

**“A PROSPECTIVE COMPARATIVE STUDY BETWEEN  
STAPLERS AND CONVENTIONAL HAND-SEWN  
ANASTOMOSIS IN GASTROINTESTINAL SURGERY”**

**Dissertation submitted to**

**THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY**

**In partial fulfillment of the regulations**

**For the award of the degree of**

**M. S. DEGREE BRANCH- I**

**GENERAL SURGERY**



**MADRAS MEDICAL COLLEGE**

**THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY,**

**CHENNAI.**

**APRIL 2015**

## **CERTIFICATE**

This is to certify that the dissertation titled  
**“A PROSPECTIVE COMPARATIVE STUDY BETWEEN STAPLERS  
AND CONVENTIONAL HAND – SEWN ANASTOMOSIS IN  
GASTROINTESTINAL SURGERY”** is the original work done by **Dr. A.  
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## **DECLARATION**

I **Dr. A. PRABAKARAN** declare that this dissertation titled “**A PROSPECTIVE COMPARATIVE STUDY BETWEEN STAPLERS AND CONVENTIONAL HAND – SEWN ANASTOMOSIS IN GASTROINTESTINAL SURGERY**” is a record of the original work done by me in the Department of General surgery and Rajiv Gandhi Government General Hospital, Chennai during my postgraduate course of M.S General Surgery from 2012 - 2015 under the guidance of my professor Prof. R.A. Pandyaraj, M.S., F.R.C.S. and head of the department Prof. P. Ragumani M.S., It is submitted to The Tamil Nadu Dr.MGR Medical University, Chennai towards the partial fulfillment of the requirement for the award of M.S., degree in General Surgery, April 2015. This record of work has not been submitted previously by me for the award of any degree from any other university.

**Dr. A. PRABAKARAN**

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### **INTRODUCTION**

“For a proper and perfect gastrointestinal anastomosis , the factors to be considered are ‘ time required for surgery’, ‘restoration of normal GI function’, ‘effective hemostasis’, ‘ reduction of tissue damage’, and ‘ prevention of postoperative mortality and morbidity’; for example, anastomotic leak (sepsis)”.

“Fundamental for GI anastomosis whether, hand –sewn technique or stapling technique is, good approximation without tension and good blood supply” .

“Staplers are capable of cutting and stapling at the same time and avoiding the need for clamping. The increased cost of the staplers is offset by reduction in operating time. Circular staplers have better access in difficult areas like lower Pelvic surgery, sparing many patients from permanent colostomy”.

“Accordingly , it is worthwhile to study the GI anastomosis by using staplers or hand-sewn technique”.

## **AIM OF STUDY**

To compare hand-sewn technique with surgical stapling technique in a prospective cohort study in patients undergoing elective gastrointestinal surgeries.

## **REVIEW OF LITERATURE**



## **HISTORICAL BACKGROUND**

An extensive review of the history of the intestinal anastomosis was given by Mol in 1970. Before 19<sup>th</sup> century, surgery of the intestine was limited to closure of traumatic Perforations.

The oldest method to close intestinal wound was described by the Indian physician Sushruta, 800 years before Christ, who used the Jaws of ants to hold the wound margins together.

For centuries it was realized that a transverse wound of the Intestine was lethal, and if the direction of the wound was Longitudinal there was a small chance to survive.

The first circular intestinal suture in man was performed in 1730 by Ramdohr, by invagination of a gangrenous bowel segment. Through the pioneer work of Travers (1812), Lembert (1826) and Dieffenbach (1826) it became known that careful approximation of the peritoneal coating of the cut intestine provides good healing.

The first report of a successful intestinal resection and anastomosis using the suture technique of Lembert, was published by Dieffenbach from Berlin in

1836. Even today the non penetrating inverting seromuscular stitch named after Lembert is utilized by many surgeons in intestinal suturing.

As experiences in intestinal suturing grew during the 19th century, it became clear that resection and anastomosis of the colon carried a considerable risk of leakage compared to other parts of the gastrointestinal tract. Successful surgery of the abdomen and its organs become possible for the first time after the discovery of general anaesthesia and the introduction of antiseptics and asepsis, after Lister's publication in 1867.

Still in 1884, 10 out of 20 patients who underwent intestinal resection and anastomosis in the clinic of Billroth, died because of intestinal leakage and peritonitis."

This led to the introduction of numerous types of sutures, anastomoses in one, two and three layers, and using different suture materials.

Nevertheless the discussion of which type of anastomosis is the best continues till today.

The understanding of the role of colonic bacteria and the introduction of standard mechanical cleansing and the use of systemic or local antibiotics have further improved results of intestinal surgery.

The introduction of staplers in recent decades have enabled to construct a safe anastomosis in places difficult to reach with conventional suture techniques.

Nowadays, under normal conditions resection and anastomosis carry low risks. But even today, during conditions when construction of an anastomosis has a higher failure rate, a temporary diverting stoma could be constructed.

Even today much surgical research is performed to find methods and techniques to improve the safety of colonic anastomoses.

Prior to nineteenth century, intestinal surgeries were limited to exteriorization by means of a stoma or closure of simple lacerations.

Lembert then described his seromuscular suture technique in 1826,

“Anastomosis may be created between two segments of a bowel in a multitude of ways. It may be end-to-end, side-to-side, or side-to-end”.

“The submucosal layer of the intestine provides the strength of the bowel wall and must be incorporated in the anastomosis to assume healing”.

“The most important complication of the gastrointestinal anastomosis is anastomotic leak and wound dehiscence”.

For making a relatively good, safe and reliable anastomosis by

- 1.meticulous technique
- 2.tension free anastomosis
- 3.maintain good tissue vascularity
- 4.perioperative optimization of nutritional status
- 5.avoiding concomitant systemic illness
- 6.perioperative optimization of medical comorbid illness like DM and HT
7. Avoidance of harmful drugs such as steroids and vasopressors.

“The main aim of our study is comparison of hand-sewn gastrointestinal anastomoses and stapler anastomotic technique”.

“Restoring intestinal continuity after partial enterectomy and/or colectomy is central to gastrointestinal surgery”.

“In 1826 Lembert’s described the interrupted seromuscular suturing technique , which became the mainstay in gastrointestinal surgery in the second half of the century”.

A Connell stitch is made in both ends. The Connell stitch is made by passing the suture from the outside in, then inside out, on one end. The same step is repeated on the other end in the form of a continuous U-shape.

“Currently, the single-layer extramucosal anastomosis is popular, as advocated by Matheson of Aberdeen, as it probably causes the least tissue necrosis or luminal narrowing”.

#### “BENEFITS OF STAPLING DEVICE”

1. “Minimizing tissue manipulation and trauma”,
2. “Less bleeding and edema at the anastomotic site”,
3. “Quick return of gastrointestinal function”
4. “Rapid patient recovery”.

“The main drawback of staplers is – COST”

“Anastomotic dehiscence occur around 7<sup>th</sup> postoperative day”.

Although it may seem that surgical stapling devices have completely replaced hand suturing of bowel anastomoses, hand suturing remains a crucial skill in every surgeon's armamentarium.

Hand suturing uniformly invokes an inflammatory response from dragging the suture material through the bowel.

The choice of suture material used by surgeons is not based on a strong preponderance of scientific evidence.

Everting and inverting anastomoses have come in and out of favor over the last 2 centuries, as have many anastomotic techniques.

**“FOR VERY GOOD GI ANASTOMOSIS” :**

1. “Ensure an adequate blood supply, eliminate tension, maintain hemostasis, and handle tissues gently”.
2. “Use an inverting (serosa-to-serosa), or an everting, with minimal exposed mucosa, technique”.
3. “Avoiding internal hernia by closing mesenteric defect”.
4. “A single-layer anastomotic technique is an acceptable technique”.

Many published studies have compared inverting and everting anastomoses throughout the GI tract.

It is clear that with everting anastomoses, the role of the omentum and other peritoneal defense mechanisms is increased because of the need to seal the anastomosis and assist in healing.

Although everting patterns do not initially impinge on intestinal lumen, stenosis of the anastomosis may result from extra luminal adhesions and increased fibroplasia.

Currently, inverted anastomosis is the most widely used technique worldwide.

In this study, we compare hand suturing with surgical stapling in patients undergoing elective gastric surgery.

“Surgical stapling were first introduced by Hultl, Humer in 1908”.

The modern era of mechanical staplers was launched by American surgeon Mark Ravitch .

“The basic instruments are the LDSTM (Ligates and divides to save), TA 30TM (thoracoabdominal), TA 55TM, TA 90TM, GIATM (gastrointestinal anastomosis), and the EEATM (end-to-end) surgical staplers”.

“The LDS is employed in dividing mesentery, mesocolon, and the omentum. Although ingenious, it has been the least successful of the stapling instruments”.

“The GIA, TA 30, TA 55, and the TA 90 are used for opening, closure, resection and anastomosis”.

“Results are compared in terms of morbidity, mortality, leak and duration of the procedure”.

Randal Baker’s group has popularized the “science of stapling” to promote awareness on how gastro-intestinal leaks occur from staple line.

“The cause of leaks fall into two key categories: mechanical/tissue causes that occur postoperative day 0 to 2 and make up the vast majority of leaks”.

“Ischemic causes that occur postoperative days 5 to 7, but are very rare”.

**Principles of avoiding mechanical/tissue causes of leaks include the following :**

- “Optimal stapling allows adequate time for tissue compression and creep(elongation when crushing force applied)”

- “Stress relaxation is reduction in the amount of force required to maintain applied displacement and is important to avoid tearing of tissues from excess tissue shear or tensile stress”.

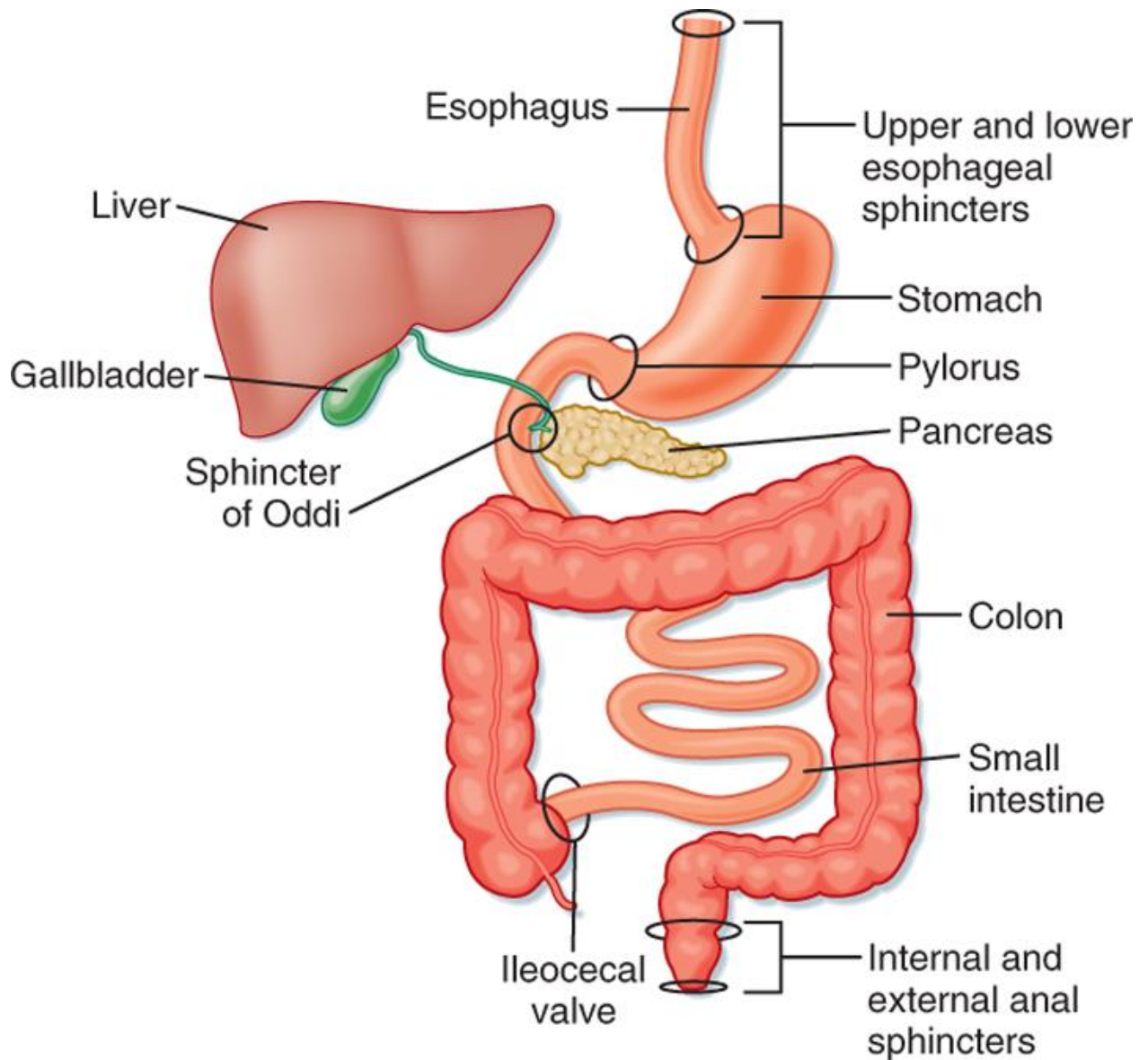


## **“NEED FOR THE STUDY”**

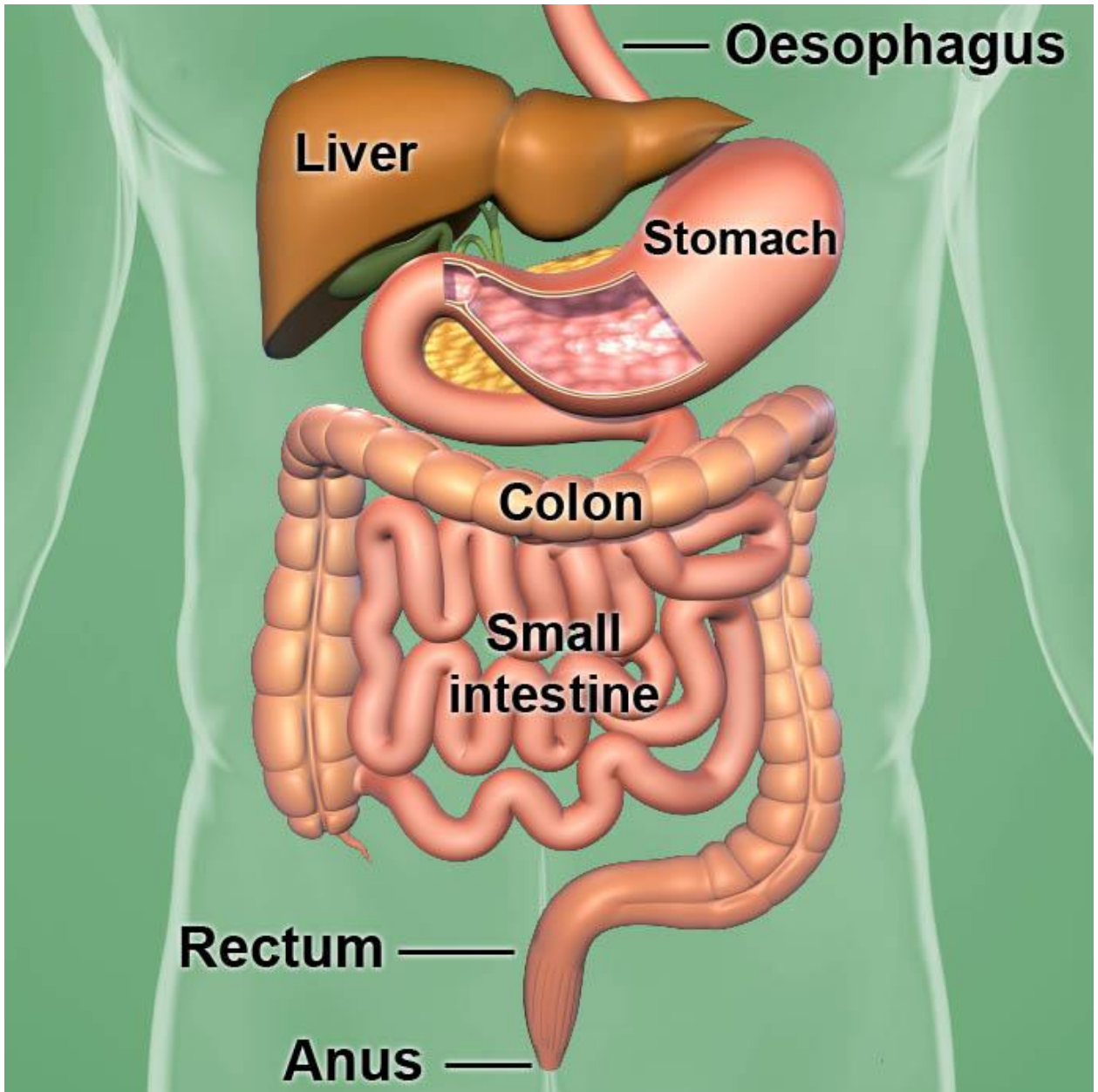
- “Conventional (hand-sewn) technique of intestinal anastomosis has been in vogue for several decades. Staplers which were developed to simplify surgery began to have significant impact”.
- “To compare staplers versus conventional anastomosis with respect to certain intra-operative and post-operative parameters”.
- “Although stapling is an alternative to hand-suturing in gastro-intestinal surgery, recent trials specifically designed to evaluate differences between the two in surgery time, anastomosis time, and return to bowel activity are lacking”.

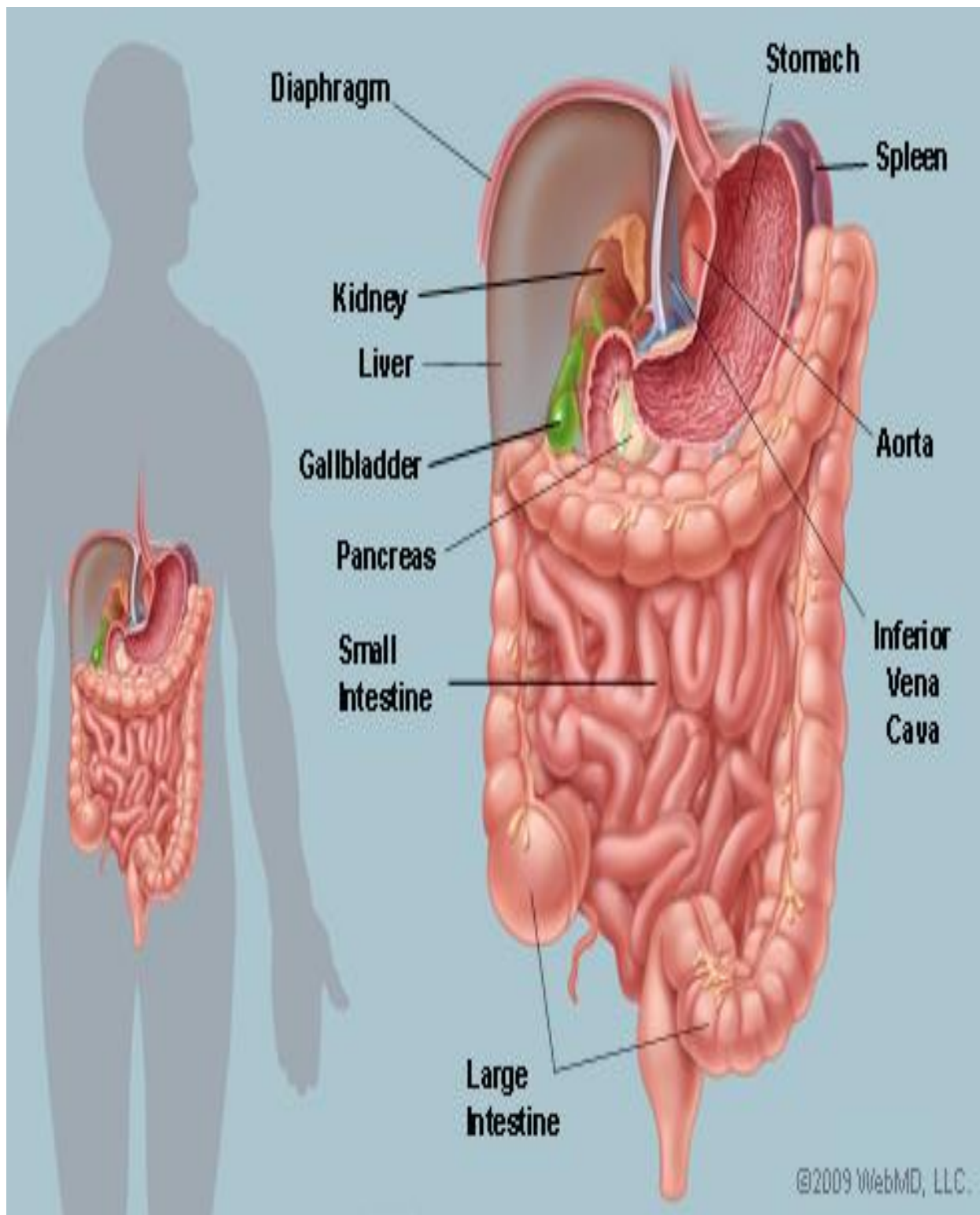
- “This trial compares the outcomes of the two groups undergoing elective surgery requiring a single gastric, small, or large bowel anastomosis”.
- “Restoring intestinal continuity after partial enterectomy and/or colectomy is central to gastrointestinal surgery. In recent years, mechanical stapling devices have improved and have become more versatile so that many surgeons now consider stapling technique as best alternate method of anastomosis to suture technique, for speed, safety, efficiency and easy access”.
- “The purpose of the study is to compare the feasibility, safety and efficacy of the outcome of stapler and hand-sewn anastomosis in gastrointestinal surgeries”.

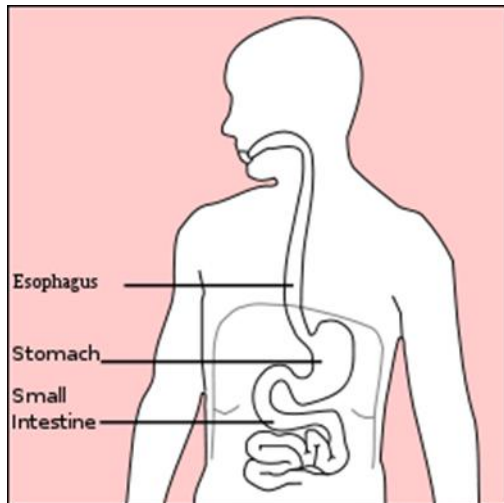
## SURGICAL ANATOMY OF GASTROINTESTINAL SYSTEM



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.  
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The stomach lies in the epigastric region. It consists of:

“FUNDUS”

“BODY”

“POSTERIOR WALL”

“ANTERIOR WALL”

“GREATER CURVATURE”

“LESSER CURVATURE”

“CARDIA “

“PYLORIC CANAL”

“PYLORIC ANTRUM”

“PYLORIC SPHINCTER”

“INCISURAE ANGULARIES”

“GASTRIC CANAL”

“RUGHAE”

“ARTERY”;-

1. “RT. GASTRIC ARTERY”
- ,2. “LT.GASTRIC ARTERY”
- ,3. “RT.GASTRO-EPIPLOIC ARTERY”
4. “LT.GASTRO-EPIPLOIC ARTERY”
5. “SHORT GASTRIC ARTERIS”

“VEIN”;-

1. “RIGHT GASTRIC VEIN”,
2. “LEFT GASTRIC VEIN,”
3. “RIGHT GASTRO-EPIPLOIC VEIN”
- ,4. “LEFT GASTRO-EPIPLOIC VEIN”,

5. "SHORT GASTRIC VEINS"

**"NERVE";-**

1. "CELIAC GANGLIA",

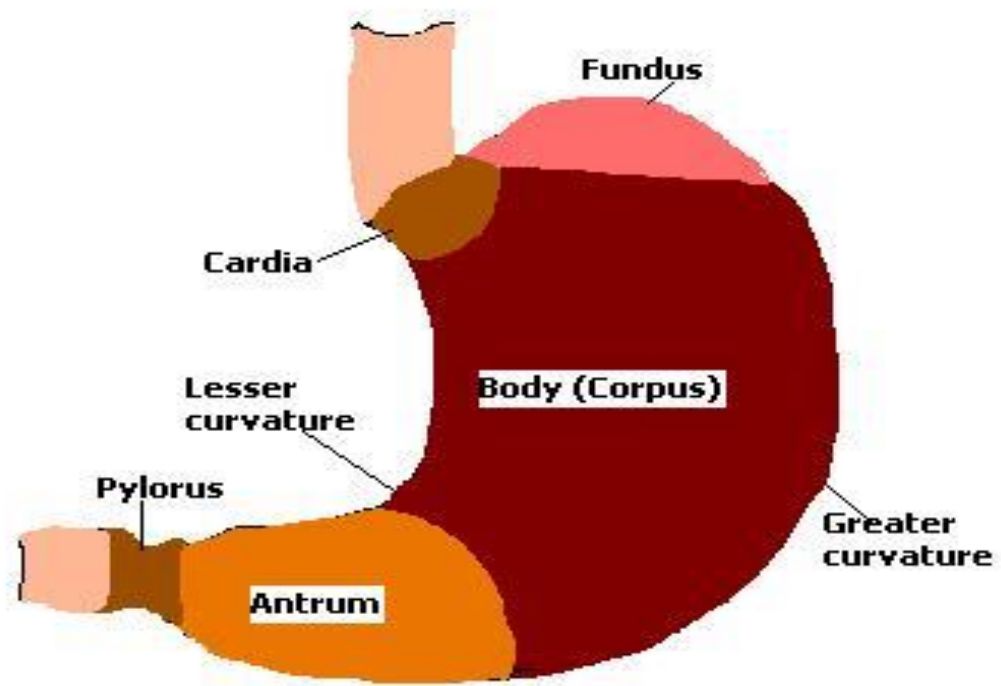
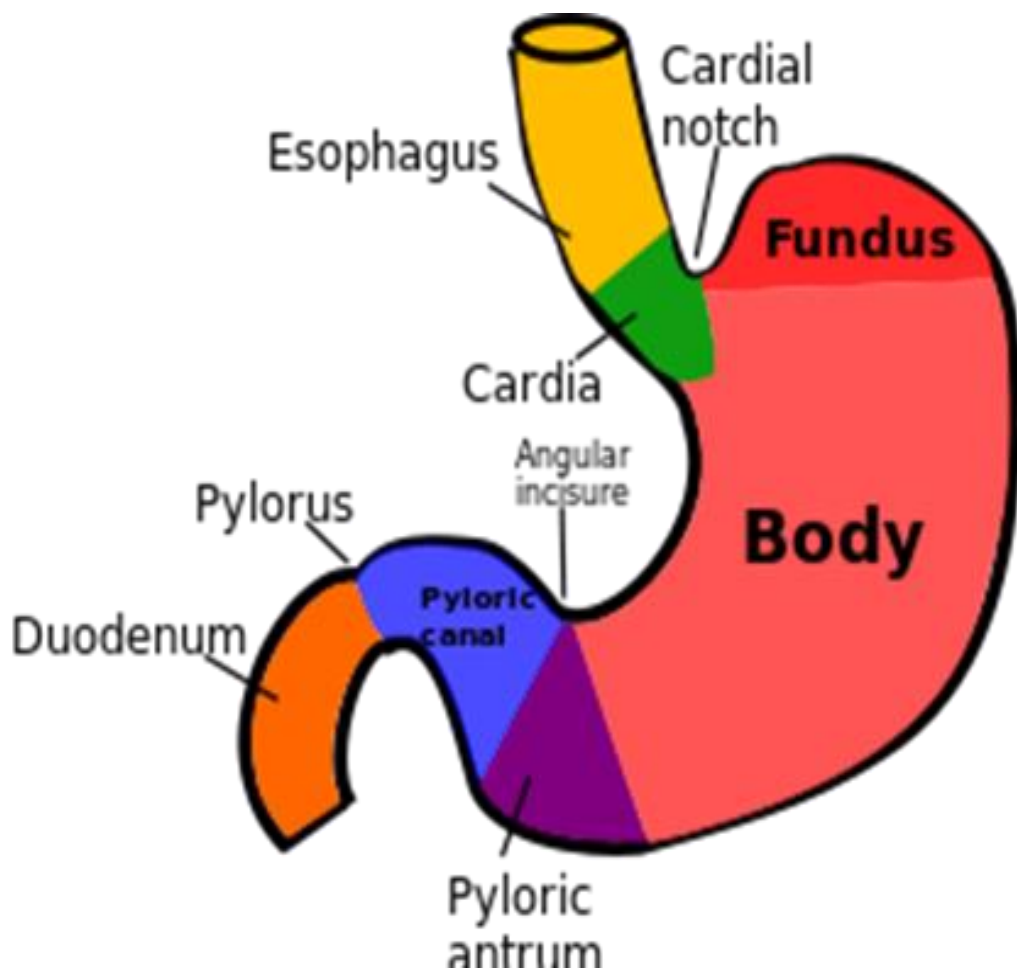
2. "VAGUS NERVE"

**"LYMPH NODES";-**

1. "PERIGASTRIC LYMPHNODE"

2 ".CELIAC PLEXUS NODE"





1. “The stomach lies between the esophagus and the duodenum (the first part of the small intestine)”.

