

## **“PROSPECTIVE STUDY OF VARIOUS SURGICAL TECHNIQUES AND FACTORS AFFECTING THE OUTCOME OF BOWEL ANASTAMOSIS”**

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### **Abstract:**

#### Background:

Bowel resection and anastomosis are commonly performed surgeries in general surgery for various causes like gangrene bowel, perforation, carcinomas. Bowel anastomosis can be done by hand sewn technique or using staplers. There are various factors that affect anastomosis healing are poor nutritional status, diabetes mellitus, anaemia, smoking etc.

most common complications of bowel anastomosis are anastomotic leak, bleeding, stricture, obstruction

The main aim of the study is

1. To study the outcome of anastomosis performed through hand-sewn Versus stapler.
2. To study the outcome of anastomosis done in elective surgeries versus Emergency surgeries.
3. To study various factors affecting the outcome of bowel anastomosis.

#### Methods:

The study is a prospective cross-sectional study of 50 cases who Attended Surgical OPD and casualty (emergency department), Andhra Medical College, King George Hospital, Visakhapatnam and underwent bowel resection and anastomosis over two years. A detailed history and physical examination after taking informed Consent.

Investigations like erect x-ray abdomen, Ultrasonogram abdomen, Routine blood investigations like complete blood picture, blood sugar, Renal function tests, liver function tests, and contrast-enhanced Computerized tomography (CECT) abdomen if necessary.

#### Results:

- The incidence of AL in the present study is 11%. 63.6% of the AL is seen In males.
- The majority of them are seen in the 7<sup>th</sup> decade, followed by the 4<sup>th</sup>Decade.
- Smoking, anemia, and hypoalbuminemia are significant risk factors for AL.
- Diabetes mellitus, as such, is not a significant risk factor for AL.
- 40% of the patients having sepsis developed AL.
- 8 out of 11 AL are of emergency, which is statistically significant.

-AL is not significantly associated with either hand-sewn or stapler in Whichever circumstance used.

-CRP is significantly associated with the development of AL ( $p < 0.01$ ).

### **CONCLUSIONS:**

There is no significant difference between hand sewen and stapler anastomosis. Preoperative factors like anemia, hypoalbuminemia, smoking are the risk factors for anastomotic leak. Serum c reactive protein is a predictor of anastomotic leak

Keywords: Bowel anastomosis, hand sewen vs circular stapler, various factors that affect anastomatic leak

### **INTRODUCTION:**

Four layers characterize the digestive tract from the esophagus to the anus. From inside out, the layers are mucosa, submucosa, muscularis Propria, and serosa. The innermost lining of the GIT is mucosa. Depending On the section of GIT, it has various functions like protection from toxic or Irritant substances, secretion, and absorption of multiple substances. It Contains three layers. They are epithelium, lamina propria, and muscularis Mucosa. Lamina propria contains lymphatic tissue, i.e., mucosa-associated Lymphoid tissue (MALT). Muscularis mucosa contains smooth muscle, which On contraction creates folds and helps in increased absorption(12). It also Helps in generating local movements. Migration and hyperplasia of epithelial Cells help in sealing the mucosal defect during anastomosis and thus creates a barrier to the luminal contents(13). Mucosal eversion and inversion delay this process, which usually occurs in three days(14). Direct opposition is the Best.

The submucosa comprises of areolar connective tissue containing Interwoven collagen and elastic fibers, blood vessels, lymphatics, and nerve Fibers. Submucosa provides tensile strength to the GIT and is responsible for anchoring the suture that holds the anastomosed bowel ends together. Halsted discovered this fact, which was a significant advance and formed The basis for most of the various suturing and stapling techniques(15). Type I collagen is the predominant variant followed by type III and type V(16)

Muscularis propria is the next layer. Except in mouth and pharynx, the entire GIT has smooth muscle (three layers in the stomach and two in small and large bowel). It helps in the movement of food by peristalsis and mechanical digestion by segmentation. The circular layer helps in forming Sphincters that not only helps in opening and closing of lumen but also in mechanical digestion(12)

The next layer is serosa, which has different nomenclature at different Segments of GIT like adventitia in the esophagus, visceral peritoneum Elsewhere. This visceral peritoneum helps in the formation of mesentery for Small bowel and mesocolon for the colon. Inverting type of suture technique helps in good serosal apposition, which minimizes the risk of leakage(17,18).

