ANALYSIS OF ADVANTAGES OF SINGLE LAYER Vs DOUBLE LAYER ANASTOMOSIS OF BOWEL

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CERTIFICATE

This is to certify that the dissertation entitled **"ANALYSIS OF ADVANTAGES OF SINGLE LAYER Vs DOUBLE LAYER ANASTOMOSIS OF BOWEL"** submitted by **Dr. K.S. GOKULNATH PREMCHAND** to the faculty of General Surgery, The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfillment of the requirement for the award of M.S. Degree (Branch I) General Surgery is a bonafide work carried out by him during the period of July 2008 to June 2010 under my direct supervision and guidance.

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DECLARATION

I, Dr. K.S. GOKULNATH PREMCHAND solemnly declare that the dissertation titled **"ANALYSIS OF ADVANTAGES OF SINGLE LAYER Vs DOUBLE LAYER ANASTOMOSIS OF BOWEL"** at Govt. Rajaji Hospital has been prepared by me. This is submitted to **The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** in partial fulfillment of the requirement for the award of M.S. Degree (Branch I) General Surgery, examination to be held in April 2011.

Place : Madurai.

Date : **Dr. K.S. GOKULNATH PREMCHAND**

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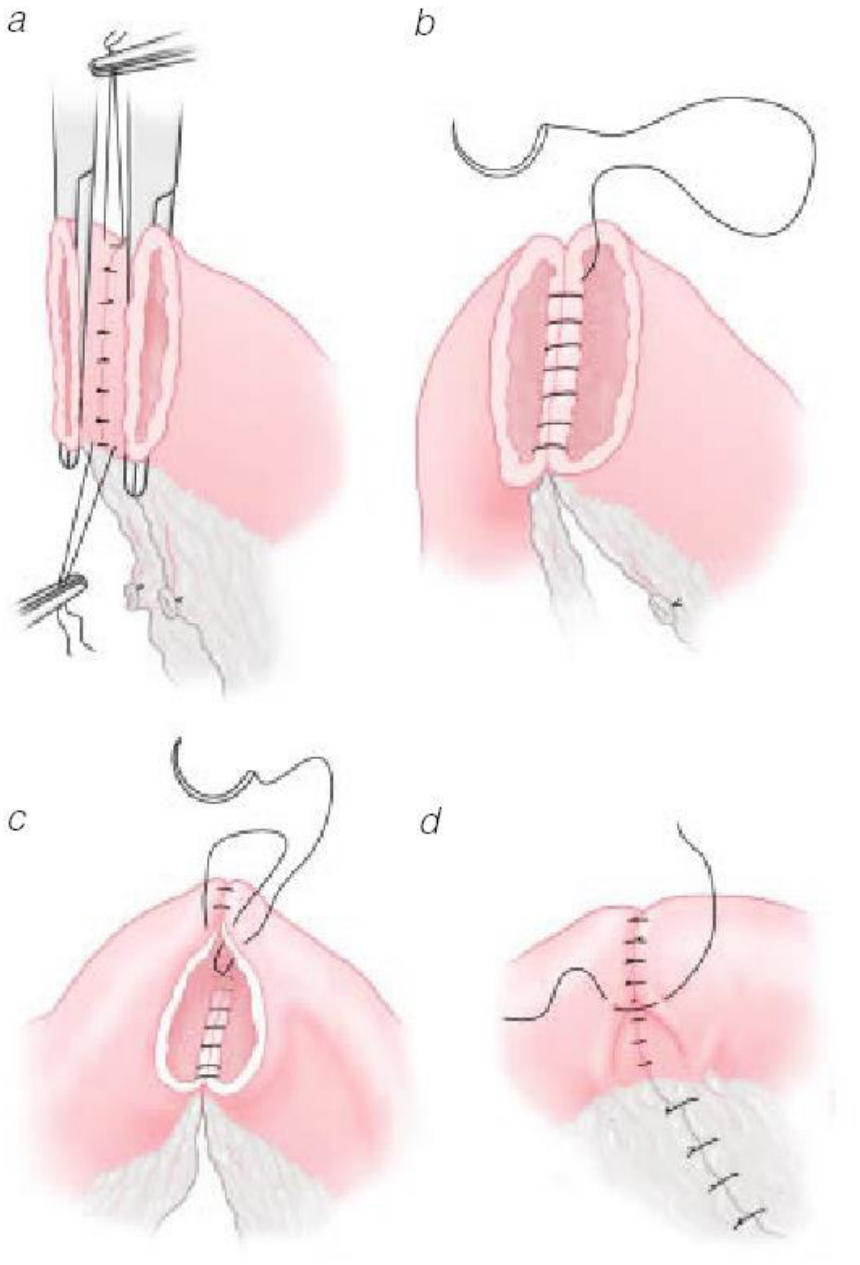
CONTENTS

INTRODUCTION

In the modern day surgical practice, we come across situations in abdominal surgery, where we require resection and anastomosis of bowel.

In small bowel resection and anastomosis, conventionally, two layer suturing technique i.e., inner layer with absorbable suture material in continuous fashion and outer layer with non absorbable suture material in a continuous or interrupted fashion, was considered secure.

Recently, it has been advocated that anastomosis of small bowel with a single layer suturing using a non absorbable monofilament suture material in a continuous fashion has the same outcome when compared to double layer suturing technique.



In our study, we have compared the advantages of single layer anastomosis of small bowel, over double layer anastomosis.

AIMS AND OBJECTIVES

Our study aims to study the:

1. Complications of Single layer technique and the Double layer technique in emergency and elective surgeries.

2. Time consumption for performing single layer anastomosis as well as double layer anastomosis.

3. Cost effectiveness of single layer anastomosis.

ANATOMY

The small bowel is a convoluted tube extending from the pylorus of stomach to the ileoceacal valve where it ends in the large bowel.

Small bowel is about 7m in length which gradually diminishes in size from its commencement to its termination.

It is contained in the central and lower part of the abdominal cavity.

It is surrounded above and at the sides by the colon.

It is related anteriorly with the greater omentum and abdominal parietes and is connected to the vertebral column by a fold of peritoneum, the mesentery.

Small intestine is divisible into three portions. The duodenum, the jejunum and the ileum.

Duodenum

The Duodenum has received its name from being about equal in length to the breadth of twelve fingers (25 cm.). It is the shortest, the widest, and the most fixed part of the small intestine, and has no mesentery, being only partially covered by peritoneum.

Its course presents a remarkable curve, somewhat of the shape of an imperfect circle, so that its termination is not far removed from its starting-point.

In the adult the course of the duodenum is as follows: commencing at the pylorus it passes backward, upward, and to the right, beneath the quadrate lobe of the liver to the neck of the gall-bladder, varying slightly in direction according to the degree of distension of the stomach: it then takes a sharp curve and descends along the right margin of the head of the pancreas, for a variable distance, generally to the level of the upper border of the body of the fourth lumbar vertebra.

It now takes a second bend, and passes from right to left across the vertebral column, having a slight inclination upward; and on the left side of the vertebral column it ascends for about 2.5 cm., and then

ends opposite the second lumbar vertebra in the jejunum. As it unites with the jejunum it turns abruptly forward, forming the duodenojejunal flexure.

From the above description it will be seen that the duodenum may be divided into four portions: superior, descending, horizontal, and ascending.

Relations

The superior portion (pars superior; first portion) is about 5 cm. long. Beginning at the pylorus, it ends at the neck of the gall-bladder.

It is the most movable of the four portions.

It is almost completely covered by peritoneum, but a small part of its posterior surface near the neck of the gall-bladder and the inferior vena cava is uncovered; the upper border of its first half has the hepatoduodenal ligament attached to it, while to the lower border of the same segment the greater omentum is connected.

It is in such close relation with the gall-bladder that it is usually found to be stained by bile after death, especially on its anterior surface.

