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FACTORS AFFECTING HEALING OF GASTROINTESTINAL TRACT ANASTOMOSIS: A PROSPECTIVE STUDY

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ABSTRACT

Background: Intestinal resection and anastomosis is still by far the most common alimentary tract surgery done by the present day general surgeon.
Objective: To identify the risk factors for anastomotic leakage following intestinal anastomosis.
Materials and Methods: The present study was done on 50 patients admitted in General Surgery, Department of Surgery, S.N. Medical College, Agra who required intestinal resection and anastomosis due to varying pathology, from November 2015 to June 2017.
Result: Out of various factors the most appealing ones are the state of nutrition of patient, state of hypovolemia, condition of peritoneal cavity, fecal loading of bowel and preparation of bowel.
Conclusion: we also conclude and support for wider use of single layer anastomosis which is easier and quicker to make, maintain a greater lumen, with less tissue trauma and early vascularisation.
Keywords: Risk Factors, Healing, Gastrointestinal Tract Anastomosis.

INTRODUCTION

Our knowledge of the gastrointestinal surgery has developed gradually over the centuries from a mystical to a scientific level over many centuries. Today operations on the gastrointestinal tract are among the most frequent surgical procedure .Our knowledge of gastrointestinal healing has advanced and we have greater understanding of the impact of local and systemic factor on the anastomotic healing.[1]

All most all the procedures on alimentary tract expect a few are performed to re- establish its continuity and integrity either by suturing or stapled technique.

Safety in the gastrointestinal surgery may thus depend to a greater extend on the factor that influence the healing of anastomosis and technical expertise of the operating surgeon in his performance of the anastomosis. However, with adequate supervision, there is little difference between the outcomes of anastomoses performed by trainee and those performed by established surgeon .Hence the host related factor influencing healing play an important role in the outcome, once the fundamental principal of gastrointestinal suturing are followed.[2]

Factors known to influence intestinal wound healing,[3,4]

(1) General Factors

Vitamin C, probably has little relevance to wound healing.

Slow healing has been associated with large doses of corticosteroids.

HIV infection leading to AIDS complex is another significant cause of impaired anastomotic healing.

Other systemic diseases which are implicated to affect the intestinal anastomosis healing are anaemia, diabetes mellitus, chronic obstructive pulmonary disease.

LOCAL FACTORS

1. Blood flow: Oxygen is must for hydroxylation of lysine and proline during collagen synthesis, and low oxygen tension has been shown to affect wound healing adversely .Marginal devascularisation which may seriously affect

blood supply is avoided by meticulous preparation leaving only 5mm of nacked bowel at mesenteric border.

2. Radiation: Radiation causes changes in the intestinal micro circulation, which may be responsible for increased incidence of anastomotic leakage.
3. Bacterial contamination: It has been proved that infection at the suture line is the cause of collagen lysis, which in turn may impair the intestinal anastomotic healing.
4. Distraction of Anastomosis: It has been evaluated that distraction of anastomosed bowel ends may occur if neostigmine is used to reverse the effect of muscle relaxants
5. Drains: A drain material is that form a fibrous tract, inserted in close proximity to the suture line may produce harmful effects by provoking a marked inflammatory response.
6. Suture Materials:

The ideal suture does not exist but one can deduce that it should be strong enough to provide necessary mechanical support of the anastomosis

Here in this study I have made an attempt to study the effect of various host related factor on the outcome of bowel anastomosis.

MATERIALS AND METHODS

The present with study was performed in 50 patients, who presented in emergency with acute abdomen or were admitted as a routine case for a disease that required resection and anastomosis of bowel. All these patients were admitted in the surgical department of S.N Medical College Agra from November 2015to June 2017. Only those patients who required bowel resection and anastomosis have included in the present study.

Sample size and method–

All patients undergoing intestinal resection and primary anastomosis during period of study of study by simple random sampling.

Inclusion Criteria:

This study was performed in patients of adult age group i.e. those of 18 years or above age and below 60 years of both sex.

Exclusion Criteria

1. Below 18 year and above 60 year.
2. Patient undergoing an initial diversion procedure and simple closure of stoma later.
3. Patients undergoing gastrointestinal and biliary-enteric anastomosis.