Oesophagus and distal third of rectum are devoid of this serosal protection layer, so they are at a higher risk for Anastomotic leakage(19,20)

### **GASTROINTESTINAL HEALING:**

When mucosa is injured or involved, it heals by epithelial proliferation. Serosa and mucosa healing occurs without scarring. Full-thickness injuries healing requires additional mechanisms that provoke fibroblastic response leading to scar formation(21). As in any injury, there will be an initial phase of transient vasoconstriction followed by vasodilatation and increased vascular Permeability following incision of the gut leading to bowel wall edema, which must be kept in mind while suturing to avoid ischemic necrosis. After the Initial phases of healing, finally, serosal healing help in the formation of the Water-tight seal. The early integrity of anastomosis depends on the suture Holding capacity of the submucosal layer.

.In the proliferative phase, collagen synthesis and lysis simultaneously occur. The lysis by the collagenase enzyme is responsible for low anastomotic strength. After 1-2 weeks, over the submucosal granulation Tissue develops the epithelial layer. The anastomosis becomes thinner and stronger in the final phase of healing. Any factor that enhances collagen lysis or impedes its synthesis is responsible for weaker anastomosis leading to leak and failure.

The factors that set the GIT apart from other tissues are its multi-layered architecture, colonized microorganisms, and its downregulation of blood Supply during hypovolemic shock.

Various other factors are influencing the healing of bowel anastomosis. Can Be broadly divided into

Local factors: Hypovolemia, overenthusiastic dissection of the mesentery, or inappropriate suturing causes a reduction in blood supply at the perianastomotic site, tension at the suturing site and radiation causing damage to the micro-circulation influences healing.

Systemic factors: Age, malnutrition (cancer cachexia, vitamin deficiency, Zinc deficiency, hypoalbuminemia), jaundice, sepsis, and uremia has detrimental effects on tissue healing.

Granulocytes in the presence of sepsis are responsible for the increased collagenolytic activity, and they stay longer In the colon in comparison to the ileum.

Various surgical techniques and factors like suture materials:

As elsewhere, ideal suture material should

- Retain its strength until the anastomotic integrity is secured.
- Have minimal tissue reaction and unfavorable to infection.
- Easy handling and knotting.

Monofilament sutures do not provide scaffolding where organisms can Proliferate, so they are superior to multifilament sutures and are therefore immune. Nonabsorbable monofilament sutures are closest to ideal for anastomotic healing in the gastrointestinal tract. Minimal tissue reaction Observed with stainless steel used in stapler devices.

Synthetic absorbable suture materials have an advantage like, they do the Job and disappear. Thus, no foreign body is left and is ideal for intestines. Vicryl remains to be the choice of suture material in GIT anastomosis.

### **MATERIALS AND METHODS**

The study is a prospective cross-sectional study of 50 cases who attended Surgical OPD and casualty (emergency department), Andhra Medical College, King George Hospital, Visakhapatnam and underwent bowel resection and anastomosis over two years

#### *Inclusion criteria:*

All patients who are suffering from intestinal obstruction, neoplastic lesions, tuberculosis undergoing resection and anastomoses.

#### *Exclusion criteria:*

- Patients below 18 years of age.
- Unwilling patients.
- Other than bowel-to-bowel anastomosis like pancreaticojejunostomy, choledochojejunostomy, etc., are excluded.
- Patients seropositive for HIV, HbsAg, HCV excluded.
- Death due to other causes.

#### *Study methodology:*

Prior approval from Institutional Ethics Committee

A detailed history and physical examination after taking informed consent.

Investigations like erect x-ray abdomen, Ultrasonogram abdomen, routine blood investigations like complete blood picture, blood sugar, renal function tests, liver function tests, and contrast-enhanced computerized tomography (CECT) abdomen if necessary.

Age more than 60 years is considered old age.

Hemoglobin less than 10 gm/dl considered as anemia, and albumin less than 2.5 gm/dl considered as hypoalbuminemia.

Surgical treatment (hand-sewn and stapler techniques) is blockrandomized.

All hand-sewn small bowel and ileo-transverse anastomosis are done in two-layers, inner layer with absorbable 3-0 Vicryl and outer layer with non-absorbable 3-0 silk in a continuous fashion.

All hand-sewn large bowel anastomosis is done in a single layer using non-absorbable 3-0 silk in an interrupted fashion.

