stricture formation. A recent Cochrane database review compared the effectiveness of single-layer versus double-layered gastrointestinal anastomosis. It suggested further trials aimed to reduce the limitation of the review since the conclusion was derived from a smaller number of patients recruited in relatively moderate qua trials. Therefore, the present study was designed to compare the efficacy, safety, and cost-effectiveness of single-layer versus double-layer gastrointestinal anastomosis method.

This comparative study endeavors to compare the outcome of single-layer versus double-layer gastrointestinal anastomosis in terms of the duration required to perform gastrointestinal anastomosis, post-operative complications such as an anastomotic leak, and duration of hospital stay in each group. Anastomosis like other surgeries, do have linked morbidity and sometime mortality. The morbidity and mortality in anastomose are determined by a variety of factors that may be controlled. Anastomotic leak, bleeding, wound infection, and anastomotic stricture are important complications associated with intestinal anastomosis. Despite of availability of literature and research work on the single-layer and double-layer anastomosis, there are no definite concluding findings that determine the suitability of either technique.

Aims and objectives

General

To compare the utility of single-layer gastrointestinal anastomosis versus double-layer gastrointestinal anastomosis.

Specific

1. To compare the following parameter with respect to single-layer versus double-layer gastrointestinal anastomosis-
    a. Duration required to perform single-layer and double-layered gastrointestinal anastomosis
    b. Duration of hospital stay in single- and double-layered gastrointestinal anastomosis
2. To study post-operative complications such as an anastomotic leak, pelvic abscess post-operative nausea and vomiting (PONV), and wound infection in single- and double-layered gastrointestinal anastomosis.

MATERIALS AND METHODS

A hospital-based prospective comparative study was conducted in the General Surgery Department of Bankura Sammilani Medical College with a time frame of about 11/2 years (March 2021–August 2022) from ethical approval. A total number of 52 patients of the age group 18–80 years admitted in the General Surgery Ward of Bankura Sammilani Medical College and Hospital, underwent gastrointestinal anastomosis were chosen as the study population.

Inclusion criteria

1. First 52 patients underwent elective gastrointestinal anastomosis at their hospital
2. Age more than 18 years and <80 years 53.

Exclusion criteria

1. Patients who are not willing to give written informed consent
2. Patients with serious comorbid conditions such as renal failure, and collagen vascular disease
3. Pregnant women will not include in this study.

Data were analyzed using Statistical Package for the Social Sciences version 21. Variables measured on a ratio/interval scale were summarized as Means and Standard deviations. Categorical variables like rates of various post-operative complications were summarized as frequencies. Graphs were prepared on Microsoft Excel.

Intergroup comparison of continuous variables (such as age, duration of surgery, and hospital stay) was done using an independent t-test. Intergroup comparison of categorical variables (rate of complications, gender, etc.) was done using the Chi-square test. P≤0.05 was considered statistically significant.

RESULTS

A prospective observational comparative study has been carried out in the department of general surgery, BSMC and H from March 2021 to August 2022, 52 patients underwent gastrointestinal anastomosis. Complete observational and analysis of all the parameters studies are as follows:

In the single-layered group: 5 patients are in ≤50 years of age, 12 patients are in 51–60 years of age, 6 patients are in 61–70 years of age, and 3 patients are in ≥71 years of age. In the double-layered group: 4 patients are in ≤50 years of age, 9 patients are in 51–60 years of age,10 patients are in 61–70 years of age, and 3 patients are in ≥71 years of age. In this study, 9 (17.3%) patients were ≤50 years of age, 21 (40.4%) patients were 51–60 years of age, 16 (30.8%) patients were 61–70 years of age and 6 (11.5%) patients were 71> years of age. In this study, most of the patients belong to the age interval of 51–60 years (Table 1 and Figure 1).

In this study, 17 (32.7%) patients were female, and 35 (67.3%) patients were male. In the single-layered group, 10 patients are female and 16 patients are male. In the

double-layered group, 7 patients are female and 19 patients are male (Table 2 and Figure 2).

In our study, 20 (38.5%) patients had distal radical gastrostomy with anterior gastrojejunostomy, and 32 (61.5%) patients had palliative gastrojejunostomy (Table 3 and Figure 3).