Method of study

On admission, a proper history was obtained from patient or attendant and the patient was subjected to complete clinical examination.

For the patients who were admitted in emergency, resuscitation was started immediately. Routine and some specific investigations were done in all the patients to reach a clinical diagnosis. Each patient was subsequently explored and exact pathology was dealt with. In all these patients resection of diseased of part of the intestine and anastomosis either by single layer or double layer technique was done to restore the bowel continuity.

Protocol used to manage the patients included in study is as follows:

History and clinical evaluation

From patient's age, general examination and past history, the factors adversely affecting healing of intestinal anastomosis were taken into consideration and special attention was given to them.

Resuscitation

When the general condition of the patient improved, he was subjected to exploration. Surgical treatment of the patient was done according to pathology of bowel and general condition of the patients.

Investigations

a. Plain skiagram of chest PA view and skiagram of abdomen AP view in erect posture was obtained in each patients.
b. Ultrasonography of abdomen was done in all patients.
c. Other special investigations like Barium studies, colonoscopy, and CT scan abdomen etc. was done in some patients admitted as a routine surgical cases to reach up to a diagnosis prior to exploration.
d. Total and differential count and haemoglobin percentage.
e. Urine, routine & microscopic examination, blood urea, blood sugar (fasting), serum creatinine; serum electrolytes, serum proteins, was done as per requirement and facilities available pre-operatively in all patients.

Pre-operative Bowel Preparation

Pre-operative mechanical and antimicrobial preparation was done only in all the elective cases. Mechanical bowel preparation was done with administration of oral polyethylene glycol (Peg lee) on the day prior to surgery in all the patients. Patient was kept on liquid diet a day prior to surgery and per-rectal enema was given to all an evening prior to surgery. Antimicrobial preparation given to patients consisted of oral salts of erythromycin and metronidazole a day prior to surgery.

Pre-operative intra-venous antibiotic as a single shot, usually a third generation cephalosporin was given to all the patients including those who were taken as an emergency case. No bowel preparation was done in emergency case

Procedure

All the patients were operated in the same set up under general anesthesia, in most of the cases a midline abdominal incision was used, care was taken to avoid Peritoneal contamination in clean peritoneal cavity. Where already contaminated, the peritoneal cavity. Where already contaminated, the peritoneal cavity was thoroughly washed with good amount of lukewarm normal saline.

The intestine to be anastomosed was prepared by ligating all the vessels on the serosal surface adjacent to cut edges, reducing the bleeding to a

minimum. Vascularity of the intestine was assessed by examining the cut ends of intestine for its colour, normal ooze, and arterial flow. Anastomosis was performed either in single layer or double layer.

Double layer anastomosis was performed with a continuous first layer of absorbable suture material and the second layer by non absorbable suture applied in interrupted fusion. Single layer anastomosis was performed with extramucosal technique using absorbable suture material in interrupted fusion.

Absorbable suture material used was polyglycolic acid (vicryl) of strength 3-0 on 16mm half circle find round bodied needle. Non absorbable suture used silk 3-0, on 16 mm round bodied needle. Angle stitches placed in the transverse axis of intestine about 0.5-1 cm apart from cut edges, starting with the posterior layer first followed by the anterior layer. Stitches were placed at about 5 mm margin from the cut edges and keeping the inter-stitch distance of about 5-7mm and tied tight enough to achieve approximation and hemostasis at the same time avoiding the strangulation of tissue under the suture. Knots were tied on the serosal surface so that they do not lie between the cut edges of mucosa. All anastomosis were done end to end. The resultant defect in the mesentery was repaired with absorbable suture. Omental wrapping was done of the anastomosis site.

Closure of Abdomen

At the end of the procedure the peritoneal cavity was lavaged with good amount of saline in all the contaminated cases and drained with Romson's abdominal drain kit. Rectus sheath closure of abdomen was done in single layer by using none absorbable suture with monofilament ethilon loop no -1. Skin was sutured with ethilon 3-0 in mattress fashion.

Post--operative assessment

Post operatively all patients were kept nil by mouth and were treated with intravenous fluids, nasogastric suction, intravenous antibiotics, analgesics and supportive treatment; particular attention was paid to any sign that could indicate an anastomotic leakage, such as evidence of intra-abdominal sepsis or prolonged paralytic ileus.