It is in relation above and in front with the quadrate lobe of the liver and the gall-bladder; behind with the gastroduodenal artery, the common bile duct, and the portal vein; and below and behind with the head and neck of the pancreas.

The descending portion (pars descendens; second portion) is from 7 to 10 cm. long, and extends from the neck of the gall-bladder, on a level with the first lumbar vertebra, along the right side of the vertebral column as low as the upper border of the body of the fourth lumbar vertebra.

It is crossed in its middle third by the transverse colon, the posterior surface of which is uncovered by peritoneum and is connected to the duodenum by a small quantity of connective tissue.

The supra- and infracolic portions are covered in front by peritoneum, the infracolic part by the right leaf of the mesentery.

Posteriorly the descending portion of the duodenum is not covered by peritoneum.

The descending portion is in relation, in front, from above downward, with the duodenal impression on the right lobe of the liver,

the transverse colon, and the small intestine; behind, it has a variable relation to the front of the right kidney in the neighbourhood of the hilum, and is connected to it by loose areolar tissue; the renal vessels, the inferior vena cava, and the Psoas below, are also behind it.

At its medial side is the head of the pancreas, and the common bile duct; to its lateral side is the right colic flexure.

The common bile duct and the pancreatic duct together perforate the medial side of this portion of the intestine obliquely some 7 to 10 cm. below the pylorus; the accessory pancreatic duct sometimes pierces it about 2 cm. above and slightly in front of these.

The horizontal portion (pars horizontalis; third or preaortic or transverse portion) is from 5 to 7.5 cm. long.

It begins at the right side of the upper border of the fourth lumbar vertebra and passes from right to left, with a slight inclination upward, in front of the great vessels and crura of the diaphragm, and ends in the ascending portion in front of the abdominal aorta.

It is crossed by the superior mesenteric vessels and the mesentery.

Its front surface is covered by peritoneum, except near the mid line, where it is crossed by the superior mesenteric vessels.

Its posterior surface is uncovered by peritoneum, except toward its left extremity, where the posterior layer of the mesentery may sometimes be found covering it to a variable extent.

This surface rests upon the right crus of the diaphragm, the inferior vena cava, and the aorta. The upper surface is in relation with the head of the pancreas.

The ascending portion (pars ascendens; fourth portion) of the duodenum is about 2.5 cm long.

It ascends on the left side of the aorta, as far as the level of the upper border of the second lumbar vertebra, where it turns abruptly forward to become the jejunum, forming the duodenojejunal flexure.

It lies in front of the left Psoas major and left renal vessels, and is covered in front, and partly at the sides, by peritoneum continuous with the left portion of the mesentery.

The superior part of the duodenum, as stated above, is somewhat

movable, but the rest is practically fixed, and is bound down to neighbouring viscera and the posterior abdominal wall by the peritoneum. In addition to this, the ascending part of the duodenum and the duodenojejunal flexure are fixed by a structure to which the name of Musculus suspensorius duodeni has been given. This structure commences in the connective tissue around the coeliac artery and left crus of the diaphragm, and passes downward to be inserted into the superior border of the duodenojejunal curve and a part of the ascending duodenum, and from this it is continued into the mesentery.

It possesses, according to Treitz, plain muscular fibers mixed with the fibrous tissue of which it is principally made up. It is of little importance as a muscle, but acts as a suspensory ligament.

Jejunum & Ileum

The part of the small intestine from the end of the duodenum is called as Jejunum & ileum. Proximal two fifth forms the jejunum and the distance three fifth forms the ileum.

Even though there is no morphological line of distinction between jejunum and ileum the character of the small intestine gradually undergoes a change from the commencement of the jejunum to the end of

the ileum so that a portion of the bowel taken from these two situations would present characteristic and marked differences.

The jejunum is wider (diameter about 4cm) and thicker, more vascular and a deeper colour than the ileum, so that a given length weighs more.

The circular folds otherwise called as Valvulae Conniventes of is mucous membrane are large and thickly set and its villi are larger than in the ileum and are smaller and tend to assume a circular form.

By grasping the jejunum between the finger and the thumb the circular folds can be felt through the walls of the gut: these being absent in the lower part of the ileum, it is possible in this way to distinguish the upper from the lower part of the small intestine.

The ileum is narrow (diameter 3.75 cm) and its coats thinner and less vascular than those of the jejunum.

It has few circular folds and are small and disappear entirely towards its lower end but aggregated lymph nodules (Peyer's patches) are larger and more numerous.

The jejunum for the most part occupies the umbilical and left iliac regions while the ileum occupies chiefly the umbilical, hypogastric, right iliac and pelvic regions.

The terminal part of the ileum usually lies in the pelvis from which it ascends over the right Psoas and right iliac vessels: it ends in the right iliac fossa by opening into the medial side of the commencement of the large intestine.

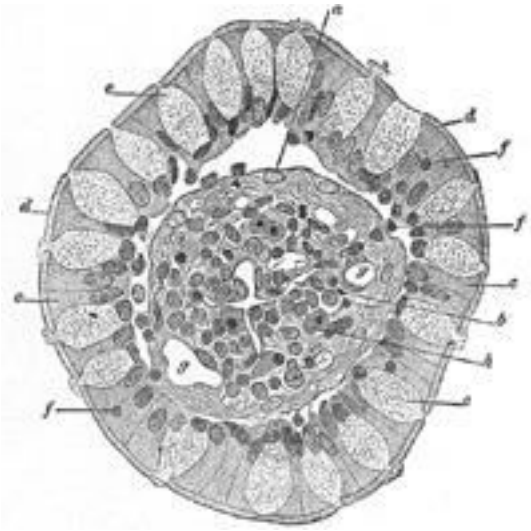
The jejunum and ileum are attached to the posterior abdominal wall by an extensive fold of peritoneum, the mesentery which allows the free motion so that each coil can accommodate itself to changes in form and position.

The mesentery is a fan shaped structure. Its posterior border or root is about 15cm in length and is attached to the posterior abdominal wall from the left side of the body of the second lumbar vertebra to the right sacroiliac joint, crossing successively the horizontal part of the duodenum, the aorta, the inferior venacava, the ureter and right psoas muscle.

The breadth of the ileum between its vertebral and intestinal borders averages about 20 cm and is greater in the middle than at its upper and lower ends.

According to Lockwood, it tends to increase in breadth as age advances. Between the two layers of which it is composed are contained blood vessels, nerves, lacteals and lymph glands together with a variable amount of fat.

Transverse section of a villus from the human intestine.



Transverse section of a villus, from the human intestine.

a. Basement membrane, here somewhat shrunken away from the epithelium.

b. Lacteal.

c. Columnar epithelium.

d. Its striated border.

e. Goblet cells.

f. Leucocytes in epithelium.

f'. Leucocytes below epithelium.

g. Bloodvessels.

h. Muscle cells cut across.

Structure of the small intestine

The wall of the small intestine is composed of four coats.

1. Serous
2. Muscular
3. Sub mucous
4. Mucous

The serous coat is derived from the peritoneum. The superior portion of the duodenum is almost completely surrounded by this membrane near its pyloric end but is only covered in front at the other extremity.

The rest of the small intestine is surrounded by the peritoneum excepting along its attached or mesenteric border here a space is left for the vessels and nerves to pass to the gut.

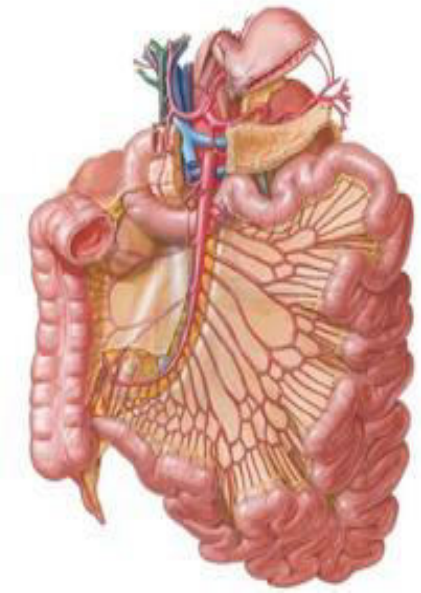
The muscular coat consists of two layers of unstriped fibres an outer longitudinal and an inner circular layer. The muscular coat is thicker at the upper than at the lower part of small intestine.