Postoperative care and follow up for any anastomotic leak for two weeks.

Anastomotic leak defined by a defect in the bowel wall at the site of anastomosis, leading to communication with the lumen. AL identified using tachycardia, fever, leukocytosis, enteric contents in the drain, and peritonitis. Appropriate investigations like imaging used to diagnose doubtful AL cases.

Comparison among hand-sewn versus stapler, elective versus emergency, sepsis versus no sepsis, small bowel versus large bowel, and influence of preoperative comorbidities over postoperative AL is made .

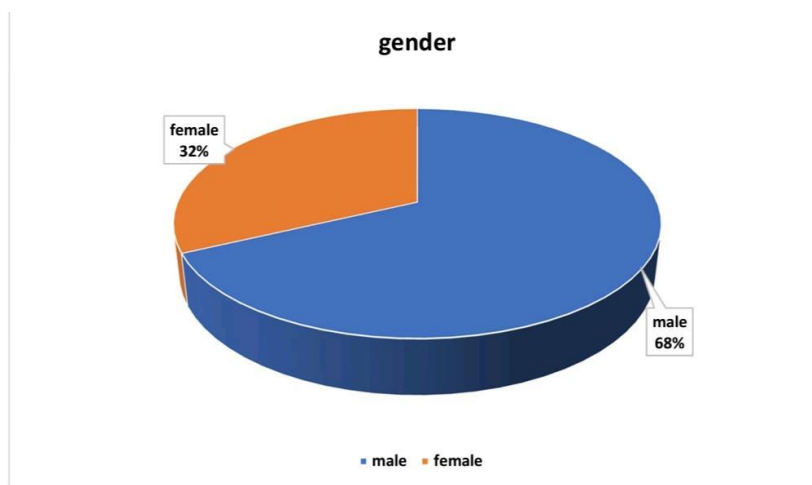
After completion of the study, findings and results were analyzed using SPSS software. Chi-square test, Fischer exact test, and unpaired t-test and logistic regression analysis are done wherever applicable.

**RESULTS:**

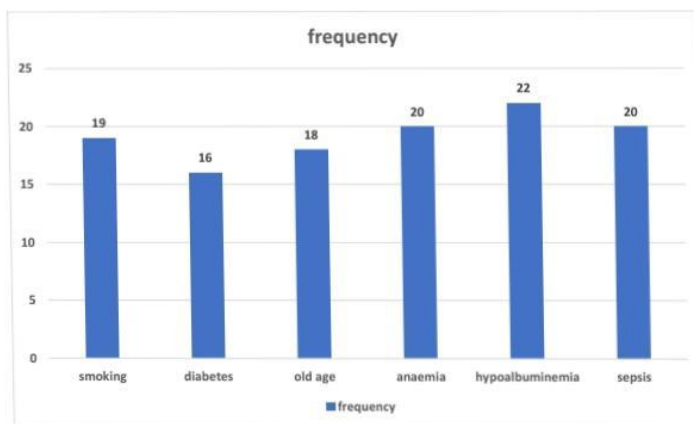
A statistical analysis of data having 50 cases admitted, evaluated, and treated in the Department of Surgery, King George Hospital, Visakhapatnam during a period of 2 years was done and the results are noted below.

*Age and sex incidence:*

In this study, males contributed 68%, and females contributed 32% of the cases. The incidence in this study shows males are more predisposed. (2.1 times)



*Analysis of the factors taken in the study :* In the present study, 46 out of 50 cases have one or more than one risk factor, and only 4 cases have none of the risk factors taken into the study.



**Figure 8 Incidence of risk factors in the study**

For the convenience of the study, the grouping of the resections is as follows:

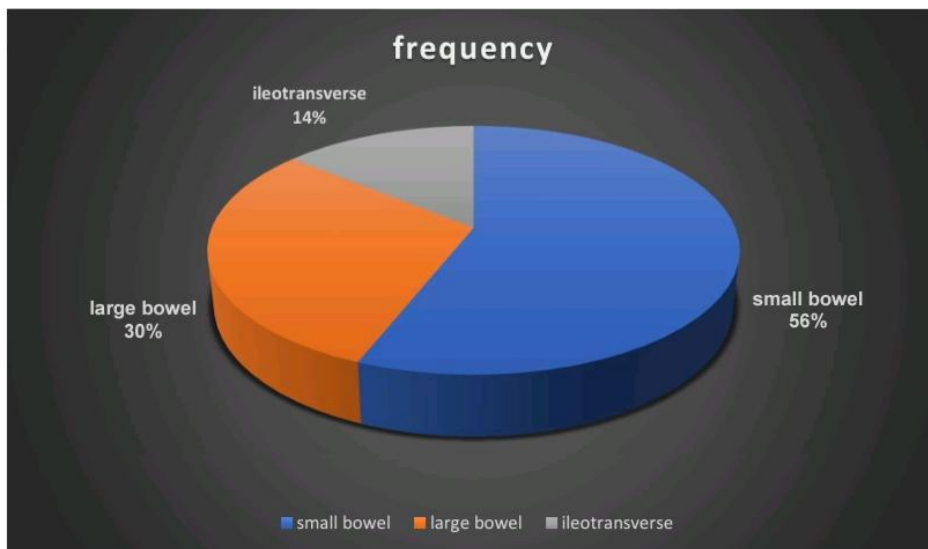


Figure 15 showing the proportion of anastomosis done on various parts of the bowel

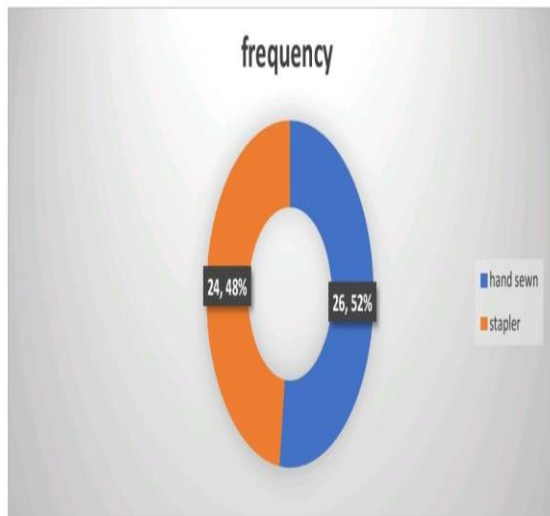
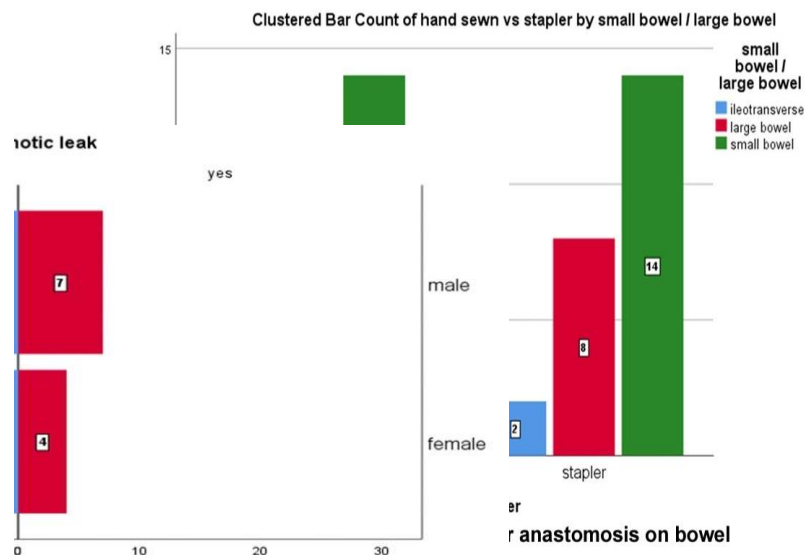


Figure 16 frequency of hand-sewn or stapler



anastomosis on bowel

...ing to 22% in this study. Out of the 11 cases, seven are males, and four are females having an odds ratio of 0.47, implying that AL is twice (2.12) common in males when compared to females.

*Anastomotic leak in smokers and diabetics:*

Out of the 11 cases, 7 are smokers, and 4 are non-smokers. Only 4 out of 31 non-smokers postoperatively developed a leak, showing AL likely to occur 3.93 times more common in smokers to non-smokers and association is significant ( $p < 0.05$ ).

In this study, 4 out of 11 patients who developed AL are diabetics. Out of 34 non-diabetics, seven have shown leaks post-operatively. AL likely to occur 1.28 times more in diabetics.