When the aspirate form nasogastric tube decreased and bowel rounds appeared and patient showed no signs of peritoneal irritation, the nasogastric tube was taken out and oral fluids were started. Drain was removed on an average 5 days from the day of operation.

Follows -Up

After complete recovery patients were discharged from hospital and reviewed in follow-up period, every 15 days till 2 months post-operatively for any features of post-operative obstruction or stricture formation, peritoneal sepsis, wound infection and persistent pyrexia.

RESULTS

The present study was performed on patients in adult age group i.e. above 18 year of age. Most of the patients were in the age group of 40 to 60 years.

Table 1: Age group of the patient

S.No.	Age group in yrs.	No. of patients	Percentage
1	18-40	20	40%
2	40-60	30	60%
	Total	**50**	**100%**

Out of the 50 patients included in present study 31 were males and 19 were females.

Out of the patients 38 were admitted in emergency and were taken up as emergency cases. 12 patients were admitted as routine cases from the outpatient department. Out of the 12 routine cases 10 were having either single/multiple ileal stricture and 2 cases were of malignancy of the large bowel .In emergency bowel prepration was not done.

Table 2: Indication for resection and anastomosis

S.No.	Diagnosis	No.of cases	Percentage
1	Penetrating/blunt trauma abdomen	07	14%
2	Perforation peritonitis	22	44%
3	Intestinal obstruction/gangrene/stricture	16	32%
4	Malignancy	03	6%
5	Strangulated hernia	02	4%
	Total	**50**	**100%**

Table 3: Intra-abdominal sepsis

S.No	INTRA –ABDOMINAL SEPSIS	No of case	Percentage
1	PRESENT	30	60%
2	ABSENT	20	4O%
	TOTAL	**50**	**100%**

Most of the patients who required resection and anastomosis of bowel were having perforation as the underlying pathology. 2 of these patients were having perforation either single or multiple in the jejunum or ileum. No case of spontaneous perforation of large bowel was found in the study. 5

patients were of penetrating/stab injury abdomen and 2 patients were having blunt trauma of abdomen. 7 of the patients subjected resection and anastomosis were having acute intestinal obstruction at the time of presentation out of these 2 were having stricture as the cause at different levels in ileum and 2 were having gangrenous portion of small bowel on exploration and 2 were diagnosed as case of sigmoid volvulas. 1 patient was having growth in the sigmoid colon. 10 cases were having stricture in the ileum as the preoperative diagnosis, demonstrated as per the special radiological examinations (Barium Swallow and enteroclysis). Gangrenous portion of small bowel was also found in 2 patients who required emergency surgical intervention due to strangulated inguinal hernia. 2 patients operated as routine cases were having malignancy of the large bowel as the cause, proved as pre the pre-operative histo-pathological examination of the colonoscopy biopsy from there. One patient with malignancy of the sigmoid colon presented as cases of acute intestinal obstruction in the emergency.

It was found that almost all the patients who were malnourished with serum albumin level less than 3g% were also having anaemia with their heamoglobin levels less than 10g%.

Most of the patients in the present study having blood pressure at the time of presentation more than 90 mmHg and the state of dehydration and electrolyte abnormalities were corrected as per the individual case. Most of the patients were haemodynamically stable by the time they were taken for operation.

10 patients were haemodynamically unstable at the time of presentation with blood pressure less than 90 mmHg and were in state of shock. Out of these 6 patients were of perforation peritonitis, 2 were having acute intestinal obstruction with gangrenous bowel, 1 of blunt trauma abdomen with splenic trauma and 1 of penetrating jury abdomen with liver tear. These patients were resuscitated with cystalloids. Colloids and blood as per the individual case. 2 of these patients having perforation peritonitis required ionotropic support. Patient with perforation peritonitis who presented with shock were having history of abdominal complaints for more than 5 days and were also found to have gross contamination of their peritoneal cavity at the time of exploration.

