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A Prospective Clinical Study on Resection And Anastomosis of Bowel In A Teritiary Care General Surgical Unit.

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Abstract:
Background: *Bowel anastomosis are common procedure in both elective and emergency general surgery.*
Objective: *To study the incidence of intestinal resections and anastomosis and various causes leading to it and evaluate the factors determine the healing of anastomosis*
Materials and Methods: *A prospective observational study at a single centre with all patients who underwent bowel resections and anatomosis for various causes during a period of July 2014 to November 2016 were included for analysis. Demographic factors like age, gender, aetiology, resection site(small bowel/large bowel/combined), various suture methods & suture materials usage and post op complications were studied.*
Findings: *A total of 50 patients included in this study who underwent bowel resections and anastomosis in both elective and emergency surgeries. Out of 50 patients most of them were belongs to 16- 30 years age group with male preponderance. Different aetiologies being obstruction 66%, trauma 22%, mass 8%, perforation 4%. Out of 50 patients 66% were operated on emergency basis and remaining 34% were operated on elective basis. Out of 50 patients 58% of patients underwent small bowel anastomosis,26% patients underwent large bowel anastomosis remaing 16% underwent anastomosis between small and large bowel. Anastomotic leaks observed only in small bowel anastomosis and emergency surgery group which corresponds to 4%.*
Conclusions: *Adequate blood supply with no tension suturing is needed for successful anatomosis along with good suture material and good surgical technique. Good post operative care by improving his/her nutritional status and general condition lead to successful outcome.*
Keywords: *Anastomosis, gastrointestinal , small and large bowel.*

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I. Introduction

The basic principles of intestinal suture were established by Travers, Lembert and Halsted more than 100 years ago.[1] Restoration of intestinal continuity after removal of a pathological lesion affecting the bowel, by joining the two ends is called anastomosis. This operative procedure is of central importance in the practice of a general surgeon and is still by far the most common surgical procedure, especially in the emergency setting, and is also commonly performed in the elective setting when resections are carried out for benign or malignant lesions of the gastrointestinal tract, done by the present day General Surgeon. A disastrous complication of intestinal anastomosis is anastomotic leak resulting in peritonitis, which is associated with high morbidity and mortality. Proper surgical technique and adherence to fundamental principles is imperative to ensure successful outcome after intestinal anastomosis. Safety in gastrointestinal surgery may thus depend to a large extent on the technical expertise of the operating surgeon in his performance of the intestinal anastomosis. This expertise is acquired with practice as is any other skillful art but a gastrointestinal operation involves a series of exercises in surgical judgment and it is imperative to adhere to several well-established principles.

The main ones relate to the creation of a tension-free join with good apposition of the bowel edges in the presence of an excellent blood supply. So many studies concluded that both suturing and stapling have equal safety without much difference in post operative anastomotic leaks.[2-6] In literature so many studies showed that anastomtic healing will be depend on local and systemic factors. Local factors include 1. Adequate blood supply 2. Absence of tension 3. Healthy tissue edges 4. Bacterial contamination 5. Distal obstruction 7. Radiation injury 8. Bowel preparation . systemic factors include 1. Patients nutrition 2. Sepsis 3. Hypovolumia 4. Drugs/; steroids, NSAIDS etc 5. Ureamia 6. jaundice etc. Nevertheless, anastomotic leakage and dehiscence remain frequent and serious problems associated with high morbidity and mortality.

II. Materials And Methods

This study involved all the patients undergoing intestinal resection and subsequent anastomoses for various causes in the departments of General Surgery at GGH, Guntur. A total of 50 patients between July 2014 to November 2016 have been studied. The clinical study has been undertaken with the following objectives and aims.1.Incidence of intestinal resections and Anastomosis in Government General Hospital, Guntur and various causes leading to it. 2.To study important factors which determine the healing of Gastrointestinal tract after anastomosis and verify their significance in healing of anastomosis. 3. To study various suture methods used for anastomoses at different anatomical locations and thus determine the most ideal suture material for these techniques in our study.