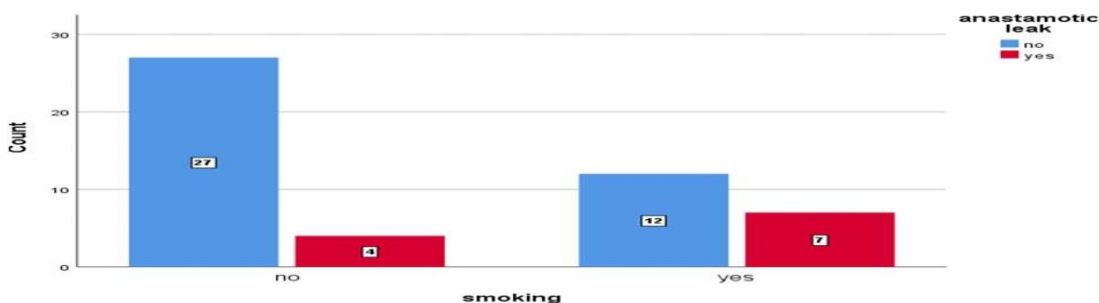


Figure 20 AL vs. smoking

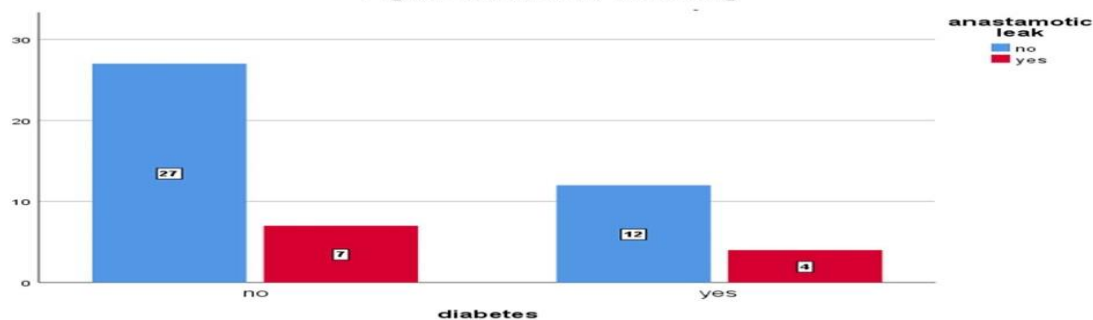


Figure 21 AL in diabetics

*Anaemia vs anastomotic leak:*

Out of the 11 cases who developed AL, 10 cases have hemoglobin less than 10.1 gm/dl, i.e., the median Hb level of the study group ( $p < 0.05$ ). Four cases had hemoglobin less than  $2 \times (S.D)$ , i.e., 7.2 gm/dl, 3 of them developed AL. In the AL group, the incidence of anemia is 12.2 times more