2. “The gastro colic omentum extends between greater curvature of the stomach to transvers colon”.

3. It has 2 sphincters.

1. “oesophageal sphincter -found in the cardiac region, not an anatomical sphincter”

2. “the pyloric sphincter dividing the stomach from the small intestine”.

3. “parasympathetic (stimulant) and sympathetic (inhibitor) plexuses (networks of blood vessels and nerves in the anterior gastric, posterior, superior and inferior, celiac and myenteric)”.

4. “Stomach is a distensible organ in a relaxed state the adult stomach occupies the volume of 50-75 ml. and can expand upto 1 litre”.

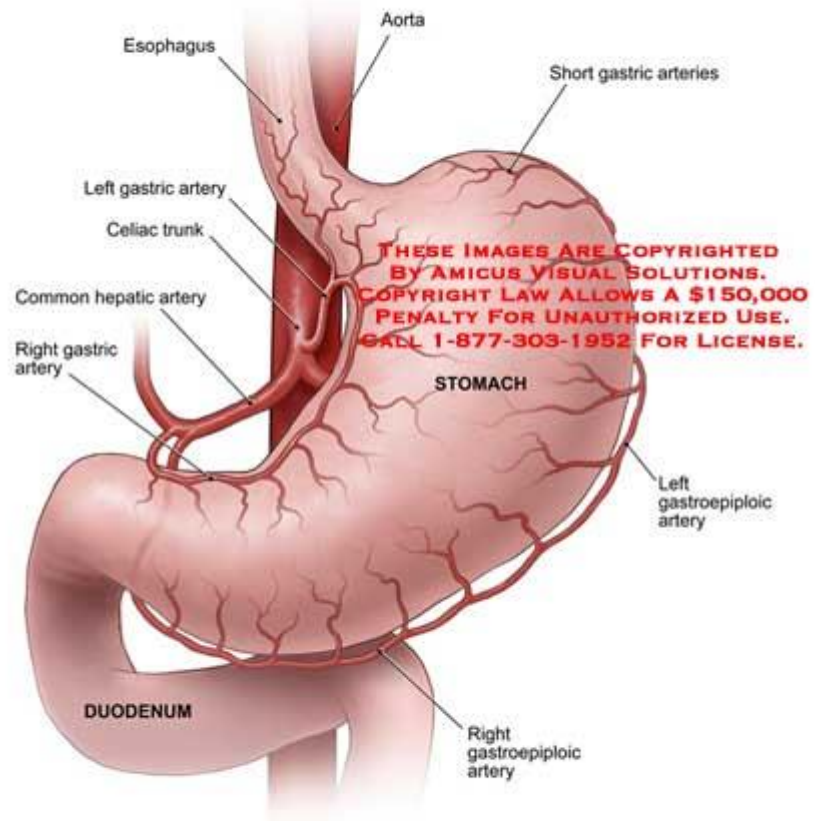
## “ ANATOMY OF STOMACH”

It has 4 section

1. “The cardia – where the contents of the esophagus empty into the stomach”.  
“The cardia is defined as the region following the "z-line".
- 2 “The fundus is formed by the upper curvature of the organ”.
3. “The body (Latin: corpus) is the main, central region”.
4. “The Pylorus is the lower section of the organ that has pyloric canal and pyloric sphincter” .

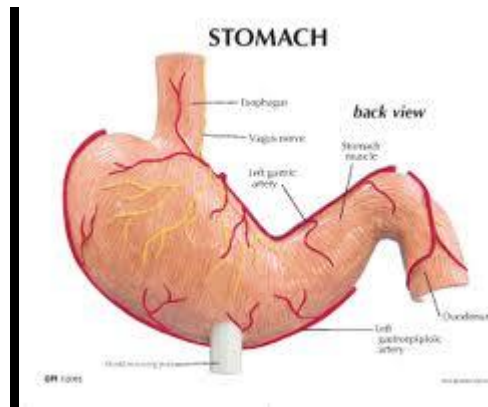
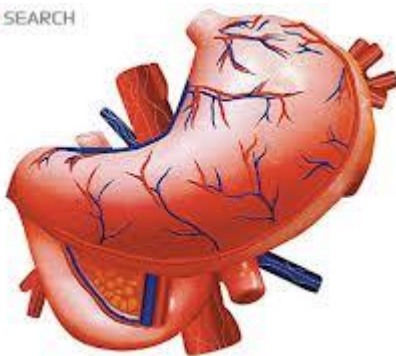
# BLOOD SUPPLY

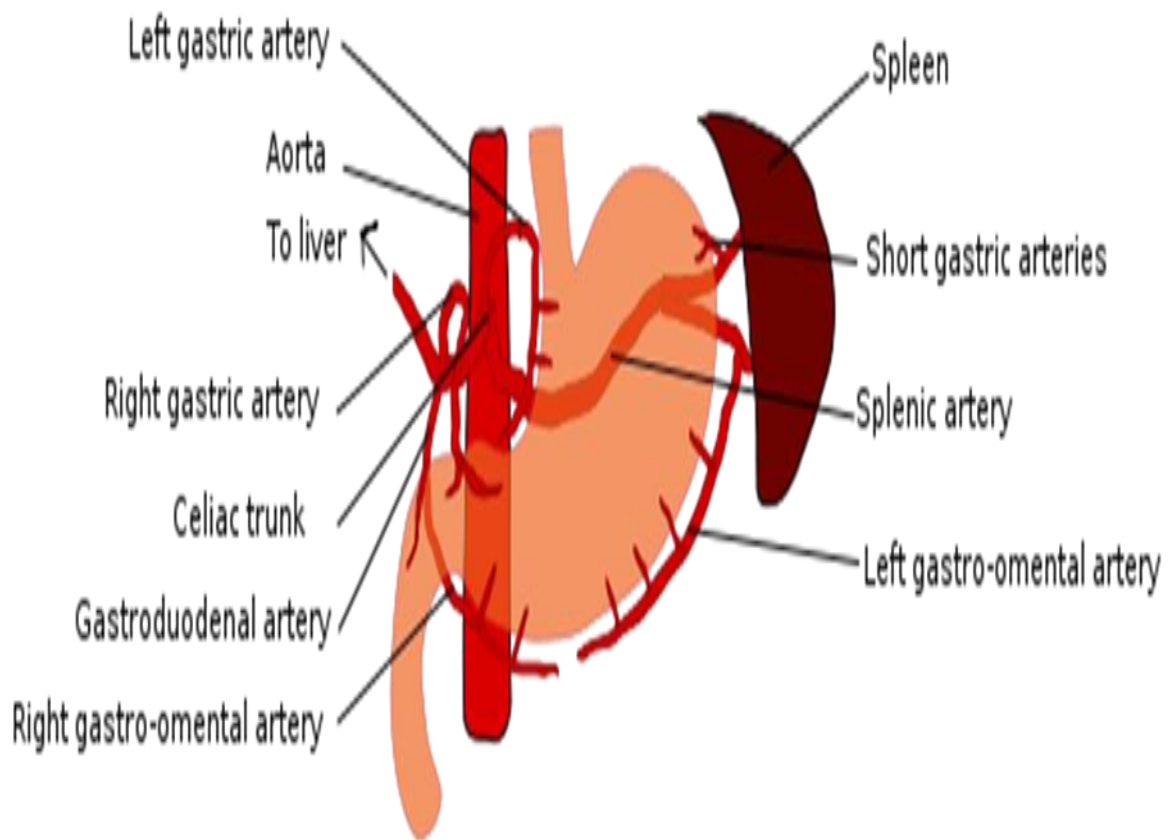
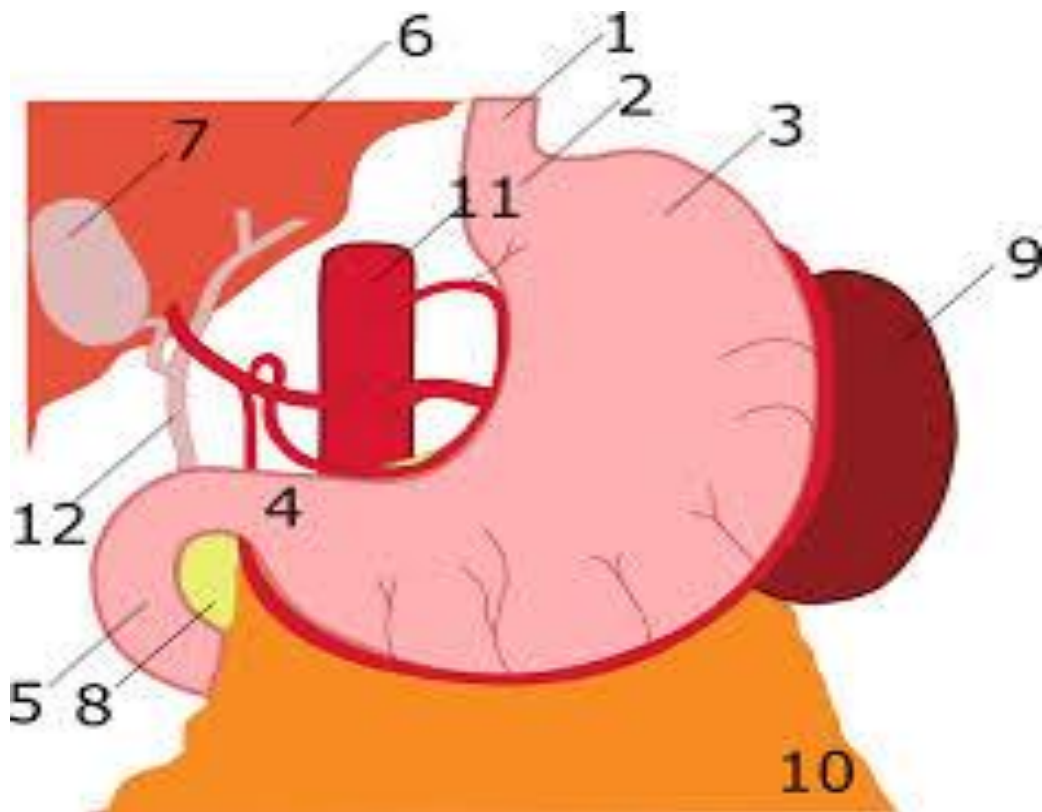
## Normal Vascular Supply to the Stomach



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HOBBY SEARCH





“BLOOD SUPPLY TO THE STOMACH”

“ARTERY”;-

1. “RIGHT GASTRIC ARTERY”
- ,2. “LEFT GASTRIC ARTERY”
- ,3. “RIGHT GASTRO-EPIPLOIC ARTERY”,
4. “LEFT GASTRO-EPIPLOIC ARTERY”,
5. “SHORT GASTRIC ARTERIES”

“The lesser curvature”-

1. “THE RIGHT GASTRIC ARTERY”- below, and
2. “THE LEFT GASTRIC ARTERY” above,- then cardiac

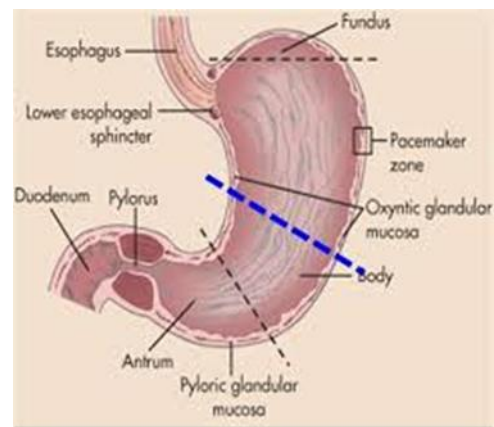
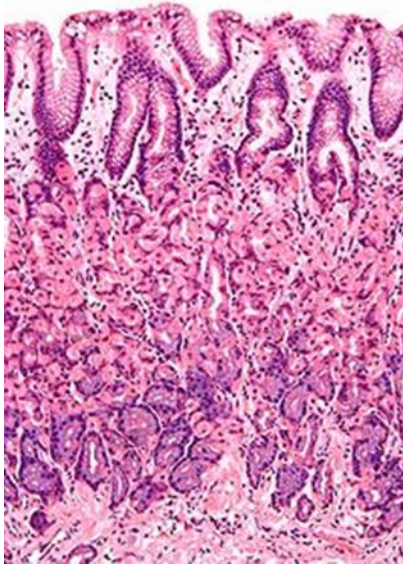
region also.

“ The greater curvature”-

1. “THE RIGHT GASTRO-EPIPLOIC ARTERY”  
below.
2. “THE LEFT GASTRO-EPIPLOIC ARTERY”  
above.

“SHORT GASTRIC ARTERY” arising from splenic artery supplies fundus of the stomach and upper portion of the greater curvature”.

## Histology



“The mucosa of the stomach” consists of:

1. “the epithelium”
2. “ the lamina propria”
3. “muscularis mucosae”.
4. “ Meissner's plexus” .
5. “muscularis externa” .

6. “inner oblique layer”.

7. “middle circular layer”.

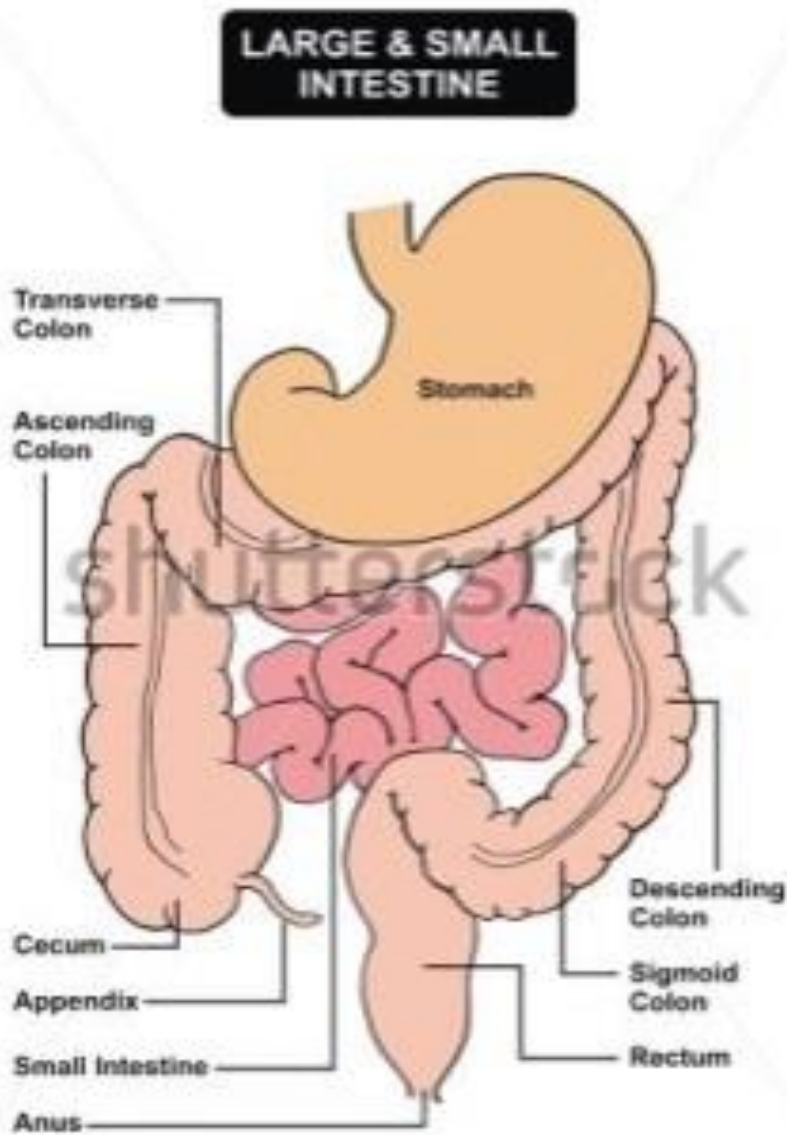
8. “Outer longitudinal layer”

9. “serosal layer”

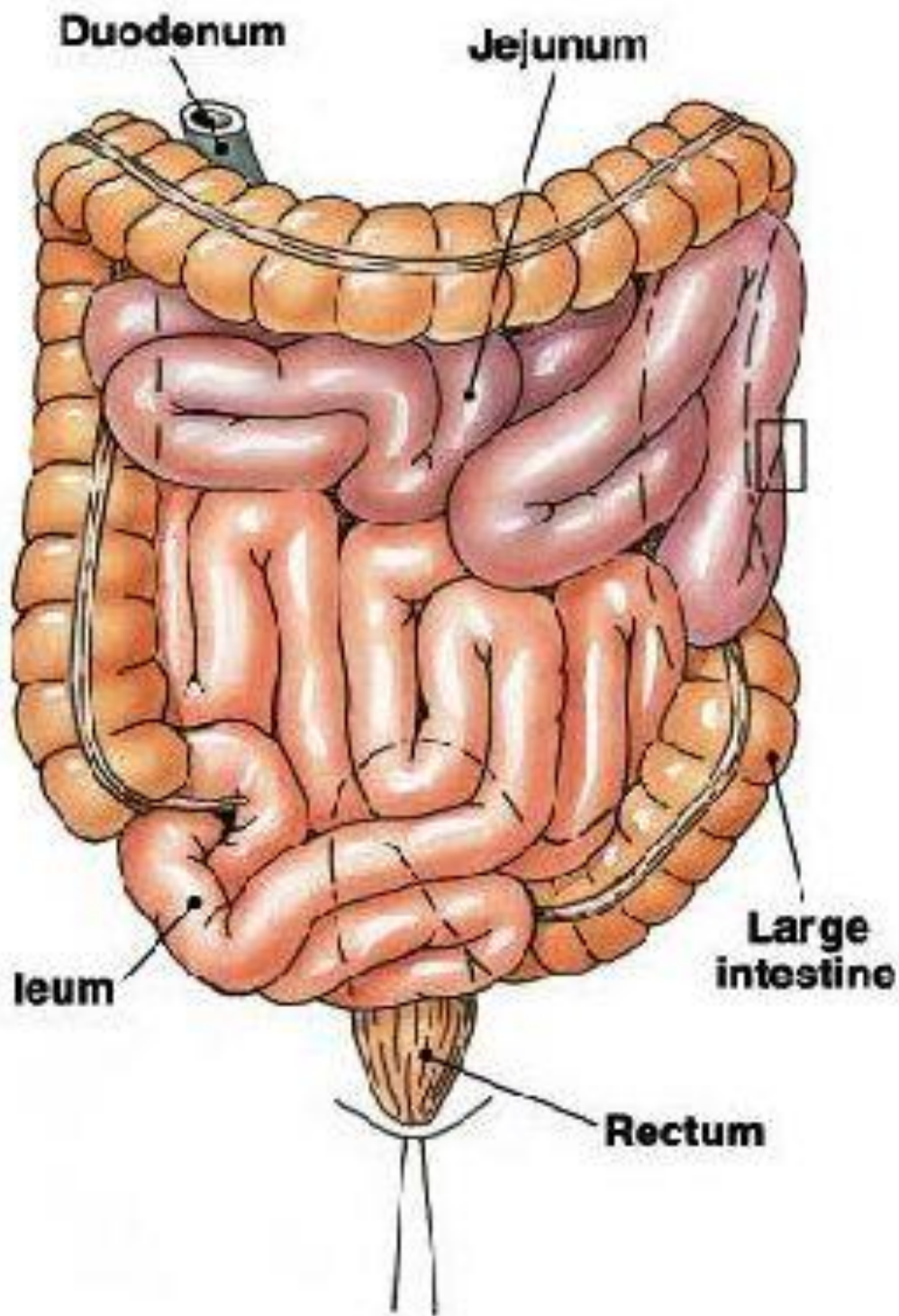
“Auerbach's plexus (“myenteric plexus”) is found between the outer longitudinal and the middle circular layer”.



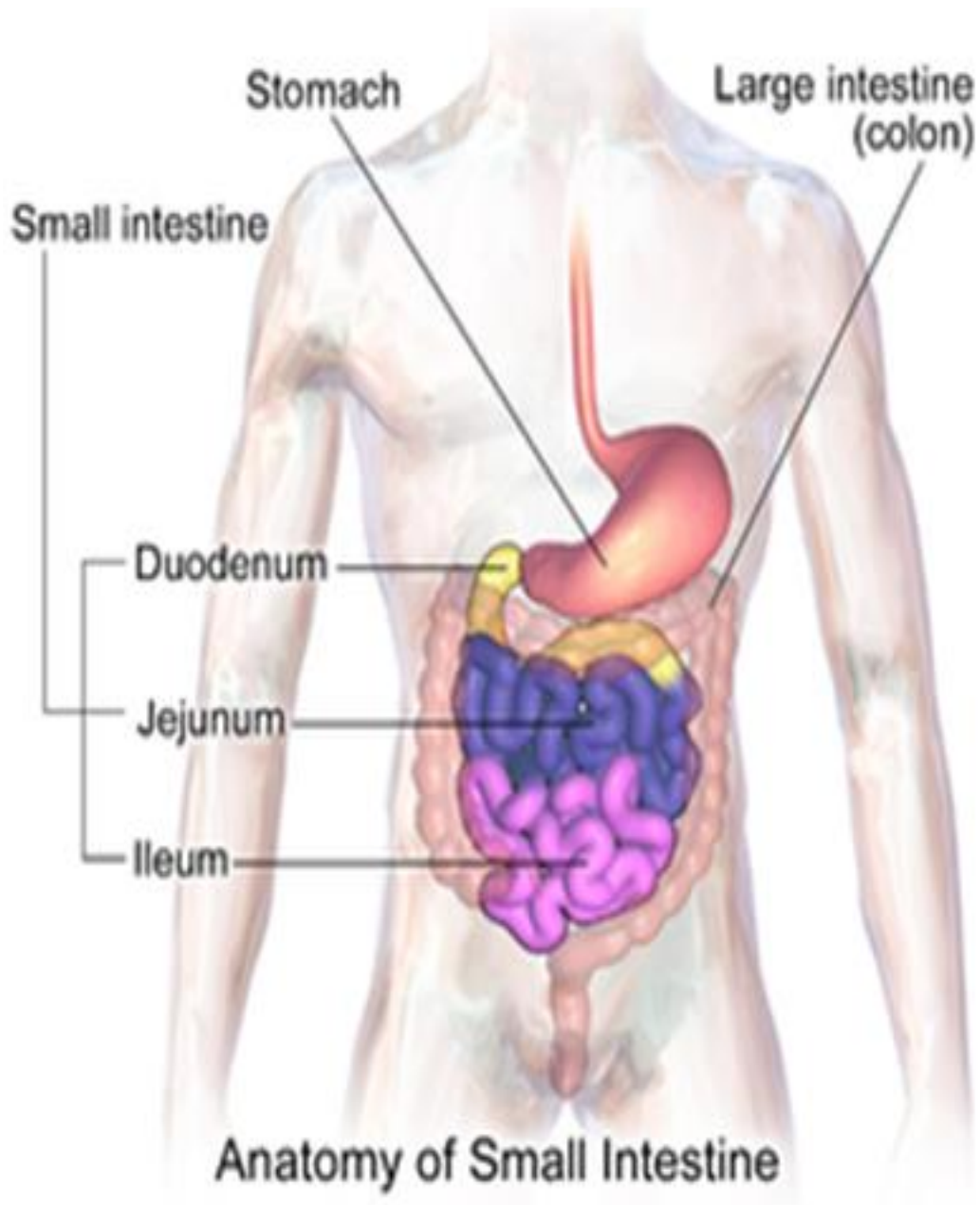
## SMALL INTESTINE



## Regions of the Small Intestine



## SMALL INTESTINE

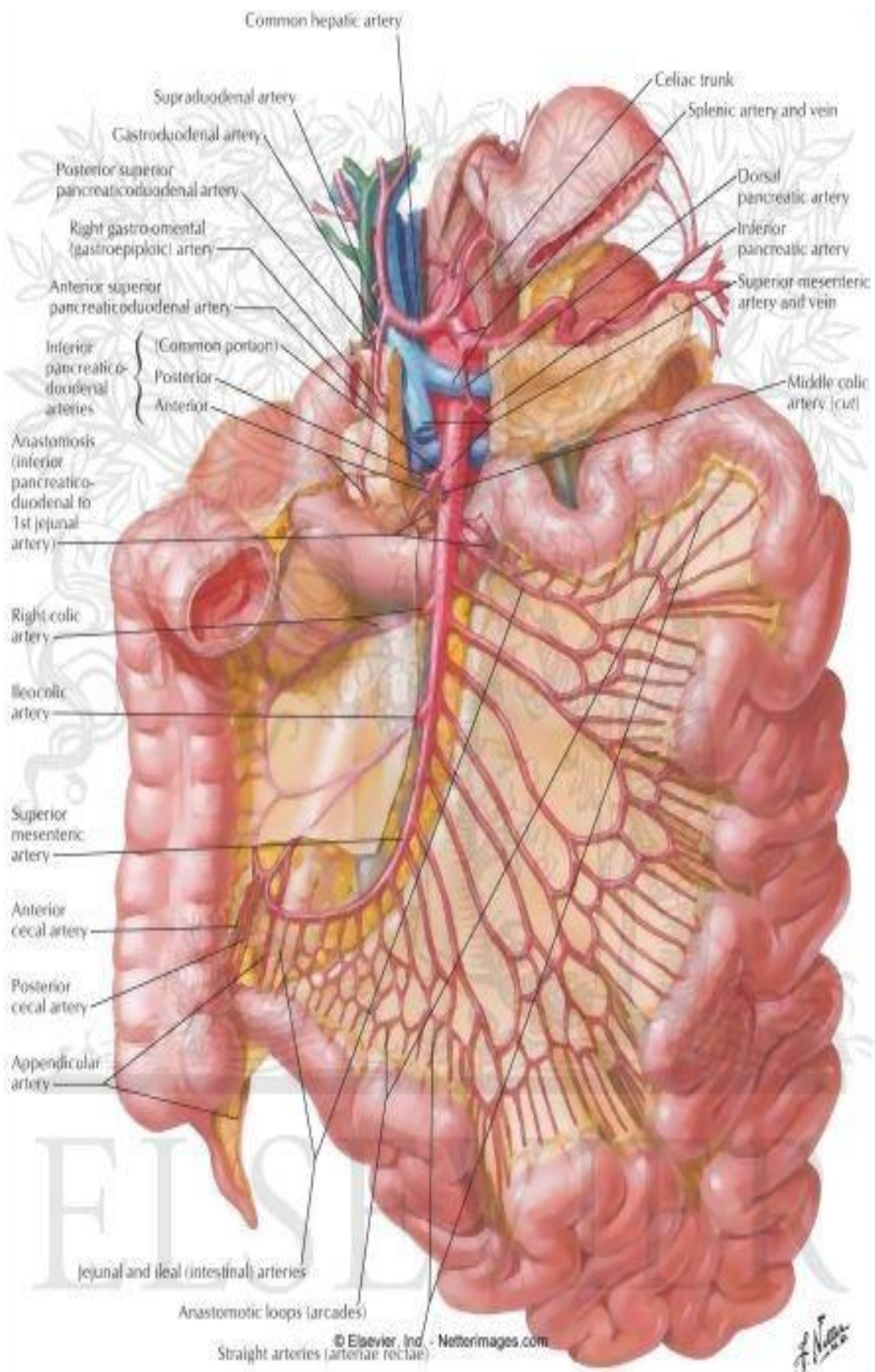


**ARTERY;- “ SUPERIOR MESENTERIC ARTERY”**

**VEIN;- “ HEPATIC PORTAL VEIN”**

**NERVE;- “ CELIAC GANGLIA, VAGUS”**

**LYMPH;- “ INTESTINAL LYMPH TRUNK”**



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“The small intestine (or small bowel) is the part of the gastrointestinal tract following the stomach.

