A Clinical Study of the Intra Operative Factors Affecting the Outcome of Intestinal Resection and Anastomosis

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Abstract:-

➤ *Background of Study*

Intestines form a major part of human digestive system. Both in terms of length as well as surface area, the small and large intestines constitute about 90% of the digestive system. Intestines form a major part of human digestive system. One of the most common surgeries done on the intestines is resection and anastomosis. It is the surgical procedure of removing the diseased portion of the bowel and joining the normal viable disease free bowel ends.

➤ *Objective*

To identify patient and surgeon related intraoperative factors that affects the outcome of intestinal resection and anastomosis and predispose to anastomotic leak.

➤ *Method*

50 cases requiring intestinal resection and anastomosis admitted in hospitals associated with Bangalore Medical College and research institute were selected after applying inclusion and exclusion criteria.

➤ *Conclusion*

Delay in presentation and aetiology ,End to side anastomosis and anastomosis between small bowel and large bowel has a higher risk for anastomotic leak

I. INTRODUCTION

Intestines form a major part of human digestive system. Both in terms of length as well as surface area, the small and large intestines constitute about 90% of the digestive system. They play a major role in absorption of nutrients, water and other micro nutrients. Thus they play a major role in growth and proper functioning of the human body. Any pathological condition of the bowel leads to disturbance in the homeostasis of the human body.

Timely intervention and correction of the pathologies affecting the bowel is of utmost importance in providing a healthy functional life to the patient.

One of the most common surgeries done on the intestines is resection and anastomosis. It is the surgical procedure of removing the diseased portion of the bowel and joining the normal viable disease free bowel ends.

History of bowel anastomosis goes back to early 17th and 18th century. Galen was the first person to coin the term "Anastomosis"

➤ *Aim and Objectives of the Study*

To identify the patient and surgeon related intraoperative factors that affects the outcome of intestinal resection and anastomosis and predispose to anastomotic leak.

II. METHODOLOGY

This study was conducted with the approval of institutional ethical committee. 50 cases requiring intestinal resection and anastomosis admitted in hospitals affiliated to Bangalore Medical College and research institute were selected after applying inclusion and exclusion criteria.

These cases were followed up intra operatively and post operatively until discharge from hospital or another outcome like anastomotic leak or death of the patient.

➤ *Inclusion Criteria:*

* Patients Age >18yrs
* Patients Requiring Intestinal Resection and Anastomosis

➢ *Exclusion Criteria:*

- Patient's Age <18yrs
- Pregnant Women, Prisoners, Cognitively Impaired Subjects
- Immuno Compromised.

➢ *Factors Studied*

In this study the intra operative factors affecting the outcome of intestinal resection and anastomosis.

➢ *Intra Operative Factors*

These are the factors that are influenced by the patient as well as the operating surgeon. These are partly non-modifiable and partly modifiable. This study evaluates how the modifiable factors influence the outcome of intestinal anastomosis Patient related intra operative factors include

- Aetiology – Gangrene, Malignancy, Trauma.
- Delay in Surgery – Admission to Incision Time Surgeon Related Intra Operative Factors Include.

➢ *Type of Anastomosis based on bowel orientation*

- End to End
- End to Side
- Side to Side

➢ *Type of Anastomosis based on bowel involved*

- Small bowel- small bowel
- Small bowel- large bowel
- Large bowel- large bowel

➢ *Type of anastomosis based on layers*

- Single Layer
- Double Layer

III. RESULTS AND DISCUSSION

➢ *Intra Operative Factors*

Intra operative factors can be patient dependent or surgeon dependent or both. Some the factors are modifiable while others like presence of gangrene or malignancy or the aetiology for which the patient is undergoing resection is non-modifiable.

➢ *For the Ease of Analysis, the Intra Operative Factors Studied are Divided into*

- Patient dependent
- Surgeon dependent **Patient Dependent Factors** These include
- Aetiology
- Delay in presentation

➢ *Aetiology*

The aetiology or the disease process for which the patient is undergoing intestinal resection and anastomosis plays the most crucial role in the outcome. Etiology is classified for the purpose of the study into 3 main categories based on the frequency of presentation

- *They are*

✓ Gangrene
✓ Malignancy
✓ Others – trauma, diverticulosis etc

➢ *Gangrene*

Gangrene of bowel is one of the major etiologies resulting in resection and anastomosis. Gangrene occurs as a result of diminished vascular supply to the bowel. It can occur in many ways.