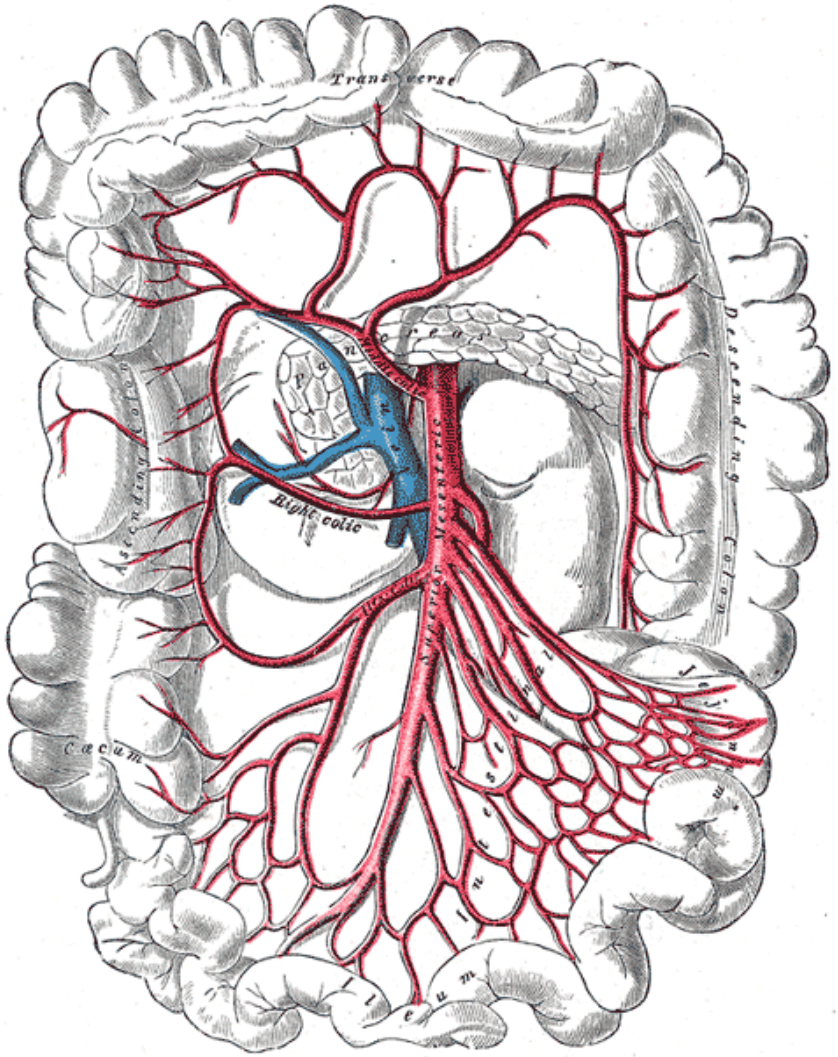
The mucous membrane is thick and highly vascular at the upper part of the small intestine; but somewhat paler and thinner below.

Next to the sub mucous coat is a double layer of unstriped muscular fibres outer longitudinal and inner circular the muscularis mucosae internal to this is a quantity of retiform tissue enclosing in its meshes lymph corpucles and in this the blood vessels and nerves ramify.

Lastly is the basement membrane supporting a single layer of epithelial cells which throughout the intestine are columnar in character. At their superficial or unattached ends they present a distinct layer of highly refracting material, marked by vertical straie, the striated border.

Blood supply of the jejunum and the ileum.





Arterial Supply

- The arteries to the jejunum and ileum arise from the **superior mesenteric artery**, the 2nd of the **unpaired branches of the abdominal aorta**.

- This artery usually arises at the level of **L1 vertebra**, about **1 cm inferior to the coeliac trunk**, and posterior to the body of the pancreas.

- There are **15-18** jejunal and ileal branches that arise from the left side of the **superior mesenteric artery**.
- These arteries pass between the two layers of mesentery and unite to form **loops** or **arches** called **arterial arcades**.
- From these, **vasa recta** (L. Straight vessels) arise.

Venous Drainage

- The **superior mesenteric vein** drains the jejunum and ileum.
- This accompanies the **superior mesenteric artery**, lying **anterior and to its right** in the root of the mesentery.

- This vein unites with the **splenic vein** to form the **portal vein**.

Lymphatic Drainage of the Jejunum and Ileum

- The **lacteals** in the intestinal villi empty their milk-like fluid (L. *Lactis*, milk) into a plexus of lymph vessels in the walls of the jejunum and ileum.
- These lymph vessels pass between the two layers of mesentery to the **mesenteric lymph nodes**.
- From here, the lymph drains ultimately to the **thoracic duct**.

Innervation of the Jejunum and Ileum

- The innervation is through the **superior mesenteric plexus** extensions along the arteries.
- The **sympathetic supply** is from the **greater splanchnic** and **lesser splanchnic nerves**.
- The **parasympathetic supply** is from the **posterior vagal trunk via the coeliac plexus**.

Difference between jejunum and ileum :

	Jejunum	Ileum
Position	Upper left abdomen	Lower right abdomen
Extent	2/5	3/5
External feel and Appearance	Thick, wide, vascular	Thin, narrow, pale
Peyer's patches	Few	Many
Vascular arcades	Few	Many
Vasa recti	Long	Short
Mesenteric fat	Less	More

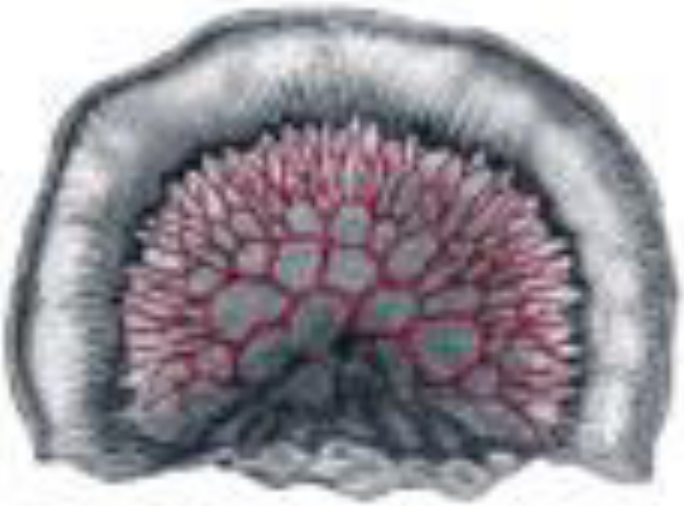
Arterial arcades

THREE FEET FROM DJ FLEXURE

SIX FEET FROM DJ FLEXURE

NINE FEET FROM DJ FLEXURE

TWELVE FEET FROM DJ FLEXURE



SEVENTEEN FEET FROM DJ FLEXURE

TWENTY FEET FROM DJ FLEXURE

DEVELOPMENT OF THE GUT

The gut is an endoderm-derived structure. At approximately the sixteenth day of human development, the embryo begins to fold ventrally (with the embryo's ventral surface becoming concave) in two directions: the sides of the embryo fold in on each other and the head and tail fold toward one another.

The result is that a piece of the yolk sac, an endoderm-lined structure in contact with the ventral aspect of the embryo, begins to be pinched off to become the primitive gut.