“ Important for digestion and absorption of food takes place. The small intestine is composed of a duodenum, jejunum, and ileum”.

“ It receives bile juice and pancreatic juice through the hepatopancreatic duct, controlled by the sphincter of Oddi”.

“The average length of the small intestine in an adult human male is 6.9 m (22 ft 8 in), and in an adult female 7.1 m (23 ft 4 in)”.

“ It is approximately 2.5–3 cm in diameter”.

“The surface area of the human small intestinal mucosa averages 30 square meter”

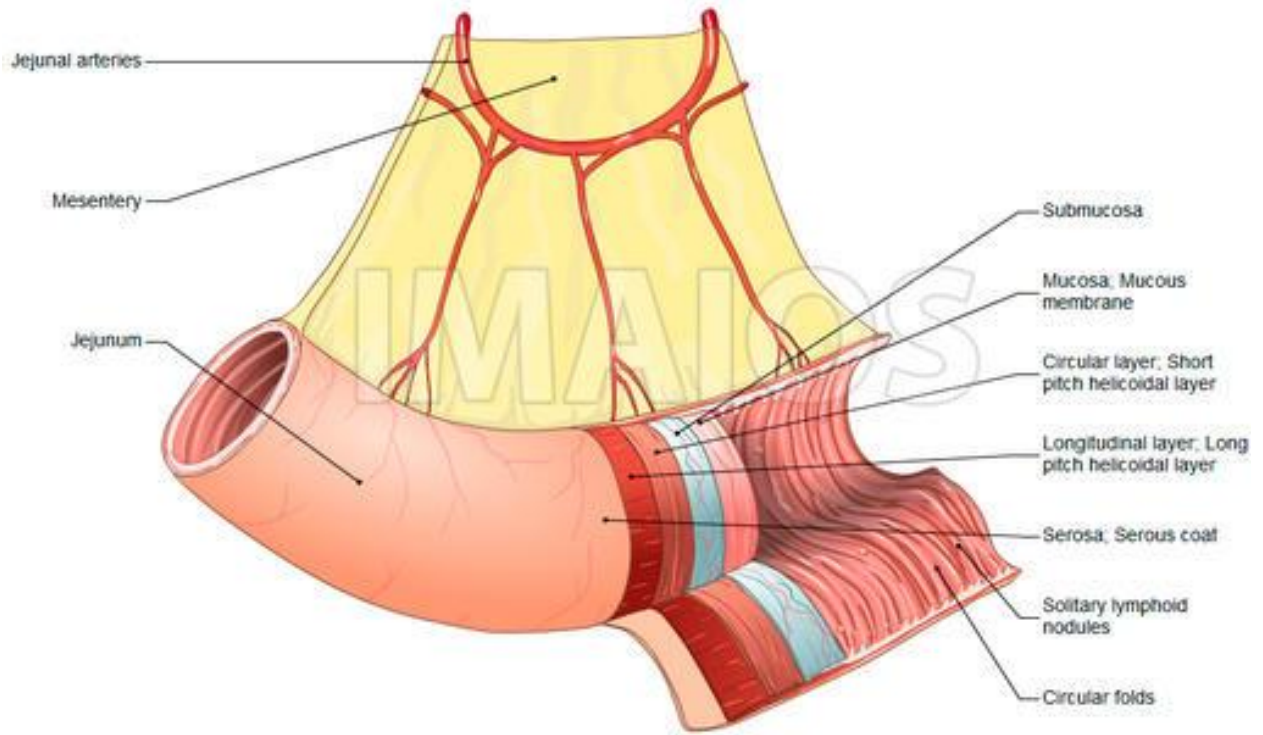
**The small intestine is divided into three structural parts:**

Duodenum

Jejunum

Ileum

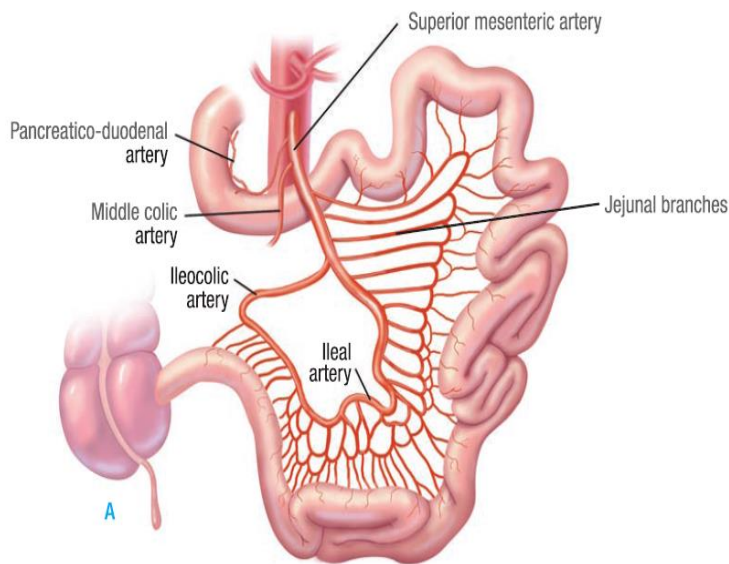
Which is covered by Peritoneum.

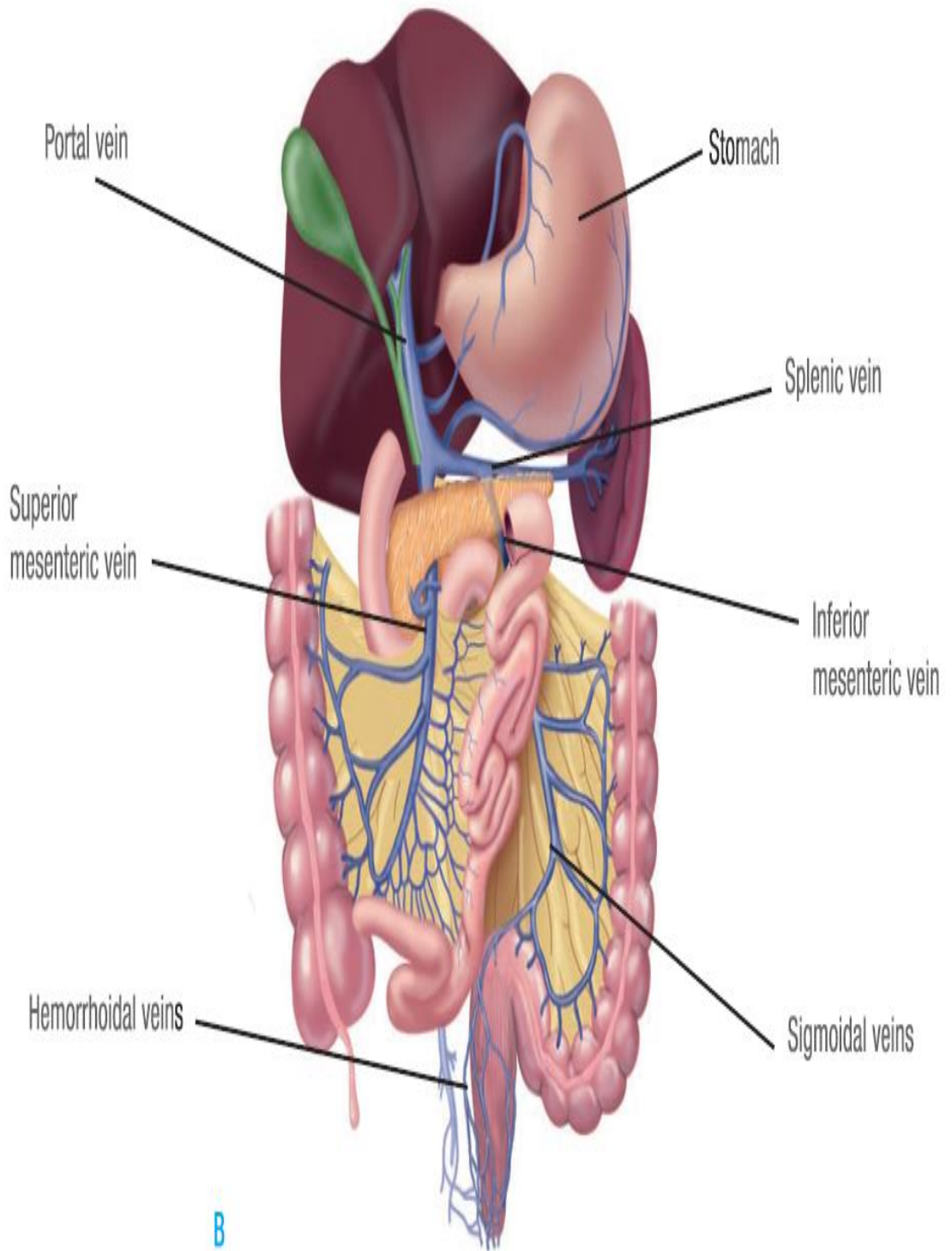


Illustrations: A. Micheau - MD

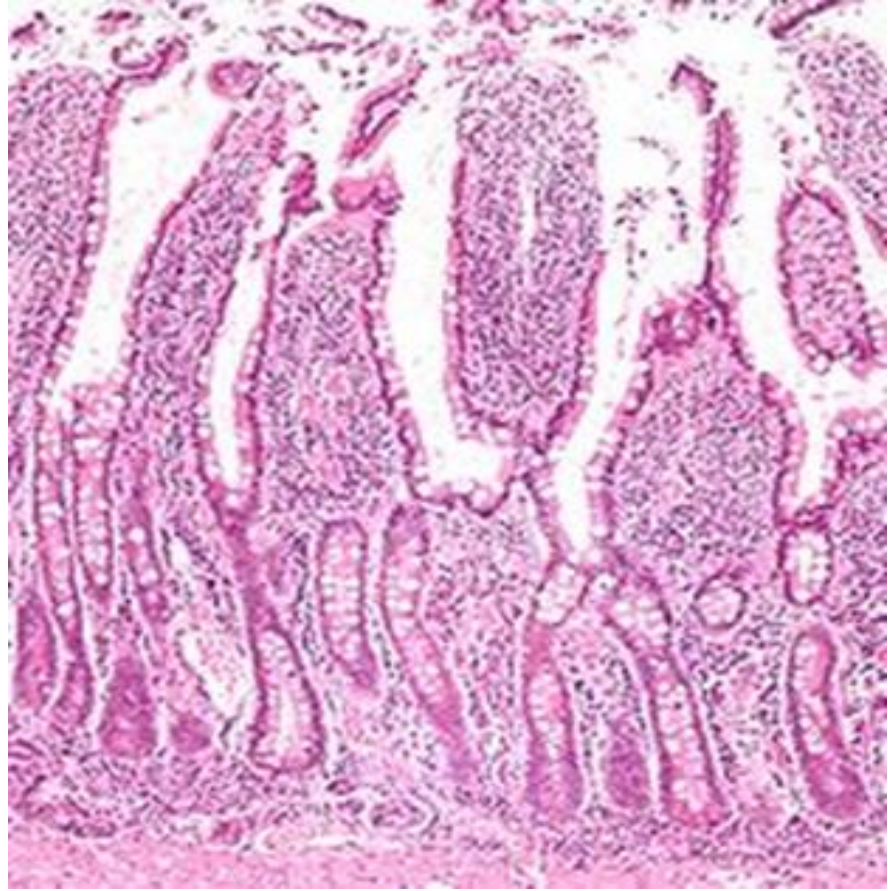
Anatomy

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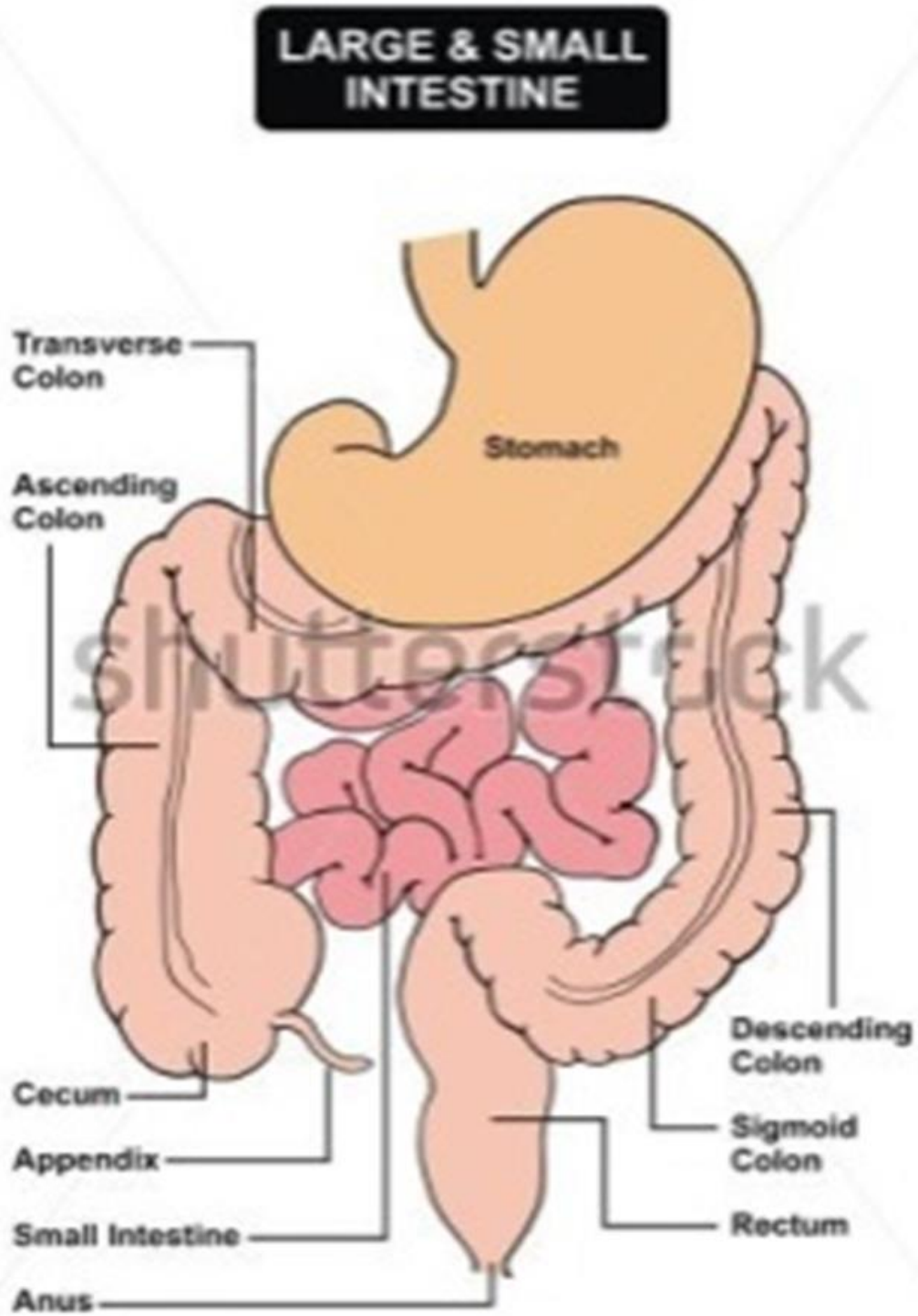


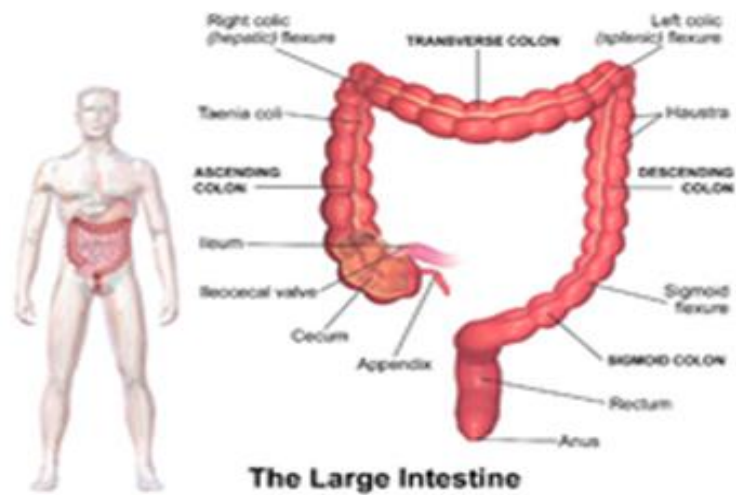




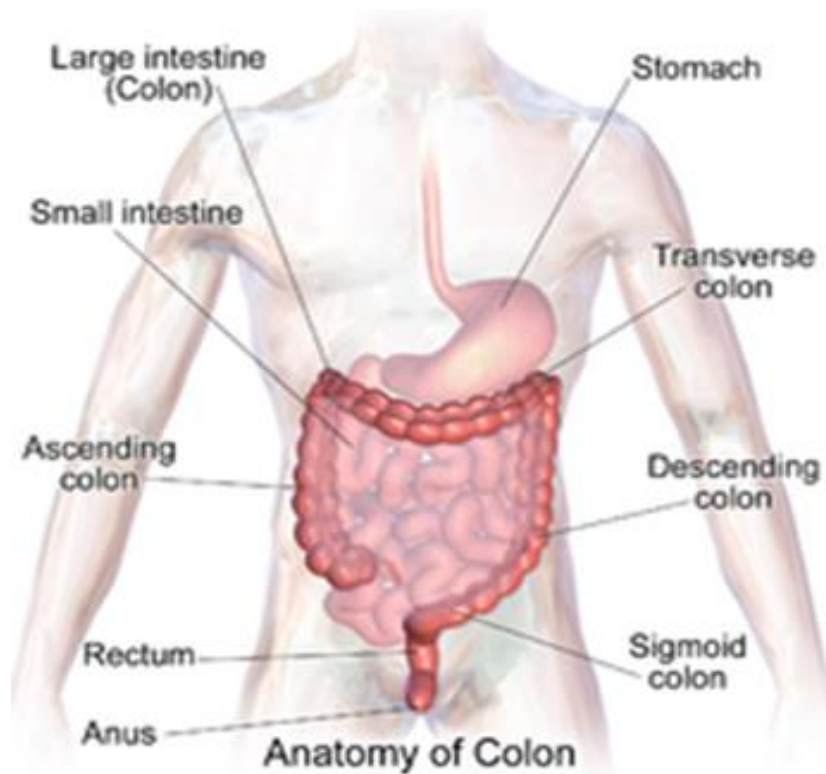
**"HISTOLOGY OF SMALL INTESTINE"**

# LARGE INTESTINE





colon is last part of the digestive system .



## **FOUR PARTS OF COLON:**

“the ascending colon, the transverse colon, the descending colon, and the sigmoid colon (the proximal colon usually refers to the ascending colon and transverse colon)”.

“ The cecum, colon, rectum and anal canal make up the large intestine”.

## **Locations along the colon are:**

The ascending colon

The right colic flexure (hepatic)

The transverse colon

The transverse mesocolon

The left colic flexure (splenic)

The descending colon

The sigmoid colon – the v-shaped region of the large bowel

“The colon are either intraperitoneal or retroperitoneal in the abdominal cavity”.

“Retroperitoneal organs are fixed in location. Intraperitoneal organs are completely surrounded by peritoneum and are therefore mobile”.

“The ascending colon, descending colon and rectum are retroperitoneal”,

“The caecum, appendix, transverse colon and sigmoid colon are intraperitoneal”.

## **ASCENDING COLON**

“This is the first section of the large intestine and is connected to the small intestine by a section of bowel called the cecum. The ascending colon runs through the abdominal cavity, upwards toward the transverse colon for approximately eight inches (20 cm)”.

“The cecum receives the solid wastes of digestion from the ileum via the Ileocecal valve”.

## **TRANSVERSE COLON**

“The transverse colon is the part of the colon from the hepatic flexure to the splenic flexure”.

“The transverse colon is attached to the stomach by a wide band of tissue called the greater omentum”.

“On the posterior side, the transverse colon is connected to the posterior abdominal wall by a mesentery known as the transverse mesocolon”.

“The transverse colon is encased in peritoneum, and is therefore mobile”.

“The proximal two-thirds of the transverse colon is perfused by the middle colic artery, a branch of SMA, while the latter third is supplied by branches of the IMA. The "watershed" area between these two blood supplies, which represents the embryologic division between the midgut and hindgut, is an area sensitive to ischemia”.

## **DESCENDING COLON**

“The descending colon is the part of the colon from the splenic flexure to the beginning of the sigmoid colon”.

“It is retroperitoneal in two-thirds of humans. In the other third, it has a usually short mesentery”.

“The arterial supply comes via the left colic artery”.

## **SIGMOID COLON.**

“The name sigmoid means S-shaped”.

“The sigmoid colon is the part of the large intestine after the descending colon and before the rectum”.

“The walls of the sigmoid colon are muscular, and contract to increase the pressure inside the colon, causing the stool to move into the rectum”.

“The sigmoid colon is supplied with blood from several branches (usually between 2 and 6) of the sigmoid arteries, a branch of the IMA. The IMA terminates as the superior rectal artery”.

“Sigmoidoscopy is a common diagnostic technique used to examine the sigmoid colon”.

“Cecum – the first part of the large intestine”

“Taeniae coli – three bands of smooth muscle”

“Haustra – bulges caused by contraction of taeniae coli”

“Epiploic appendages – small fat accumulations on the viscera”

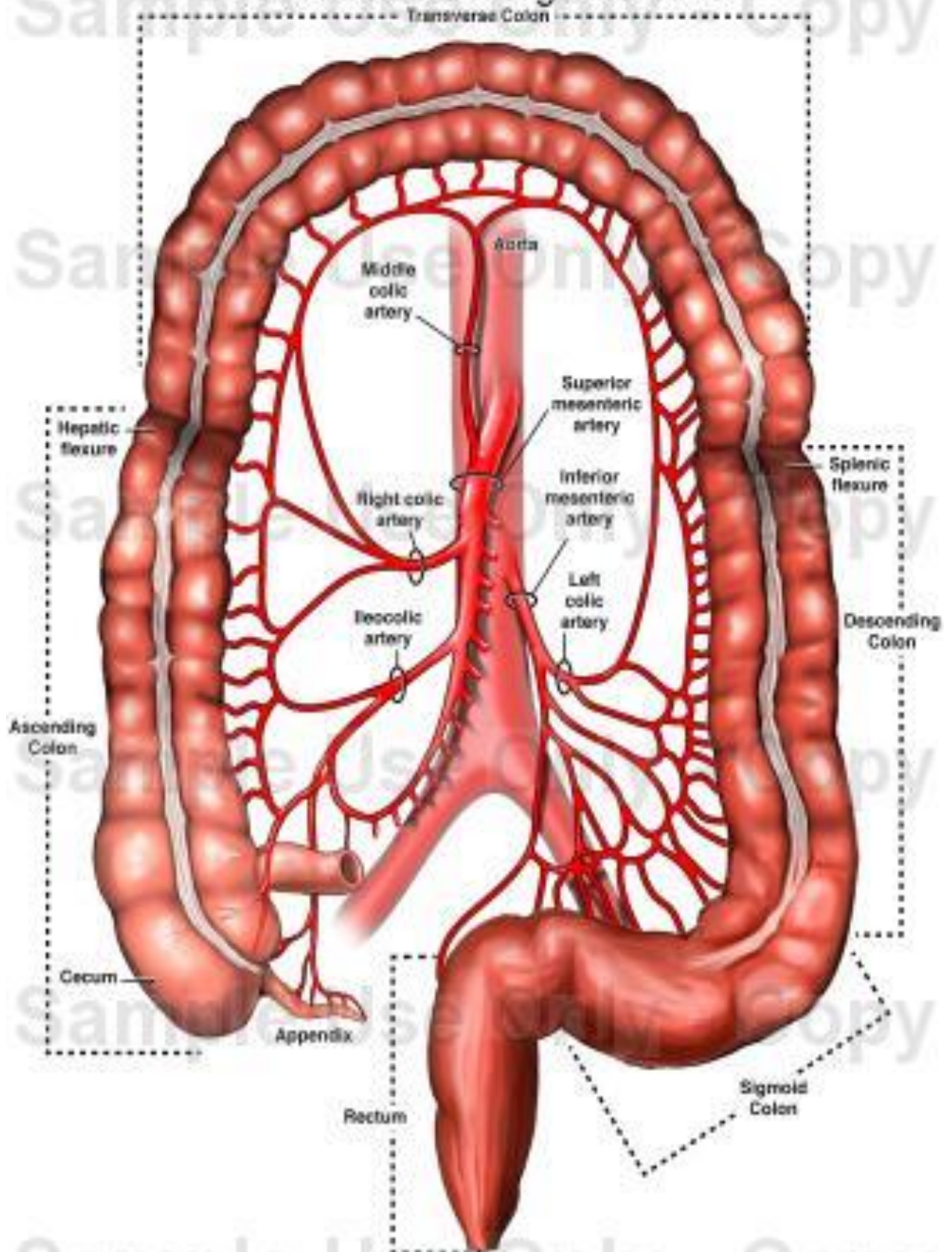
“The taenia coli run the length of the large intestine. Because the taenia coli are shorter than the large bowel itself, the colon becomes sacculated, forming the haustra of the colon which are the shelf-like intraluminal projections”.



**BLOOD**

**SUPPLY**

### Vasculature of Large Intestine





Arterial supply to the colon comes from branches of the

“superior mesenteric artery (SMA)”.

“inferior mesenteric artery (IMA)”.

“Venous drainage usually mirrors colonic arterial supply, with the inferior mesenteric vein draining into the splenic vein, and the superior mesenteric vein joining the splenic vein to form the hepatic portal vein that then enters the liver”.

## **LYMPHATIC DRAINAGE**

“Lymphatic drainage from the entire colon and proximal two-thirds of the rectum is to the paraaortic lymph nodes that then drain into the cisterna chyli. The lymph from the remaining rectum and anus can either follow the same route, or drain to the internal iliac and superficial inguinal nodes. The pectinate line only roughly marks this transition”.

## **GASTROINTESTINAL ANASTOMOSIS**

“For proper GI anastomosis accurate approximation of the bowel lumen without much tension on anastomotic site and with an adequate and good blood supply is fundamental”.

“Anastomotic leak with failure of anastomosis is still a common problem for surgeons. Failure rates range from 1.5% - 2.2%”

“It depends on the type of anastomosis performed and whether the procedure was an elective or an emergency.”

“Anastomotic leaks are associated with high morbidity and a 10 fold rise in mortality. It causes increase in the duration of the hospital stay”.