Table 4: Operative procedure performed

S.No.	State	No. of patients	Percentage
1	Jejuno Jejunal anastomosis	04	8%
2	Ileo-ileal anastomosis	25	50%
3	Ileo colic anastomosis	17	34%
4	Colo colic anastomosis	04	8%
	Total	**50**	**100%**

Jejuno-jejunal anastomosis performed in 2 patients with blunt trauma abdomen and 2 patients with pathological jejunal perforation with stricture in the immediate distal portion. Ileo-ileal anastomosis was done in 25 patients, out of which 5 were having penetrating/stab injury abdomen, 12 cases were of ileal perforations, 2 were having inguinal hernias with strangulated ileal bowel loops and rest were cases of intestinal obstruction and strictures. Ileo-colic anastomosis was performed in 17 patients out of which 8 cases belonged to the group of perforation peritonitis, 1 was having malignancy of ascending colon and 8 presented as case of obstruction or with intestinal stricuture. Colo-colic anastomosis was performed in 4 patients out of which 2 were having sigmoid volvulus and 2 were cases of malignancy of sigmoid colon.

All the anastomosis performed were of end-to end type in inverting fashion. Patients were randomly selected for single or double layer type of anastomosis.

Table 5: Single layer or double layer anastomosis

S.No.	Site of anastomosis	No. of patients With single layer Anastomosis	No,of patients with double layer anastomosis
1	Jejuno-jejunal anastomosis	02	02
2	Ileo-Ileal anastomosis	13	12
3	Ileo-colic anastomosis	8	09
4	Colo-colic anastomosis	02	02
	Total	**26**	**24**

Out of total of 50 intestinal anastomosis, 26 were performed by single layer technique and 24 were performed by double layer technique. Details of which are given in above table.

The factors which may be of relevance in anastomotic healing were also taken into consideration during studies. 10 patients were found have Hb% below 10g%, 38 patients were taken for operative procedure as emergency cases and no pre-operative bowel preparation was done in these cases. Bowel preparation was done in all the 12 cases operated upon as routine cases. Gross peritoneal sepsis/fecal soiling was found in 30 cases at time of exploration. Intra - operative bowel decompression as done in all the emergency cases with unprepared bowel. 2 patients in the present study were having

associated medical problems one was a known diabetic on oral hypoglycemic and the other was asthmatic on oral bronchodilator and steroid therapy. None of the patient was found to have jaundice either pre or post operatively. Omental wrapping of the anastomotic suture line was done in all the case. Post-operative intravenous antibiotic therapy for an average of 5days was given in all these which generally consisted of a third generation cephalosporin or a quinolone and an aminoglycoside with metronidazole. Intra-peritoneal drains were kept in all the patients operated as emergency cases and removed on an average the 5th post operative day, depending upon amount it was draining.

DISCUSSION

Intestinal anastomosis, whether inverted or everted, single layer or double layer, sutural or stapled always, robs the deep of surgeon's and creates a silent dread in the mind until the patient gets discharged from the ward. No doubt he did it to salvage the life of the patient. But few days he thinks only about the anastomosis.

Benazmin Travers (1812) in his publication wrote quite soundly "The union. of divided bowel requires the contact of cut extremities in their entire circumference The species of suture employed is of secondary importance if it secures this contact.[1]

Even though lot of factors related to the patient affect the healing of intestinal anastomosis, the sutural technique has its own role in anastomosis. A great deal of controversy still exists over relative merits and demerits of different methods of anastomosis.

Anaemia frequency is blamed for defective wound healing. Most surgeons today are of the opinion that normal healing is jeopardized when the hematocrit falls below 35% Crawford and ketcham (1966) 1 and Hugo et al (1969) 1 have demonstrated the delitirious effect of anaemia on the breaking strength of wounds in their studies. Heughan and Hunt (1973) also emphasized that healing is impaired by conditions which are associated with anaemia such as malnutrition and abnormalities in circulating blood volume.

Mukherjee et al (1969) and Daly et al (1970, 1972) have reported a significant decrease in tensile strength of intestinal anastomosis associated with malnourishment.

In present studies we analysed 50 cases, out of which we faced a leak percentage of 6%. Anaemia (Hb% <10 gm%) hypoproteinemia (S. Albumin <3 g%) and significant hypovolemia was there in 20% of patients in present studies.