In our study, 26 (50.0%) patients had double-layered gastrointestinal anastomosis (among them 10 patients underwent distal radical gastrectomy with GJ and 16 patients underwent palliative GJ) and 26 (50.0%) patients had single-layered gastrointestinal anastomosis (among them 10 patients underwent distal radical gastrectomy with GJ and 16 patients underwent palliative GJ) (Table 4 and Figure 4).

In our study, 3 (5.8%) patients had anastomotic leak. In double layered, 1 (3.8%) patient had an anastomotic leak. In single layered, 2 (7.7%) patients had anastomotic leaks (Table 5 and Figure 5).

The association of anastomotic leak with layer of gastrointestinal anastomosis was not statistically significant (P=0.552003).

In single layer 1 (3.8%) had pelvic abscess. In the double-layer no patient had a pelvic abscess. In the total study population 1(1.92%) had pelvic abscess (Table 6 and Figure 6).

The association of pelvic abscess with layer of gastrointestinal anastomosis was not statistically significant (P=0.4924).

In double layered, 6 (23.1%) patients had PONV. In single layered, 5 (19.2%) patients had PONV. In our study, 11 (21.2%) patients had PONV (Table 7 and Figure 7).

The association of PONV with layer of gastrointestinal anastomosis was not statistically significant (P=0.73419).

In single layered, 4 (15.4%) patients had wound infection. In double layered, 2 (7.7%) patients had wound infection. In our study, 6 (11.5%) patients had wound infection (Table 8 and Figure 8).

The association of wound infection with layer of gastrointestinal anastomosis was not statistically significant (P=0.385332).

In above table showed that the mean duration of anastomosis (mean±SD) was 37.7500±8.4942 min.

In single layered, the mean duration of anastomosis (mean±SD) was 29.7308±2.4909 min.

In double layered, the mean duration of anastomosis (mean±SD) was 45.7692±2.6879 min (Table 9 and Figure 9).

The distribution of the mean duration of the anastomosis with layer of gastrointestinal anastomosis was statistically significant (P<0.0001).

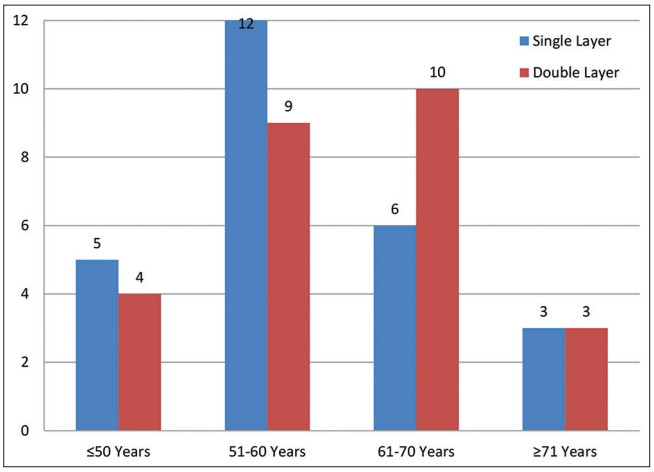

Figure 1: Distribution of age with respect to single and double layer

Table 1: Distribution of age interval in the group in both groups

Age in group	Single layered	Double layered	Total	Percent
≤50	5	4	9	17.3
51–60	12	9	21	40.4
61–70	6	10	16	30.8
≥71	3	3	6	11.5
Total	26	26	52	100.0

Table 2: Distribution of sex

Sex	Single layered	Double layered	Total	Percentage
Female	10	7	17	32.7
Male	16	19	35	67.3
Total	26	26	52	100.0

Table 3: Distribution of procedure

Procedure	Single layer	Double layer	Frequency	Percent
Distal radical gastrostomy with anterior gastrojejunostomy	10	10	20	38.5
Palliative gastrojejunostomy	16	16	32	61.5
Total	26	26	52	100.0

Table 4: Distribution of layer of gastrointestinal anastomosis

Layer of gastrointestinal anastomosis	Distal radical gastrectomy with GJ	Palliative GJ	Frequency	Percent
Double layered	10	16	26	50.0
Single layered	10	16	26	50.0
Total	20	32	52	100.0

Table 5: Association between anastomotic leak: Layer of gastrointestinal anastomosis