### **“PRINCIPLES OF SUCCESSFUL INTESTINAL ANASTOMOSIS”**

“Well-nourished patient with no systemic illness”

“No fecal contamination, within the gut”

“Adequate exposure and access”

“Well-vascularized tissues”

“Absence of tension at the anastomosis”

“Meticulous technique”.

# GASTRO INTESTINAL ANASTOMOTIC HEALING

## BOWEL WALL ANATOMY;

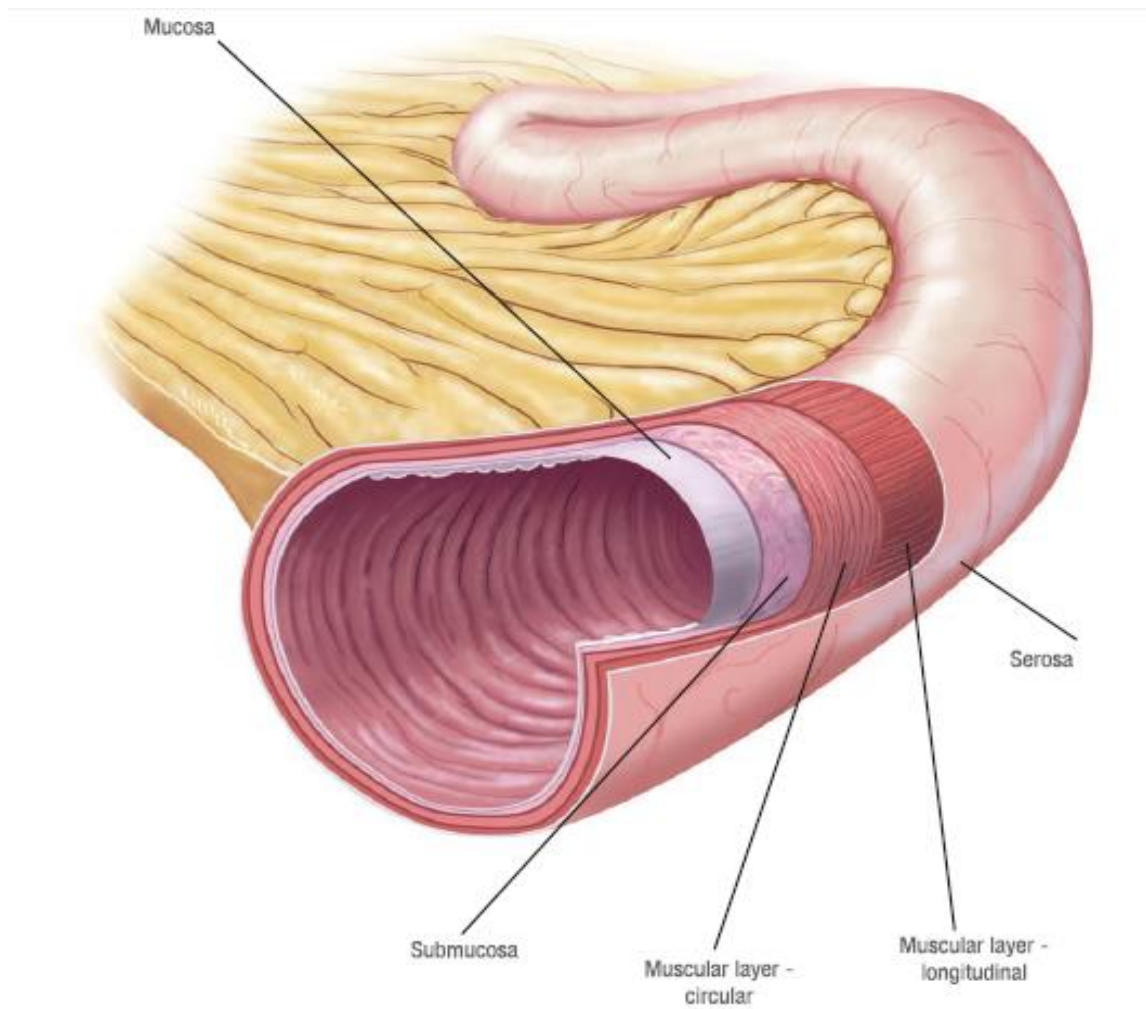
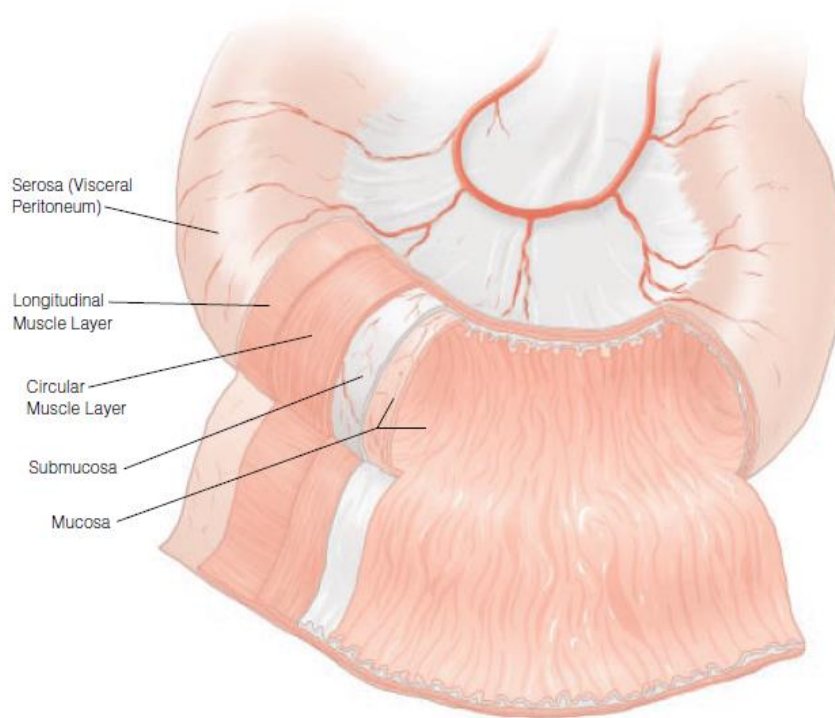


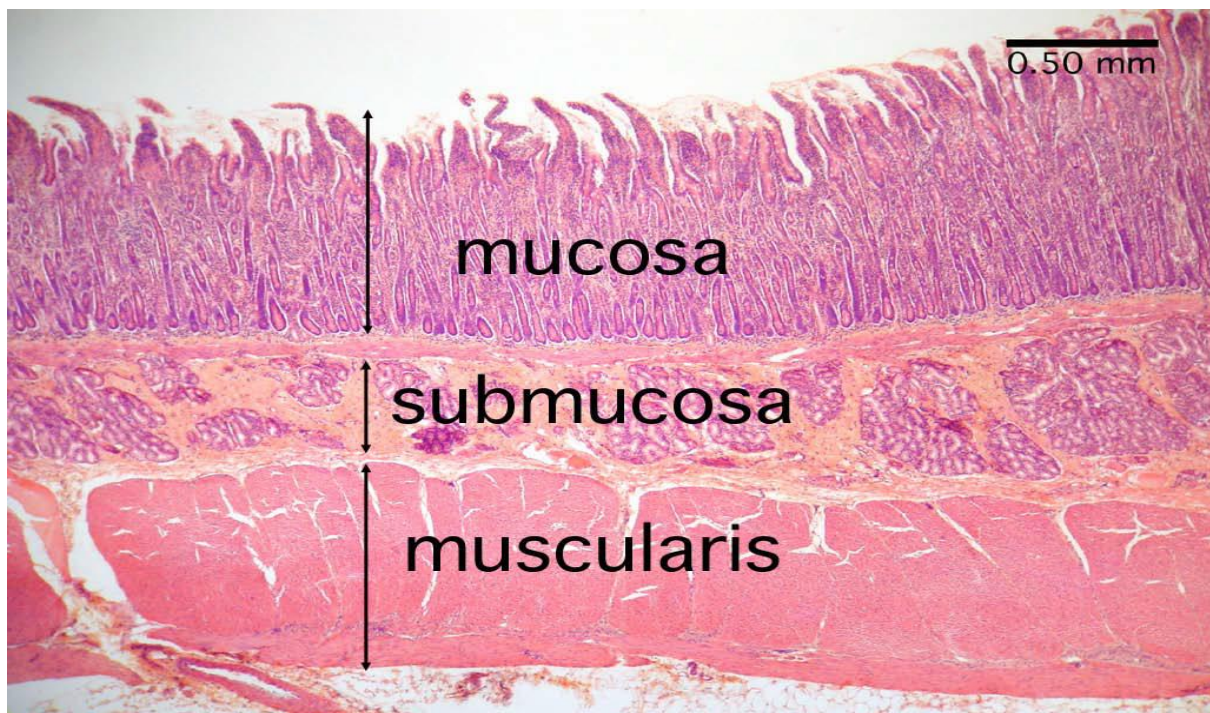
Figure 4-1 Bowel wall anatomy.



1. “Submucosa of the bowel provides most of the strength to the bowel wall”.
2. “Serosa of the bowel lumen holds the suture better than muscular layer”.
3. “Absence of serosal layer in thoracic part of oesophagus and the rectum causes the anastomotic suturing of this part, very difficult than other parts of the bowel”.
4. “Additionally the oesophagus and large intestine have lesser blood supply than stomach and small intestine which tends to heal more readily”.

5. “Submucosal layer contains high content of collagen fibers which provides the the tensile strength of the bowel”.

6. “Intestinal wall strength is determined by collagen fibers in the submucosal layer”.



### **Healing Phases;**

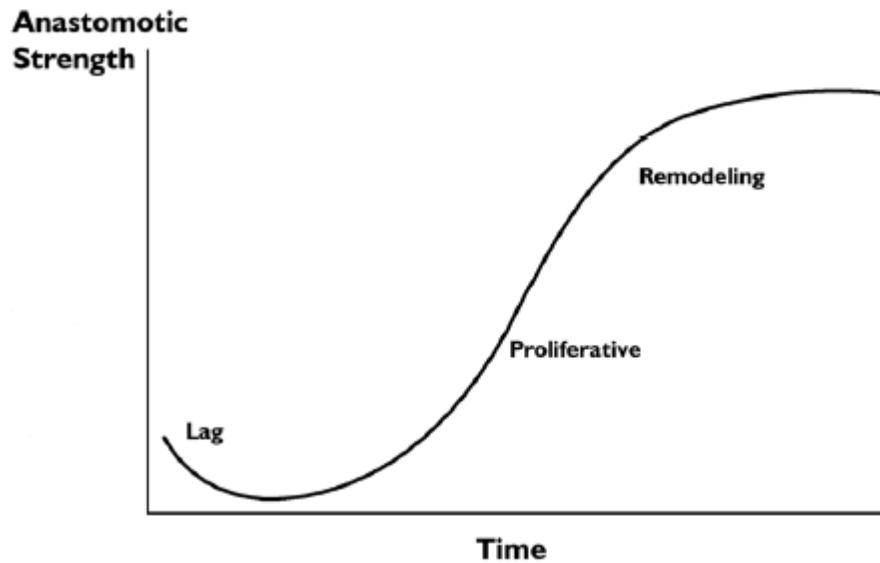
#### **Acute inflammatory “lag” phase**

Neutrophils and macrophages

#### **Proliferative phase**

Fibroblast – collagen synthesis in EC matrix

#### **Remodeling/maturation phase.**



7. “The overall strength of the scar tissue determined by maturity of the collagen fibers which is related to the degree of fiber and fibril cross-linking”.

8. “The strength of the anastomosis is measured by bursting pressure. This pressure tends to raise throughout the postoperative period reaching 60% by 3<sup>rd</sup> to 4<sup>th</sup> postoperative period and reaching 100% by one week”.



## **“Principles of Successful Intestinal Anastomosis”**

### **“Technical Factors”**

“Adequate blood supply”

“Tension-free”

“Minimize contamination”

“Meticulous technique”

### **“Patient-Related Factors”**

“Malnourished”

“Chronic steroid use”

“Diabetes mellitus”

“Malignancy, prior chemoradiation”

“Hypotension/Shock”

“Emergency surgery”

## **“Technical Options for Fashioning Anastomoses”**

### **“SUTURING: TECHNICAL ISSUES”**

#### **“Placement of Sutures”**

##### **“Interrupted sutures”;**

“refer to placement of single sutures that are passed through tissue and tied individually. The needle should be inserted at right angles to the tissue, pass through both aspects of the tissue to be approximated, and exit at right angles. In passing the needle in on one side and on removing it from the opposite side, it is important to follow the curve of the needle as the needle passes through the tissue. If the wrist is malpositioned, rather than smoothly following the arc of the needle, the needle will be dragged through the tissue. This should be avoided because it tends to tear tissue and can bend the needle if the tissue is resistant. The distance from the entry point to the edge of the wound should be approximately equal to the thickness of the tissue being sutured, and the distance between successive sutures should be approximately double the thickness of the tissues. Distance between sutures should be uniform”.

**“Continuous sutures”;**

“ are inserted in an identical manner to interrupted sutures for the initial (anchoring) suture, but after tying the first suture, the rest of the sutures are inserted at a 45° angle in a continuous manner until the far end of the wound is reached, where the suture is tied. An assistant must follow the suture, maintaining the correct tension along the wound. If this does not occur, there is a risk of purse-stringing the suture (by pulling the closure too tight) or of leaving the suture line with gaps, which may lead to wound complication, including separation or dehiscence”.

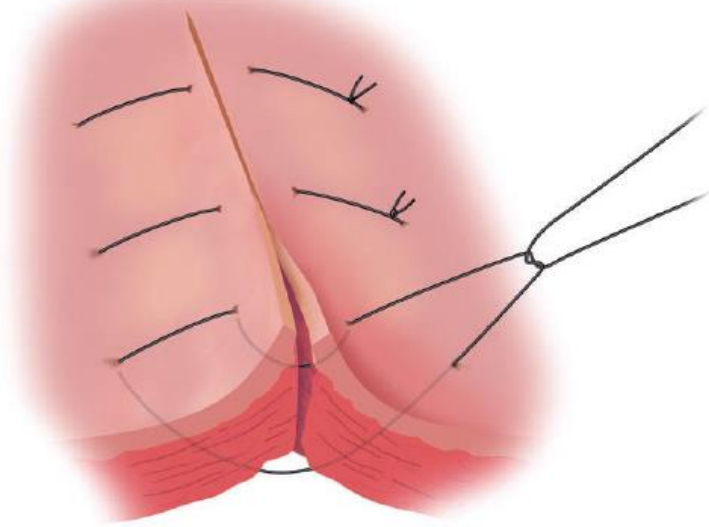


Figure 4-3, A Vertical mattress sutures.

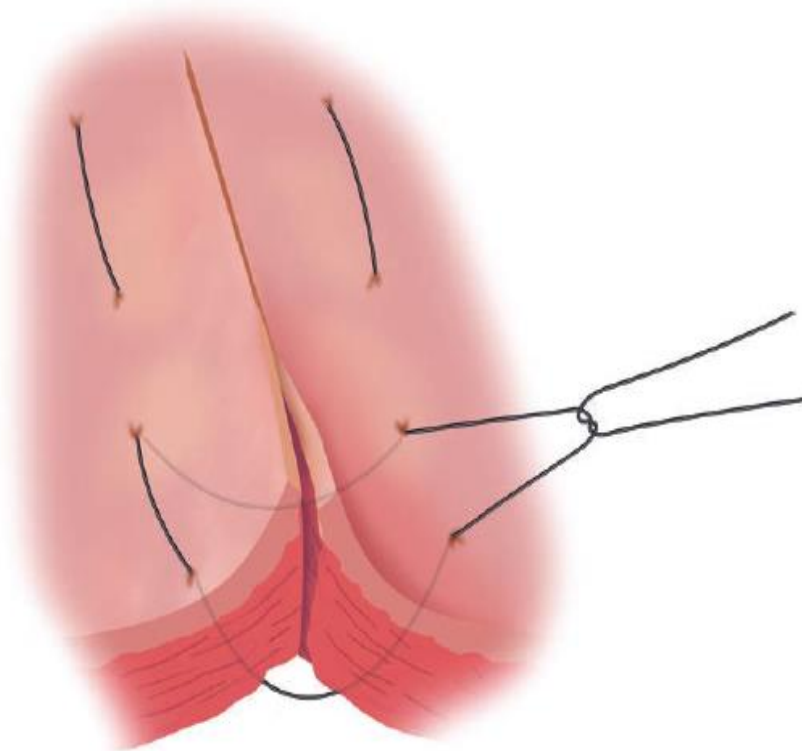


Figure 4-3, B Horizontal mattress sutures.

## **“Choice of Suture Material”**

1. “Suturing materials used for anastomosis is foreign body to anastomosis which produces an inflammatory reaction to bowel lumen”.

2. “The relative efficiency of absorbable and non absorbable suture material concluded that the strength of the anastomosis”.

3. “which is expressed as a percentage of normal tissue strength”.

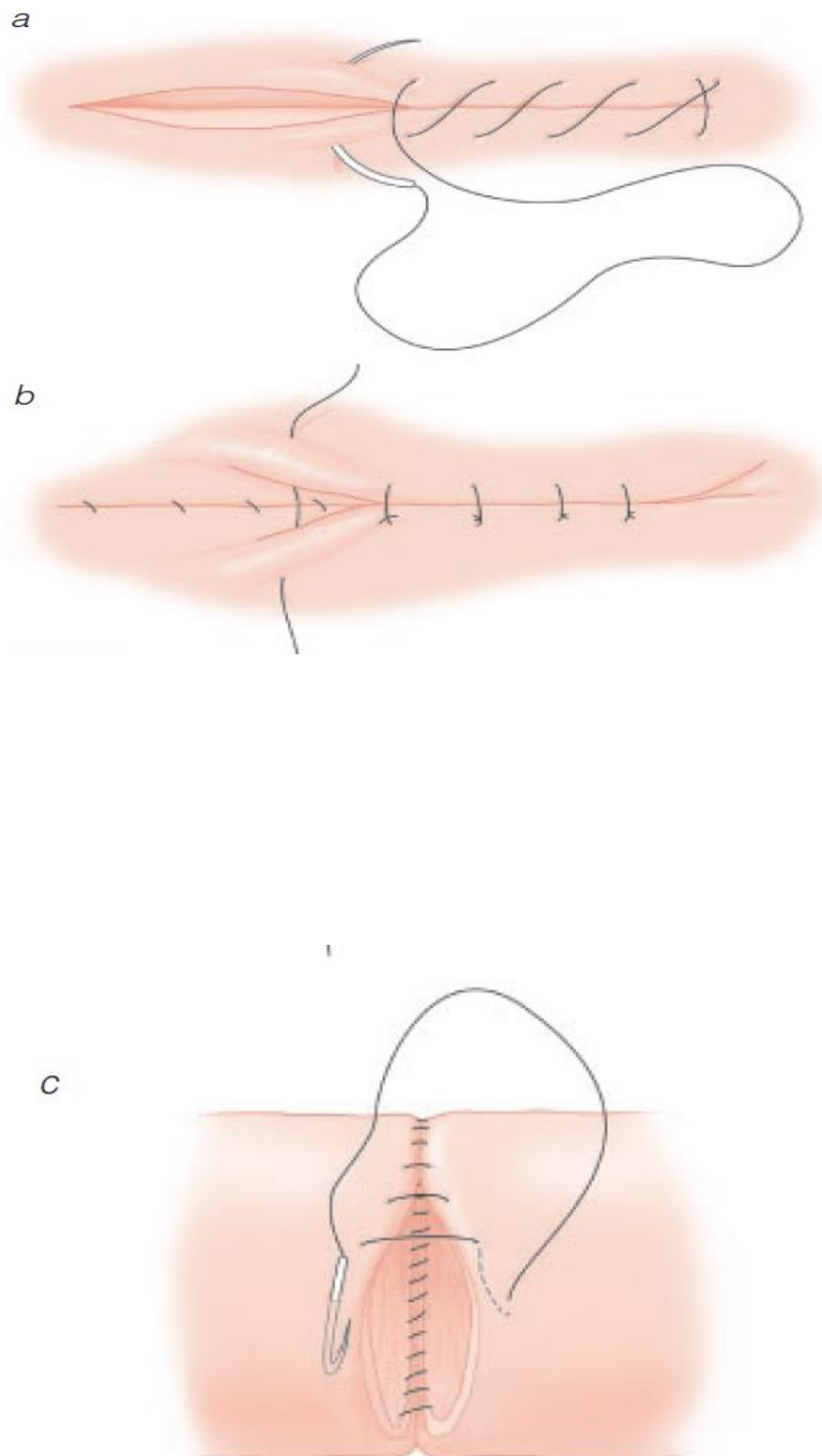
## **“The ideal suture material”:—**

1. “Ideal suture material is the material does not produce inflammatory tissue reaction and provides maximum strength to the anastomosis in the lag phase of the wound healing”.

2. “monofilament > multifilament”

3. “ideal suture material is not yet discovered till now. which is always surgeons preference”.

## “Continuous versus Interrupted Sutures”



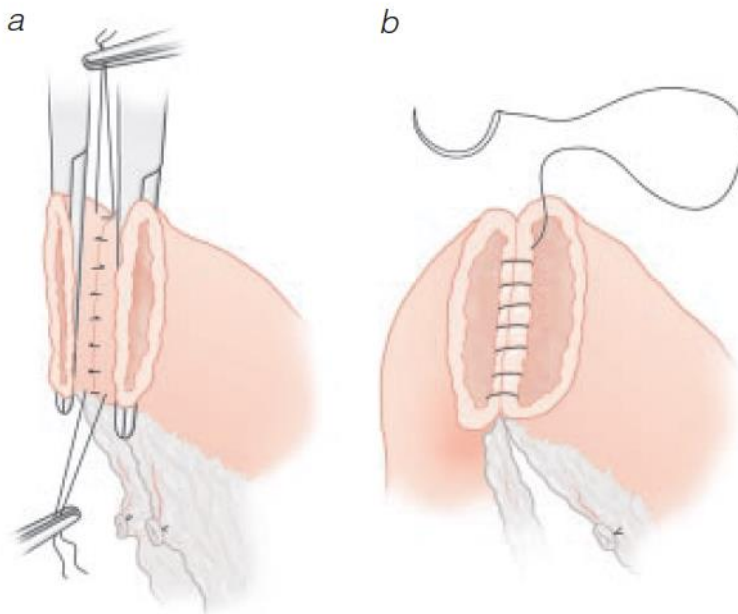
**Figure 2** Shown are stitches commonly used in fashioning intestinal anastomoses: (a) the continuous over-and-over suture, (b) the interrupted Lembert suture, and (c) the Connell suture.

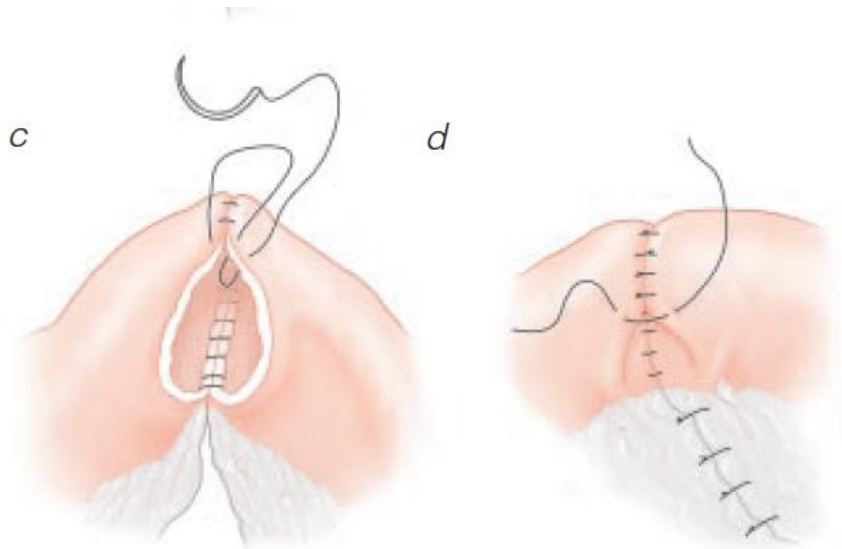
## “Single-Layer versus Double-Layer Anastomoses”

“Regarding GI anastomosis double layer anastomosis was 1<sup>st</sup> described procedure”.

“In double layer anastomosis inner layer is continuous or interrupted suture using absorbable suture material”.

“ outer layer is interrupted using weather absorbable or non absorbable suture material”.





**Figure 3** Double-layer end-to-end anastomosis. (a) Interrupted Lembert stitches are used to form the posterior outer layer. (b) A full-thickness continuous over-and-over stitch is used to form the posterior inner layer. (c) A Connell stitch is used to form the anterior inner layer. (d) Interrupted Lembert stitches are used to form the anterior outer layer.

1. “Initially double layer anastomosis is consider to be safe for healing process”
2. “But microscopic pathological observation shows microscopic area of necrosis sloughing out anastomotic tissues are noted”.
3. “Later single layer anastomosis was developed.which results in very good out come compare with double layer anastomosis”.
4. “the out come measured by post op return of bowel function by passing flatus,hearing bowel sound and starting oral fluids”.



5. “the choice of single or double layer anastomosis depends surgeons preference. Non of the study shows which is better”.

6. “in case of friable tissue and edematous tissue double layer without tension suturing is preferred”.

### **“Development of Surgical Stapling Devices”**

**“Early Development;** In 1826, Henroz, a Belgian surgeon, invented a device made from two rings that allowed the surgeon to approximate everting tissues from two bowel segments”.

“In 1892, John B. Murphy from Chicago, Illinois, developed a mechanical device for gastrointestinal anastomoses”.

“It took the form of an anastomotic ring and was intended to create cholecystoduodenostomy”.

“It came to be known as the “Murphy button.” This device became very popular and was subsequently used for both bowel and gastric anastomosis. Murphy proved that it was possible to create a mechanical device to perform an anastomosis; however, his vision for mechanical stapling clashed with the rising popularity of sutures, which were becoming more reliable and more popular”.



Linear stapler



Contour curved cutting stapler

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**Figure 6-7** Linear staplers and cartridges used in anastomosis.



Courtesy Ethicon Endo-Surgery, Inc.



**Figure 6-8** Linear cutting stapler.

## **“STAPLING:TECHNICAL ISSUES”**

### **“Choice of Stapler”**

“The modern Surgical stapling devices were first introduced in 1908 by Hüttl”;

“The surgical practice was dramatically changed for the past 25 years due to development of this reliable and disposable staplers”.

### **“THREE DIFFERENT TYPES OF STAPLER USED FOR GASTROINTESTINAL ANASTOMOSES.”**

“ **The transverse anastomosis (TA) stapler** is the simplest of these. This device places two staggered rows of B-shaped staples across the bowel but does not cut it: the bowel must then be divided in a separate step”.

“**The gastrointestinal anastomosis (GIA) stapler** places two double staggered rows of staples and simultaneously cuts between the double rows”.

“**The circular, or end-to-end anastomosis (EEA), stapler** places a double row of staples in a circle and then cuts out the tissue within the circle of staples with a built-in cylindrical knife. All of these staplers are available in a range of lengths or diameters”.

“Staplers may be used to create functional or true anatomic end-to-end anastomoses as well as side-to-side anastomoses”.

“The staples themselves are all made of titanium, which causes little tissue reaction”.

“They are not magnetic and do not cause subsequent difficulties with MRI scanning”.

**“In a functional end-to-end anastomosis**, two cut ends of bowel (either open or stapled closed) are placed side by side with their blind ends beside each other. If the bowel ends are closed, an enterotomy must be made in each loop of bowel to allow insertion of the stapler”.