Inclusion criteria for selection of cases : All the patients undergoing small and large bowel intestinal resections for various causes requiring an anastomosis for distal continuity of bowel.
Exclusion criteria for selection of cases: 1.All the biliary and enteric anastomoses/ pancreatico-enteric anastomoses. 2. Patients with malignancy who have undergone pre-operative radiotherapy and chemotherapy. 3.Steroid dependent patients. 4.Patients who died in the immediate post operative period in whom viability of anastomosis can not be assessed.
Methods for collection of Data: Detailed history along with clinical assessment done by collegiums of general surgeons. Appropriate investigations performed over the patients like X ray abdomen, ultra sound of abdomen, CT scan abdomen.

III. Results

The total number of cases considered in this study were 50. These cases were considered for the study using the inclusion and exclusion criteria as mentioned above.
Sex Incidence: In the present study there were 38(76%) male patients and 12(24%) female patients. The male to female ratio n around 3:1
Age Incidence: In the present study patients below 15 years were 3(6%),in the age group 16-30yrs were 18(36%), in the age group 31-45yrs were 12(24%), in the age group 46-60yrs were 12(24%), the age group 61 & above considered old age were 5(10%).

Causes for Intestinal Resection and Anastomoses:

Malignancy : In the present study, 4 (8%) out of 50 patients underwent intestinal resection and anastomoses for malignant conditions. Out of which carcinoma Caecum – 1, Ca.Transverse Colon – 2, Ca.Sigmoid colon – 1.

Abdominal Tuberculosis : In the present study 5 out of 50 cases underwent Intestinal Resection and Anastomoses for Abdominal Koch's. All of them were Ileo-caecal kochs out of which 4 cases were operated on emergency basis. 1 case was operated electively.

Strangulated Hernia : In the present study 5 (10%) out of 50 cases underw ent Intesti nal Resection and anastomoses for strangulated hernia. Amongst which 2 (50%) were for strangulated Inguinal hernia and 2(50%) were for strangulated incisional hernia and 1 for strangulated umbilical hernia

Enteric Fever Related : In the present study 2 out of 50 cases underwent Intestinal Resection and Anastomoses for Enteric fever Related condition. And all the cases were operated for ileal perforation with peritonitis.

Etiologies of Resection and Anastomosis : In the present study out of 50 cases 33 cases were presented with acute intestinal obstruction and 11 cases were due to trauma and 4 cases presented with mass and 2 cases presented with perforation(Graph1).

Etiologies of Obstruction : Out of 33 cases of Obstruction 7 cases were operated for Mesenteric tear, 7 cases for Stricture, 5 cases for volvulus, 5 cases for strangulated hernia, meckel's diverticulum – 3 cases, Intussusception 2 cases, 1 case was due to malignancy. 1 case was due to tubercular mass.(Graph 2)

Relevance of Emergency and Elective Surgery to the development of Leak:

Resection and Anastomoses : Out of the 50 patients who were operated for resection and anastomoses of Bowel, 33 patients (66%) were operated on an emergency basis and the remaining 17 patients (34%) were operated on an elective basis with preoperative bowel preparation and correction of nutritional status and haemopoitic deficiencies if present.(Graph 3)

Surgeries and Leaks : Leaks observed in this series were only in the emergency laparotomy group. Out of the 33 patients who underwent emergency surgery 2 (4%) patients developed postoperative anastomotic leaks.

Divisions for the resection and anastomoses: For convenience of the study the resections done have been divided as follows: 1.Isolated Small bowel Anastomoses 2.Isolated Large bowel Anastomoses 3.Anastomoses between Small and Large bowel.

1.Small bowel Anastomoses**:** Includes Jejunal Resection Anastomoses, Ileal Resection and Anastomoses and Jejuno-Ileal Anastomoses. Total number of patients who underwent anastomoses in the Small bowel was 29 (58%). Among which Jejunal Anastomoses were 6 (21%), Ileal Anastomoses were 18(62%) and the Jejunoileal Anastomoses were 5(17%).

2.Large bowel anastomoses: Includes patients undergoing segmental resection and End to End Anastomosis most of the cases were done for volvuless. Total number of patients who underwent anastomoses for large bowel were 13, amongst which left hemicolectomy were 2(15.3%), segmental resection and anastomoses was done for 7(54%) for sigmoid volvulus and other 3 (23%) cases were due to trauma, 1 (7%) case for stricture.

