Original Research

A Comparative Study of Stapler Anastomosis Over Hand Sewn Anastomosis in Gastrointestinal Surgeries

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ABSTRACT

Introduction: Bowel anastomosis are common procedures in both elective as well as emergency gastrointestinal surgeries. The anastomosis technique in emergency and elective procedures depends on site, bowel calibre and underlying disease. The advent of mechanical stapling devices hasrevolutionised the field of gastro-intestinal surgery in the recent times. However, universal availability, surgeon familiarity and trust as well as the cost factor are limiting factors to their use. The present study aims to evaluate the stapler anastomosis and traditional hand sewn technique with respect to their perioperative outcomes.

Material and Methods:100 patients who required intestinal anastomosis were included in the study. These patients were randomised into two groups- H(hand sewn) and Group S (stapler anastomosis) with 40 patients each. In group H, intestinal anastomosis was done using the classical double layer techniquewhilst in group S, anastomosis was done using mechanical stapling devices. A comparison was made between both the groups in terms of per- operative and post-operative outcomes i.e., time taken for anastomosis, incidence of anastomotic leak, return of bowel activity and restoration of enteral feeds and rates of other complications such as paralytic ileus and wound infection.

Results: The most significant difference was in the mean duration required for hand sewn anastomosis in comparison to stapler use (26.14 $\pm$ 4.52 mins vs 5.57 $\pm$ 2.31). Lesser bowel handling and operative time meant earlier return of bowel activity (2.39 $\pm$ 0.74 *vs* 3.35 $\pm$ 1.09 days) and restoration of oral feeds in stapler group. In terms of postoperative leak and other complications, hand sewn intestinal anastomosis offered no definite advantage over the stapler anastomosis with similar outcomes observed.

Conclusion: Considering the duration of procedure and ease of completion, use of mechanical staplers for intestinal anastomosis may prove the optimal choice in most gastro-surgical situations.

Keywords:anastomosis,mechanicalstaplers,handsewn

INTRODUCTION

The word *anastomosis* comes from the Greek word ―*ana* (without) and ―*stoma*- (a mouth), reflecting joining of the cut ends of a tubular hollow viscus (bowel) or a vessel, after resection or a bypass procedure. Intestinalanastomosis is a surgical procedure done to restore the continuity between two formerly distant or non-contiguous parts of intestine after rectifying or by-passing the underlying pathology. Intestinal anastomosis dates back to the era of *Sushruta* "The Great Indian Surgeon". He described the use of black ants during the suturing of bowel anastomosis.[1]Lembert then revolutionised the field of intestinal anastomosis when he described his seromuscular suture technique in 1826 which became and remained the mainstay of gastrointestinal anastomosis in the later part of the century. In the recent times, there has been great development in surgery regarding improved surgical techniques, anaesthetic care, antibiotic prophylaxis, etc. which have vastly contributed to better outcomes in surgical procedures post intestinal anastomosis. Currently, as initially advocated by *Matheson* of Aberdeen and later corroborated by various studies in the contemporary literature, a single layer extra mucosal anastomosis has gained popularity as the choice amongst the hand-

sewn techniques, as it probably causes the least tissue necrosis and luminal narrowing.[2]However, the real technological advancement which brought about a paradigm of shift in the field of gastrointestinal surgery has been represented with the advent of mechanical stapling devices, the first of which were introduced by Hultl in 1908.[3] Intestinal anastomosis is commonly required to be performed in a variety of benign and malignant conditions and may involve different segments of both the large and small intestine. Common indications include malignancies, strangulated hernias, intussusception, mesenteric ischemia induced bowel gangrene, traumatic bowel injury, radiation enteritis, Inflammatorybowel disease refractory to medical therapy and many more including even the enterostoma closures. One way to classify an intestinal anastomosis is based upon the orientation of the proximal and the distal cut ends with respect to each other and may include an end to end, end to side or a side-to-side anastomosis. Furthermore, the anastomosis may be carried out in one of the following ways: -

1. Conventional Methods

a. Hand-sewn techniques which may be single layer (Interrupted or continuous) or two layered

b. Stapled anastomosis[4]

2. Unconventional methods

a. Compression rings- Biodegradable anastomosis ring-BAR(Valtrac™) and non-biodegradablering (AKA2)

b. Tissue Glues

c. Laser Welding.[5]