The yolk sac remains connected to the gut tube via the vitelline duct. Usually this structure regresses during development; in cases where it does not, it is known as Meckel's diverticulum.

During fetal life, the primitive gut can be divided into three segments: foregut, midgut, and hindgut. Although these terms often are used in reference to segments of the primitive gut, they nevertheless are used regularly to describe components of the definitive gut as well.

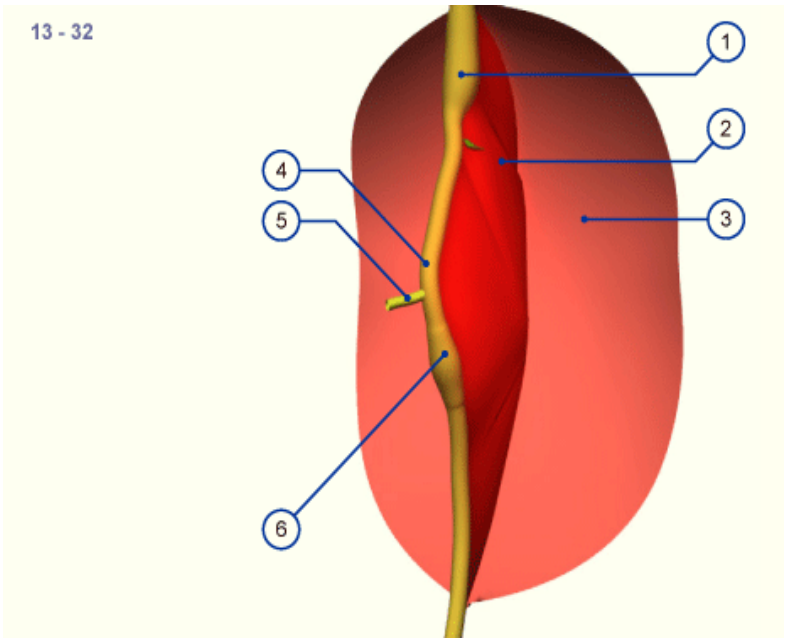
Each segment of the gut gives rise to specific gut and gut-related structures in later development. Components derived from the gut proper, including the stomach and colon, develop as swellings or dilatations of the primitive gut.

In contrast, gut-related derivatives—that is, those structures that derive from the primitive gut, but are not part of the gut proper—in general develop as outpouchings of the primitive gut. The blood vessels supplying these structures remain constant throughout development.

Part	**Part in adult**	**Gives rise to**	**Arterial supply**
Foregut	the pharynx, to the upper duodenum	pharynx, esophagus, stomach, upper duodenum, respiratory tract (including the lungs), liver, gallbladder, and pancreas	branches of the celiac artery
Midgut	lower duodenum, to the first two-thirds of the transverse colon	lower duodenum, jejunum, ileum, cecum, appendix, ascending colon, and first two-thirds of the transverse colon	branches of the superior mesenteric artery
Hindgut	last third of the transverse colon, to the upper part of the anal canal	last third of the transverse colon, descending colon, rectum, and upper part of the anal canal	branches of the inferior mesenteric artery

Intestinal rotation: 32 days

The midgut begins to extend into the umbilical coelom and forms the umbilical loop, whereby initially from the apex only a wide connection to the **umbilical vesicle** exists. In the further development this junction becomes constricted to become the omphalomesenteric duct. Mostly it is later obliterated, but can also partially remain as a Meckel's diverticulum. In the beginning the umbilical loop is positioned sagittally.

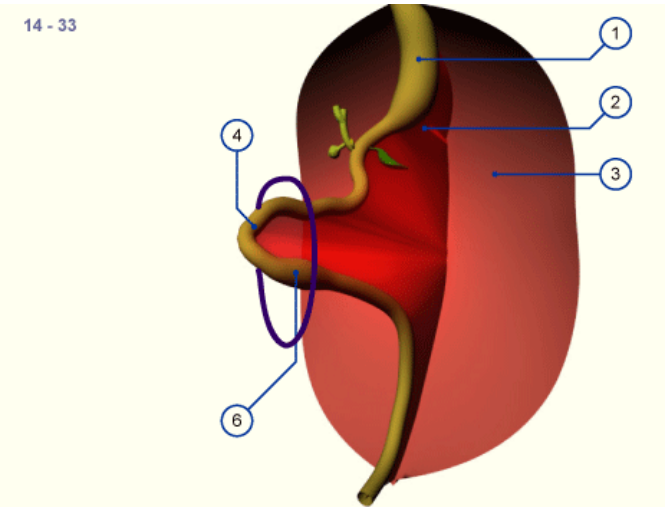


The intestinal tube becomes enwrapped by the visceral peritoneum that connects it to the posterior body wall forming the dorsal mesenterium (red surface). In this stage the intestinal tube is almost straight and is connected to the umbilical vesicle by the omphalo-mesenteric duct.

1 Stomach
2 Mesenterium
3 Parietal peritoneum
4 Intestinal loop
5 Omphalomesenteric duct
6 Caecum

Intestinal rotation : 33 days

Only when the **umbilical loop** lengthens and grows into the **umbilical coelom** does it experience a **rotation of 90 degrees in a clockwise direction** as seen from the embryo. The cranial pedicle comes to lie to the right and the caudal to the left. The umbilical loop now has a **horizontal position**. Through the cranio-caudal growth gradient, the cranial pedicle forms first through lengthening of several loops in the umbilical coelom.

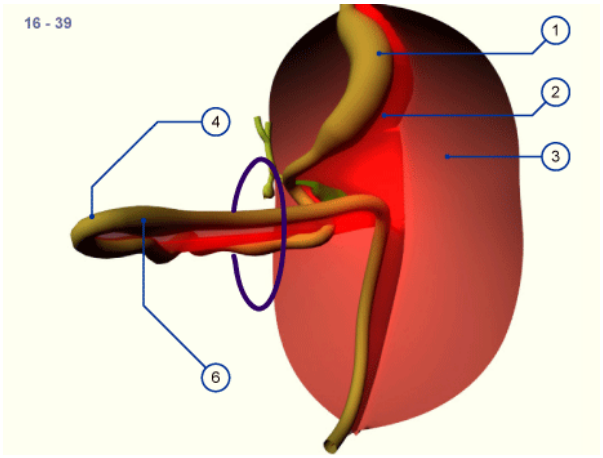


The navel opening is schematically indicated by the blue ring. The developing intestines invade the abdominal space, gliding into it.

1 Stomach
2 Mesenterium
3 Parietal peritoneum
4 Intestinal loop
6 Caecum

Intestinal rotation: 39 days

The developing umbilical loop extends further into the umbilical coelom because there is no more room for it within the embryo's abdominal cavity. It is the time of the strongest flexion of the embryo. Very soon a thickening in the region of the caudal pedicle of the intestinal tube is also to be seen: the **caecum**. Visually, it becomes an important fixed point for purposes of orientation.

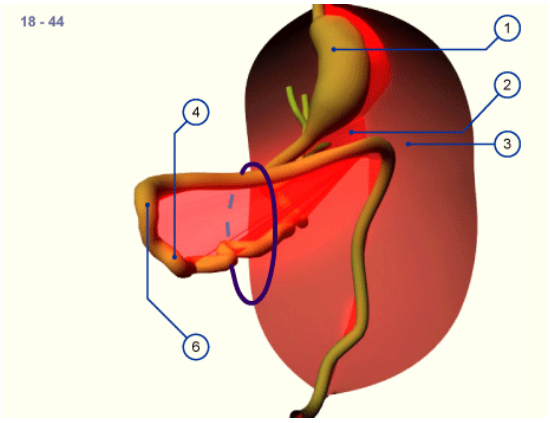


The entire intestinal loop has relocated in the umbilical coelom due to the limited space conditions in the abdominal cavity. The intestinal loop now has a horizontal orientation and the lengthening tube has formed several loops in the cranial pedicle. The caudal part is still straight.