3.Anastomoses between Small and Large Bowel**:** Includes patients who underwent Right hemicolectomy, Segmental resection or limited resection and anastomosis either End-to-End, End-to-Side or Side-to-Side. Total number of patients who underwent anastomoses between small and large bowel were 8(16%). Amongst which right hemicolectomy were 4 (50%), segmental resection was done in 4 (50%) cases.

Bowel Anastomoses and Leaks : Among the 29 patients who underwent small bowel an astomoses 2(7%) anastomoses leaked. Among the 13 patients who underwent large bowel anastomosis no leaks were observed. Among the 8 patients who underwent anastomosis between small and large bowel no leaks were observed(Graph 4).

Risk Factors: In the present study out of 50 patients 35 (70%) had either single or multiple risk factors and 15 (30%) had no risk factors. The risk factors observed have been categorized in the table1.

Relevance of leaks t o risk factors: Out of the 35 patients who had varied risk factors 2(6%) anastomoses leaked. Amongst them 33patients who had anaemia 1 case leaked, 33 patients who had peritonitis 2 (6%) cases leaked, 10 patients who had uremia 1 case leaked 5 patients who were more than 61 years of age no cases were leaked.

Techniques Used for Anastomoses:

1.Small bowel Anastomoses: Out of the 29 cases of small bowel anastomoses 28(97%) were done in Two layers and 1 (3%) case was anastomosed by Single layer interrupted sutures. **Two Layer Anastomoses & Leakas :** Amongst the **28 cases** anastomosed by TWO layers, 7**(**25%) cases were anastomosed by outer interrupted and inner continuous fashion out of which 1(14%) anastomosis leaked. 22**(**78%**)** cases were anastomosed by both layers in interrupted fashion out of which 1 (5%) anastomosis leaked. **Signle Layer anastomosis and Leaks :** One cases was anastomosed by single layer interrupted sutures, no leak was observed.

2.Large bowel anastomoses: out of the 13 cases of large bowel anastomoses 7(54%) cases were anastomosed in Two layers and 6(46%) cases were anastomosed by single layer interrupted sutures. Out of these 13 cases none of the anastomoses were leaked. Whether it is done in single or double layer.

3.Small and Large bowel anastomoses: Out of the 8 cases of anastomoses between small and large bowel 7 (88%) were anastomosed in Two layers. 1 (12%) was anastomosed in single layer with interrupted sutures. Some recent reports have described single-layer continuous anastomosis using monofilament sutures as requiring less time and cost than any other method, without incurring any added risk of leakage.[2,3]

Suture Materials Used: The following are the suture materials used for anastomoses done in different anatomical location of the intestine

1.Small bowel anastomoses (29): Vicryl alone used for 20 cases out of which 1 patient had post op leak. Silk alone used for 9 cases out of which 1 patient had leak.2.Large bowel anastomoses (13): Vicryl alone used for 10 cases and silk used for 3 cases .3. Small & Large bowel anastomoses (8): vicryl alone used for 6 cases, silk alone used for 1 acse and vicryl and silk combined used for 1 case.

Mortal Ity: Patients who died in the immediate post operative period before assessment of the viablility of anastomosis were excluded.Out of the 2 patients who developed Leak, in one case leak detected on 4th POD. Relaparoty done on 5th post operative day and patients was recovered. In the other patient leak detected on 5th post operative day, patient expired on 6th post operative day.

III. Discussion

Most operations on the gastrointestinal tract involve the suture or anastomoses of the gut, and it is this aspect of the alimentary canal that is associated with dangerous complications. The break down of the suture line of anastomoses can result in faecal fistulation and serious or fatal septic complications.[7] Operations on the intestines are very common surgical procedures being done by the surgeons. Even though resection and anastomoses of the intestines is a common surgical procedure it is still at times associated with morbidity in the form of anastomotic leak, stricture formation, fecal fistula and diverticulum and at times Mortality due to the associated septic complications. Morbidity in patients is not only a loss to the patient but to the society in which the patient is a part. Anastomotic leaks result in dramatic increase in hospital stay and as such the management is an expensive affair to the patient and in a majority of cases operated in a Government Hospital to the nation. In the present series out of a total of 50 patients in the period of study, 12 were female patients (24%) and the

remaining majority i.e., 38 were male (76%). The ratio of male to female was almost 3:1 .The incidence of intestinal resections in females was low when compared to males, however not much statistical weight age can be thrown onto this finding. The present study showed the maximum incidence of resection anastomoses was between patients in the age range of 16 to 30 years (36%) - 18 cases and the next group was those above 31-45 years (24%) and 46-60 years (24%).