Anastomotic leak	Double layered	Single layered	Total
No	25	24	49
Row %	51.0	49.0	100.0
Col %	96.2	92.3	94.2
Yes	1	2	3
Row %	33.3	66.7	100.0
Col %	3.8	7.7	5.8
Total	26	26	52
Row %	50.0	50.0	100.0
Col %	100.0	100.0	100.0

Table 6: Distribution of pelvic abscess

Pelvic abscess	Single layer	Double layer	Total
No	25	26	51
Yes	1	0	1
Total	26	26	52

Table 7: Distribution of PONV

PONV	Single layer	Double layer	Total
No	21	20	41
Row%	51.2	48.8	100.0
Col%	80.8	76.9	78.8
Yes	5	6	11
Row%	45.5	54.5	100.0
Col%	19.2	23.1	21.2
Total	26	26	52
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

PONV: Post-operative nausea and vomiting

Table 8: Distribution of wound infection

Wound infection	Single layer	Double layer	Total
No	22	24	46
Row%	47.8	52.2	100.0
Col%	84.6	92.3	88.5
Yes	4	2	6
Row%	66.7	33.3	100.0
Col%	15.4	7.7	11.5
Total	26	26	52
Row%	50.0	50.0	100.0
Col%	100.0	100.0	100.0

In the single layer 22 (84.6%) patients stayed ≤10 days, 1 (3.8%) patient stayed 11–15 days, 2 (7.7%) patients stayed 16–20 days, and 1 (3.8%) patient stayed ≥21 days in hospital in post-operative period.

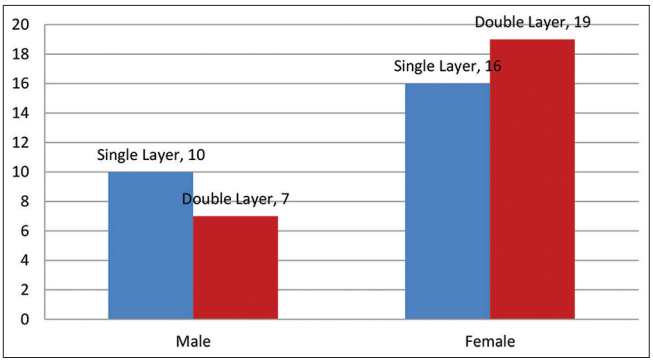

Figure 2: Distribution of sex with respect to single and double layer

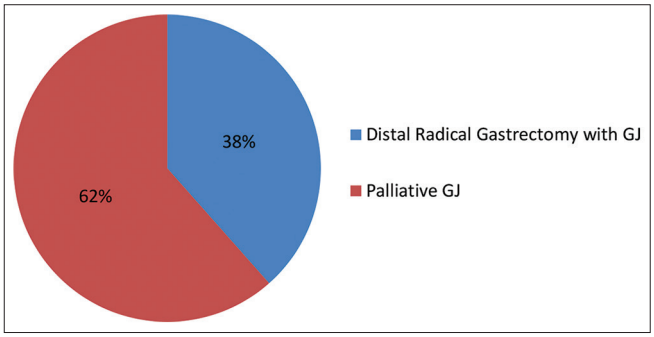

Figure 3: Distribution of procedure

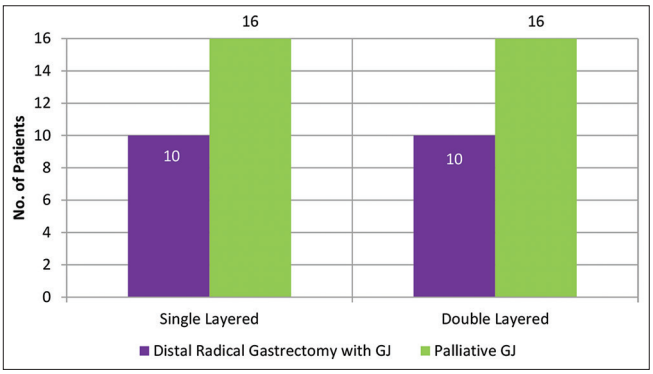

Figure 4: Distribution of layer of anastomosis with respect to procedure

In double layer 8 (30.8%) patients stayed ≤10 days, 16 (61.5%) patients stayed 11–15 days, 2 (7.7%) patients stayed 16–20 days and no patient stayed ≥21 days in the hospital in post-operative period.