1 Stomach
2 Mesenterium
3 Parietal peritoneum
4 Intestinal loop
6 Caecum

Intestinal rotation : 44 days

As development proceeds the intestinal loop turns further around its **own axis**. The extension of the intestinal loop into the umbilical coelom has reached its maximum. This **physiologic navel hernia** remains in existence up to the 9th week of pregnancy. (Omphalocele / umbilical hernia)



The largest part of the intestinal loop lies in the umbilical coelom and several loops have formed through the lengthening in the cranial, small intestine region.

1 Stomach
2 Mesenterium
3 Parietal peritoneum
4 Intestinal loop
6 Caecum

PRINCIPLES OF INTESTINAL ANASTOMOSIS

Successful intestinal anastomosis depends on the following:

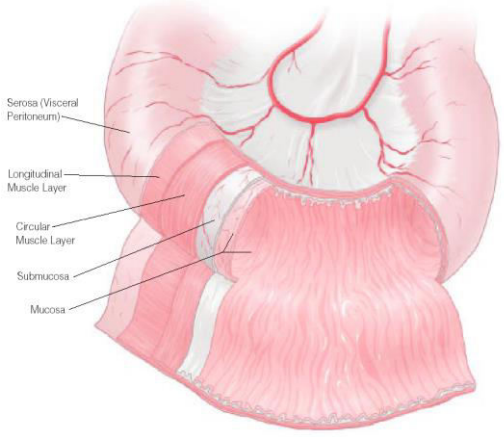
1. Meticulous technique.
2. Well nourished patient with no systemic ileus.
3. No faecal contamination either within the gut or in the surrounding peritoneal cavity.
4. Adequate exposure and access.
5. Good vascularity of the tissue.
6. Absence of tension at the anastomotic site.
7. Layer to layer approximation.

Healing of intestinal anastomosis :

It depends upon the

- Strength of bowel wall – sub mucosa.
- Strongest component i.e., collagenous – connective tissue.

Collagen is the single most important molecule for determining intestinal strength secreted from fibroblast.



Collagen turn over

- Degradation of mature collagen begins in the first 24 hrs.
- Predominate for the first 4 days.
- By 1 week, collagen synthesis is the dominant force.
- After 5 to 6 weeks, no significant increase in the amount of collegen in a healing anastomosis.
- Local infection increases collegenase activity and reduces levels of circulating collagenase inhibitors.

Collagen synthetic capacity

- Relatively uniform throughout the large bowel less in the small intestine.
- Synthesis is significantly higher in the proximal and distal small intestine than in the mid jejunum.
- Overall collagen synthetic capacity is somewhat less in the small intestine.
- No strength difference in ileal and colonic anastomosis at 4 days.
- Colonic collagen formation is much greater in the first 48 hrs.

REVIEW OF LITERATURE

The basic principles of the intestinal suture were established more than 100 years ago by Travers, Lambert and Halsted and have undergone notifications the passage of time. In 1926, Lembert, described a suturing technique in which serosal opposition was done. Senn described two layered interrupted anastomosis while Halsted advocated one layer anastomosis. Number of techniques have been devised at different times. Yet single layer or double layer anastomosis is of operating surgeon's choice.

The objectives against double layered anastomosis is that in most of the cases it fails to oppose correctly and it results in large amount of ischaemic tissue within suture line which increases the chances of necrosis and that of leakage.

Narrowing of lumen is more in double layer than in single layer anastomosis.

Single layer anastomosis carries least damage to submucosal vascular plexus and chances of narrowing of lumen incorporates strongest sub mucosal layer and accurate tissue opposition.

Two layer anastomosis was done by Larry in the 19th century. Historically two layer anastomosis using interrupted silk sutures for an outer inverted seromuscular layer and a running absorbable suture for a transmural inner layer has been standard for most surgical situations.

Some recent reports have described single layer continuous anastomosis using monofilament sutures as requiring less time and cost than any other method without incurring any added risk of leakage.

The single layer continuous anastomosis is a contemporary innovation first described by Hautefeuille in 1967. In the USA, Allen et al first mentioned this technique.

Length of surgery was less in single layer than in two layer anastomosis and lesser trauma was caused in single layer anatomosis.

It took less time when compared to double layer anastomosis.

It caused lesser narrowing of the intestinal lumen.

It promoted more rapid vascularisation and mucosal healing.

It increased the strength of the anastomosis.

It improved post operative return to normal bowel function. Many surgeons probably now use single layer suture due to reduction in

ischemic, tissue nerves or narrowing of the lumen compared to two layer methods.

Systematic reviews of Non-randomized controlled trials comparing Single Vs Double layer anastomosis of small bowel found no difference between anastomotic leak rates. These studies evaluated results of intestinal anastomosis in urgent and elective patients among the two methods of single or double layer anastomosis.

MATERIALS & METHODS

All adult patients requiring intestinal anastomosis at Govt. Rajaji Hospital from July 2008 to June 2010 were considered eligible.

Totally 60 patients were included in our study. 30 patients under went single layer anastomosis and 30 patients underwent double layer anastomosis.

Patients who underwent elective or emergency surgery were included in our study.

Based on a careful history and meticulous physical examination, combined with adjunctive investigations, a decision to operate urgently or electively was taken.

Baseline laboratory parameters like blood urea, blood sugar, serum creatinine, serum electrolytes, blood grouping and typing were done in all the cases, to rule out co morbid conditions.

Evaluation of patients with Acute abdomen

Immediately after receiving the patient, primary survey was done, which included resuscitation secondary survey included definitive management.

Definitive Management

Ultra sonogram abdomen and CT scan abdomen was not done as a routine diagnostic investigation; however few cases were subjected to the same in view of the special circumstances.

A proforma of each case including the age, sex and an accurate history was compiled. Personal history of previous surgery, alcohol or drug intoxication were specifically sought for. Plain X-ray abdomen, Chest X-ray PA view and four quadrant aspiration were done in required patients.

All the patients received in emergency situations were resuscitated with Ringer Lactate solution and or blood or both before surgical intervention and were mandatorily maintained on Nasogastric suction, continuous bladder drainage with the help of Foley's catheter, intravenous fluid replacement and broad spectrum antibiotics. Postoperative complications were specifically sought for and treated appropriate as and when they arose. Elective patients were investigated appropriately before surgery.

Technique of Small Bowel Anastomosis

In double layer anastomosis we performed two layer anastomosis using a 2/0 vicryl continuous suturing for inner mucosal layer and a 2/0 silk interrupted for outer seromuscular layer.

The affected segment of bowel was divided between clamps and resected.

The bowel ends were cleaned with a betadine swab and approximated. All two layer anastomosis were constructed using interrupted 2/0 silk Lembert sutures for the outer layer and a running 2/0 polyglycolic acid suture for the transmural inner layer.

All single layer anastomosis were constructed using a continuous 2/0 silk double needle suture that began at the antimesenteric border. Bite was taken such that it included whole of serosa and part of mucosa so that mucosa got approximated. Each bite included 4 to 6 mm of the seromuscular wall; the larger bits were used at the mesenteric border to ensure an adequate seal. Each stitch was advanced approximately 5 mm.

To avoid ischemia of the anastomosis the surgeon had to ensure that only adequate pressure was applied to the suture while following to approximate the end of the bowel and render the anastomosis air tight.

Air tightness of the anastomosis was checked by dipping the anastomotic site into normal saline. If there was air leak interrupted sutures with 2/0 silk was made at the site of air leak.

The time recorded for the construction of the anastomosis began with the placement of the first stitch and ended with cutting the excess material from the last stitch.

Anastomotic failure was defined as a fistula documented radio graphically or by the finding of a non absorbable suture material draining from the wound after oral administrations or a visible disruption of the suture line during re exploration.