Causes for the resection: In this study there were various causes for the resection of the intestine. Majority of the anastomoses were done for acute intestinal obstruction. Amongst the various causes for obstruction mesenteric ischemia with gangrene and strictures were most common. Mesenteric ischemia with gangrene was observed in 7 cases (21%). Many of the intestinal resections treated in the U.S and U.K were treated early without the necessity for the resection of either gangrenous bowel or ischaemic bowel. Early diagnosis, better socioeconomic conditions and literacy among the patients in the West all reduce the incidence of resections for the underlying intestinal obstruction in these patients. In this series a majority of the resections done for intestinal obstruction were done for gangrenous bowel with the patient already in septicemia and with other metabolic derangements. Strictures were seen in 7 cases (21%) followed by volvulus seen in 5 cases i.e., 15% and strangulated hernia accounting for 15% of all cases of obstruction i.e., seen in 5 cases. Out of the 5 cases 2 were strangulated inguinal hernia, 2 were strangulated incisional hernia and 2 were strangulated umbilical hernia. Abdominal tuberculosis was seen in 5 cases. Out of those 5 cases 3 cases presented to the emergency department with obstruction and the intra operative finding was stricture at ileo caecal junction, 2 cases were operated electively. One presented with mass in right iliac fossa and the other operated electively for sub acute intestinal obstruction. Total no. of resection and anastomases done for malignancy were 4. Out of those 4 cases 1 case presented to the emergency with obstruction and the other 3 cases presented with mass per abdomen and were operated electively. Other causes for acute intestinal obstruction requiring resection and anastomosis were Meckel's diverticulum (3 cases), intussusception (2 cases), bands (2 cases), 1 case of malignancy presented with obstruction. Second most common cause for undergoing resection and anastomosis was trauma accounting for 11 cases i.e., 22% of all cases. All these cases were operated on emergency basis after adequate resuscition and stabilization of the patient. Most of theme were due to hemoperitoneum with mesenteric tear with gangrene of bowel. Enteric fever related intestinal disease accounted for 2 patients and (4%) of the total patients who underwent resection and anastomoses of the intestine. Ileal perforations was the major manifestations of the disease. However no patient were seen with perforation related to enteric fever in other parts of the bowel.Incidence of gangrene to bowel with mesenteric ischemia is rising. The cause for it has to be find out in the future.

Anatomical Divisions of the resections: In the present study all the patients who underwent resections were divided into the following groups: 1.Isolated Small Bowel Anastomoses 2.Isolated Large Bowel Anastomoses 3.Anastomoses between Small and Large Bowel.Among these 3 groups the maximum patients were in the small bowel group accounting for 29 patients and 58% of the total patients, then it was the small to large bowel group accounting for 8 patients and 16% of patients and the last group i.e., the isolated large bowel group accounted for 13 patients and 26%.Among the small bowel resections, Ileal resections were the majority accounting to 18 patients and 62% of all small bowel resections. In 6 patients (21%) Jejunal resection and anastomosis was carried out. Jejunoileal resection and anastomosis was done in 5 patients (17%). Among the anastomoses done between the large and small bowel Right Hemicolectomy was done in 4 (50%) and segmental or limited resection and anastomosis was done in the remaining 4 cases.Amongst the isolated large bowl group left hemicolectomy was done in 2 cases, segmental resection with end to end and anastomosis was done in 7 cases, 3 cases were operated due to trauma and other case was operated due to stricture.