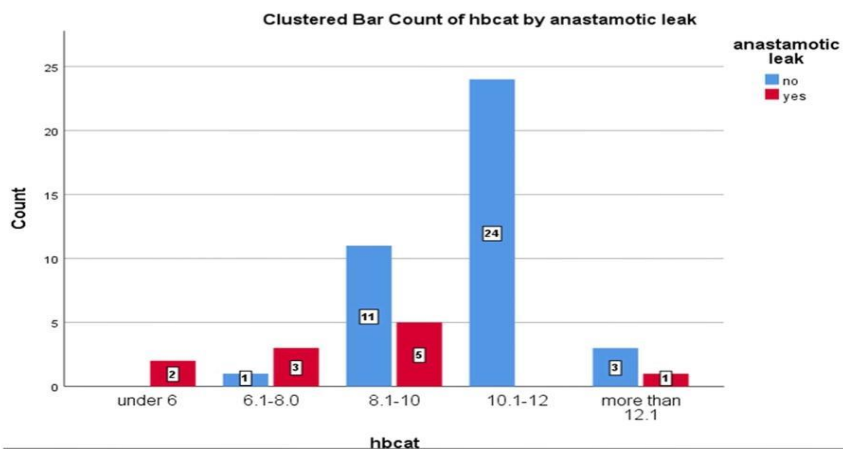
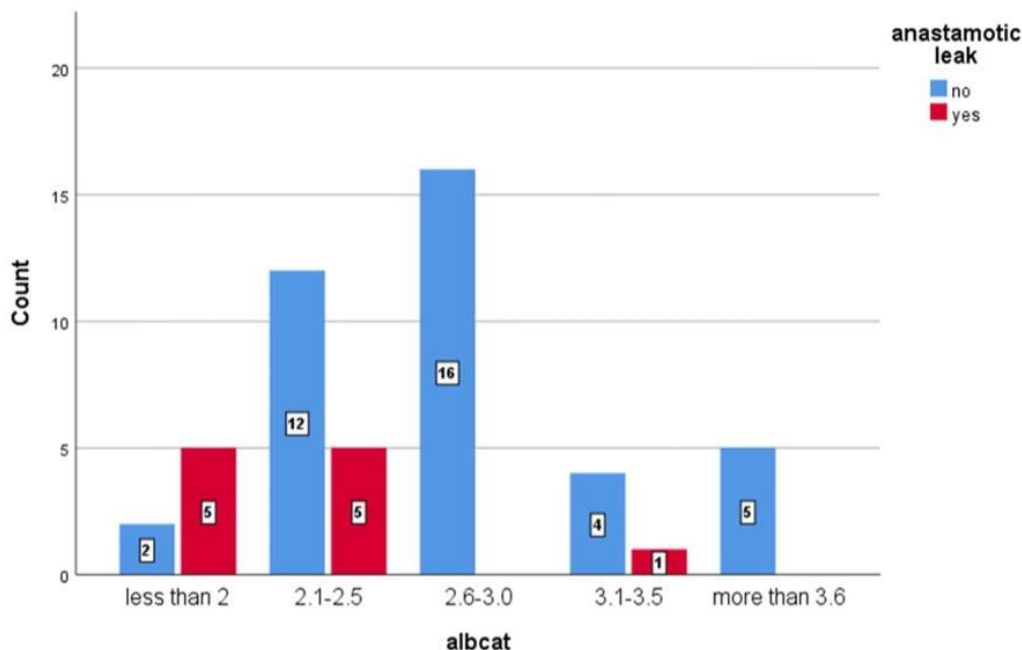


Figure 23 AL vs. Hb

*Albumin vs anastomotic leak:*

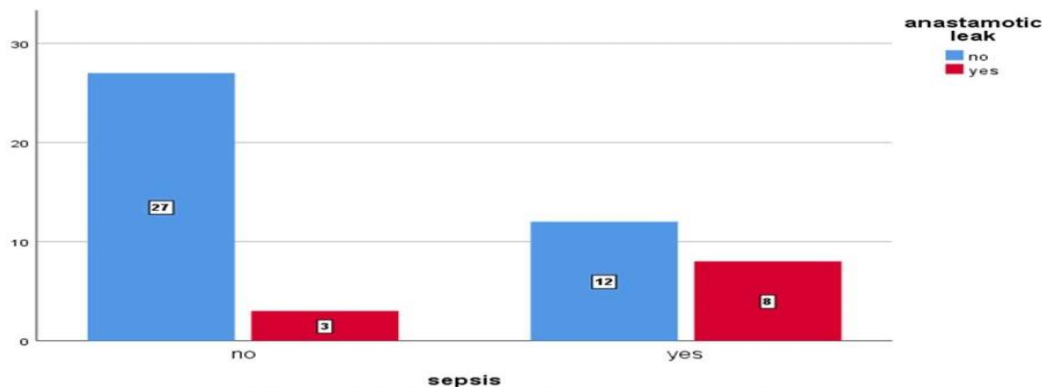
Albumin levels in the study population distributed along a normal distribution curve with a range of 1.22-3.94 gm/dl ( $\pm 2 * S.D$ ). Of the 11 cases who developed AL, 10 cases have albumin less than 2.5 gm/dl. AL likely to occur 17.8 times more common in cases having albumin less than 2.5



**Figure 24 anastomotic leak vs. albumin category**

*Sepsis vs anastomotic leak:*

In this study, out of 20 patients having sepsis intraoperatively, 8 developed AL, and only 3 out of 30 patients, who do not have sepsis developed AL in the postoperative follow up. So, there is six times likely chance of getting AL who are having sepsis intraoperatively.



**Figure 25 Anastomotic leak in Sepsis**



*Anastomotic leak in Hand-sewn vs stapler:* 7 out of 26 hand-sewn cases developed AL and 4 out of 24 stapler anastomoses cases developed a leak. In this study, there is no statistically significant association between AL and type of anastomosis ( $p>0.05$ ).