In this study, 30 (57.6%) patients stayed ≤10 days, 17 (32.7%) patients stayed 11–15 days, 4 (7.7%) patients

Table 9: Distribution of mean duration of anastomosis (in minutes) among the study population

Group	Number	Mean	SD	Minimum	Maximum	Median	P-value
Single layer	26	29.7308	2.4909	25.0000	33.0000	30.0000	P<0.0001
Double layer	26	45.7692	2.6879	42.0000	52.0000	46.0000	
Total	52	37.7500	8.4942	25.0000	52.0000	37.5000	

Table 10: Distribution of duration of hospital stay (days) among the study population

Duration of stay (days)	Single layer	Double layer	Percent
≤10	22	8	57.6
11–15	1	16	32.7
16–20	2	2	7.7
≥21	1	0	1.9
Total	26	26	100

stayed 16–20 days, and 1 (1.9%) patient stayed ≥21 days in hospital in post-operative period (Table 10 and Figure 10).

In above table showed that the mean duration of hospital stay (mean±SD) was 10.7692±3.3232 days.

In single layered, the mean duration of hospital stay (mean±SD) was 9.6923±3.6526 days.

In double layered, the mean duration of hospital stay (mean±SD) was 11.8462±2.6030 days (Table 11 and Figure 11).

The distribution of mean duration of hospital stay with layer of gastrointestinal anastomosis was statistically significant (P=0.0179).

DISCUSSION

Rydygier, a polish surgeon, is credited with the first attempt at gastroenterostomy in 1881. The first successful gastroenterostomy (gastroduodenostomy) was carried out by Billroth in 1881. It was performed on a patient with carcinoma of the stomach following partial gastrectomy.[3]

Later that year, while operating on a case of pyloric carcinoma, Wolfer noted an extension of the growth into the pancreas. Because gastrectomy was not possible, he went on to perform the first successful palliative gastrojejunostomy.[4]

The process of gut anastomotic healing mimics that of wound healing.[7] A leading role is played by the submucosa, where collagen synthesis and degradation take place.[8] Most of the strength of the bowel wall resides in the submucosa and hence this is the only layer which provides mechanical strength to the anastomosis while other layers contribute