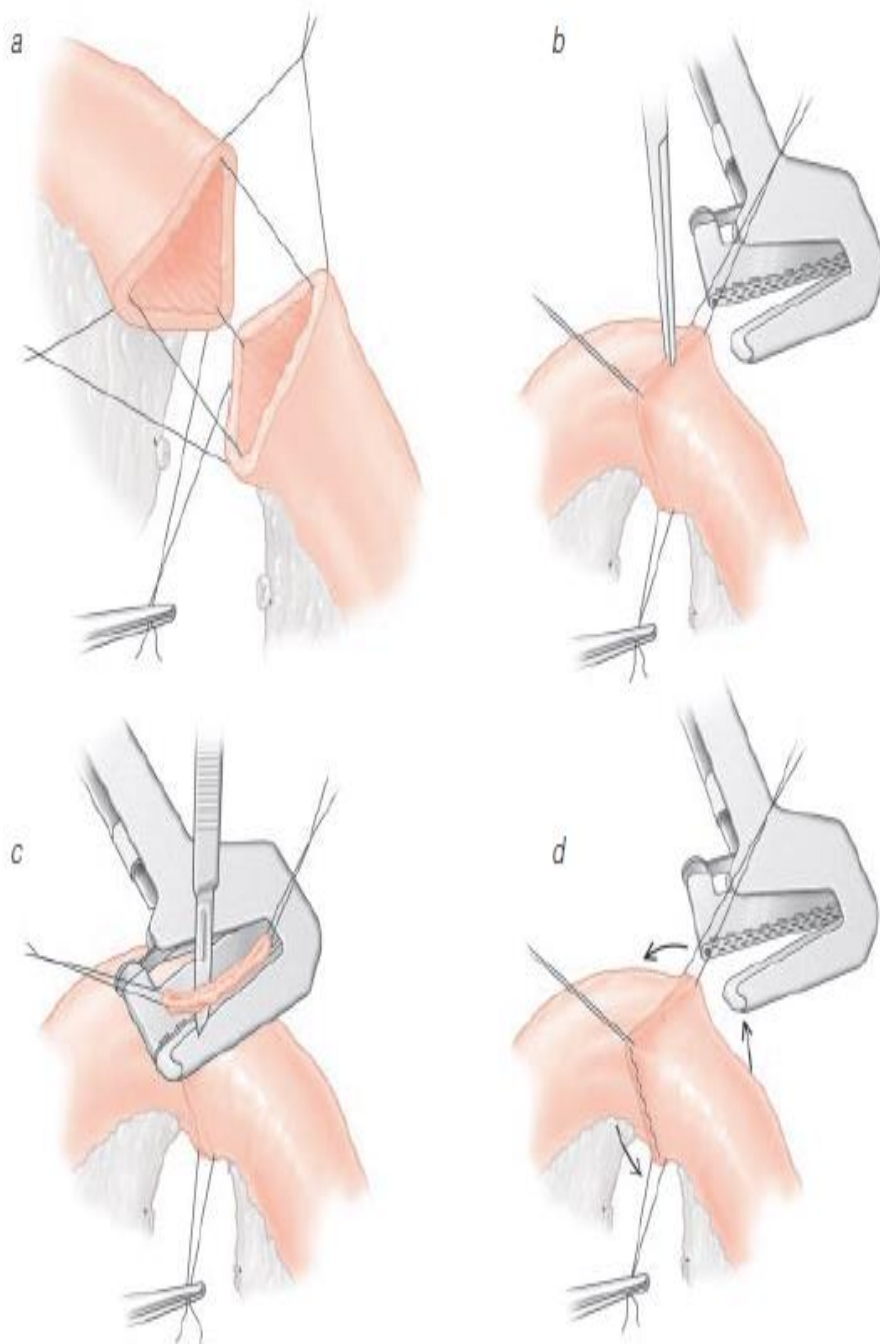
“A cutting linear (GIA) stapler is then used to fuse the two bowel walls into a single septum with two double staggered rows of staples and to create a lumen between the two bowel segments by dividing this septum between the rows”.

“A noncutting linear (TA) stapler is then used to close the defect at the apex of the anastomosis where the GIA stapler was inserted. An alternative, and cheaper, method of closing the defect is to use a continuous suture. The cut and stapled edges of the bowel should be inspected for adequacy of hemostasis before the apex is closed”.

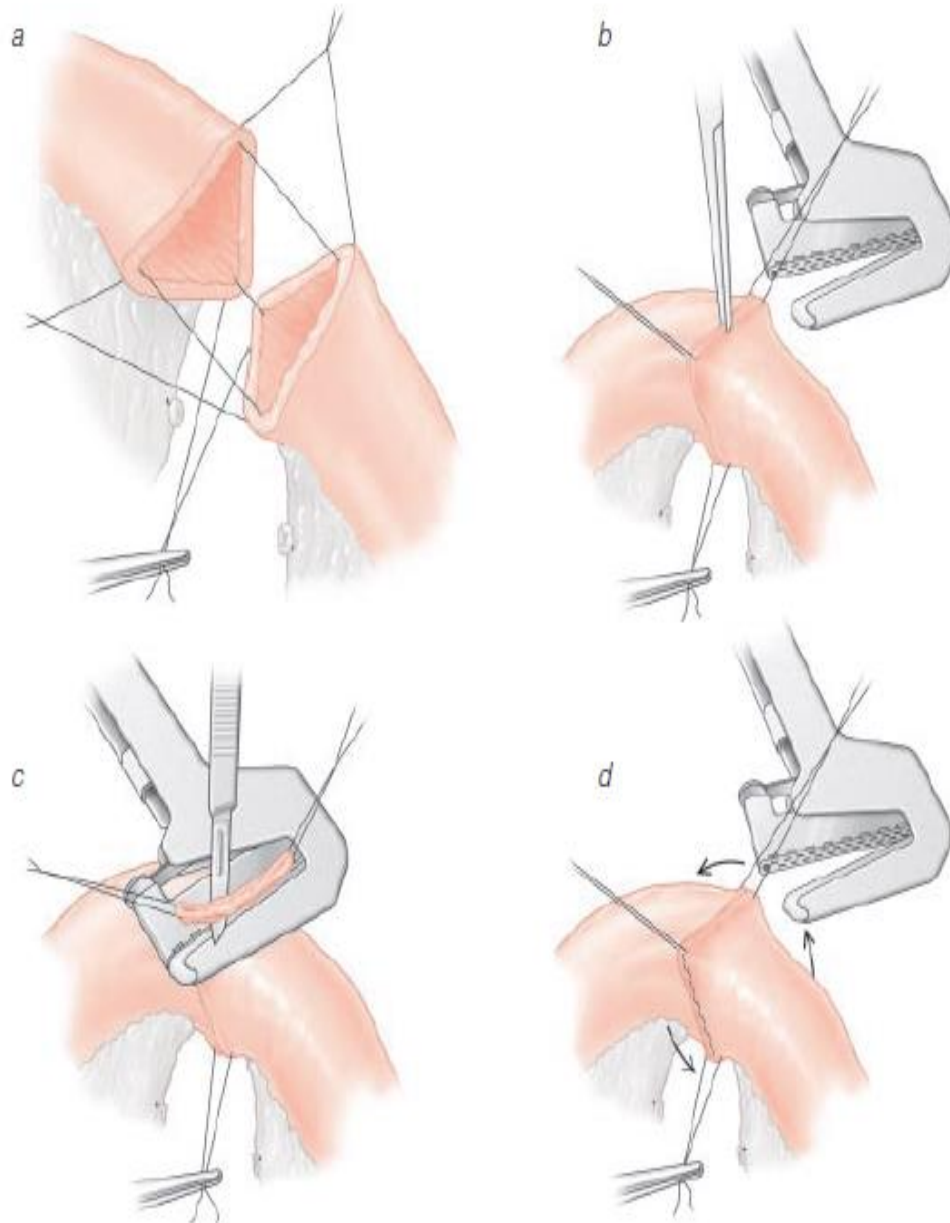
“True anatomic end-to-end stapled anastomoses may be fashioned with a linear stapler by triangulating the two cut ends and then firing the stapler three times in intersecting vectors to achieve complete closure”.

“ The potential drawback of this approach is that the staple lines are all everted. It is often easier to join two cut ends of bowel with an EEA stapler, which creates a directly apposed, inverted, stapled end-to-end anastomosis”.

“ The circular staplers can be more difficult to use at times because of the need to invert a complete circle of full-thickness bowel wall. In addition—at least at locations other than the anus— they typically require closure of an adjacent enterotomy”.



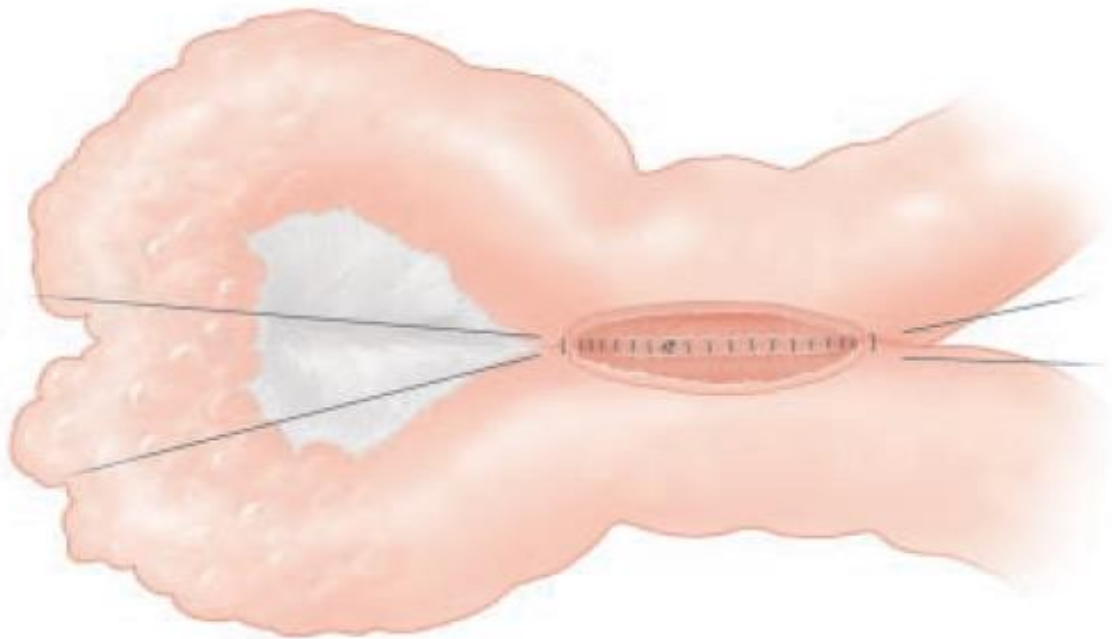
**Figure 4** End-to-end anastomosis with linear noncutting stapler. (a) The bowel ends are triangulated with three traction sutures. (b) A noncutting linear stapler (TA) is placed between two of the sutures. (c) The stapler is closed and the excess tissue excised. (d) The bowel is rotated, and steps b and c are repeated twice more to close the remaining two sides of the triangle.



**Figure 4** End-to-end anastomosis with linear noncutting stapler. (a) The bowel ends are triangulated with three traction sutures. (b) A noncutting linear stapler (TA) is placed between two of the sutures. (c) The stapler is closed and the excess tissue excised. (d) The bowel is rotated, and steps b and c are repeated twice more to close the remaining two sides of the triangle.

## “OPERATIVE TECHNIQUES FOR SELECTED ANASTOMOSES”

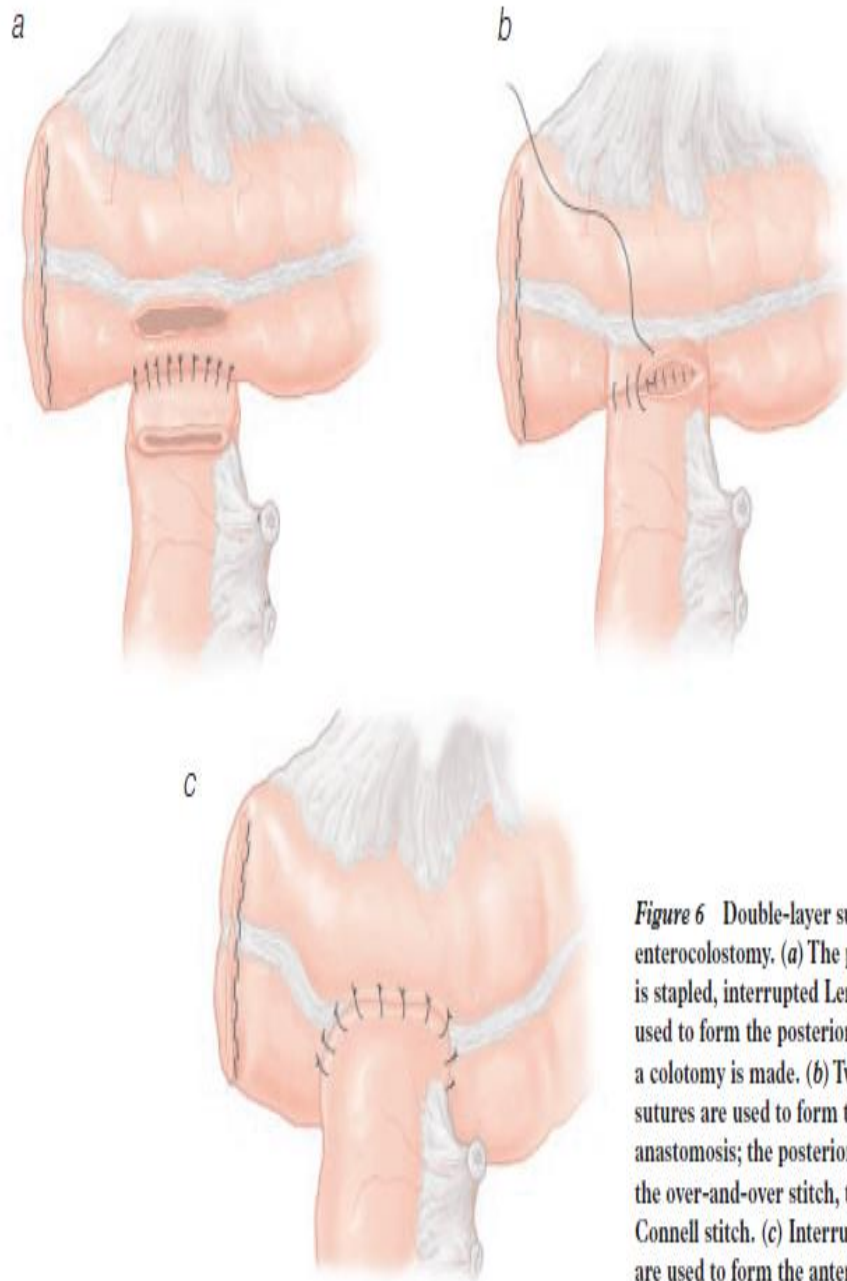
### “SINGLE-LAYER SUTURED EXTRAMUCOSAL SIDE-TO-SIDE ENTEROENTEROSTOMY”



**Figure 5** Single-layer sutured extramucosal side-to-side enteroenterostomy. A full-length suture is started in the back wall and run through the seromuscular and submucosal layers in the direction of the surgeon; the corners of the enterotomy are approximated with a baseball stitch, and a single Connell stitch is used to invert the anterior layer. A second suture is started at the same spot on the posterior wall and run in the opposite direction, again through all layers except the mucosa; the corners of the enterotomies are approximated with a baseball stitch, and the suture is continued in either the Connell stitch or the over-and-over stitch to complete the anterior wall of the anastomosis.



## “DOUBLE-LAYER SUTURED END-TO-SIDE ENTEROCOLOSTOMY”



**Figure 6** Double-layer sutured end-to-side enterocolostomy. (a) The proximal bowel end is stapled, interrupted Lembert stitches are used to form the posterior outer layer, and a colotomy is made. (b) Two continuous sutures are used to form the inner layer of the anastomosis; the posterior portion is done with the over-and-over stitch, the anterior with the Connell stitch. (c) Interrupted Lembert stitches are used to form the anterior outer layer.

## **“DOUBLE-LAYER SUTURED END-TO-SIDE ENTEROCOLOSTOMY”**

1. “Proximal bowel end is stapled and separated”.
2. “Posterior outer layer sutured with interrupted lambert stitch”
3. “Colotomy is made on distal colon by using electrocautery”.
4. “Two continuous suture are used to form the inner layer of the anastomosis”.
5. “The posterior part I done with the over-and-over stitch and the anterior part is with Connell stitch”.
6. “Anterior outer layer is formed with using the interrupted lambert stitches”.

## **“DOUBLE-STAPLED                      END-TO-END                      COLOANAL ANASTOMOSIS”**

“The circular EEA stapler comes with both a standard anvil and a trocar attachment”.

“The rectal stump is closed with an angled linear non cutting stapler”.

“A purse-string suture is placed around the colotomy”

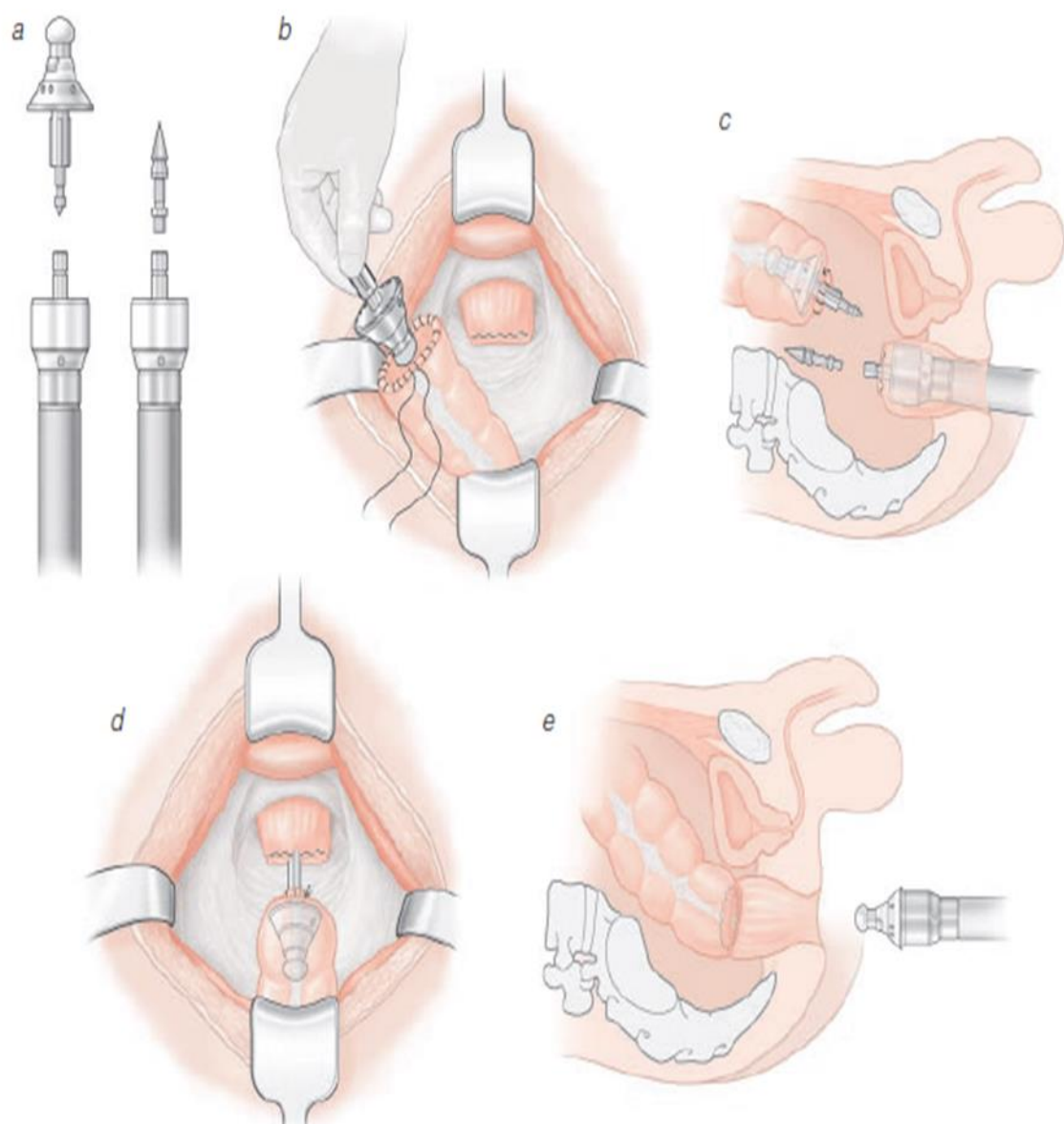
“The anvil of the stapler is placed in the open end and secured”.

“The stapler, with the harp trocar attachment is in place, is inserted into the anus”.

“The trocar is made into pierce the rectal stump at or near the staple line.after which the trocar is removed”.

“The anvil in the proximal colon is joined with the stapler in the rectal stump”.

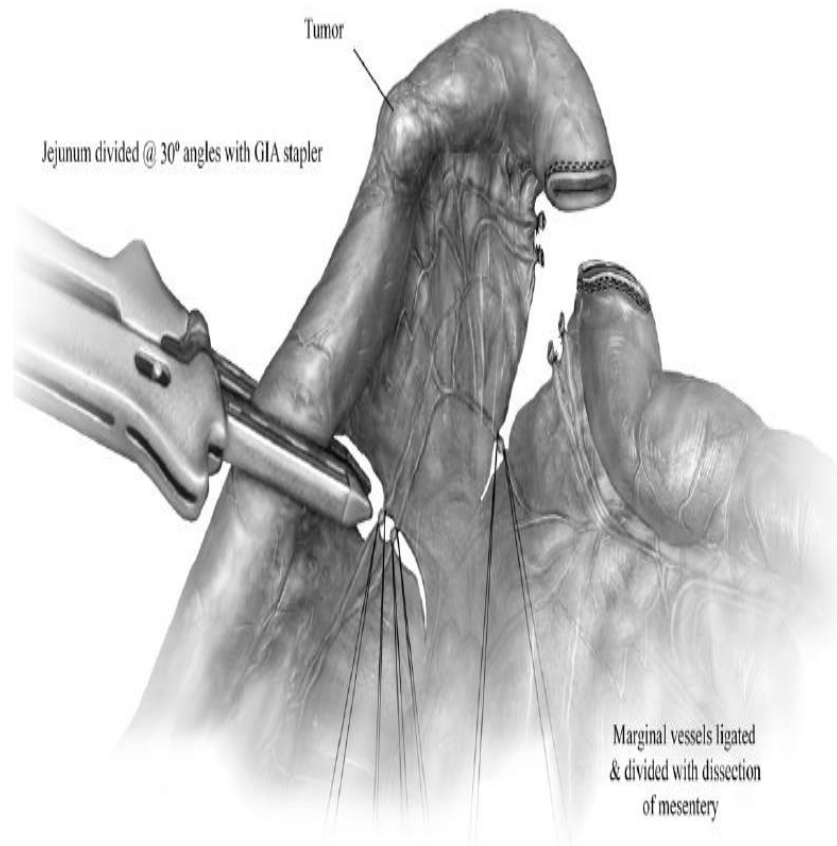
“Both the edges of the bowel brought together and the stapler is fired and then gently released”.



**Figure 7** Double-stapled end-to-end coloanal anastomosis. (a) The C-EEA stapler comes with both a standard anvil (left) and a trocar attachment (right). (b) The rectal stump is closed with an angled linear noncutting stapler. A purse-string suture is placed around the colotomy, and the anvil of the stapler is placed in the open end and secured. (c) The stapler, with the sharp trocar attachment in place, is inserted into the anus, and the trocar is made to pierce the rectal stump at or near the staple line, after which the trocar is removed. (d) The anvil in the proximal colon is joined with the stapler in the rectal stump, and the two edges are slowly brought together. (e) The stapler is fired and then gently withdrawn.

---

## Operative Technique



## SMALL BOWEL RESECTION

## OPERATIVE TECHNIQUE;

“The segment of diseased small bowel is transected by using GIA staplers”

“Make an window in the mesentery of the small bowel, here important point is window should be as close as mesenteric aspect of the bowel”.

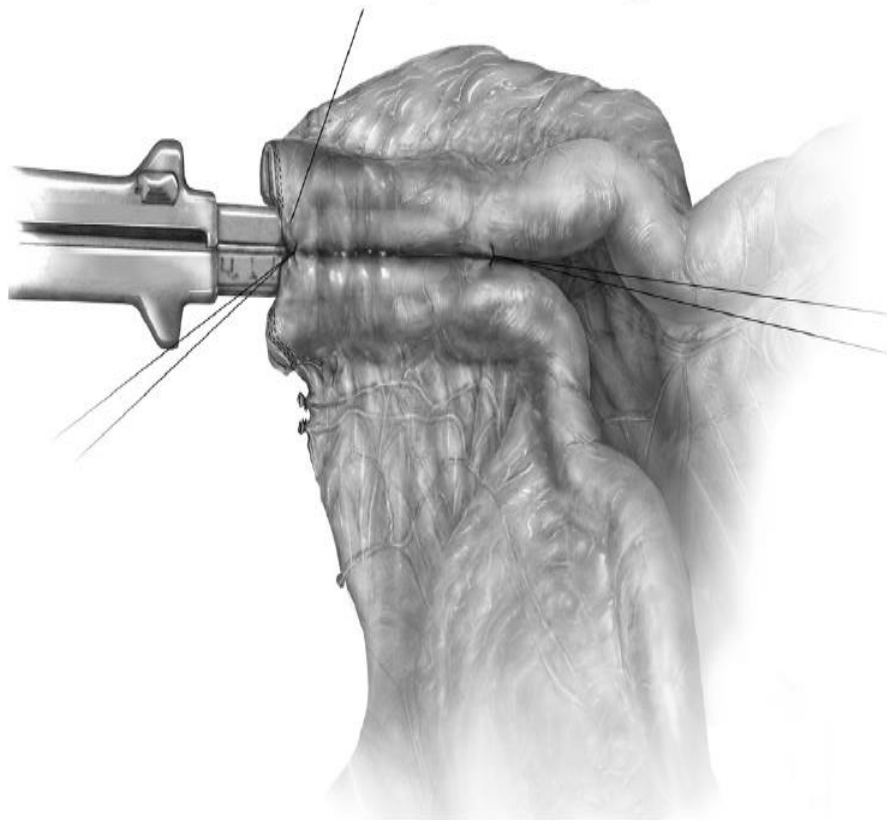
“Lower jaw of the stapler applied through the defect in the mesenteric side and upper jaw should apply in the antimesenteric border”.

“After obtaining the optimal position both the jaw closed”

“A 30-degree angle should be maintained with longer edge located on the mesenteric aspect of healthy bowel. This will increase the blood supply to the stapled line bowel”.

“The same procedure repeated in the distal bowel end using reloaded cartridge for the GIA linear cutter”.

Small corner of stapled jejunum removed to form jejunotomy for  
insertion of each stapler arm on antimesenteric side of jejunal limbs



“CREATION OF FUNCTIONAL END-TO-END ANASTOMOSIS”

## “CREATION OF FUNCTIONAL END-TO-END ANASTOMOSIS”

“The two segments of antimesenteric border of transected small bowel are brought together”.

“ Connell sutures can be placed near the two parallel staple lines and approximately 10 cm further along the bowel length. Alternatively, the surgeon’s assistant can hold up and approximate the two bowel segments”.

“ A Babcock clamp placed carefully on the antimesenteric corner”.

“Using curved Mayo scissors, the surgeon can then cut out the corner of the staple line of each bowel segment”.

“here to avoid spillage of enteric content”.

“Blunt atraumatic bowel clamps can also be placed across the bowel. Holding the corner of the enterotomy with a Babcock instrument to provide counter traction, the jaws of a GIA stapler can then be inserted into each bowel segment”.