The complication of wound infection, anastomotic leak, fistula, intra abdominal abscess formation were also included in the analysis because they are potentially related to the anastomosis.

Post Operative care

Like all patients undergoing abdominal surgery early post operative mobilisations was encouraged to reduce the potential risk for development of deep vein thrombosis and pulmonary embolism.

In those who underwent elective surgery identification of high risk patients, particularly those with cardiac and respiratory disease and those undergoing an extensive procedure was done.

On the first post operative day, serum proteins were measured and fresh frozen plasma and Injection Human Albumin were transfused in patients with hypoproteinaemia. Their Hemoglobin status was checked and compatible blood transferred accordingly.

All the patients who underwent ileal resection and end to end anastomosis and Truncal Vagotomy with Posterior Gastrojejunostomy whether it is single layer or double layer were started sips of oral fluids on the 4^{th} or 5^{th} post operative day once the patients passed flatus and bowel sounds were heard. Till then they were maintained Nil per mouth, continuous nasogastric suction and intravenous fluids. We observed earlier return of bowel sounds in patients who underwent single layer anastomosis.

On the 5^{th} or 6^{th} post operative day, after tolerating oral fluids we started soft diet.

Bowel surgery involving anastomosis particularly in the emergency setting, has the potential for development of complications.

Good surgical technique and appropriate decision making at the time of intervention reduces the potential for postoperative problems.

The ideal anastomosis is one, which does not leak, does not obstruct, and facilitates restoration of normal bowel function within a few days of reconstruction. The greatest morbidity and mortality is not with the development of postoperative bowel complications but with delays in recognising problems and instituting management.

Apart from ileus, the postoperative intestinal problems that one may encounter include mechanical obstruction, anastomotic dehiscence, intra abdominal abscess formation and fistula formation.

Intolerance to oral intake, development of peritonitis, pain, or systemic evidence of sepsis, should raise the possibility of suture dehiscence. This usually occurs in the first few postoperative days and may give rise to a controlled fistula or peritoneal soiling. This contamination may be localized (intra abdominal abscess) or generalized resulting in septicaemia and multiorgan failure.

With the advancement of radiological techniques the vast majority of localized intraabdominal abscesses can be successfully drained using percutaneous techniques.

Failure to improve despite percutaneous drainage is an indication for an open procedure. Gastrografin dye is useful in identifying anastomotic leakages and obstructions. If there were a high index of suspicion for suture dehiscence, such as diffuse peritonitis or systemic deterioration, re-exploration of the abdomen becomes essential.

In our study one patient in each group developed intra abdominal abscess. As they did not respond to conservative line of management we performed exploratory laparotomy.

Inter-loop abscesses were drained and anastomotic breakdowns were defunctioned by fashioning an appropriate stoma. Re-suturing leaking bowel in the presence of peritoneal contamination exposes the patient to an unacceptable mortality rate. Enterocutaneous fistulae were best managed conservatively in the initial period. A stoma bag was placed over the cutaneous opening and gastrograffin studies were instigated to identify the origin of the fistulous tract. We inserted a central line, commenced TPN, and allowed only clear fluids. We waited for spontaneous closure of fistula. Immediate re-exploration of a fistula is a recipe for disaster, which may only result in the subsequent development of further fistulae.

In one of our cases a defunctioning stoma was performed for a high-output fistula that did not respond to conservative line of management. After the initial inflammatory process got settled, the patients' nutritional status optimized and after appropriate radiological investigations performed, re-exploration done and fistula dealt with electively.

In patients with Duodenal Ulcer with Gastric Outlet Obstruction, Truncal Vagotomy with Posterior Gastrojejunostomy done in single layer or double layer.

In cases of Ileal Perforation where the patients required resection, unhealthy bowel was resected and end to end anastomosis was performed.

For calculations of the outcome variables of leak, wound infection, fistula formation and time for construction of the anastomosis used the number of anastomosis in each group for the denominator.

Calculations of the cost of materials were based on the actual hospital costs for the suture material used by the surgeons.

For two layer anastomosis one pack of 2/0 vicryl and one pack of 2/0 silk were utilized. For single layer anastomosis, one pack of 2/0 silk was utilized.

All procedures were performed by our unit Chief and Asst. Professors.

All the procedures were approved by the Ethical Committee formed by The Dean, Government Rajaji Hospital, Madurai.

Statistical Tools used in our study

The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using **Epidemiological Information Package (EPI 2008).**

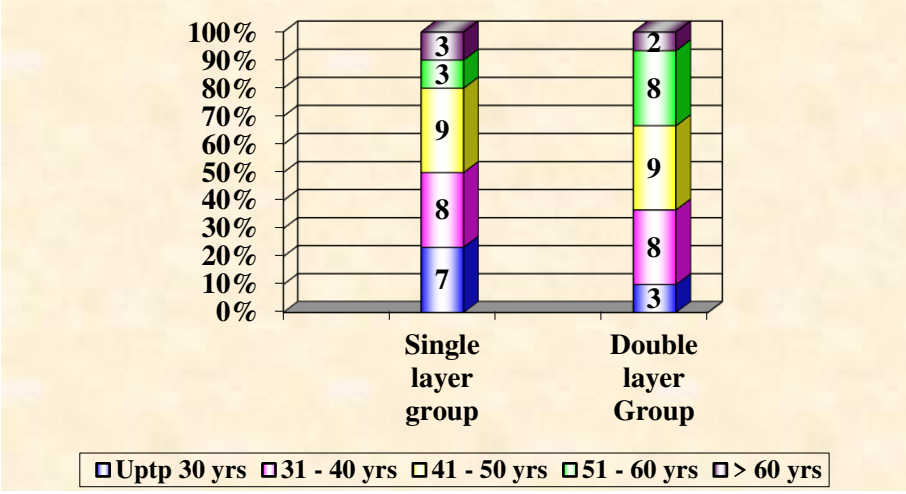
Using this software range, frequencies, percentages, means, standard deviations, chi square and 'p' values were calculated. Kruskul Wallis chi-square test was used to test the significance of difference between quantitative variables. A 'p' value less than 0.05 is taken to denote significant relationship.

RESULTS

We conducted the study in 30 patients with single layer anastomosis and 30 patients with double layer anastomosis from July 2008 to June 2010 at Government Rajaji Hospital, Madurai. The age distribution of the patients is shown in the Table.

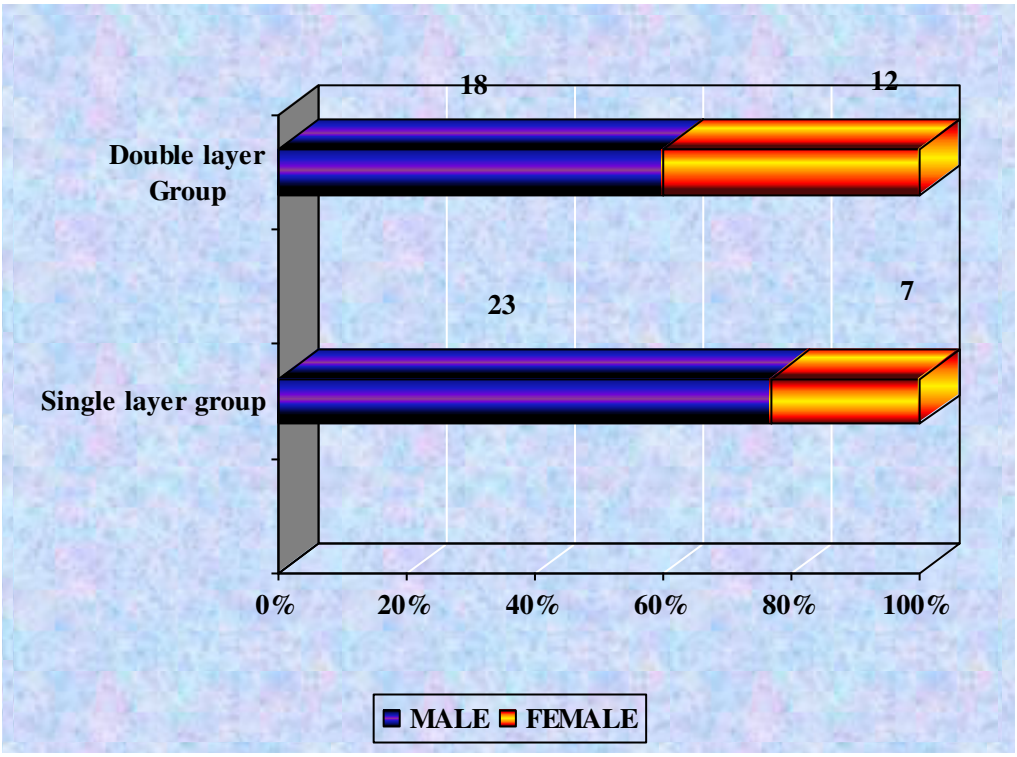
Age in Years	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
upto 30	7	23.3	3	10
31 - 40	8	26.7	8	26.7
41 - 50	9	30	9	30
51 - 60	3	10	8	26.7
Above 60	3	10	2	6.6
Total	30	100	30	100