Anastomotic Dehiscence and Leaks: Multiple small RCTs and several larger retrospective studies have been published with conflicting results about suturas and stapler usage. Some have suggested that the anastomotic leak rates are similar[8-12]; some that stapling is preferable to suturing[13], and vice versa[14]. In present study all cases were underwent sutural anastomosis as non availability of staplers in present hospital A total of 2 patients (4%) developed postoperative leaks among which 1 patient recovered with a relaparotomy and the other patient died on 6th post operative day.It was remarkable to note that all the patients who developed anastomotic leaks were operated upon as an emergency. There were no leaks observed in the patients who were adequately prepared before hand and were operated on an elective basis. All patients who got leak belongs to small bowel group this cannot be attributed to the anatomical position but merely because this group accounted for more patients i.e., almost 58% of the total patients. Another reason for the higher number of leaks in this group could be that 100% of these patients in the small bowel group were operated on an emergency basis without prior nutritional preparation. The patient who had leak is having gangrene of the whole small bowel except 10cms jejunum and 10 cms ileum.

The days of diagnosing the leak ranged from 2 to 6 days, and leak was diagnosed on the 4th day in 1 patient and on the 5th day in the other patient None of the patients in this study underwent routine radiological investigations for the diagnosis of postoperative leaks as is done in many of the Western Centers. Patients who

developed leak postoperatively were diagnosed without the help of any other radiological modality and were further managed with clinical suspicion alone.

Correlation of Leak with Risk Factors: 35 out of 50 patients had 1 or more risk factors like anaemia, peritonitis, diabetes, respiratory complications like COPD, ureamia and old age.

- Both the patients who got post operative leaks had 1 or more risk factors.
- 33 patients (66%) had anaemia of hemoglobin less than 10gm%, Out of the 2 patient who developed leak 1 patient is having anemia.
- As a majority of these anaemic patients did not develop leak its significance in anastomotic healing is doubted.
- Bacterial peritonitis was observed in 33 patients (66%) out of which 2 patients developed postoperative anastomotic leaks.
- In both the patients who had leak there was preoperative Hypovolaemia-shock.
- Out of the 2 cases who developed leak 1 patient was transfused 1 unit of whole blood and other patient was given 4 units of fresh blood perioperatively.
- Out of the 50 patients 1 patient had PTB and 1 patient had COPD. In both cases no leak was observed. Hence it has no relevance with leak.
- Out of the 50 patients 5 patients were >61 years old, none of these patients got leaks. Thus it has no relevance with leak.
- Out of the those 50 patients 4 patients had high blood sugar levels and none of these 4 patients got leaks. Only 1 patient is a known diabetic and he developed no leak. If blood sugar levels were controlled properly it does not have any detrimental effect on anastomotic healing.
- 10 Patients out of 50 had their blood urea levels >50 mg/dl. Out of them 1 patient (10%) developed leak.

Correlation of the technique used for the anastomoses and the suture materials used for anastomosis versus leaks: In the small bowel a majority of the anastomoses done were by (28 and 97% of them) 2 layered technique. Amongst which 7(25%)cases were anastomosed with an outer interrupted and inner continuous method of anastomoses and the preferred suture material being Outer silk and inner Vicryl or both layers with vicryl 22 (78%) were anastomosed by the two layered anastomoses with both interrupted. Only 1 case operated by doing the anastomoses in a single layer with interrupted sutures.

- In the large bowel 7 cases (54%) were done by two-layered anastomoses with both layers in interrupted fashion. 6 cases of the colonic anastomoses were closed in a single layer with interrupted sutures.
- Out of the 2 patients who developed leak in both of them anastomosis was done in two layers. In one case anastomosis was done by using vicryl for both layers in interrupted sutures. In the other case anastomosis was done by only silk for both layers with outer interrupted and inner continues sutures.
- Of all the varying combinations of suture materials used, minimal rate of leak was observed when Vicryl alone was used in either of the small or large bowel.
- Due to cost factor and non affordability, none of the cases were anastomosed using staple devices.