- *Major pathologies producing bowel gangrene are*

✓ Vascular occlusion
✓ Injury to supplying vessels

Bowel, both small and large intestine receives its blood supply through its mesentery. So any occlusion or injury to mesentery and its vessels produce bowel gangrene.

Mesenteric vascular occlusion can occur in two ways. It can be a mechanical occlusion like that of a volvulus or an obstructed hernia or it can be due to an embolic or thrombotic occlusion of the vessels producing mesenteric ischemia.

When there is a mechanical obstruction, first a stage of venous congestion occurs in the bowel. This leads on to accumulation of inflammatory fluids in the bowel wall, which aggravates the congestion and further diminishes blood supply. Then the stage of gangrene sets in. This leads on to peritonitis and its sequelae.

Mesenteric vascular ischemia occurs as a result of occlusion of the mesenteric vessels by an embolus or a thrombus. Superior mesenteric artery is most commonly affected than inferior. This can also occur in a non occlusive fashion, as a result of hypotension or hypo perfusion or due to vasospasm due to shock - Non occlusive mesenteric ischemia (NOMI).

Gangrene of the bowel requires immediate intervention in the form of emergency exploratory laparotomy and resection of the gangrenous bowel. Viability of the cut ends should be ensured before anastomosis. Fresh bleeding from the cut end mucosa indicates viability. If the ends don't bleed or the mucosa is dark red, viability is doubtful. In such cases, the ends should be further trimmed until vascularity is ensured. Once vascularity of the ends is ensured, we can proceed on to anastomosis. Mesenteric window created during resection should be closed to avoid internal herniation.

> *Malignancy*

Tumors of intestine are another pathology requiring resection and anastomosis of bowel. Benign tumors require a limited resection while malignant ones require resection of the entire length of bowel supplied by the particular vessel supplying the segment with tumor along with removal of the corresponding lymph node stations as well[2].

> *Small Bowel Tumours*

Tumours of small bowel are rare. They constitute about 3% of all GI malignancies even though small bowel constitutes 80% of the total length of the Git and 90 % of the total mucosal surface area.

Early diagnosis is difficult as they are very vague in presentation.

- *Benign Tumours of Small Bowel Includes*

✓ Adenoma
✓ Leiomyoma
✓ Lipoma
✓ Haemangioma
✓ Polyps

These tumours usually present with vague symptoms like colicky abdominal pain, haemorrhage etc. Commonly they are an on table diagnosis.Treatment usually involves resection and anastomosis Malignant tumours of the small bowel includes.

✓ Adeno carcinoma
✓ Lymphoma
✓ Carcinoid
✓ Liposarcoma
✓ Secondaries in the small bowelTreatment includes
✓ For duodenal tumours pancreatico duodenectomy
✓ For ileal/jejunal tumours radical resection with 10cm margin alongwith mesenteric clearance
✓ Adeno carcinoma of terminal ileum requires right hemicolectomy.

> *Large Bowel Tumours*

Large bowel tumours are more common than small bowel tumours. They can be benign or malignant.Benign tumours include different types of polyps, adenoma etc. Malignant tumours are found to arise from different part of the colon like caecum, ascending colon, transverse colon, descending colon, sigmoid colon.Treatment varies according to the location of the tumour.

Caecum and ascending colon – Right hemicolectomy[1] Hepatic flexure – extended right hemicolectomy Transverse colon – transverse colon with both flexures Descending colon – left hemicolectomy.