In the present studies 76% of cases were operated as emergency cases which no bowel preparation could be given preoperatively. 36% of the total cases were having moderate to significant peritoneal sepsis and fecal soling at exploration.

All the 3 patients who suffered anastomotic leakage were taken up as emergency cases with no bowel preparation and having significant peritoneal contamination on exploration. Goligher et al (1970) 5 reported higher incidence of anastomotic dehiscence in patients with gross contamination of peritoneal cavity and with fecal loading of bowel in whom no bowel preparation was given.

P.J.O Dwyer (1989) also emphasized that bowel preparation enhances the anastomotic integrity. Arhendt et al (1966) also reported that intra-abdominal sepsis impairs the intestinal reparative collagen and protein synthesis and impairs the healing process in bowel surgery.

Buchin and Van (1974) reported more tissue necrosis and there experimental evidence of adhesion formation and necrosis in double layer standard technique of anastomosis. There is more or less unanimous observation about the narrowing of lumen associated with double-layer anastomosis, Gatzon and associates (1966) 6 were of the opinion that a mucosa to mucosa coadpatation would reduce anastomotic stenosis to a minimum.

Letwin and Williams (1967) showed that the single layer inverting method gave better results than two layer method in small bowel anastomosis. They claimed that the amount of vascular damage and tissue necrosis was less in single layer anastomosis.

Similarly the studies by Hamilton (1967) Gil7 and others and Orr (1969) 8recommended the single layer inverting anastomosis as the safest and least likely to interfere with vascularity and suture line healing.

Our results also confirm the above conclusion in that there was no sign of stenosis or stricture formation in the post-operative period and even in the follow-up studies.

Even in present study a leak had occurred in the anastomosis performed by single layer method, but we cannot include it amongst the demerits of technique: other factors such as sepsis at site of anastomosis, faulty technique and poor nutritional status should be considered.

Anastomotic dehiscence are less because better blood supply is maintained in extramucosal technique. At the same time the strangulation of cut edges of bowel is avoid and as such prevailing the avascular necrosis. This can be explained asdue to fact that in double layer anastomosis the terminal vessel angulation is more than 90 degree, so the blood supply is hampred, while in single layer extramucosal technique it seldom occure.

In a comparative experimental study the pressure tolerance at anastomotic site showed that the standard anastomosis leaked at 140mm Hg pressure while the single layer with blood pressure greater than 150 mm Hg.

Since now it is true that engages the sub mucosa adequately is sufficient for union and surgeon meticulously choose a suture technique which is reliable like single layer. Similarly we can say that

the double layer method which require an additional layer is more time consuming and difficult.

In the series of 50 patients analyzed only 2 were having associated problems (one with diabetes and other having uremia). Although postoperative wound infection was seen in these case but none of them suffered any complication related to anastomosis healing. Little evidence indicate that diabetes affect the gastro-intestinal tract healing process.

Although the anastomotic dehiscence is a continuing problem because of contribution of a lot factor and only the sutural technique does not affect it in broad looking, but even then if other factor can be brought as near to normal, the single layer extra-mucosal method of anastomosis possess some qualities which surpass the standard traditional method of intestinal anastomosis.

The results of the various previous clinical studies related to gastro-intestinal anastomosis healing are

Study	**Anastomotic leak percentage**
Goligher et al (1970) [5]	8.6%
N.W.M Orr (1969) [8]	6.0%
Mathewson and lrving (1975) [9]	5.0%
Present studies	6.0%

Above table shows that the anastomotic leak percentage in the present studies are almost comparable to the other studies conducted in past from time to time at various places.

CONCLUSION

The result of present study confirm the common impression that a number of factors are involved in the aetiology of anastomotic dehiscence.

Out of various factors the most appealing ones are the state of nutrition of patient, state of hypovolemia, condition of peritoneal cavity, fecal loading of bowel and preparation of bowel.

But by improved methods and avoiding local factors, it seems that the incidence of anastomotic dehiscence is less in single layer extramucosal anastomosis.

It is well known that the strength of anastomosis lies in submucosa. In double layer anastomosis the inverted first layer not provide any support to withhold the union and it slough during the first week. So it is surprising to say as the second layer to double inverting anastomosis methods is to provide additional security against leak.

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