Range	22 -88 years	28 - 72 years
Mean	41.7 years	45.7 years
SD	13.9 Years	11.4 years
P	0.1272 Not significant	



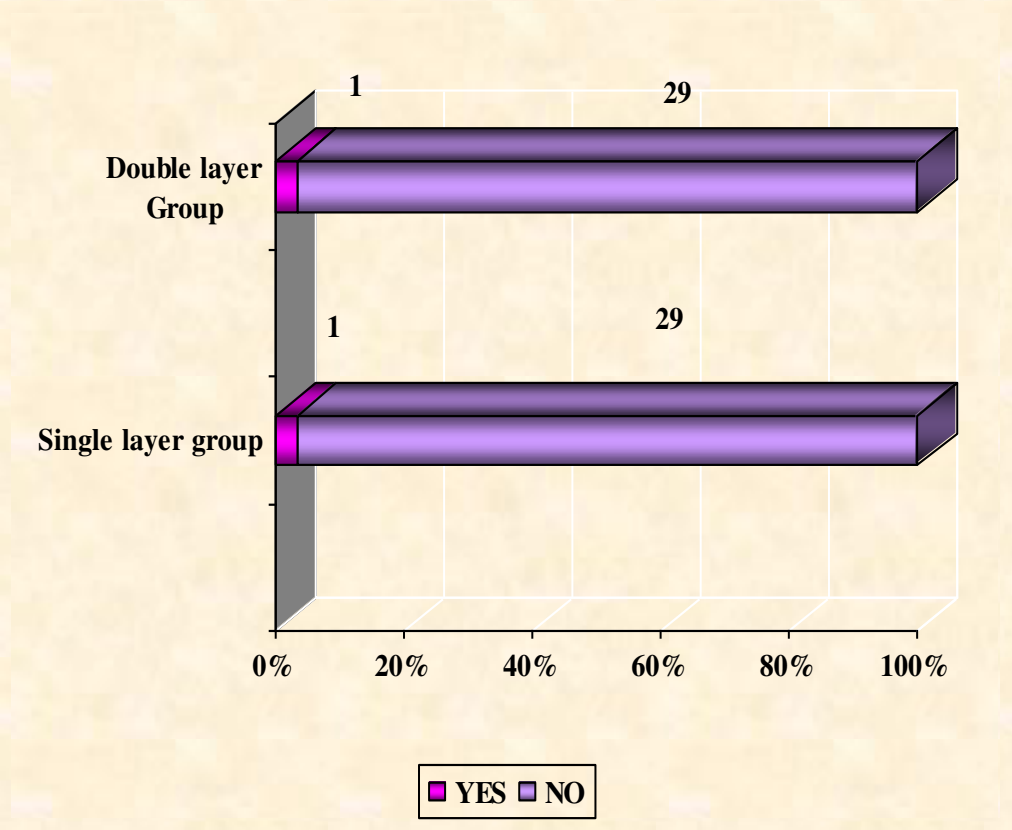
Sex distribution

Sex	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Male	23	76.70	18	60.00
Female	7	23.30	12	40.00
Total	30	100.00	30	100.00
P	0.267 Not significant			



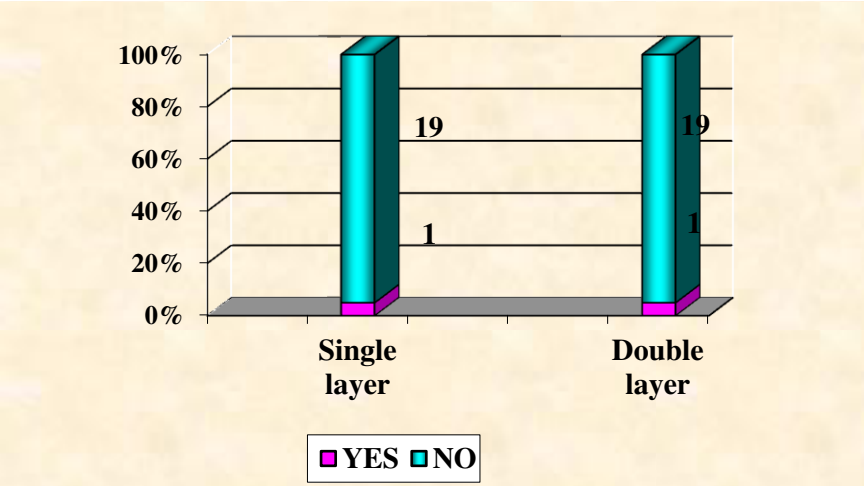
Anastomotic Leak

Anastomotic Leak	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	1	3.30	1	3.30
No	29	96.70	29	96.70
Total	30	100.00	30	100.00
P	0.7542 Not significant			