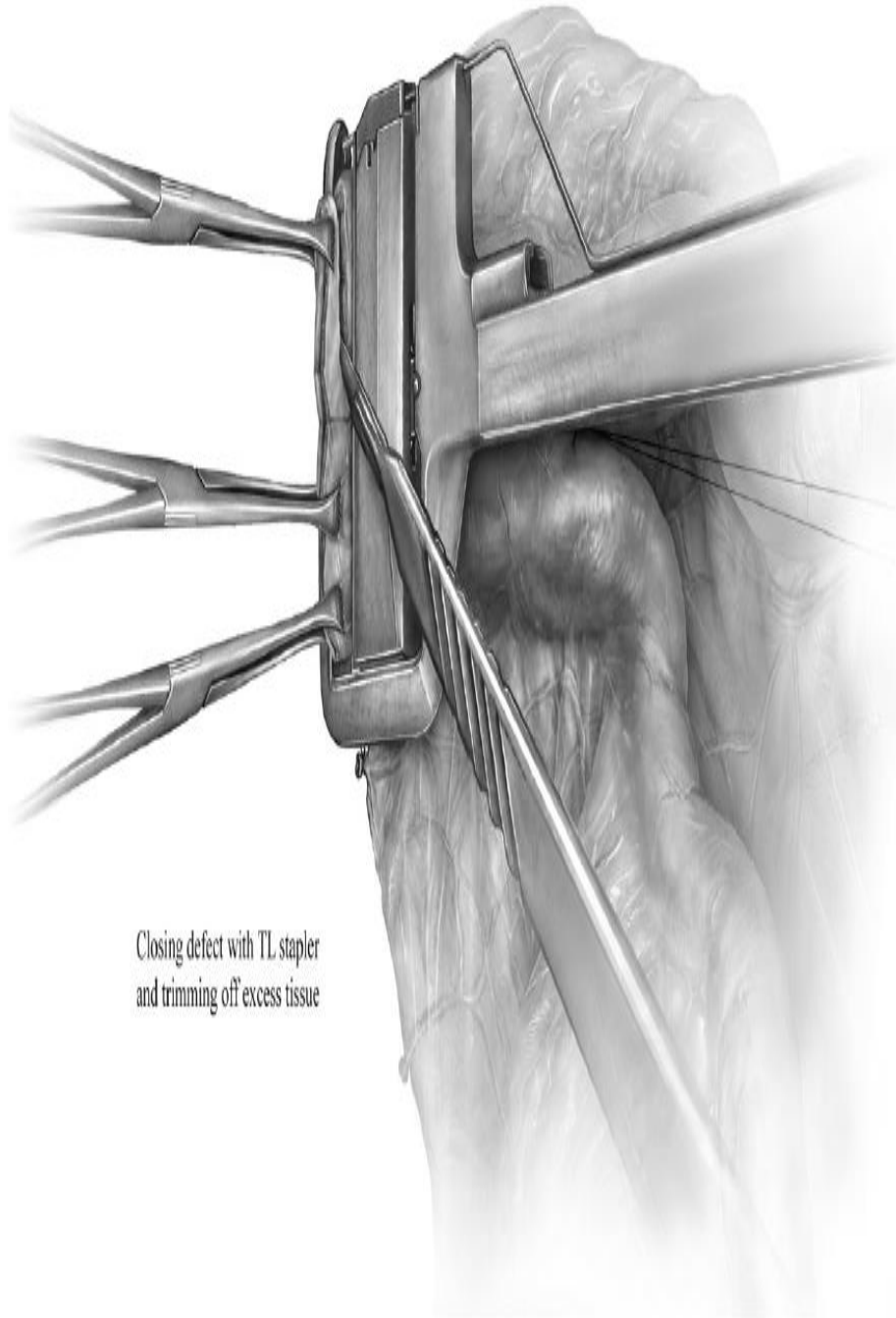
“ The bowel ends must then be positioned properly such that the GIA will close around the two parallel antimesenteric bowel walls. As well, one should ensure that the stapler’s jaws are inserted completely into the bowel ends, so as to create as large a common lumen as possible”.

“ the surgeon should check one more time that no mesentery has been inadvertently incorporated in the anastomosis by sweeping a finger underneath the two bowel ends”.

“The GIA can then be fired and removed”.

“Closing the remaining enterotomies, by using 3-0 vicryl. the internal staple lines should be inspected for bleeding before closing”.

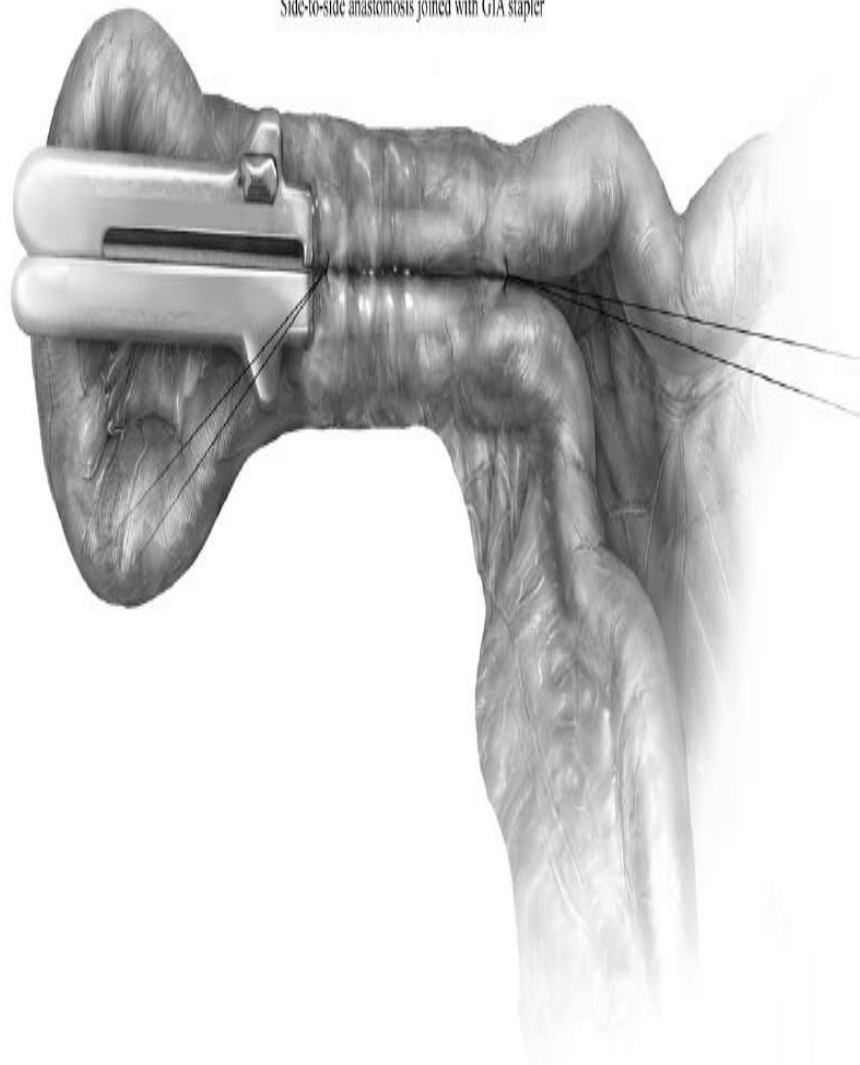




Closing defect with TL stapler  
and trimming off excess tissue

“CLOSURE OF FUNCTIONAL END-TO-END ANASTOMOSIS”

Side-to-side anastomosis joined with GIA stapler

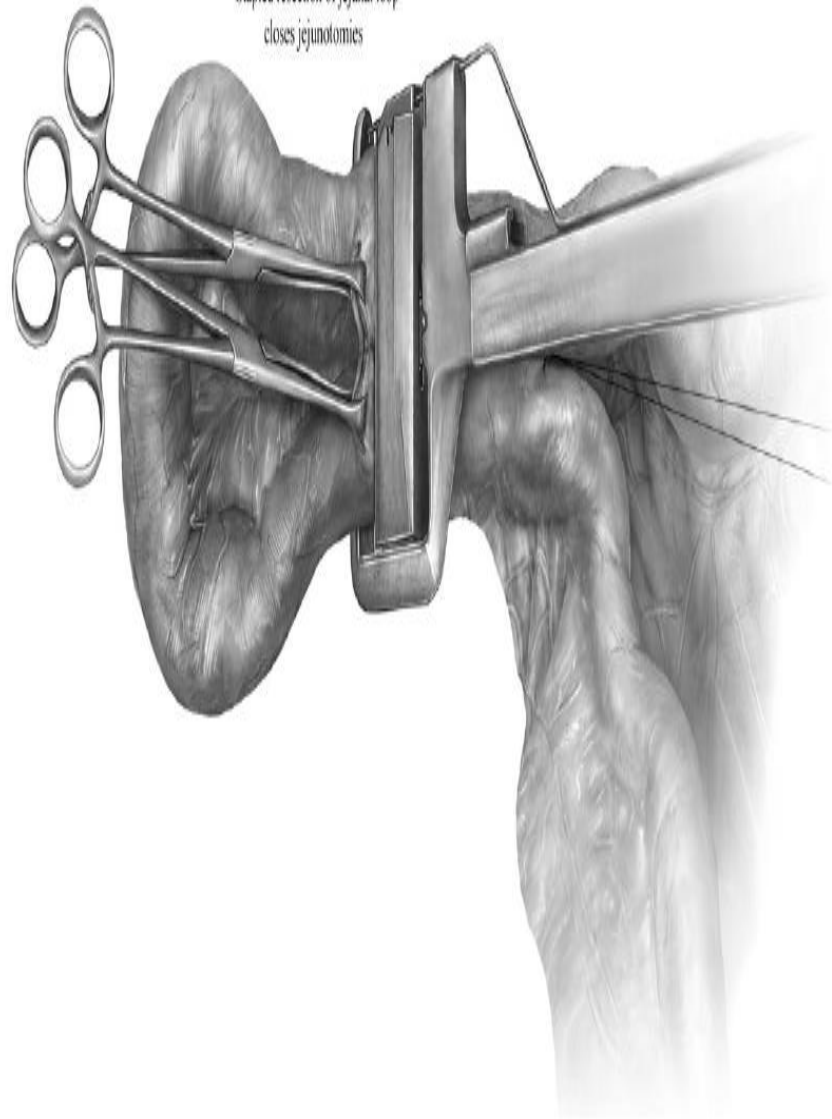


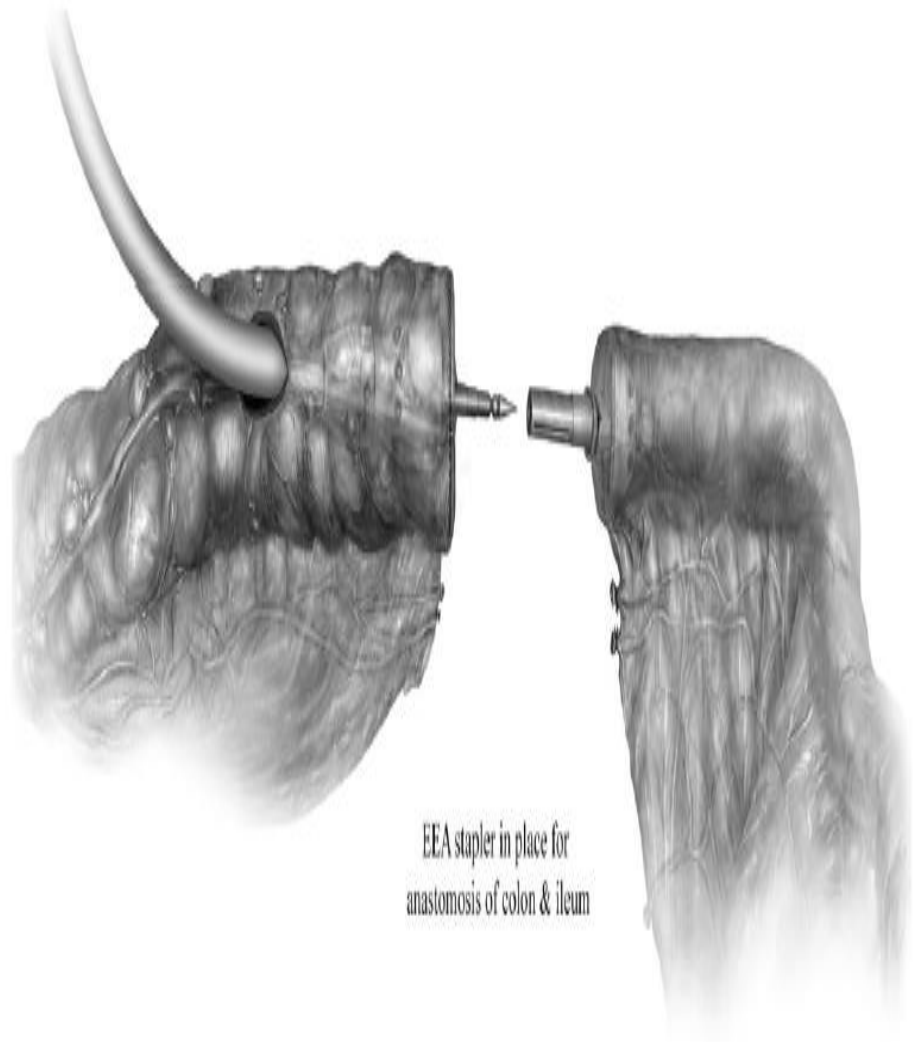
**“SIDE – TO SIDE GI ANASTOMOSIS”**

## **“SIDE-TO-SIDE GI ANASTOMOSIS”**

1. Select appropriate bowel to create anastomosis.
2. Two transverse enterotomies are created in the bowel by using electrocautery
3. here avoid spillage or entering into the opposite side of the lumen.
4. the arm of the GIA stapler introduced into the enterotomies and GIA staplers properly positioned check for avoiding mesenteric involvement then fire it.
5. the GIA staplers removed and the common lumen are closed with 3-0 vicryl.
6. hemostasis secured

Stapled resection of jejunal loop  
closes jejunotomies





EEA stapler in place for  
anastomosis of colon & ileum

**“END-TO-END ILEOCOLIC ANASTOMOSIS”**

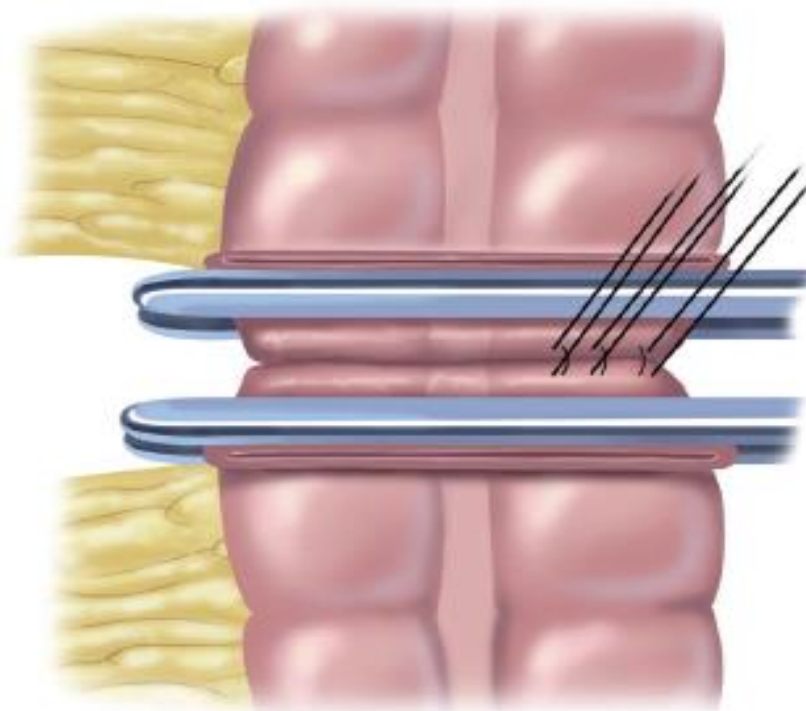
## **“END-TO-END ILEOCOLIC ANASTOMOSIS”**

1. First diseased ileocolic bowel segment mobilized in an usual manner.
2. Ileum is transected by using TA stapler
3. Colon is transected by using the GIA stapler.
4. With the use of prolene 2-0, a purse string suture taken at distal ileal side
5. The anvil of the EEA stapler introduced into the distal ileum and purse string tied off around the rod.
6. Colotomy created in the colon and EEA circular stapler introduced into the colon.
7. Then both the ends are approximated, the rod and trocar closed.
8. Care must be taken to avoid injury to mesenteric side then fired the stapler.
9. Finally colotomy closed with 3-0 vicryl.



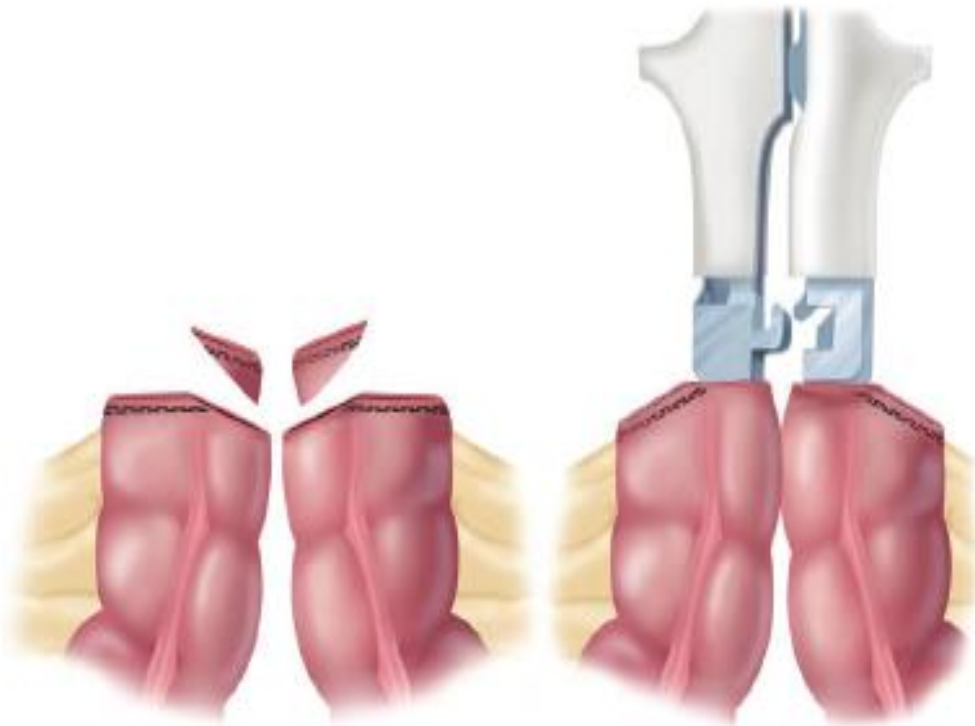
## **END-TO-SIDE ILEOCOLIC ANASTOMOSIS**

**CLAMPS ARE ROTATED TO EXPOSE THE POSTERIOR SEROSAL SURFACES FOR APPROXIMATION.**





**PROPER MANNER OF ENGAGING CUTTING BLADES WHEN  
USING LINEAR CUTTING STAPLER.**



## **“MATERIALS AND METHODS”**

“From our Prospective study from march 2014 to august 2014 in Chennai at rajiv Gandhi government general hospital. A total of 100 patients were divided into 6 groups, depending on the surgery such as posterior gastrojejunostomy, anterior gastrojejunostomy, sub total gastrectomy and anterior gastrojejunostomy with jejunojunctionostomy (Billroth II), ileostomy closure, colostomy closure, and hemicolectomy. Of 100 patients, 50 patients were hand-sewn group and the other 50 patients were in the stapler group which was grouped randomly by using lot”.

“ In the posterior gastrojejunostomy group , there were 14 cases, of this 12 male and 2 female cases. Among 14 cases , 7 cases were hand-sewn, 7 cases were stapler group. The average mean age of the posterior gastrojejunostomy group is 56. The average mean age of the patients in stapler group 56.28. the average mean age of the patients in hand-sewn group 55.71”.

“In case of carcinoma stomach with anterior gastrojejunostomy group, there were 20 cases, of this 6 female and 14 male cases. Among 20 cases, 10 cases were hand-sewn, 10 cases were stapler group. The mean age of the anterior gastrojejunostomy group 64.7. The mean age of the patients in Stapler group 65. The mean age of the patients in Hand-sewn group 64.4”.

“In case of carcinoma stomach, subtotal gastrectomy with anterior gastrojejunostomy with jejunojunctionostomy (Billroth II) group, there were 32 cases, of this 13 female and 19 male cases. among 32 cases, 16 cases were hand-sewn, 16 cases were stapler group. the average mean age of the patients in this group is 49.15. the average mean age of the patients in Stapler group 46.81. The average mean age of the patients in Hand-sewn group is 52.12”.

“In case of ileostomy closure group, there were 14 cases, of this 2 female and 12 male cases. Among 14 cases, 7 cases were hand-sewn, 7 cases were stapler group. The average mean age of the patients in ileostomy closure group is 43.28. the average mean age of the patient in Stapler group is 35.28. the mean age of the patient in Hand-sewn group is 51.28”.

“In case of colostomy closure group, there were 8 cases, of this 4 female and 4 male cases. Among 8 cases, 4 cases were hand-sewn, 4 cases were stapler group. The mean age of the patients in colostomy closure group is 44.25. the average mean age of the patients in Stapler group 51.75. the average mean age of the patient in Hand-sewn group is 36.75”.

“In case of hemicolectomy group, there were 12 cases, of this 5 female and 7 male cases. Among 12 cases, 6 cases were hand-sewn, 6 cases were stapler group. The average mean age of the patients in hemicolectomy group is 54.75. the mean age of the patients in Stapler group is 52. The average mean age of the patients in Hand-sewn group is 57.5”.

“Every patients were selected randomly by using lot for hand-sewn/stapler bowel anastomosis. Elective cases only included for surgery”.

“For gastrojejunostomy, hand-sewn anastomosis was done using continuous two-layer technique. Hand-sewn colorectal anastomosis was done using single-layer, interrupted sutures”.

“Staplers used in the study were linear staplers (Advant 55), linear cutters (Advant 55), and circular staplers (CDH 29)”.

“All the patients had body mass index in the moderately built range. All of them had good nutritional reserve preoperatively with serum albumin in the normal range”.

“Every patient had standard preoperative bowel preparation and prophylactic antibiotic was given”.

“All the patients were studied for the parameters such as total operating time, time of return of bowel sounds, day of resumption of oral feeds, postoperative hospital stay, and postoperative complication—*anastomotic leak*”.

“C-morbid conditions such as hypertension, diabetes among the patients were under control and fitness for surgery was taken by physician and cardiologist”.

### **“INCLUSION CRITERIA”**

1. “Patients electively undergoing for bowel resection & anastomosis”.
2. “patients underwent diversion procedure in emergency situation, now requiring for stoma closure”.
3. “nutritionally well-nourished patients those who hb%  $> 10$  gms, serum albumin  $> 3$  gms” .

### **“EXCLUSION CRITERIA”**

1. “patients with indication of surgery other than mentioned in inclusion criteria”.
2. “associated surgeries & extended surgeries”
3. “all emergency surgeries requiring bowel resection & anastomosis”
4. “severe anemia & malnourished patients those were hb%  $< 10$  gms, serum albumin  $< 3$  gms”.
5. “advanced stage of malignancy in case of ca. stomach 7ca. rectum”

## PROFORMA

Name: Age/Sex:

Address: Occupation:

SYMPTOMS:

Abdominal pain, vomiting, & altered bowel habits

PAST HISTORY:

Previous h/o surgery/ radiation/ chemotherapy

PERSONAL HISTORY:

- Smoking
- Alcohol

GENERAL EXAMINATION:

VITAL SIGNS:

PR

BP

RR

LOCAL EXAMINATION:

- Examination of supraclavicular node
- Examination of pedal edema
- Examination of nutritional status

SYSTEMIC EXAMINATION:

ABDOMEN:

- Ascitis
- Palpable Mass
- Palpable Liver

#### PER RECTAL DIGITAL EXAMINATION:

- Growth
- Secondary Deposits

#### INVESTIGATIONS:

- CBC
- RFT
- LFT
- OGD-SCOPY
- COLONOSCOPY
- BIOPSY
- CECT-ABDOMEN
- LOOPOGRAM

#### TYPE OF ANASTOMOSIS:

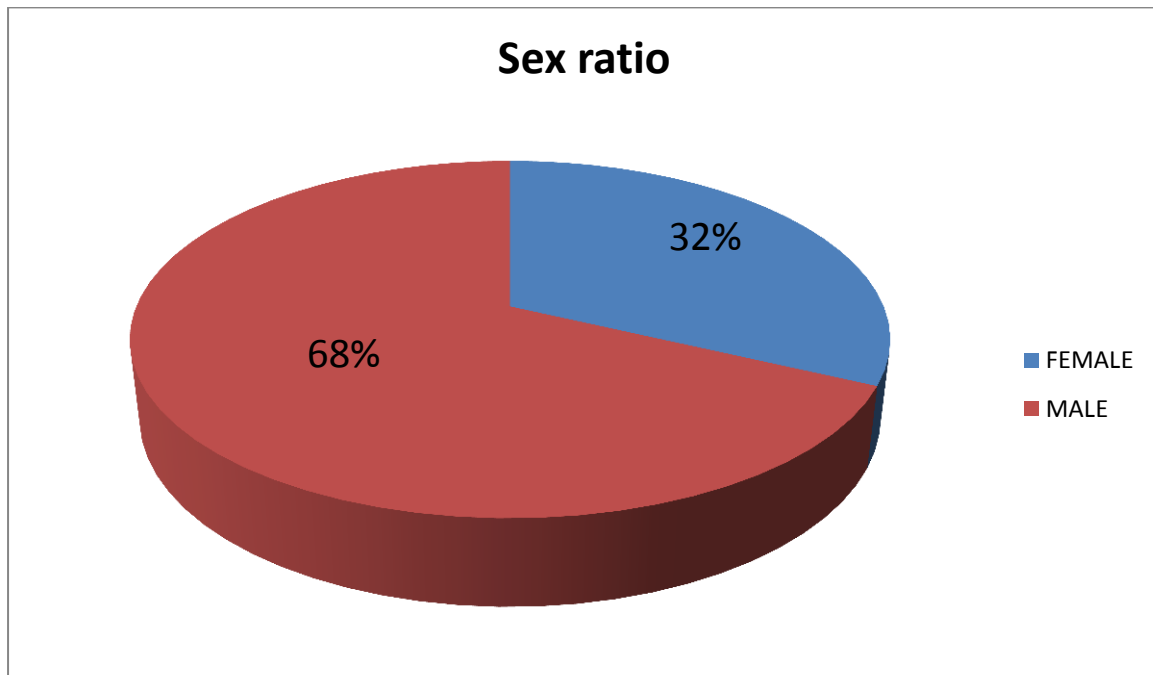
- HAND-SEWN
- STAPLER

#### POST OPERATIVE PARAMETERS:

- “TOTAL OPERATING TIME”.
- “RETURN OF BOWEL SOUNDS AND RESUMPTION OF ORAL FEEDS”.
- “POST OPERATIVE HOSPITAL STAY”.
- “ANASTOMOTIC LEAK”.