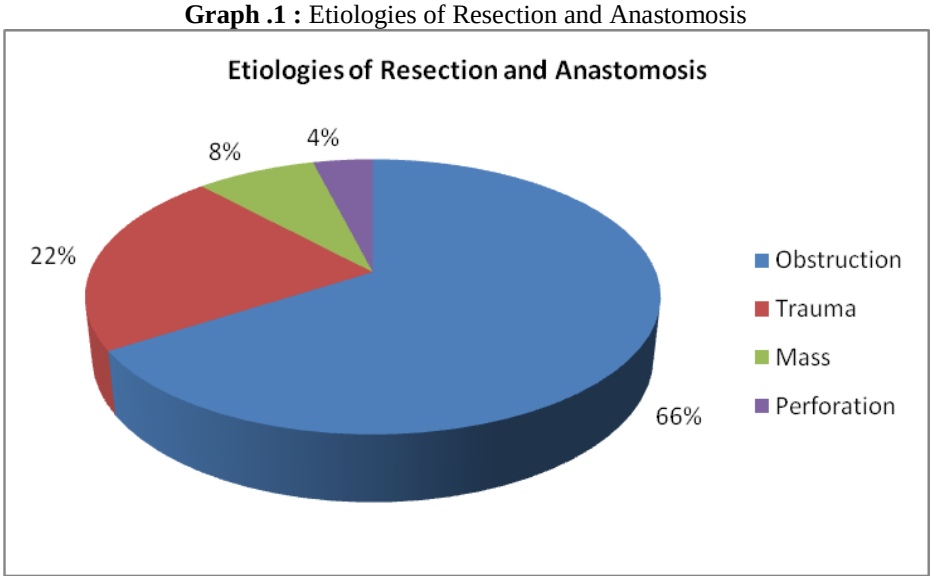
Mortality and Morbidity: The total inpatient mortality observed in this study was in a single patient. A total of 2 patients developed anastomotic leak. Out of the 2 patients 1 patient developed leak on 4^{th} post operative day, relaparotomy done on 5^{th} post operative day and the patient recovered. In the other patient leak detected on 5^{th} Post Operative day and the patient expired on 6^{th} post operative day. The morbidity observed by the patient of significance was postoperative wound infection, which was observed in 5 patients (10%). All these 5 patients had peritonitis. All of them with wound infection were treated conservatively with extended coverage of antibiotics and daily dressings.

Limitation of the study: 1. No comparison between staplers and sutural anastomosis as in our hospital staplers were not available. 2. Sample size relatively less.

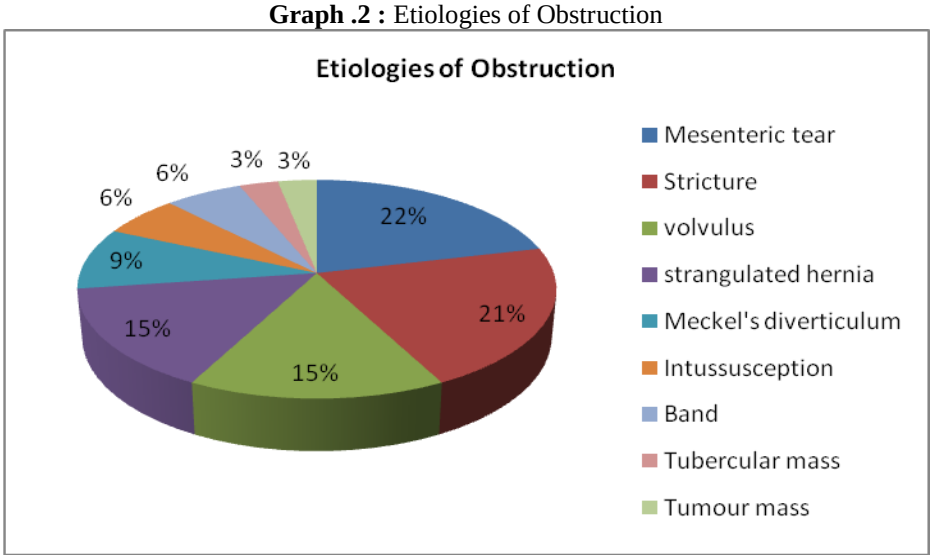
IV. Conclusion

Adequate blood supply to the two cut mucosal edges is essential for good anastomosis. Ends should be sutured without undue tension. Irrespective of the suture material used the anastomoses will heal. In general there should be no difference in the rate of leak with different anatomical locations, but in this study there were more leaks in the small bowel because it was in relation to them being the majority of the cases.