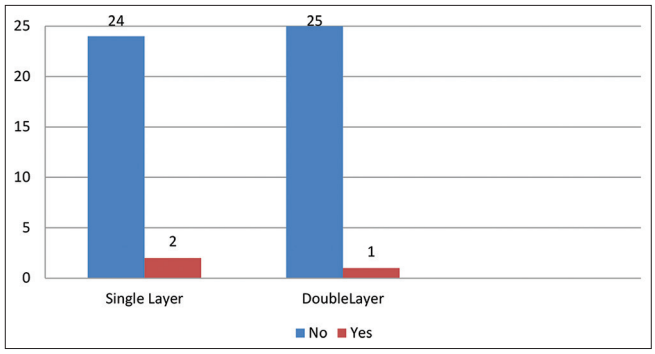

Figure 5: Figure atic representation of anastomotic leak in both group

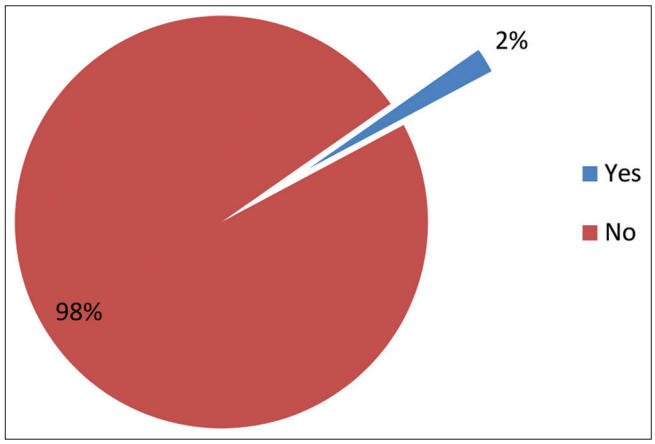

Figure 6: Distribution of pelvic abscess

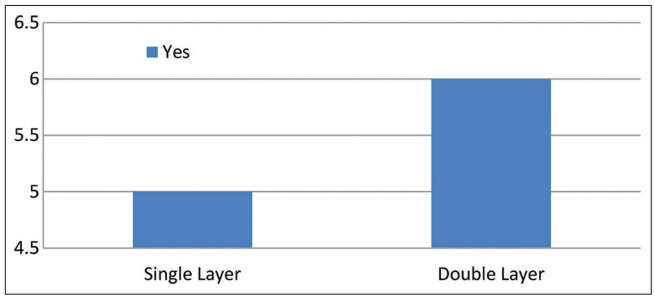

Figure 7: Graphical representation of PONV in both group

very little; that is why sutures that do not stitch onto the submucosa are unreliable.[9] The objections against the traditional double-layer anastomosis are that it ignores the principles of accurately opposing the clean-cut edges and a large amount of ischemic tissue is incorporated in the suture line which may increase the risk of leak. The inner layer increases the chances of strangulation of mucosa due to the damage to the submucosal vascular plexus and

Table 11: Distribution of mean duration of hospital stay

Group	Number	Mean	SD	Minimum	Maximum	Median	P-value
Single layer	26	9.6923	3.6526	7.0000	22.0000	8.0000	P=0.0179
Double layer	26	11.8462	2.6030	8.0000	19.0000	11.0000	
Total	52	10.7692	3.3232	7.0000	22.0000	10.0000	

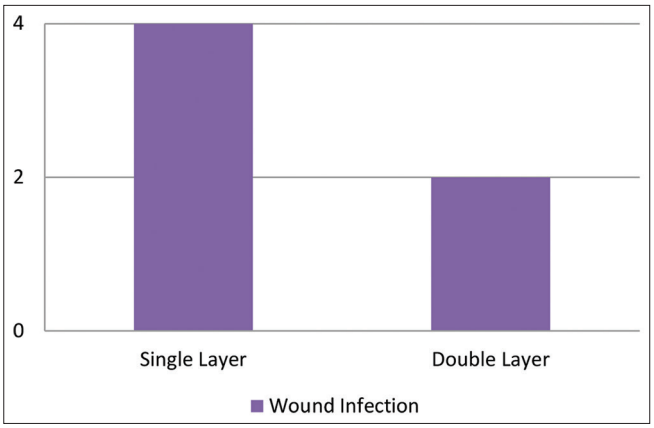

Figure 8: Graphical representation of wound infection in both group

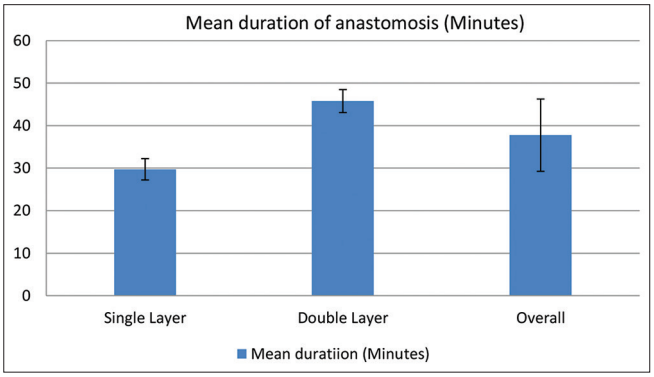

Figure 9: Graphical representation of the mean duration of anastomosis among the study population

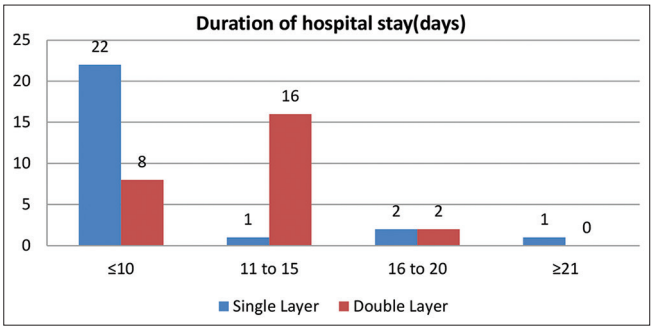

Figure 10: Distribution of duration of hospital stay in both group

the outer seromuscular layer may lead to narrowing at the site of anastomosis.[10] Many studies have reported that single-layer anastomosis takes less time to create,[11] allows more accurate-tissue apposition,[12] and causes less damage to the vascularity of bowel wall[13] and less narrowing of the intestinal lumen.