> *Others*

Other pathological conditions requiring intestinal resection andanastomosis include

- Multiple perforations
- Large perforations
- Mesenteric tears compromising vascularity
- Diverticulitis

Table 1 Comparing No of Cases with Bowel Gangrene, Malignancy and other Cases with Anastomotic Leak Rate

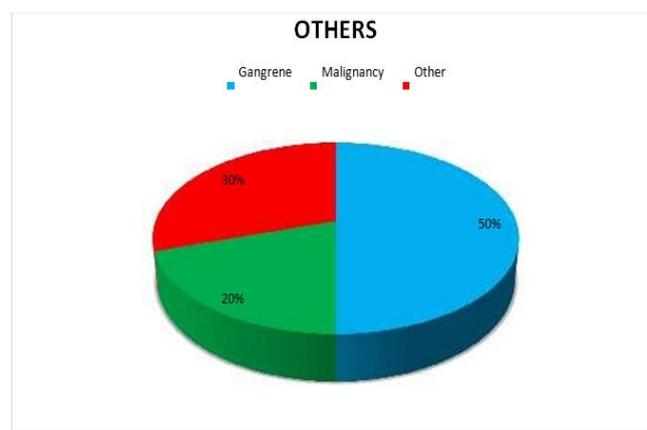|	No of cases (T=50)		Anastomotic leak	
Gangrene	25	50%	5	20%
Malignancy	10	20%	0	0%
Other	15	30%	1	6.7%

Chart 1 Pie chart of distribution of cases of gangrene, malignancy and others cases

50% of the patients included in the study underwent intestinal resection and anastomosis for bowel gangrene commonly as a result of obstructed hernias and other intestinal obstructions.

20% or 10 out of 50 patients underwent resection and anastomosis as a partof treatment for malignancies.

30% or 15 patients underwent resection for miscellaneous conditions like multiple perforations, large perforations, mesenteric tears etc.

On comparing the numbers of anastomotic leak, maximum number of anastomotic leak (5 in number) was encountered in patients who underwent resection for bowel gangrene. This number amounts to a leak rate of a huge 20% among the patients with bowel gangrene.

None of the patients treated for malignancy developed anastomotic leak.

A single patient treated of a miscellaneous aetiology also developed anastomotic leak.

This clearly points out the high risk of developing anastomotic leak in case of patients with bowel gangrene.

All safety precautions like adequate vascularity of the cut ends, adequate level of serum proteins, post operative care should be maintained for a successful outcome.

IV. ADMISSION TO INCISION DELAY

This is more important in case of emergencies like gangrene bowel, mesenteric ischemia, traumatic bowel and mesenteric injuries etc.

➢ *The Delay Occurs in Two Fronts*

- *Delayed Presentation of the Patient*
- *Delay in Operating*
- *Delay in Presentation of the Patient*

In the study, delay is studied in the form of duration of symptomsbefore presentation.

Table 2 Comparing Leak Rate with Presentation Time of Patient

	No. of cases (T=50)		Anastomotic leak	
<1 day	10	20%	2	33.3%
>1 day	40	80%	4	66.7%

Chart 2 Pie Chart Showing Delayed Presentation is having Higher Chances of Anastomotic Leak

Among the total 50 patients followed, 80% or 40 patients presented with more than 1 day duration of symptoms, whereas 10 patients presented within 1 day of onset of symptoms.
Out of the total 50 patients, 6 patients developed anastomotic leak. Among these 6 patients, 4 patients presented with more than 1 day delay accounting for 66.7% of the total.

Thus it is clear that a delay in presentation influences the outcome ofresection and anastomosis.

V. ANASTOMOSIS

➢ *This is the most important surgeon related factor which influence theoutcome Anastomosis can be studied under various classes.*

- *Based on Bowel Involved*
- *Based on Orientation of Bowel*
- *Based on Number of Layers in which the Anastomosis is done*

- *Based on Bowel Involved*

Based on the bowel involved, the anastomosis can be between two small bowel segments, two large bowel segments or between a small bowel and a large bowel as in Ileo – transverse colic anastomosis.