The technique for intestinal anastomosis in emergency and elective procedures depends on the site, bowel calibre and underlying disease as well as the expertise and resource availability with the surgical team. The decision to choose stapler anastomosis or hand sewn anastomosis depends upon diameter of bowel ends and their condition (whether normal or edematous/ friable), underlying suspected pathology and contamination, available equipment and time and surgeon's preference. Sutured anastomosis, despite the technological advancement, remains the commonly used method especially in peripheral areas. The newer stapling devices used for intestinal anastomosis can perform the anastomosis in lesser time but are costlier and many surgeons are less familiar with them. However, in today's day and age, the surgical staples are becoming more popular and universally available for use in abdominal operations with their design becoming much more convenient and efficient much in contrast to the bulky and non-ergonomic ones of the previous century

Figure:1 Historical bulky staplers (left); sleek modern staplers (right)

Types of staplers being used in gastrointestinal surgeries nowadays include

1. Transverse Anastomosis or Thoraco-Abdominal Stapler (TA) : mainly used for transecting purposes
2. Gastro-intestinal Anastomosis (Linear Cutter) (GIA) stapler : most commonly used stapler for small and large bowel side to side (functional end to end) anastomosis
3. Circular or end to end anastomosis stapler (EEA) : used in colo-rectal or esophago-enteric anastomosis amongst other forms of end to end anastomosis
4. Endoscopic stapling device(Endo GIA gun) : used in laparoscopic procedures

These staplers use differently colour coded cartridges which indicate the different intact and closed staple heights (after firing) which are utilised according to the type of tissue in the anastomosis (small or large bowel, rectum, stomach or other tissues like pancreas, omentum or even vessels). As with the use of mechanical stapling devices, technical failure is a rarity and also anastomosis is more consistent and can be attained at difficult locations. However, in ambiguous situations or one's with lesser margin for error, surgeons worldwide continue to trust their own hands for the anastomosis.

The key to successful anastomosis is attained when two viable ends of the bowel are anastomosed without tension and are with good vascularity. Most

significant or sinister complications associated with intestinal anastomosis is dehiscence and anastomotic leak. Breakdown of anastomosis leads to considerable perioperative morbidity and mortality. The incidence of complications can be reduced to a major extent if certain surgical tenets are followed. These include perioperative nutritional optimization, effective management of systemic diseases, perioperative optimization of medical comorbidities and avoidance of drugs such as vasopressors and corticosteroids to the extent feasible. The ultimate motive is to create a safe and healthy bowel anastomosis.

The present study aims to know the advantages if any of stapler anastomosis over the conventional hand sewn anastomosis in respect of perioperative outcomes such as the operative time, anastomotic integrity, appearance of bowel sounds, resumption of oral feeds, other complications and post operative hospital stay.

MATERIAL AND METHODS

The present study was conducted in the Department of General Surgery, Govt. Medical College and Rajindra Hospital Patiala from January 2020 to July 2021. A total of 80patients admitted in the General Surgery Department for elective as well as emergency gastrointestinal surgeries were enrolled in the study after fulfilling the eligibility criteria. An institutional ethical committee clearance was obtained. The 80 patients were randomly(computer generated numbers) divided in two groups of 40 each - Group H (Handsewn Anastomosis) and Group S (Stapler Anastomosis). An informed and written consent regarding the surgery as well as the study design and protocol was taken from all the patients before the surgery. All cases were managed and followed up in the same hospital by the same surgical team.

Inclusion Criteria

1. The patients of both sexes admitted requiring emergency or elective gastrointestinal surgery with bowel anastomosis for various benign or malignant conditions
2. Subjects who gave consent to be a part of the study

Exclusion Criteria

1. Age less than 12 years
2. All pregnant ladies
3. Patients undergoing radiotherapy
4. Patients otherwise medically unfit, not fit for anaesthesia and on anti-coagulant therapy.
5. Patients who refused to join the study or left the hospital before final evaluation.

Pre-operative workup

A detailed history taking & clinical examination of the patients were done. Relevant haematological, biochemical and radiological investigations In patients admitted in emergency ward, preoperative resuscitation was undertaken first. Once the patient was stabilised, she/he was taken for emergency laparotomy without any further delay. In elective surgeries, bowel preparation was done one day prior tothe day of surgery and antibiotic prophylaxis used as per the protocols.