## RESULTS AND ANALYSIS

CHART: MALE:FEMALE RATIO



+

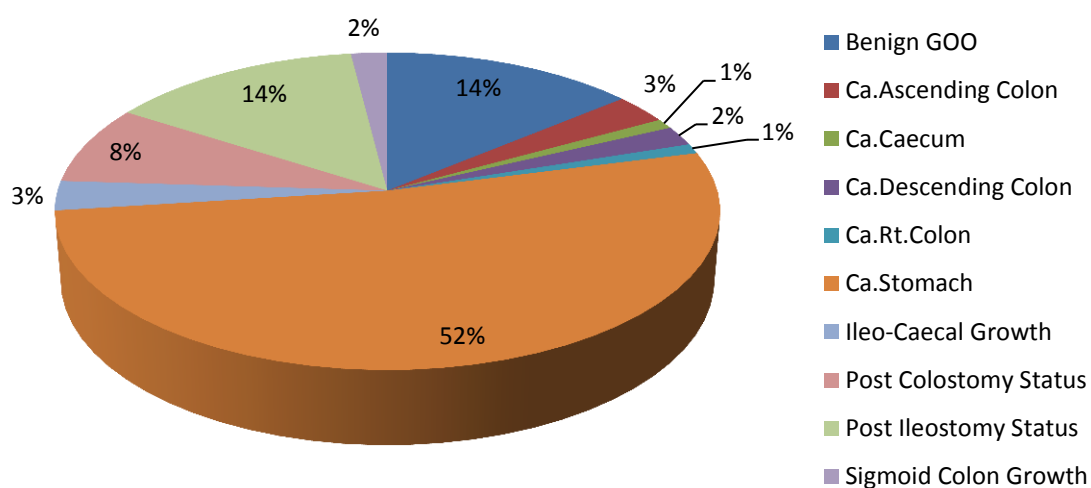
**"Sex"**

	"Frequency"	"Percent"	"Valid Percent"	"Cumulative Percent"
"Female"	32	32.0	32.0	32.0
"Male"	68	68.0	68.0	100.0
"Total"	100	100.0	100.0	

**“DIAGNOSIS”**

	“Frequency”	“Percent”	“Valid Percent”	“Cumulative Percent”
Benign GOO	14	14.0	14.0	14.0
Ca.Ascending Colon	3	3.0	3.0	17.0
Ca.Caecum	1	1.0	1.0	18.0
Ca.Descending Colon	2	2.0	2.0	20.0
Ca.Rt.Colon	1	1.0	1.0	21.0
Carcinoma Stomach	52	52.0	52.0	73.0
Ileo-Caecal Growth	3	3.0	3.0	76.0
Post Colostomy Status	8	8.0	8.0	84.0
Post Ileostomy status	14	14.0	14.0	98.0
sigmoid colon growth	2	2.0	2.0	100.0
Total	100	100.0	100.0	

**DIAGNOSIS**



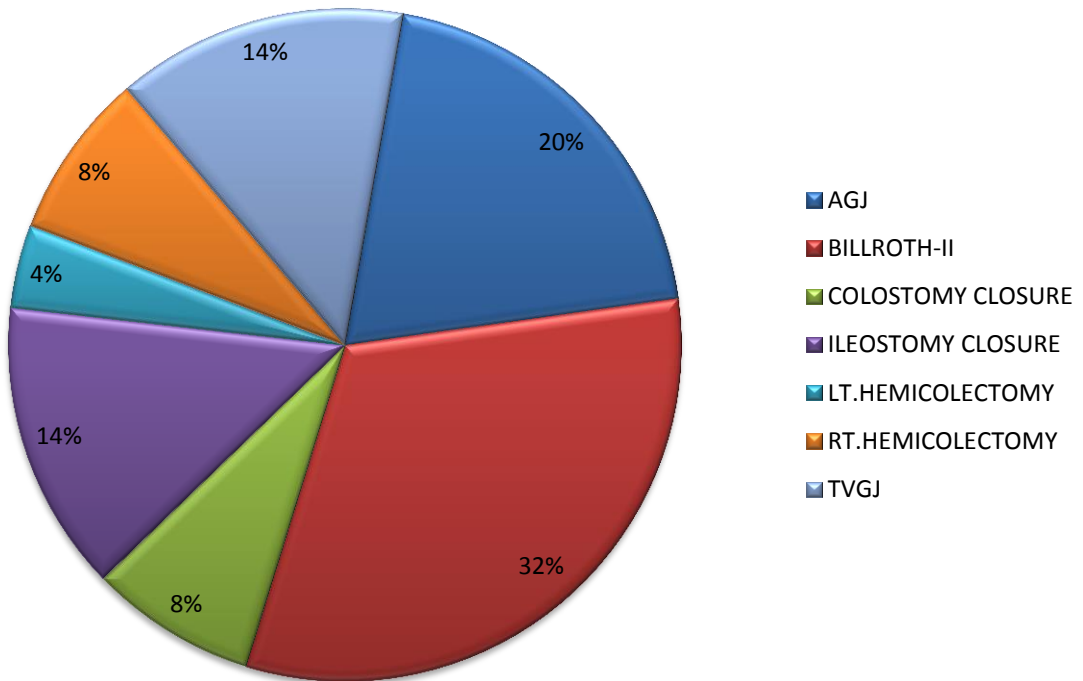


**“PROCEDURE”**

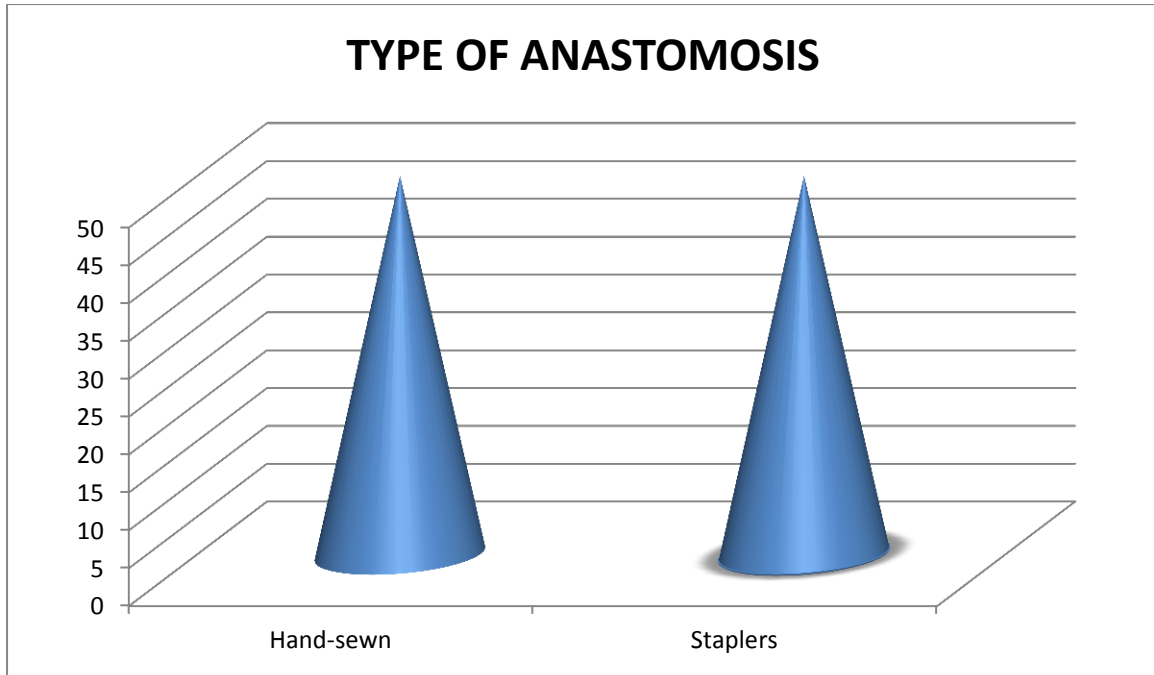
	“Frequency”	“Percent”	“Valid Percent”	“Cumulative Percent”
AGJ	20	20.0	20.0	20.0
BILLROTH-II	32	32.0	32.0	52.0
COLOSTOMY CLOSURE	8	8.0	8.0	60.0
ILEOSTOMY CLOSURE	14	14.0	14.0	74.0
LT.HEMICOLECTOMY	4	4.0	4.0	78.0
RT.HEMICOLECTOMY	8	8.0	8.0	86.0
TVGJ	14	14.0	14.0	100.0
TOTAL	100	100.0	100.0	

C

**PROCEDURE**

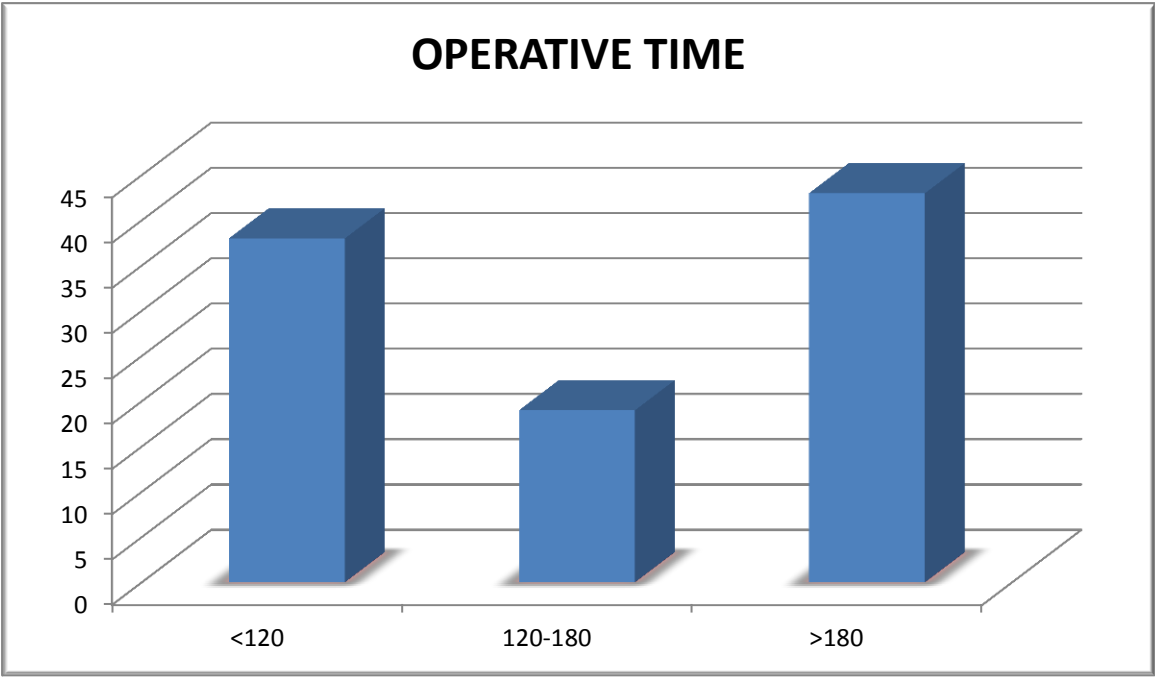


## TYPE OF ANASTOMOSIS



**“TYPE OF ANASTAMOSIS”**

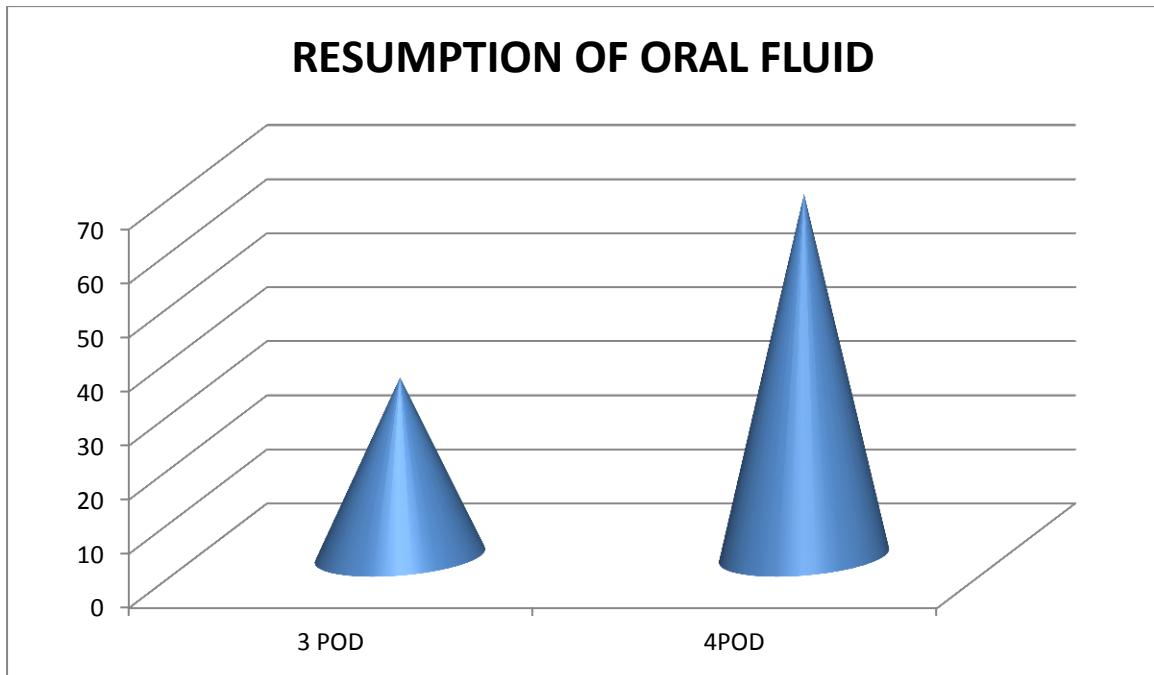
	“Frequency”	“Percent”	“Valid Percent”	“Cumulative Percent”
“Hand-sewn”	50	50.0	50.0	50.0
“stapler”	50	50.0	50.0	100.0
“Total”	100	100.0	100.0	



**“operative time”**

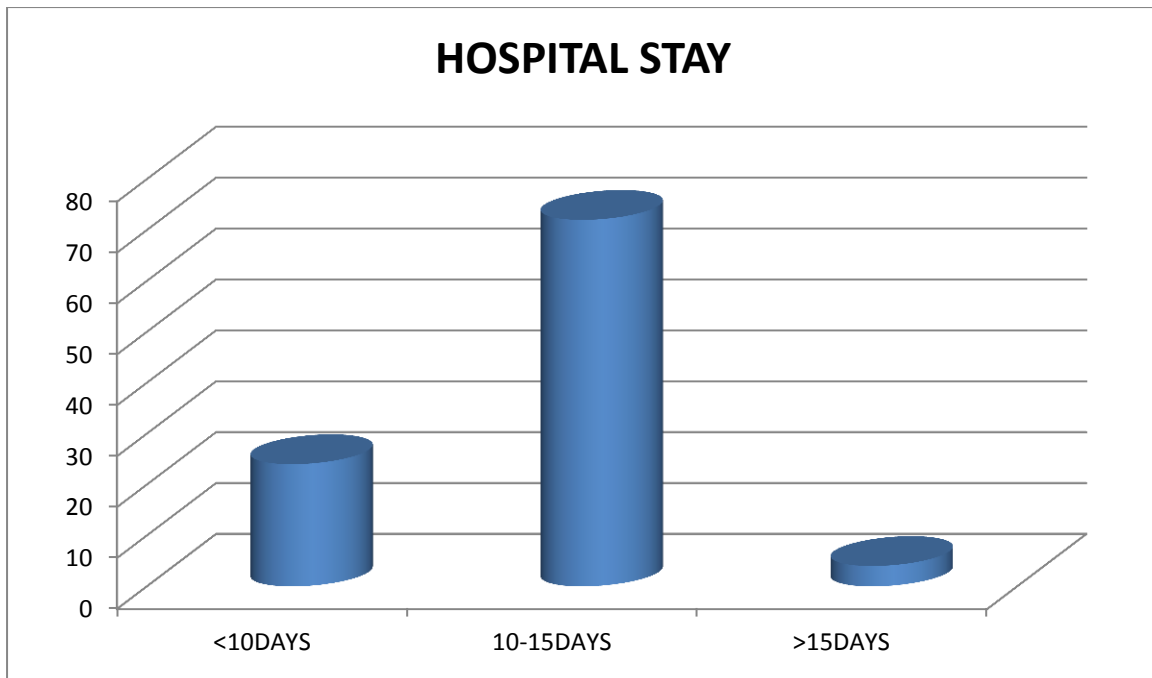
Time (min)	“Frequency”	“Percent”	“Valid Percent”	“Cumulative Percent”
<120	38	38.0	38.0	38.0
120-180	19	19.0	19.0	57.0
>180	43	43.0	43.0	100.0
Total	100	100.0	100.0	

## RESUMPTION OF ORAL FLUID



### “Orals”

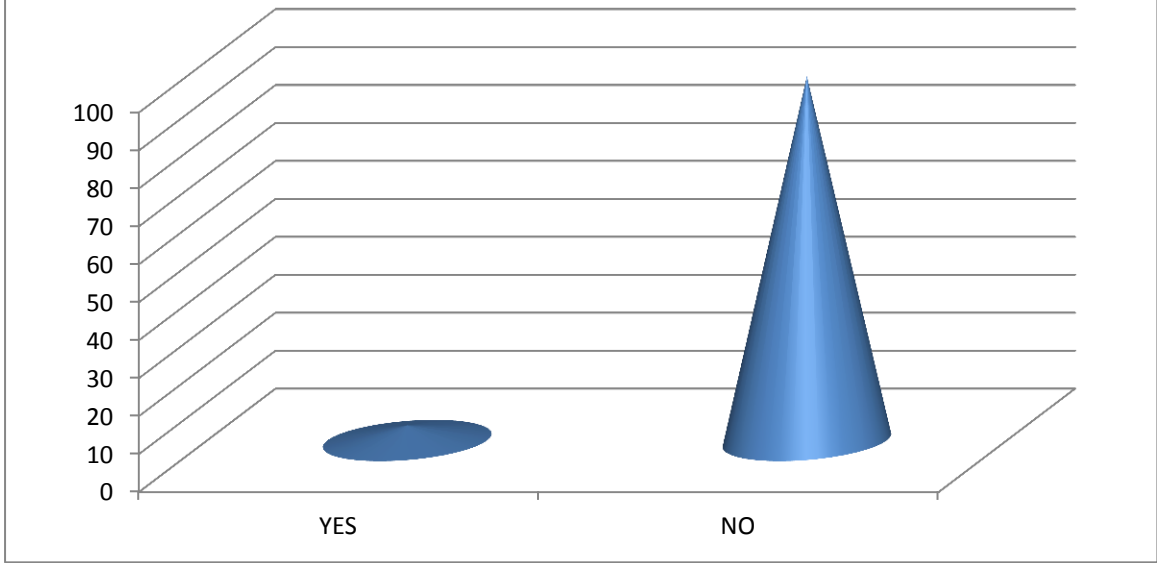
Post operative day	“Frequency”	“Percent”	“Valid Percent”	“Cumulative Percent”
3 POD	33	33.0	33.0	33.0
4 POD	67	67.0	67.0	100.0
“Total”	100	100.0	100.0	



"Hospital stay"

Hospital stay(days)	"Frequency"	"Percent"	"Valid Percent"	"Cumulative Percent"
<10 DAYS	24	24.0	24.0	24.0
10-15 DAYS	72	72.0	72.0	96.0
>15 DAYS	4	4.0	4.0	100.0
Total	100	100.0	100.0	

# ANASTOMOTIC LEAK



## "leak"

	"Frequency"	"Percent"	"Valid Percent"	"Cumulative Percent"
"No"	96	96.0	96.0	96.0
"Yes"	4	4.0	4.0	100.0
"Total"	100	100.0	100.0	

## “COMPARISON OF STAPLER VS HAND-SEWN”

### Crosstab

#### “OPERATIVE TIME”

		Operative time			Total
		<20min	120-180min	>180min	
TYPE OF ANASTAMOSIS	Hand-sewn	1	8	41	50
	Staplers	37	11	2	50
	Total	38	19	43	100

#### “Chi-Square Tests”

	“Value”	“df”	“Asymp. Sig. (2-sided)”
“Pearson Chi-Square”	69.951 <sup>a</sup>	2	.000
“Likelihood Ratio”	87.339	2	.000
“Linear-by-Linear Association”	68.963	1	.000
“McNemar-Bowker Test”	.	.	<sup>b</sup>
“N of Valid Cases”	100		

**“Directional Measures”**

			Approx. T <sup>b</sup>	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	6.893	.000
		TYPE OF ANASTAMOSIS Dependent	6.033	.000
		operativetime Dependent	6.767	.000
	Goodman and Kruskal tau	TYPE OF ANASTAMOSIS Dependent		.000 <sup>c</sup>
		operativetime Dependent		.000 <sup>c</sup>
	Uncertainty Coefficient	Symmetric	7.395	.000 <sup>d</sup>
		TYPE OF ANASTAMOSIS Dependent	7.395	.000 <sup>d</sup>
		operativetime Dependent	7.395	.000 <sup>d</sup>
	“Ordinal by Ordinal”	“Somers' d”	“Symmetric”	-21.097
TYPE OF ANASTAMOSIS Dependent			-21.097	.000
operativetime Dependent			-21.097	.000



**“Symmetric Measures”**

		“Value”	“Asymp. Std.” Error <sup>a</sup>	“Approx. T <sup>b</sup> ”	“Approx. Sig.”
“Nominal by Nominal”	“Phi”	.836			.000
	“Cramer's V”	.836			.000
	“Contingency Coefficient”	.642			.000
“Ordinal by Ordinal”	“Kendall's tau-b”	-.794	.042	-21.097	.000
	Kendall's tau-c	-.894	.042	-21.097	.000
	Gamma	-.975	.017	-21.097	.000
	Spearman Correlation	-.835	.042	-15.050	.000 <sup>c</sup>
“Interval by Interval”	“Pearson's R”	-.835	.042	-15.000	.000 <sup>c</sup>
“Measure of Agreement”	“Kappa”	. <sup>d</sup>			
	“N of Valid Cases”	100			

Test statistics

	TYPE OF ANASTAMOSIS	Operative time
Chi-Square	.000 <sup>a</sup>	9.620
df	1	
Asymp. Sig.	1.000	.000

## RESUMPTION OF ORAL FEEDS

Crosstab

Count

		orals		Total
		3rdPOD	4thPOD	
TYPE OF ANASTAMOSIS	Hand-sewn	16	34	50
	Staplers	17	33	50
	Total	33	67	100

“Chi-Square Tests”

	“Value”	“df”	“Asymp. Sig. (2-sided)”	“Exact Sig. (2-sided)”	“Exact Sig. (1-sided)”
“Pearson Chi-Square”	.045 <sup>a</sup>	1	.832		
“Continuity Correction <sup>b</sup> ”	.000	1	1.000		
“Likelihood Ratio”	.045	1	.832		
“Fisher's Exact Test”				1.000	.500
“Linear-by-Linear Association”	.045	1	.832		
McNemar Test				.024 <sup>c</sup>	
N of Valid Cases	100				

# POST OPERATIVE HOSPITAL STAY

## Crosstab

Count

		Hospital stay			Total
		<10thPOD	10-15thPOD	>15thPOD	
TYPE OF ANASTAMOSIS	Hand-sewn	12	36	2	50
	Stapler	12	36	2	50
	Total	24	72	4	100

## “Chi-Square Tests”

	“Value”	“df”	“Asymp. Sig. (2-sided)”
“Pearson Chi-Square”	.000 <sup>a</sup>	2	1.000
“Likelihood Ratio”	.000	2	1.000
“Linear-by-Linear Association”	.000	1	1.000
“McNemar-Bowker Test”	.	.	<sup>b</sup>
“N of Valid Cases”	100		

## ANASTOMOTIC LEAK

### Crosstab

Count

		leak		Total
		no	yes	
TYPE OF ANASTAMOSIS	1	48	2	50
	2	48	2	50
	Total	96	4	100

### "Chi-Square Tests"

	"Value"	"df"	"Asymp. Sig. (2-sided)"	"Exact Sig. (2-sided)"	"Exact Sig. (1-sided)"
"Pearson Chi-Square"	.000 <sup>a</sup>	1	1.000		
"Continuity Correction <sup>b</sup> "	.000	1	1.000		
"Likelihood Ratio"	.000	1	1.000		
"Fisher's Exact Test"				1.000	.691
"McNemar Test"				. <sup>c</sup>	
"N of Valid Cases"	100				

## DISCUSSION

The results were observed, analyzed, compared and submitted here.

## TOTAL OPERATING TIME

“In this study, for all surgeries, the mean operating time was shortened in the stapler group and the difference was statistically significant ( $p=0.000&0.008$ )”

**Crosstab**

Count

		operativetime			Total
		<20min	120-180min	>180min	
TYPE OF ANASTAMOSIS	Hand-sewn	1	8	41	50
	Staplers	37	11	2	50
	Total	38	19	43	100

**“Chi-Square Tests”**

	“Value”	“df”	“Asymp. Sig. (2-sided)”
“Pearson Chi-Square”	69.951 <sup>a</sup>	2	.000
“Likelihood Ratio”	87.339	2	.000
“Linear-by-Linear Association”	68.963	1	.000
“McNemar-Bowker Test”	.	.	<sup>b</sup>
“N of Valid Cases”	100		

**“Chi-Square Tests”**

	“Value”	“df”	“Asymp. Sig. (2-sided)”
“Pearson Chi-Square”	69.951 <sup>a</sup>	2	.000
“Likelihood Ratio”	87.339	2	.000
“Linear-by-Linear Association”	68.963	1	.000
“McNemar-Bowker Test”	.	.	. <sup>b</sup>
“N of Valid Cases”	100		

Test Statistics

	TYPE OF ANASTAMOSIS	operativetime
Chi-Square	.000 <sup>a</sup>	9.620 <sup>b</sup>
df	1	2
Asymp. Sig.	1.000	.008

“Thus, the over all mean operating time in GI anastomotic surgeries was shortened in stapler group hence, stapling instruments afforded significantly quicker operation.”

## “RETURN OF BOWEL SOUNDS AND RESUMPTION OF ORAL FEEDS”

“In this study, there was no statistically significant difference with respect to these parameters in stapler and hand-sewn groups (p=0.832)”.

**Crosstab**

Count

		orals		Total
		3rdPOD	4thPOD	
TYPE OF ANASTAMOSIS	Hand-sewn	16	34	50
	Staplers	17	33	50
	Total	33	67	100

**“Chi-Square Tests”**

	“Value”	“df”	“Asymp. Sig. (2-sided)”	“Exact Sig. (2-sided)”	“Exact Sig. (1-sided)”
“Pearson Chi-Square”	.045 <sup>a</sup>	1	.832		
“Continuity Correction <sup>b</sup> ”	.000	1	1.000		
“Likelihood Ratio”	.045	1	.832		
“Fisher's Exact Test”				1.000	.500
“Linear-by-Linear Association”	.045	1	.832		
“McNemar Test”				.024 <sup>c</sup>	
“N of Valid Cases”	100				

## POSTOPERATIVE HOSPITAL STAY

“In my study, there is no statistically significant difference in the postoperative hospital stay in both stapler and hand-sewn groups with respect to these parameter (p=1.00).”

**Crosstab**

Count

		Hospital stay			Total
		<10thPOD	10-15thPOD	>15thPOD	
TYPE OF ANASTAMOSIS	Hand-sewn	12	36	2	50
	Stapler	12	36	2	50
	Total	24	72	4	100

**“Chi-Square Tests”**

	“Value”	“df”	“Asymp. Sig. (2-sided)”
“Pearson Chi-Square”	.000 <sup>a</sup>	2	1.000
“Likelihood Ratio”	.000	2	1.000
“Linear-by-Linear Association”	.000	1	1.000
“McNemar-Bowker Test”	.	.	<sup>b</sup>
“N of Valid Cases”	100		



## ANASTOMOTIC LEAK

“In my study, anastomotic leak is found in the colonic anastomosis group. This was found in two patients in stapler group and two patients in hand-sewn group. All the cases were managed conservatively.”

“With respect to this parameter anastomotic leak in both these group was statistically insignificant.”

**Crosstab**

Count

		leak		Total
		no	yes	
TYPE OF ANASTAMOSIS	1	48	2	50
	2	48	2	50
	Total	96	4	100

**“Chi-Square Tests”**

	“Value”	“df”	“Asymp. Sig. (2-sided)”	“Exact Sig. (2-sided)”	“Exact Sig. (1-sided)”
“Pearson Chi-Square”	.000 <sup>a</sup>	1	1.000		
“Continuity Correction <sup>b</sup> ”	.000	1	1.000		
“Likelihood Ratio”	.000	1	1.000		
“Fisher's Exact Test”				1.000	.691
“McNemar Test”				. <sup>c</sup>	
“N of Valid Cases”	100				

## CONCLUSIONS

“Traditionally, hand-sewn technique has been the standard surgical technique for proper fashioning anastomosis in gastrointestinal surgery.”