Table 3 Showing Higher Chances of Leak in Small-Large bowel Anastomosis

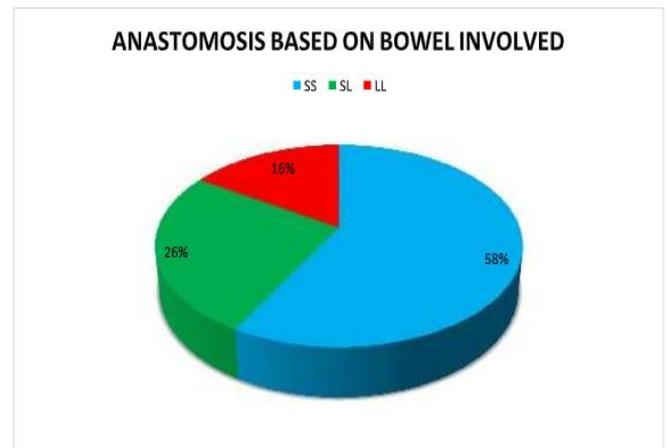|	No of cases (T=50)		Anastomotic leak	
SS	29	58%	1	3.44%
SL	13	26%	5	38.4%
LL	8	16%	0	0%

Chart 3 Pie Chart Anastomosis Based on Bowel Involved

Out of the total 50 patients, 29 patients (58%) underwent a small bowel to small bowel anastomosis. 13 patients or 26% underwent a small to large bowel anastomosis. 9 patients underwent anastomosis between two large bowel segments.

Out of the 6 patients who developed anastomotic leak, 5 patients hadundergone anastomosis between a small bowel loop and a large bowel loop, producing a leak rate of 38.4% and a single patient had undergone a small bowel to small bowel anastomosis, with leak rate of only 3.4%.

Difference in type of the bowel loops and disparity in lumen size appears to have influenced the result.

While anastomosing a small bowel to a large bowel, utmost care has to be taken, especially at the anti mesenteric ends.

- *Based on Orientation of the Bowel Loops*

While anastomosing two bowel loops, they may be oriented in different ways.

They may be oriented such that the two ends face each other and an end – to- end anastomosis can be done. Sometimes the antimesenteric ends of the two bowel loops are apposed and a side to side anastomosis is done. When the end of one loop is apposed to side of another, we perform an end– to – side anastomosis.

An end to end anastomosis is done between two endsof small bowel or two ends of large bowel. Whereas, when we anastomose a small bowel to large bowel, we usually anastomose the end of the small bowel to the side of the large bowel. This is because of the size disparity between the ends of small and large bowel.

While anastomosing the ends of small bowel or ends of large bowel, if there is size disparity, a cut can be given on the antimesenteric border of the smaller end and then anastomosis can be done. This is called as a **CHEATLE's cut.**
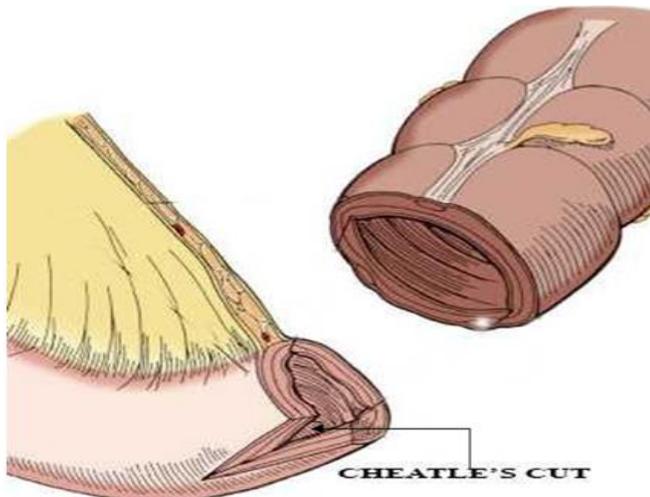

Fig 1 Showing Cheatle's Cut Made in Small Bowel Antemesentric Border

Table 4 Showing No of Cases in which End to End and End To Side Performed and Leak Rate.