Operative Procedure

In Group H, conventional hand sewn anastomosis was done using the standard double-layered anastomotic technique comprising an inner layer of continuous mucosa inverting full-thickness absorbable sutures (Polyglactin 910 in size 2-0/3-0) with an outer layer of interrupted Lembert's seromuscular sutures using a non-absorbable suture material (silk 2-0/3-0).

In Group S, stapler anastomosis was done using a linear cutter GIA stapler (side to side with functional end to end component) of tissue-appropriate staple height or a circular EEA stapler depending upon the procedure involved. A comparison was made between the two groups in terms of duration of the anastomotic procedure (taken from the beginning of the first stitch to the cutting of the last stitch in Group H and from the orientation of the cut ends to the withdrawal of the stapler post firing in the Group S), anastomotic integrity or leak rates, return of bowel activity, resumption of oral feeds and period of hospital stay. For *statistical analysis* Independent Samples t test was used to compare mean values between two methods. Chi square tests were used to compare proportion of the two values. Observations were analysed statistically and concluded and a P value of <0.05 was taken as statistically significant.

OBSERVATION AND RESULTS

The mean age of patients in both the groups was comparable at 45.45 $\pm$ 4.68 years in Group H and 43.50 $\pm$ 5.16 years in Group S (P value 0.567). Majority of the procedures were performed in the 4th and 5th decade of the life in both the groups. Gender profile in both the groups was similar with majority of patients being males (80% *vs* 77.5% in Group H & S respectively).The commonest indication for surgery in both the groups was benign inflammatory stricture (mostly post tuberculosis) (55% *vs* 60% in Group H and S respectively), followed by malignancy (Group H 20% vs Group S 25%), traumatic bowel injury and other miscellaneous causes. The commonest performed surgical procedure in both the groups was ileal resection & anastomosis (67.5% in Group H *vs* 72.5% in Group S) followed by segmental colectomies and ileo-colic or colorectal anastomosis (20% each in both the groups) and gastrojejunostomy. The case distribution & the type of procedure performed were similarly distributed in both the groups.

Operative time

Mean operative time in Group H was 26.14 $\pm$ 4.52 mins vs 5.57 $\pm$ 2.31 mins in Group S with a mean time difference of about 20.57 mins which was found to be statistically significant ($P < 0.001$).

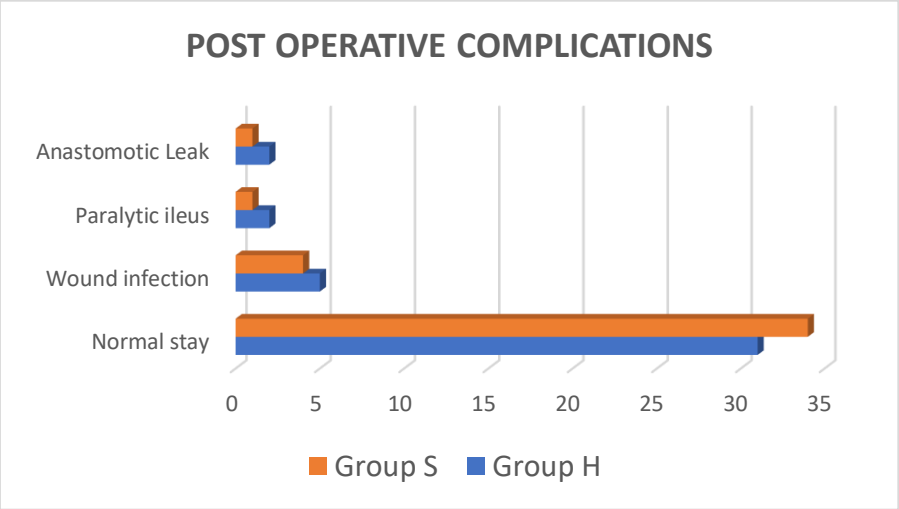
Post operative outcomes

The Group S patients fared better in this respect as far as the return of bowel activity& resumption of enteral feeds and mean hospital stay was concerned however the difference in the latter was not found to be significant. The findings are tabulated in Table - 1