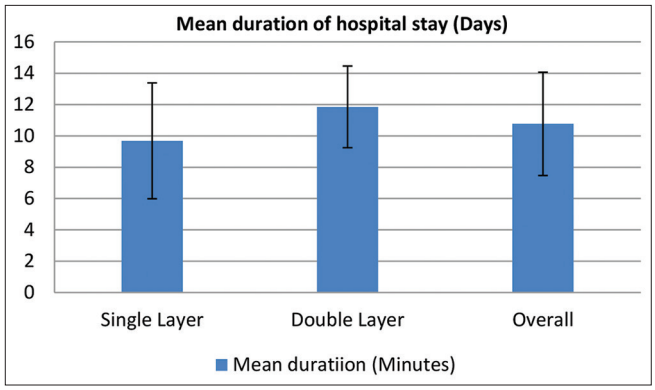

Figure 11: Distribution of mean duration of hospital stay and standard deviation

In this study 21 (40.4%) patients belong to an age interval of 51–60 years followed by an age interval of 61–70 years containing 16 patients (30.8%). In worldwide peak incidence of stomach carcinoma is seen in 60 years and older age groups 69, and 70 but in India, the age range for stomach cancer is 35–55 years in the South and 45–55 years in North.[14,15]

In this study, 35 (67.3%) and 17 (32.7%) patients out of 52 patients are male and female, respectively. Male predominance was noted with male-to-female ratio of 2:1, which are comparable with other studies.[16,17]

Anastomotic leakage was observed in 2 (7.7%) patients out of 26 patients in the single-layer and 1 (3.8%) patient out of 26 patients in the double-layer group, P<0.05. This is similar to other studies conducted by Burch et al.,[18] and Skakun et al.[19]

The average time for the construction of the single-layer anastomosis was 30 min and in the double layer was 46 min per operatively which is similar to the study conducted by Khair et al.[20]

The average duration of stay was 10 days and 12 days in single-layer and double-layer groups, respectively. This is consistent with the study conducted by Khair et al.[20]

SUMMARY

- In our study, out of 52 patients, 50% underwent single-layer anastomosis and 50% underwent double-layer anastomosis.

About 2 out of 26 patients (7.7%) in the single-layer group had an anastomotic leak while 1 out of 26 patients (3.8%) had an anastomotic leak in the double-layer group. It is evident from the study that there is no statistically significant difference in the presence of anastomotic leak between two groups with P=0.552003.

- In single-layer 1 (3.8%) patients had pelvic abscess and no patient had pelvic abscess in double layer
- A total of 11 out of 52 patients had PONV (5 patients in single-layer group and 6 patients in double-layer group). PONV no statistically significant association with layer of the anastomosis with a P=0.73419
- A total of 6 patients out of 52 patients had wound infection and 15.4% belonged to single layer and 7.7% patients belonged to double-layer group and was not statistically significant with P=0.385332
- The mean duration to perform single-layer anastomosis (mean±SD) was 29.7308±2.4909 min and the mean duration to perform double-layer anastomosis (mean±SD) was 45.7692±2.6879 min. Duration to perform anastomosis was statistically significant with layer of anastomosis (P<0.0001)
- The mean duration of hospital stay was 9.6923±3.6526 days and 11.8462±2.6030 days in single-layer and double-layer groups, respectively. It was statistically significant with layer of anastomosis with P=0.0179.

Limitations of the study

In spite of every sincere effort, our study has lacunae. The notable shortcoming of the study are:

1. The study has done in a single center
2. Sample size was small. Only 52 are not sufficient for that kind of study.

CONCLUSION

Double-layer gastrointestinal anastomosis offers no definite advantage over single-layer anastomosis in terms of complications such as an anastomotic leak, pelvic abscess, PONV, and wound infection. Considering the duration of the anastomosis procedure and duration of hospital stay, single-layer gastrointestinal anastomosis may prove the optimal choice in most surgical situations.

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Authors Contribution:
MHM- Manuscript preparation, data collection, and literature search; **SSK**- Conceptualized the study, literature search, data analysis, and interpretation; **KK**- Literature search and prepare first draft; **SC**- Concept and design of the study, review the literature, and revision of the manuscript.

Work attributed to:
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