AL in elective vs. emergency :

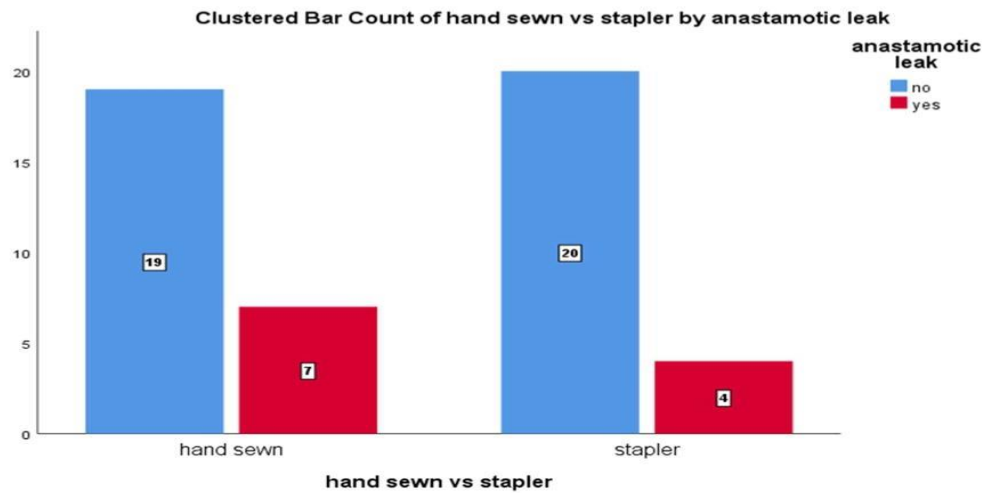


Figure 26 Incidence of AL in Hand-sewn versus Stapler

In this study, 8 out of 11 AL observed in patients presenting to the emergency. Only 3 out of 17 elective cases developed AL. AL likely to happen 1.49 times more common in an emergency to elective cases. Three out of eleven cases who underwent MBP, three cases developed AL ( $p>0.05$ )

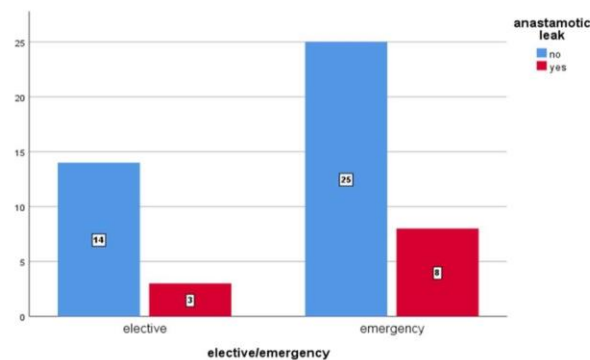


Figure 22 AL in elective vs. emergency

**Discussion:**

Most of the general surgeons do perform gastrointestinal surgeries for a long time. Surgery on the GIT involves suturing or anastomosis of bowel day in and day out. And handling these can lead to dreadful complications which were mentioned elaborately in the literature available. Keeping in

this mind, a surgeon's nightmare after operating on a bowel is an anastomotic leak. Incidence of which is variable; however, best an anastomosis is done depending on various factors. More than 30% of the laparotomies performed in our institute involves bowel resection and anastomosis.

The mortality associated with the AL is significantly high. Not only the mortality but also the morbidity to the patient should also be our concern. All these are finally leading to a tremendous financial burden to the hospital, and the state as management of AL is an expensive affair, and as these are mostly done in a Government tertiary hospital.

With the radical improvement in imaging modalities available and along with thorough clinical knowledge as a good base, AL can be identified early and should be tackled accordingly

The present study includes 50 cases who attended Surgical OPD and casualty (emergency department), Andhra Medical College, King George Hospital, Visakhapatnam and underwent bowel resection and anastomosis over two years.

The main aim of the study is

1. To study the outcome of anastomosis performed through hand-sewn Versus stapler.
2. To study the outcome of anastomosis done in elective surgeries versus Emergency surgeries.
3. To study various factors like haemoglobin, albumin, crp values, sepsis, smoking, diabetes affecting the outcome of bowel anastomosis.