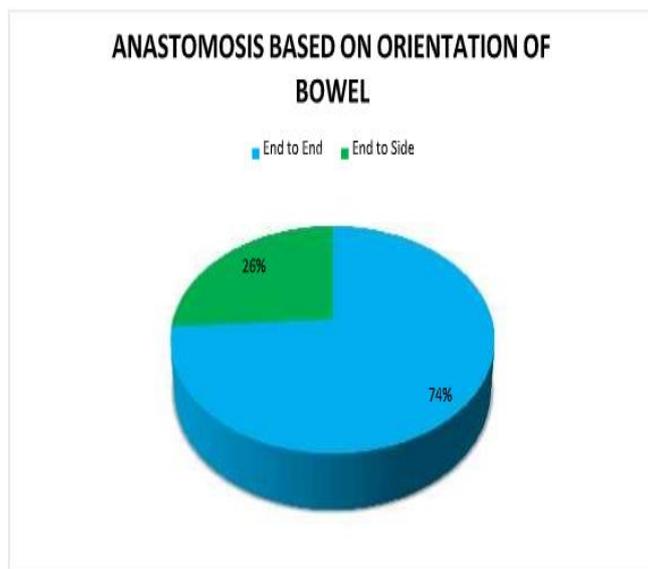|	No of cases (T=50)		Anastomotic leak	
End to End	37	74%	1	2.7%
End to Side	13	26%	5	38.5%

Chart 4 Pie Chart Showing Distribution of Cases of End to End and End to Side

None of the cases included in the study underwent a side to side anastomosis.

74% of the patients (37 patients) underwent an end to end anastomosis, while 13 underwent end to side anastomosis. Out of the 6 patients who developed leak, 5 patients had undergone end to side anastomosis. This amounts to a leak rate of 38.5% among the patients who underwent end to side anastomosis. On the other hand only 1 patient who underwent an end to end anastomosis developed anastomotic leak, accounting for 2.7% of the total.

This result may be attributed to the risk while suturing the two corner points of the anastomosis. This can be overcome to a great degree by starting of the middle on one size and ending at the middle on the opposite side rather than starting and ending at the corners.

➢ *Others*

- *Presence of a Protective Stoma* – only 2 cases in the study had protective stomas made. None of them suffered anastomotic leak.
- *Hand Sewn Vs. Stapler* – Since all the cases underwent anastomosis by hand sewn technique, which among the two is superior cannot be pointed out.
- *2 Layers Vs. Single Layer* – in our institution all intestinal anastomosis both small and large bowel are done in two layers. So commenting on this is also beyond the scope of my study.

VI. CONCLUSIONS

- Impaired vascularity or gangrene is the predominant risk factor foranastomotic leak.
- End to side anastomosis and anastomosis between small bowel and large bowel has a higher risk for anastomotic leak.
- Delayed presentation or delay in incison time has higher risk of developing anastomotic leak.

REFERENCES

[1]. Bailey and Love Short Practise of Surgery 26th Edition.
[2]. Sabiston textbook of Surgery 19th Edition.
[3]. Robbins Pathological Basis of Diseases, 8th Edition
[4]. Basic surgical techniques RM Kirk, 6th Edition
[5]. AlvesA, Panis Y, TrancartD, et al. Factors associated with clinically significant anastomotic leakage after large bowel resection: multivariate analysis of 707 patients. *World J Surg*. 2002; 26:499– 502.
[6]. Volk A, Kersting S, Held HC, et al. Risk factors for morbidity and mortality after single-layer continuous suture for ileocolonic anastomosis. *Int J Colorectal Dis*. 2011; 26:321327
[7]. Lipska MA, Bissett IP, Parry BR, et al. Anastomotic leakage after lower gastrointestinal anastomosis: men are at a higher risk. *ANZ J Surg*. 2006; 76:579–585

[8]. Golub R, Golub RW, Cantu R, et al. A multivariate analysis of factorscontributing to leakage of intestinal anastomosis. *J Am Coll Surg*.1997;184:364 –372.

[9]. Jex RK, Van Hcerden JA, Wolff BG, et al. Gastrointestinal anastomoses: factors affecting early complications. *Ann Surg*. 1992;206:138 –141

[10]. Max E, Sweeney WB, Bailey HR, et al. Results of 1,000 single-layercontinuous polypropylene intestinal anastomoses. *Am J Surg*.1991;162:461–467.

[11]. Pickleman J, Watson W, Cunningham J, et al. The failed gastrointestinal anastomosis: an inevitable catastrophe? *J Am Coll Surg*. 1999;188:473–482.

[12]. Bruce J, Krukowski ZH, Al-Khairy G, et al. Systematic review of the definition and measurement of anastomotic leak after gastrointestinal surgery. *Br J Surg*. 2001;88:1157-1168