“To gain wider acceptance, an innovative technique should be efficient and speedy with no compromise in safety.”

“In this study, one distinct advantage of staplers was the consistent reduction in operating time”.

“ However, there was no significant difference between the stapler and hand-sewn groups with respect to other parameters such as restoration of intestinal function, postoperative hospital stay, and postoperative complications”.

“Due to reduction in operating time, staplers may be advantageous in patients whose general condition is poor and who would not tolerate prolonged anesthesia”.

“Hand-sewn anastomosis can be very difficult when access is severely limited especially in low anterior resection; mechanical stapling devices have an added advantage in these situations”.

## BIBLIOGRAPHY

## BIBLIOGRAPHY

1. Leaper DJ (2008) Basic surgical skills and anastomoses. In: Williams NS, Bulstrode CJ, O'Connell PR, (ed), Bailey and love's short practice of surgery, 25th ed., Edward Arnold Ltd: Great Britain, p 239, 242–245
2. Brooks DC, Zinner MJ (2000) Surgery of the small and large bowel. In: Zinner MJ, Ellis H, editors, Maingot's abdominal operations, 10th ed., Applleton and Lange, Connecticut (USA), p 1321–1330
3. Farquharson M, Moran B (2005) Farquharson's textbook of operative general surgery, 9th ed., Edward Arnold Ltd: Great Britain, p 222–229, 234–239
4. Kirk RM. Basic surgical techniques. 5. Edinburgh: Churchill Livingstone; 2002. pp. 43–80.
5. Damesha N, Lubana PS, Jain DK, Mathur R (2008) A comparative study of sutured and stapled anastomosis in gastrointestinal operations. *Internet J Surg* 15(2)
6. George WD, West of Scotland and Highland anastomosis study group  
Suturing or stapling in gastrointestinal surgery: a prospective randomized study. *Br J Surg.* 1991;78:337–341. doi: 10.1002/bjs.1800780322. [PubMed] [Cross Ref]
7. Hollender LF, Blanchot P, Meyer C, da Silva e Costa JM. Mechanical suturing apparatus in gastrointestinal surgery. *Zentralbl Chir.* 1981;106(2):74–83. [PubMed]
8. Reiling RB, Reiling WA, Jr, Bernie WA, Huffer AB, Perkins NC, Elliott DW. Prospective controlled study of gastrointestinal stapled anastomoses. *Am J Surg.* 1980;139:147–152. doi: 10.1016/0002-9610(80)90244-5. [PubMed] [Cross Ref]
9. Scher KS, Scott-Conner C, Jones CW, Leach M. A comparison of stapled and sutured anastomoses in colonic operations. *Surg Gynecol Obstet.* 1982;155:489–493. [PubMed]

10. Scher KS, Scott-Conner C, Ong WT. A comparison of stapled and sutured anastomoses in gastric operations. *Surg Gynecol Obstet.* 1982;154:548–552. [PubMed]
11. Lustosa SA, Matos D, Atallah AN, Castro AA. Stapled versus handsewn methods for colorectal anastomosis surgery: a systematic review of randomized controlled trials. *Sao Paulo Med J/Rev Paul Med.* 2002;120(5):132–136. [PubMed]
12. Docherty JG, McGregor JR, Akyol AM, Murray GD, Galloway DJ. Comparison of manually constructed and stapled anastomoses in colorectal surgery. West of Scotland and Highland Anastomosis Study Group. *Ann Surg.* 1995;221:176–184. doi: 10.1097/00000658-199502000-00008. [PMC free article] [PubMed] [Cross Ref]
13. Nasirkhan MU, Abir F, Longo W, Kozol R. Anastomotic disruption after large bowel resection. *World J Gastroenterol.* 2006;12(16):2497–2504. [PMC free article] [PubMed]
14. Matheson NA, McIntosh CA, Krukowski ZH: Continuing experience with single layer appositional anastomosis in the large bowel. *Br J Surg*72(suppl):S104, 1985
15. Carty NJ, Keating J, Campbell J, et al: Prospective audit of an extramucosal technique for intestinal anastomosis. *Br J Surg* 78:1439,1991
16. Debas HT, Thompson FB: A critical review of colectomy with anastomosis. *Surg Gynecol Obstet* 135:747, 1973
17. Halsted W: Circular suture of the intestine—an experimental study. *Am J Med Sci* 94:436, 1887
18. Hastings JC, Van Winkle W, Barker E, et al: Effects of suture materials on healing of wounds of the stomach and colon. *Surg Gynecol Obstet* 140:701, 1975
19. Wise L, McAlister W, Stein T, et al: Studies on the healing of anastomoses of small and large intestines. *Surg Gynecol Obstet* 141:190, 1975

20. Hesp F, Hendriks T, Lubbers E-J, et al: Wound healing in the intestinal wall: a comparison between experimental ileal and colonic anastomoses. *Dis Colon Rectum* 24:99, 1984
21. Hawley PJ, Hunt TK, Dunphy JE: Aetiology of colonic anastomotic leaks. *Proc R Soc Med* 63:28, 1970
22. Fingerhut A, Hay J-M, Elhadad A, et al: Supraperitoneal colorectal anastomosis: hand-sewn versus circular staples—a controlled clinical trial. *Surgery* 118:479, 1995
23. Khubchandani IT: Low end-to-side rectoenteric anastomosis with single-layer wire. *Dis Colon Rectum* 18:308, 1975
24. Irvin T, Goligher J: Aetiology of disruption of intestinal anastomoses. *Br J Surg* 60:461, 1973
25. Olsen GB, Letwin E, Williams HTG: Clinical experience with the use of a single-layer intestinal anastomosis. *Can J Surg* 56:771, 1969
26. Sarin S, Lightwood RG: Continuous single-layer gastrointestinal anastomosis: a prospective audit. *Br J Surg* 76:493, 1989
27. Shandall A, Lowndes R, Young HL: Colonic anastomotic healing and oxygen tension. *Br J Surg* 72:606, 1985
28. Jiborn H, Ahonen J, Zederfeldt B: Healing of experimental colonic anastomoses: the effect of suture technique on collagen metabolism in the colonic wall. *Am J Surg* 139:406, 1980
29. Khoury GA, Waxman BP: Large bowel anastomosis: I. The healing process and sutured anastomoses: a review. *Br J Surg* 70:61, 1983
30. Abramowitz H: Everting and inverting anastomoses: an experimental study of comparative safety. *Rev Surg* 28:142, 1971
31. Polglase AL, Hughes ESR, McDermott FT, et al: A comparison of end-to-end staple and suture colorectal anastomosis in the dog. *Surg Gynecol Obstet* 152:792, 1981
32. O'Neil P, Healey JEJ, Clark RI, et al: Nonsuture intestinal anastomosis. *Am J Surg* 104:761, 1962

33. Orr NWM: A single layer intestinal anastomosis. *Br J Surg* 56:77, 1969
34. Templeton JL, McKelvey STD: Low colorectal anastomoses: an experimental assessment of two sutured and two stapled techniques. *Dis Colon Rectum* 28:38, 1985
35. Goligher J, Morris C, McAdam W: A controlled trial of inverting versus everting intestinal suture in clinical large-bowel surgery. *Br J Surg* 57:817, 1970
36. Fielding LP, Stewart Brown S, Blesowsky L, et al: Anastomotic integrity after operations for large bowel cancer: a multicentre study. *Br Med J* 282:411, 1980
37. Leob MJ: Comparative strength of inverted, everted and endon intestinal anastomoses. *Surg Gynecol Obstet* 125:301, 1967
38. Undre AR: Enteroplasty: a new concept in the management of benign strictures of the intestine. *Int Surg* 68:73, 1983
39. Chassin JL, Rifkind KM, Turner JW: Errors and pitfalls in stapled gastrointestinal tract anastomoses. *Surg Clin North Am* 64:441, 1984
40. Ravitch MM: Intersecting staple lines in intestinal anastomoses. *Surgery* 97:8, 1985
41. Chung RS: Blood flow in colonic anastomoses: effect of stapling and suturing. *Ann Surg* 206:335, 1987
42. Julian TB, Ravitch MM: Evaluations of the safety of end-to-end stapling anastomoses across linear stapled closure. *Surg Clin North Am* 64:567, 1984
43. Brennan SS, Pickford IR, Evans M, et al: Staples or sutures for colonic anastomosis—a controlled clinical trial. *Br J Surg* 69:722, 1982
44. Lafreniere R, Ketcham AS: A single layer open anastomosis for all intestinal structures. *Am J Surg* 149:797, 1985
45. Beart RW, Kelly KA: Randomized prospective evaluation of the EEA stapler for colorectal anastomoses. *Am J Surg* 141:143, 1981
46. Kracht M, Hay J-M, Fagniez P-L, et al: Ileocolonic anastomosis after right hemicolectomy for carcinoma: stapled or hand-sewn. *Int J Colorect Dis* 8:29, 1993

47. Valverde A, Hay JM, Fingerhut A, et al: Manual versus mechanical esophagogastric anastomosis after resection for carcinoma: a controlled trial. French Association for Surgical Research. *Surgery* 120:476, 1996
48. Akyol AM, McGregor JR, Galloway DJ, et al: Recurrence of colorectal cancer after sutured and stapled large bowel anastomoses. *Br J Surg* 78:1297, 1991
49. Everett WG, Friend PJ, Forty J: Comparison of stapling and hand-suture for left-sided large bowel anastomosis. *Br J Surg* 73:345, 1986
50. Ballantyne GH: The experimental basis of intestinal suturing: effect of surgical technique, inflammation and infection on enteric wound healing. *Dis Colon Rectum* 27:61, 1984
51. Goligher JC, Graham NG, DeDombal FT: Anastomotic dehiscence after anterior resection of the rectum and sigmoid. *Br J Surg* 57:109, 1970
52. Fok M, Ah-Chong AK, Cheng SWK, et al: Comparison of a single layer continuous handsewn method and circular stapling in 580 esophageal anastomoses. *Br J Surg* 78:342, 1991
53. West of Scotland and Highland Anastomosis Study Group: Suturing or stapling in gastrointestinal surgery: a prospective randomized study. *Br J Surg* 78:337, 1991
54. Irving AD, Scrimgeour D: Mechanical bowel preparation for colonic resection and anastomosis. *Br J Surg* 74:580, 1987
55. Hughes ESR: Asepsis in large bowel surgery. *Ann R Coll Surg Engl* 51:347, 1972
56. LeVeen HH, Wapnick S, Falk D: Effects of prophylactic antibiotics on colonic healing. *Am J Surg* 131:47, 1976
57. Irvin T, Goligher J, Johnston D: A randomized prospective clinical trial of single-layer and twolayer inverting intestinal anastomoses. *Br J Surg* 60:457, 1973.
58. van Geldere D, Fa-Si-Oen P, Noach LA, et al: Complications after colorectal surgery without mechanical bowel preparation. *J Am Coll Surg* 194:40, 2002

59. Bozetti F: Perioperative nutrition of patients with gastrointestinal cancer. *Br J Surg* 89:1201,2002
60. Kratzer GL, Onsanit T: Single layer steel wire anastomosis of the intestine. *Surg Gynecol Obstet* 139:93, 1974
61. Ravitch MM, Steichen FM: Techniques of staple suturing in the gastrointestinal tract. *Ann Surg* 175:815, 1972
62. Burg R, Geigle C, Faso J, et al: Omission of routine gastric decompression. *Dis Colon Rectum* 21:98, 1978
63. Reasbeck P, Rice M, Herbison G: Nasogastric intubation after intestinal resection. *Surg Gynecol Obstet* 158:354, 1984
64. Argov S, Goldstein I, Barzilai A: Is routine use of a nasogastric tube justified in upper abdominal surgery? *Am J Surg* 139:849, 1980
65. Sailer M, Fuchs K-H, Fein M, et al: Randomized clinical trial comparing quality of life after straight and pouch coloanal reconstruction. *Br J Surg* 89:1108, 2002
66. Gorfine SR, Gelernt IM, Bauer JJ, et al: Restorative proctocolectomy without diverting ileostomy. *Dis Colon Rectum* 38:188, 1995
67. Grobler SP, Hosie KB, Keighley MR: Randomized trial of loop ileostomy in restorative proctocolectomy. *Br J Surg* 79:903, 1992
68. Dehni N, Schlegel RD, Cunningham C, et al: Influence of a defunctioning stoma on leakage rates after low colorectal anastomosis and colonic J pouch-anal anastomosis. *Br J Surg* 85:1114, 1998
69. Law WL, Chu KW, Choi HK: Randomized clinical trial comparing loop ileostomy and loop transverse colostomy for fecal diversion following total mesorectal excision. *Br J Surg* 89:704, 2002
70. Britton J: Intestinal anastomosis, in Souba WW, Fink MP, Jurkovich GJ, et al (eds): *ACS Surgery: Principles & Practice*. Danbury, CT, WebMD Professional



Publishing, 2005, pp 644-655

71. Feil W, Lippert H, Lozac'h P, et al: Atlas of Surgical Stapling. Heidelberg, Germany, Johann Ambrosius Barth, 2000

72. Kracht M, Hay JM, Fagniez PL, et al: Ileocolonic anastomosis after right hemicolectomy for carcinoma: Stapled or hand-sewn? A prospective, multicenter, randomized trial. *Int J Colorectal Dis* 8:29-33, 1993

73. Lustosa SA, Matos D, Atallah AN, et al: Stapled versus handsewn methods for colorectal anastomosis surgery. *Cochrane Database Syst Rev* 3:CD003144, 2001

74. Resegotti A, Astegiano M, Farina EC, et al: Side-to-side stapled anastomosis strongly reduces anastomotic leak rates in Crohn's disease surgery. *Dis Colon Rectum* 48:464-468, 2005

75. Scarpa M, Angriman I, Barollo M, et al: Role of stapled and hand-sewn anastomoses in recurrence of Crohn's disease. *Hepatogastroenterology* 51:1053-1057, 2004

76. Steichen FM: Stapling Techniques: General Surgery. Norwalk, CT, United States Surgical Corporation, 1988

77. Steichen FM, Galibert LA, Wolsch RA, et al: Stapling technique in operations on the gastrointestinal tract, in Baker RJ, Fischer JE (eds): *Mastery of Surgery* (4th ed). Philadelphia, PA, Lippincott Williams & Wilkins, 2001, pp 201-225

78. West of Scotland and Highland Anastomosis Study Group: Suturing or stapling in gastrointestinal surgery: A prospective randomized study. *Br J Surg* 78:337-341, 1991

79. Yamamoto T, Bain IM, Mylonakis E, et al: Stapled functional end-to-end anastomosis versus sutured end-to-end anastomosis after ileocolic resection for Crohn's disease. *Scand J Gastroenterol* 34:708-713, 1999.



					HAEM OGLO BIN	SR.ALBUMIN			OPERATING TIME	RETURN OF BOWEL SOUND S AND RESUM PTION OF ORAL FLUIDS	POST-OP HOSPITAL STAY	AN AST AM OTI C LEA K
1	govindasamy	62	m	benign goo	10.8	4.3	tvgj	hand-sewn	180 min	4 day	10 day	no
2	balu	49	m	benign goo	11.5	4.5	tvgj	stapler	120 min	4 days	10 days	no
3	shanmugam	54	m	benign goo	10.2	3.9	tvgj	hand-sewn	200 min	4 days	10 days	no
4	murali	42	m	benign goo	11	4.2	tvgj	stapler	130 min	3 days	8 days	no
5	gopi	57	m	benign goo	10.5	3.9	tvgj	hand-sewn	180 min	4 days	9 days	no
6	sivaraj	60	m	benign goo	10.2	3.5	tvgj	stapler	130 min	4 days	10 days	no
7	mayakannan	45	m	benign goo	11.3	4.4	tvgj	hand-sewn	190 min	4 days	8 days	no
8	subramaniyam	58	m	benign goo	10.6	3.8	tvgj	stapler	120 min	4 days	9 days	no
9	kanniyappan	47	m	benign goo	11	4.1	tvgj	hand-sewn	180 min	3 days	10 days	no
10	lakshmi	55	f	benign goo	10.1	3.5	tvgj	stapler	140 min	4 days	8 days	no
11	subramani	65	m	benign goo	10.2	3.5	tvgj	hand-sewn	190 min	3 days	9 days	no
12	palani	75	m	benign goo	10	3.3	tvgj	stapler	120 min	3 days	8 days	no
13	mariyam mal	60	f	benign goo	10.2	3.5	tvgj	hand-sewn	200 min	3 days	10 days	no
14	narayanan	55	m	benign goo	10.8	3.8	tvgj	stapler	140 min	3 days	10 days	no
15	shakunthala	60	f	carcinoma stomach	10.3	3.6	agj	hand-sewn	150 min	4 days	12 days	no
16	paduvittan	65	m	carcinoma stomach	10.8	3.8	agj	stapler	100 min	3 days	12 days	no
17	mani	75	m	carcinoma stomach	10.2	3.5	agj	hand-sewn	140 min	4 days	14 days	no
18	rajamanikam	75	m	carcinoma stomach	10	3.5	agj	stapler	100 min	4 days	13 days	no
19	abdhul lathif	65	m	carcinoma stomach	11.2	4.5	agj	hand-sewn	160 min	3 days	12 days	no
20	ayyakannu	62	m	carcinoma stomach	10.6	3.9	agj	stapler	110 min	4 days	11 days	no
21	kasi	65	m	carcinoma stomach	10.3	3.6	agj	hand-sewn	150 min	4 days	12 days	no
22	subramani	63	m	carcinoma stomach	10.8	3.8	agj	stapler	110 min	4 days	11 days	no
23	thayammal	62	f	carcinoma stomach	11	4.1	agj	hand-sewn	140 min	3 days	13 days	no
24	thandavarayan	72	m	carcinoma stomach	10.2	3.5	agj	stapler	100 min	3 days	12 days	no
25	pattabi	66	m	carcinoma stomach	11.3	4.3	agj	hand-sewn	150 min	3 days	11 days	no
26	renuammal	63	f	carcinoma stomach	10.6	3.8	agj	stapler	110 min	4 days	13 days	no
27	palani	60	m	carcinoma stomach	11.2	4.3	agj	hand-sewn	160 min	4 days	12 days	no
28	nagamma l	60	f	carcinoma stomach	10.1	3.5	agj	stapler	110 min	4 days	11 days	no
29	murugesan	62	m	carcinoma stomach	11.4	4.4	agj	hand-sewn	160 min	4 days	11 days	no
30	krishnan	72	m	carcinoma stomach	10	3.5	agj	stapler	100 min	4 days	13 days	no
31	raman	69	m	carcinoma stomach	10.4	3.5	agj	hand-sewn	150 min	4 days	12 days	no

32	sulochana	60	f	carcinoma stomach	10.5	3.6	agj	stapler	110 min	4 days	11 days	no
33	soundharavalli	60	f	carcinoma stomach	10.2	3.5	agj	hand-sewn	160 min	4 days	13 days	no
34	ranganathan	58	m	carcinoma stomach	11	4.1	agj	stapler	110 min	3 days	12 days	no
35	ellappan	57	m	carcinoma stomach	11.4	4.3	billroth-II	hand-sewn	210 min	3 days	13 days	no
36	kusaelan	52	m	carcinoma stomach	11.8	4.5	billroth-II	stapler	150 min	3 days	12 days	no
37	mani	59	m	carcinoma stomach	11.1	4.1	billroth-II	hand-sewn	230 m	3 days	13 days	no
38	padhmavathy	51	f	carcinoma stomach	10.8	3.9	billroth-II	stapler	160 min	4 days	13 days	no
39	kailasam	50	m	carcinoma stomach	11.2	4.1	billroth-II	hand-sewn	210 min	4 days	12 days	no
40	moorthy	52	m	carcinoma stomach	10.6	3.8	billroth-II	stapler	160 min	4 days	13 days	no
41	veeramani	47	m	carcinoma stomach	11.4	4.4	billroth-II	hand-sewn	220 m	3 days	12 days	no
42	govindaraj	50	m	carcinoma stomach	10.2	3.5	billroth-II	stapler	150 min	4 days	14 days	no
43	rani	50	f	carcinoma stomach	10.8	3.7	billroth-II	hand-sewn	240 min	4 days	13 days	no
44	vijayabaskar	40	m	carcinoma stomach	11.8	4.5	billroth-II	stapler	160 min	3 days	12 days	no
45	annamali	40	f	carcinoma stomach	10.6	3.8	billroth-II	hand-sewn	210 min	4 days	13 days	no
46	murugan	43	m	carcinoma stomach	10.8	3.9	billroth-II	stapler	170 min	4 days	13 days	no
47	mariyammal	47	f	carcinoma stomach	11	4	billroth-II	hand-sewn	220 min	3 days	12 days	no
48	mary	50	f	carcinoma stomach	10.4	3.5	billroth-II	stapler	150 min	4 days	13 days	no
49	annappan	50	m	carcinoma stomach	10.8	3.6	billroth-II	hand-sewn	210 min	4 days	13 days	no
50	ramesh	39	m	carcinoma stomach	11.5	4.5	billroth-II	stapler	160 min	3 days	11 days	no
51	rajam	55	f	carcinoma stomach	10.2	3.5	billroth-II	hand-sewn	210 min	4 days	14 days	no
52	shabdhean	47	m	carcinoma stomach	11.1	4	billroth-II	stapler	150 min	3 days	12 days	no
53	natarajan	55	m	carcinoma stomach	10.5	3.7	billroth-II	hand-sewn	230 min	4 days	13 days	no
54	palanivel	57	m	carcinoma stomach	10.2	3.5	billroth-II	stapler	170 min	4 days	14 days	no
55	gowri	55	f	carcinoma stomach	10	3.5	billroth-II	hand-sewn	220 min	4 days	15 days	no
56	karpagam	45	f	carcinoma stomach	10.8	3.8	billroth-II	stapler	160 min	4 days	12 days	no
57	srinivasan	45	m	carcinoma stomach	11	3.9	billroth-II	hand-sewn	230 min	3 days	12 days	no
58	sekar	45	m	carcinoma stomach	11.2	4.1	billroth-II	stapler	150 min	3 days	12 days	no
59	madathy	57	f	carcinoma stomach	10	3.5	billroth-II	hand-sewn	210 min	4 days	14 days	no
60	kala	50	f	carcinoma stomach	10.2	3.5	billroth-II	stapler	160 min	4 days	13 days	no
61	bakthavatchalam	55	m	carcinoma stomach	10.4	3.7	billroth-II	hand-sewn	220 min	4 days	12 days	no
62	murugavalli	40	f	carcinoma stomach	10.2	3.5	billroth-II	stapler	150 min	4 days	12 days	no
63	chandrasekar	57	m	carcinoma stomach	10.5	3.6	billroth-II	hand-sewn	210 min	4 days	13 days	no
64	pattu	39	f	carcinoma stomach	11	4.1	billroth-II	stapler	140 min	3 days	12 days	no
65	govindhammal	45	f	carcinoma stomach	10.4	3.5	billroth-II	hand-sewn	230 min	4 days	13 days	no
66	syedali	49	m	carcinoma	10.2	3.5	billroth-II	stapler	150 min	4 days	13 days	no

				stomach								
67	narayanasamy	55	m	post ileostomy status	11	4.1	ileostomy closure	hand-sewn	150 min	3 days	8 days	no
68	subramani	42	m	post ileostomy status	11.2	4.3	ileostomy closure	stapler	120 min	3 days	8 days	no
69	muthukumar	38	m	post ileostomy status	11.5	4.4	ileostomy closure	hand-sewn	160 min	3 days	9 days	no
70	anand	34	m	post ileostomy status	11.6	4.5	ileostomy closure	stapler	110 min	3 days	8 days	no
71	rajaram	58	m	post ileostomy status	10.4	3.6	ileostomy closure	hand-sewn	150 min	4 day	9 days	no
72	nagaraj	30	m	post ileostomy status	11.6	4.5	ileostomy closure	stapler	100 min	4 days	8 days	no
73	puthiyappan	55	m	post ileostomy status	10.4	3.6	ileostomy closure	hand-sewn	160 min	4 days	8 days	no
74	paramasivam	47	m	post ileostomy status	10.2	3.5	ileostomy closure	stapler	110 min	4 days	9 days	no
75	pakiri	45	m	post ileostomy status	11	4	ileostomy closure	hand-sewn	170 min	3 days	9 days	no
76	kalaivannan	35	m	post ileostomy status	11.4	4.1	ileostomy closure	stapler	110 min	3 days	8 days	no
77	chandra	50	f	post ileostomy status	10.6	3.7	ileostomy closure	hand-sewn	150 min	4 days	8 days	no
78	meenakshi	30	f	post ileostomy status	11	4	ileostomy closure	stapler	100 min	3 days	9 days	no
79	jinna	58	m	post ileostomy status	10.4	3.7	ileostomy closure	hand-sewn	160 min	4 days	9 days	no
80	ganapathy	29	m	post ileostomy status	11.8	4.5	ileostomy closure	stapler	110 min	3 days	9 days	no
81	suresh	29	m	post colostomy status	11.6	4.5	colostomy closure	hand-sewn	180 min	3 days	30 days	yes
82	murugesan	55	m	post colostomy status	10.2	3.5	colostomy closure	stapler	120 min	4 days	10 days	no
83	selvaraj	47	m	post colostomy status	10.8	3.7	colostomy closure	hand-sewn	190 min	4 days	9 days	no
84	anushya	50	f	post colostomy status	10	3.5	colostomy closure	stapler	130 min	4 days	9 days	no
85	poongodi	28	f	post colostomy status	11.2	4.1	colostomy closure	hand-sewn	180 min	3 days	10 days	no
86	chengam mal	60	f	post colostomy status	10	3.5	colostomy closure	stapler	140 min	4 days	30 days	yes
87	prathap	43	m	post colostomy status	10.2	3.5	colostomy closure	hand-sewn	190 min	4 days	9 days	no
88	mari	42	f	post colostomy status	10.6	3.7	colostomy closure	stapler	130 min	4 day	10 days	no
89	maheswari	52	f	ca.ascending colon	10.1	3.6	rt.hemicol ectomy	hand-sewn	270 min	4 days	15 days	no

90	chellakutti	75	m	ileo-caecal growth	10	3.5	rt.hemicolectomy	stapler	200 min	4 days	30 days	yes
91	rani	58	f	ca.rt.colon	10.2	3.6	rt.hemicolectomy	hand-sewn	290 min	4 days	15 days	no
92	nagalingam	54	m	ca.caecum	10.8	3.8	rt.hemicolectomy	stapler	210 min	4 days	14 days	no
93	ravi	50	m	ca.ascending colon	10.5	3.7	rt.hemicolectomy	hand-sewn	280 min	4 day	15 days	no
94	anandhi	45	f	ca.descending colon	10.8	3.8	lt.hemicolectomy	stapler	210 min	4 days	15 days	no
95	kannayan	65	m	ileo-caecal growth	10.3	3.6	rt.hemicolectomy	hand-sewn	280 min	4 days	14 days	no
96	kala	49	f	sigmoid colon growth	10.2	3.5	lt.hemicolectomy	stapler	200 min	4 day	15 days	no
97	saroja	65	f	ca.ascending colon	10	3.5	rt.hemicolectomy	hand-sewn	270 min	4 day	15 days	no
98	rajkumar	41	m	ileo-caecal growth	10.7	3.8	rt.hemicolectomy	stapler	210 min	4 day	14 days	no
99	venkatesan	55	m	ca.descending colon	10	3.5	lt.hemicolectomy	hand-sewn	290 min	4 days	30 days	yes
100	ganesan	48	m	sigmoid colon growth	10.5	3.6	lt.hemicolectomy	stapler	220 min	4 days	14 days	no