Parameter(in days)	Group H		Group S		Pvalue
	Mean	SD	Mean	SD	
Return of bowel activity	3.35	1.09	2.39	0.74	0.03
Restoration of Enteral feeds	4.40	0.75	3.65	0.67	0.002
Mean hospital stay	9.90	2.92	9.50	2.37	0.476

Post operative complications (Figure – 2)

Post operative complications in form of anastomotic leak, paralytic ileus and surgical site infection were observed and compared. There were no complications in 65 patients (81.25%). The commonest complication encountered in the series was wound infection, which was present in 5 patients in group H (12.5%), and 4 patients in Group S (10%). It was followed by paralytic ileus in 2 patients in Group H (5%), and 1 in Group S (2.5%). 2 patients (5%) in Group H and 1 (2.5%) in Group S developed anastomotic leak, for which they underwent re-exploration. On statistical analysis, the complication rates were found to be similar. One patient expired during the hospital stay due to complications following post-op leak, from Group H. The other 3 patients suffering from the post-op leakage recovered uneventfully. The follow-up was unremarkable in a total of 79 patients (97.5%).



DISCUSSION

Gastrointestinal bowel anastomosis constitutes one of the most commonly performed surgeries worldwide due to varied pathologies of small and large intestine which may be congenital, inflammatory, traumatic, benign or malignant. Recent times have seen great development in the sphere of gastrointestinal surgeries marked by improved surgical techniques, suture materials, anaesthetic care, antibiotic prophylaxis etc consequently leading to improved outcomes in gastrointestinal anastomosis. With evolution of mechanical stapling devices and with the development of reliable and disposable stapling instruments in the recent times, stapler anastomosis is being popularly and increasingly used in various surgical spheres now a days. Irrespective of the technique used, the aim is to provide a secure, healthy, water-tight, tension-free and sustainable gastrointestinal anastomosis. The decision to finalise upon a technique is dependent upon numerous factors like the patient's general condition, the health and viability of the cut ends of the gut, the availability of the stapler/suture material as well as the surgeon's preference, familiarity and expertise in the technique. In the present study, conducted on 80 patients who underwent gastrointestinal anastomosis in some form or the other at the department of General Surgery, Rajindra Hospital and Government Medical College Patiala, various parameters like operative time, bowel activity return, resumption of oral feed and post operative complications in patients were compared between the hand sewn and stapler anastomosis methods. The demographic and gender profile in both the groups was comparable

with majority of the patients being male (78.8%) and in the 4th and 5th decades of life. This matches the general epidemiology of gut disease which is more prevalent in the male gender, whilst the age peak evens out in the middle age though malignancies may occur later.[6]In terms of diagnosis for which the bowel anastomosis was carried out, the majority of patients in both the groups underwent surgery for benign bowel strictures (mostly tubercular) followed by malignancy, trauma and strangulated hernias, amongst others. The commonest procedure performed in both the groups was ileal resection and anastomosis followed by colectomies and ileo-colic or colo-rectal anastomosis. Other anastomosis performed were gastrojejunostomies and ilio-transverse bypass procedure.Theoverall distribution of the procedures performed as well as the primary pathologies for which they were performed were found to be statistically similar in both the groups.

Comparison of Operative time

The most contrasting outcome observed in both the groups was in operative time for the anastomosis. In Group H, the mean time was 26.14 $\pm$ 4.52 mins vs 5.57 $\pm$ 2.31 mins observed in Group S ($p < 0.001$). Luechakiettisak P et al (2008) in their study upon 117 subjects also observed that mean operating time for Esophagogastric anastomosis was significantly lower in stapler group being 203.7 mins versus 218.1 mins observed in the hand sewn group.[7] Similarly, Khan AQ et al (2016) also reported significantly lesser mean total operating times in stapler Group (being 123 mins) vis-a-vis 161.5 mins in hand sewn group when compared in a series of 60 patients undergoing Colorectal Anastomosis.[8]Mohamed MA et al (2018) also reported significant predictive value in terms of operating time in their study, with operating time of 110 mins in stapler group and 140 mins in Hand Sewn group in small bowel anastomosis.[9] Thus, the result of our study was in concordance with results of these studies. Total operating times could vary depending upon the actual surgery/ resection procedure. Thus, we specifically focused only upon the mean anastomotic time. Lesser time in anastomosis consequently lowers the total operative time benefitting the patient physiology.