*Age and sex incidence :*

In the present study, who developed AL, 63.6% are male sex, which might be due to the higher male population in the study group

The majority of the patients affected are in the 7<sup>th</sup> decade, followed by the 4<sup>th</sup> decade (economically reproductive). The mean age of the population in the present study is 51.4±2.5 years

### **Various preoperative risk factors that affect anastomosis leak are:**

#### *1. Anaemia vs anastomotic leak:*

Hemoglobin levels in the study show AL likely to occur if preoperative anemia is not corrected. Hb < 10.2 gm/dl is considered as a significant risk factor. Inference from the study is preoperative anemia is a risk factor for AL, and intraoperative blood loss should also be considered in assessing risk for bowel anastomosis.

#### *2. AL vs. hypoalbuminemia :*

Preoperative hypoalbuminemia is a risk factor in the development of AL postoperatively. Analysis in this study showed a significant association between preoperative low albumin levels and AL.

The inference from these results and comparison is, irrespective of the technique followed (hand-sewn/stapler), preoperative hypoalbuminemia is a significant risk factor for postoperative AL. So, the correction of albumin perioperatively should be considered in all cases.

#### *3. AL vs. smoking :*

Smoking is a predisposing factor for AL in bowel resection surgeries. In this study, there is a positive association between smoking and AL. It infers that cessation of smoking at least four

weeks before the elective surgery, as per existing literature, decreases the risk of AL postoperatively.

*4. AL vs. Diabetes mellitus:*

Diabetes mellitus initially considered a predisposing factor for AL. At the end of the study, it is observed that there is no significant association of DM with AL (OR=1.28). But the presence of DM in AL patients due to other risk factors is associated with high chances of mortality.

It infers that DM per se is a risk factor for AL. DM, along with the associated comorbidities, is a significant risk factor for morbidity and mortality postoperatively. Pre-optimisation of the patient is needed wherever possible.

*5. AL vs. sepsis :*

In the present study, a majority of patients who developed AL ( $p=0.012$ ) have sepsis as a significant risk factor. 40% of patients having sepsis developed AL.

In this study it infers us that in the presence of sepsis intraoperatively, surgeons should be vigilant about the high incidence of AL, especially if associated with other comorbidities.

*6. AL in emergency:*

In this study, 24.24% of emergency cases developed AL, It infers that bowel resection and anastomosis in an emergency setting is an independent significant risk factor and should be tackled necessarily. Either a covering stoma or a damage control surgery should be the motive in a high risk patient with gross contamination.

*7. Hand-sewn versus stapler:*

In the present study, there is no significant difference in the incidence of AL between the two groups, it might be due to significant participation in our study is by the patients attending to casualty/emergency (66%) and 92% of the cases having one or more risk factors leading to the higher incidence of AL even in the stapled group.

*8. AL vs. CRP:*

In the present study, elevated CRP has a significant association with AL following surgery ( $p=0.0054$ ). It infers that serial monitoring of CRP and serum procalcitonin (even better than former) are early predictors of AL (even before imageology).

*Implications of the observations :*

Logistic regression analysis of different risk factors revealed that smoking, sepsis, CRP, and hemoglobin levels are independent predisposing factors significantly associated with AL ( $p<0.05$ ).

**LIMITATIONS OF THE STUDY :**

1. The number of cases in the present study is limited.
2. Serum procalcitonin, which is a better marker/predictor for AL, is not used.
3. The role of protective diversion stoma in preventing anastomotic leak among the high-risk group is not evaluated.
4. Other surgical techniques are not evaluated.

## CONCLUSION :

1. Pre-operative factors play an essential role in determining the postoperative course following surgery.
2. Anemia, hypoalbuminemia, and smoking are independent patient-related risk factors for a postoperative leak.
3. Intraoperative sepsis poses a significant threat to the anastomosis. So it should be tackled accordingly.
4. Whatever technique employed, blood flow to the cut mucosal margins is essential.
5. High leak rates in this study might be due to a more significant contribution from the emergency. In an emergency setting, with a high-risk patient, a proximal diversion stoma might help in the healing the anastomotic site.
6. In the right hand, both hand-sewn and stapler anastomosis are equally efficient. What the surgeon should keep in mind is, a bowel not suitable for hand-sewn is also not ideal for a stapled anastomosis.
7. A higher incidence of small bowel leaks in this study is due to the majority of the sample being small bowel anastomosis.
8. Serum C-Reactive protein is a predictor of anastomotic leak. The serial monitoring of CRP is an even better predictor.
9. Serum procalcitonin on postoperative days 3 and 5 is an even better predictor of sepsis.

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