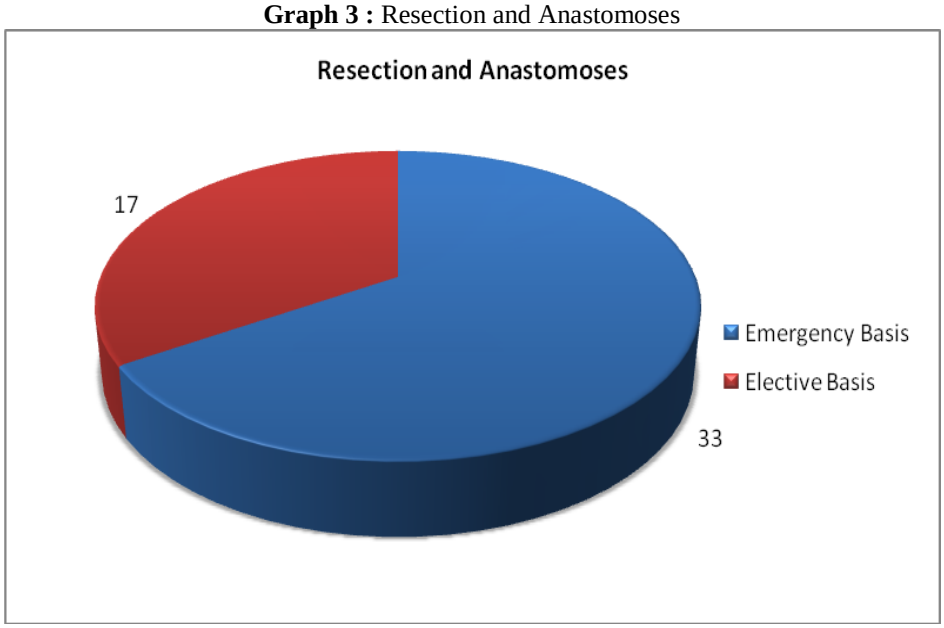
Graph .1 : Etiologies of Resection and Anastomosis



Graph .2 : Etiologies of Obstruction



Graph 3 : Resection and Anastomoses



Graph 4 : Bowel Anastomoses and Leaks

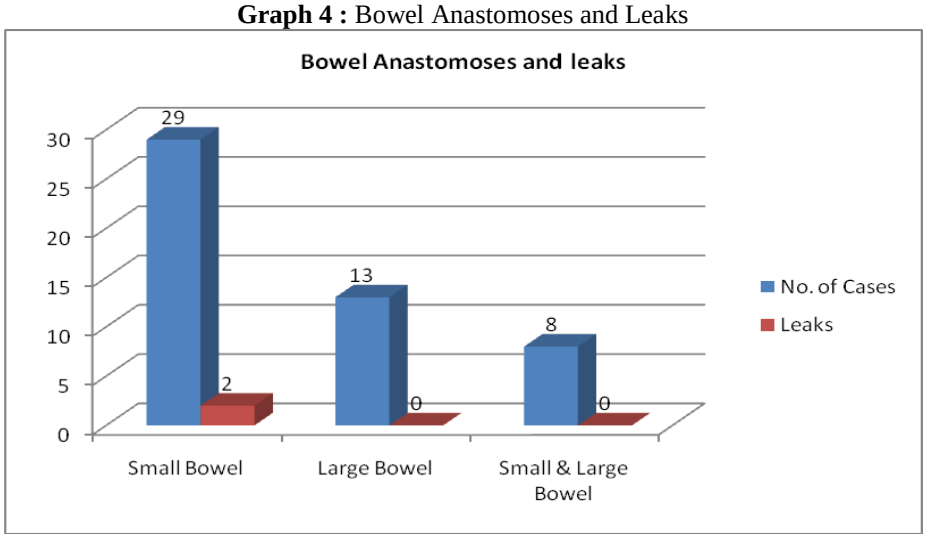


Table 1: Showing risk factors in anastomotic patients

Sl.No.	Risk Factors	Patients N=50	Percentage
1	Anaemia	33	66%
2	Peritonitis	33	66%
3	Ureaemia	10	20%
4	Old Age	5	10%
5	Diabetes	4	8%
6	Respiratory Complications	2	4%

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