Comparison of Return of bowel activity & enteral feeding

Mean return of bowel activity was significantly earlier in Group S at2.39$\pm$ 0.74 days in comparison to 3.35 $\pm$ 1.09 days in Group H. Damesha N et al (2008) also reported in their study the resumption of bowel activity in Gastrojejunostomy to be earlier in stapler group though it was statistically insignificant.[10] Nichkaode PB et al (2017) in their study recorded that mean time required for return of bowel activity in all the three procedural groups viz esophageal anastomosis, gastrojejunostomies and colorectal anastomosis was significantly lower in Stapler group in comparison to handsewn group.[11] For instance, in gastrojejunostomy in stapler group bowel activity returned in 3.44 days in comparison to 5.20 days in handsewn group. Banurekha R et al (2017) in their study reported mean time for return of bowel activity in patients undergoing Gastrojejunostomy in Stapler group at 2.13 days whereas in hand sewn group it was 2.86 days with significant p value of 0.006.[12]Lesser bowel handling and manipulation with decreased operative times with use of staplers could be factors instigating early return of peristalsis. As a result, the patients could be initiated earlier on enteral feeds (4.40 $\pm$ 0.75 in Group H *vs* 3.65 $\pm$ 0.67 in Group S)

Comparison Of Resumption of oral feeds

In our study, the meantime taken for resumption of oral feeds was much earlier in Group S being 3.65+-0.67 days versus 4.40+-0.75 days in Group H ($p = 0.002$). Damesha N et al (2008) in their study stated that resumption of oral feeds was earlier in stapler group in Gastric Resection Group being 5 days as compared to hand sewn group being 6 days. This difference between two groups were statistically significant in their study as well.[11]

Comparison Of Anastomotic Integrity and other complications

In the present study, the anastomotic leak was present in two patients (n=2, 5%) in Group H and in one patient (n=1,2.5%) in Group S in our study. The difference was not found to be significant. Similarly, other complications like paralytic ileus & wound infection were comparable in both the groups. Bhatti A et al (2013) in their study noticed that anastomotic leak was present in 3 patients (8.6%) in hand sewn group and in one patient (2.9%) in stapler group. On statistical analysis there was no significant difference between two groups in terms of anastomotic leakage.[13] Nichkaode PB et al (2017) in their study analysed the anastomotic leak in three groups separately. In Esophageal anastomosis group there was leak in one patient (4%) each in both Stapler and Handsewn Group with p value calculated at 0.81(insignificant). In Gastrojejunal anastomosis group there was no leak in both stapler and hand sewn groups. In colorectal anastomosis group there was anastomotic leak in 4 patients (23%) in Handsewn group and in one patient (5.8%) in Stapler group. The predictive value in this subgroup was significant with value being 0.0001.[10] Patil PK et al (2018) in their study noticed anastomotic leak in all the 4 subgroups of anastomotic procedures done that is in esophageal anastomosis,gastrojejunostomy, small bowel anastomosis and Ileo-colic and colo-colic anastomosis respectively but found no significant difference in the anastomotic leak or complication rateswith either stapler use or hand-sewn methods.[14]

Thus, the present study is in accordance with previous author studies with mean hospital stay lesser in stapler group found to be less when compared to the hand

sewn procedures. The difference was found to be statistically significant in some of the studies.

CONCLUSION

Ever since the advent of mechanical staplers in the early 20th century they have caught fascination of the surgeons worldwide. The staplers have undergone numerous changes in their design and applicability over the years and researchers across the globe have undertaken various studies to determine their outcomes with their use in GI surgery.To conclude, in our study, it was found that surgical outcomes in gastrointestinal anastomosis in respect of presence or absence of anastomotic leak, incidence of localised abscess formation, peritonitis and surgical site infection were quite similar in both the hand sewn and the stapler subgroups. Despite the similar peri-operative profile, the mechanical staplers offer the advantage of lesser operative times, less tissue trauma and gut handling leading to early restoration of enteral feeds. These advantages are however partially offset by the universal availability and cost factor involved, which needs to further be evaluated in larger sample size, especially in resource austere settings, for the mechanical staplers to cement their position as the technique of choice in GI anastomosis.

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