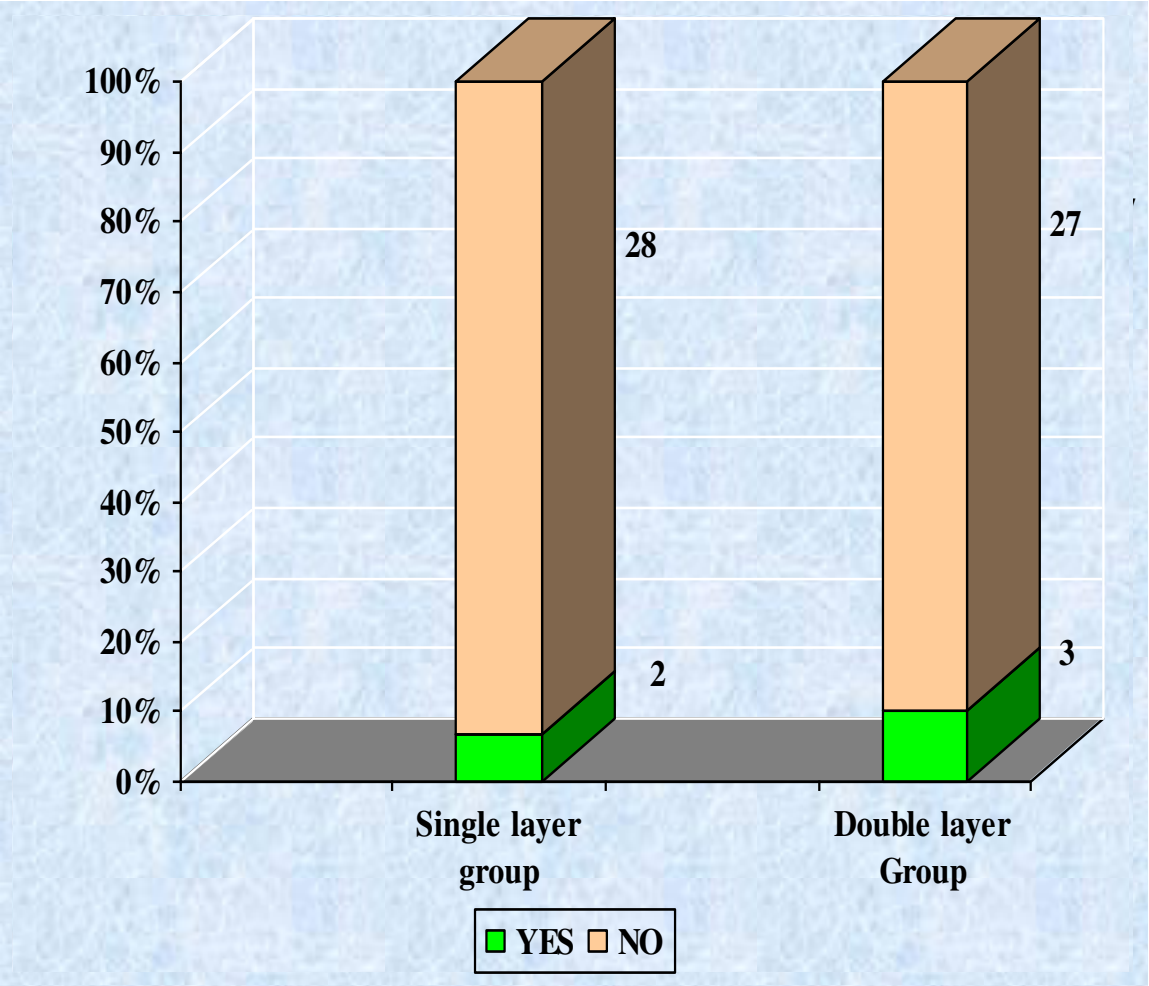
Anastomotic Leak in Emergency cases

Anastomotic Leak	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	1	5.00	1	5.00
No	19	95.00	19	95.00
Total	20	100.00	20	100.00
P	0.7564 Not significant			



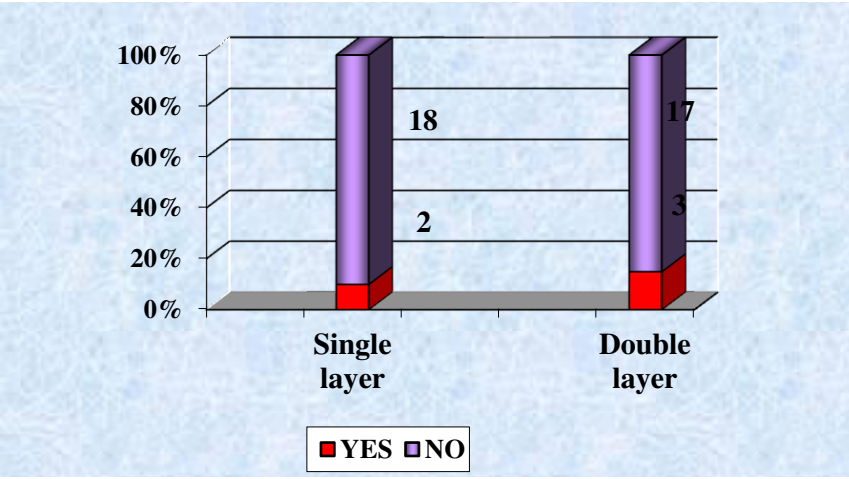
Wound Infection

Wound Infection	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	2	6.70	3	10.00
No	28	93.30	27	90.00
Total	30	100.00	30	100.00
P	0.5 Not significant			



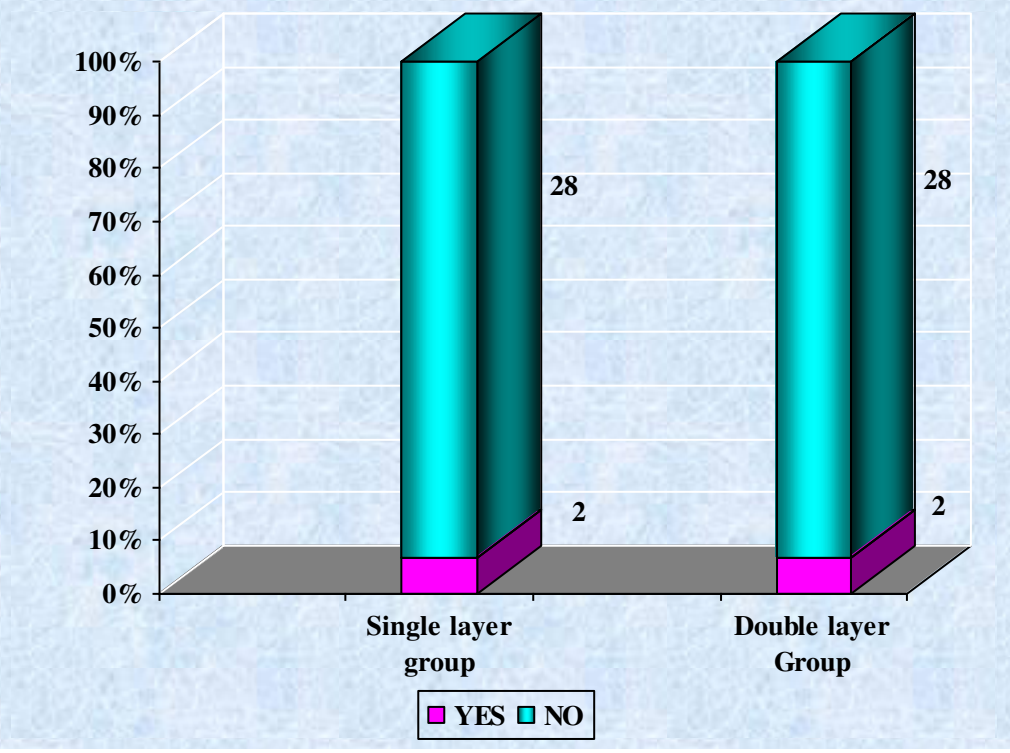
Wound Infection in Emergency cases

Wound Infection	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	2	10.00	3	15.00
No	18	90.00	17	85.00
Total	20	100.00	20	100.00
P	0.5 Not significant			



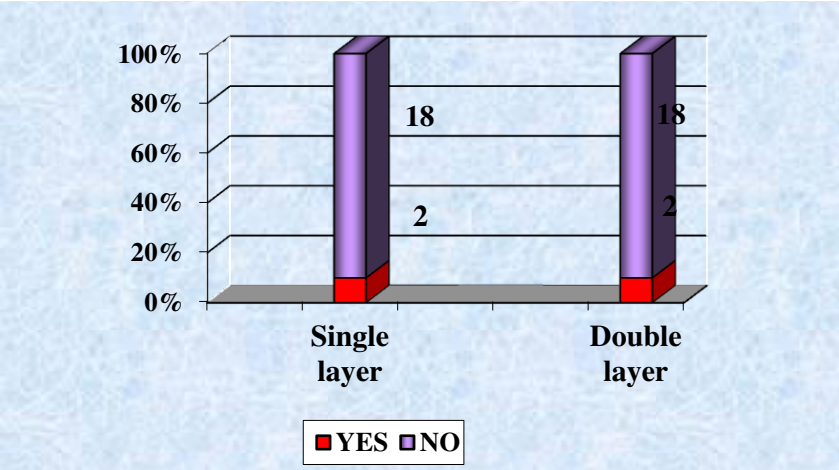
Fistulae formation

Fistulac	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	0	0.00	0	0.00
No	30	93.30	30	96.70
Total	30	93.30	30	96.70
P	0.6944 Not significant			



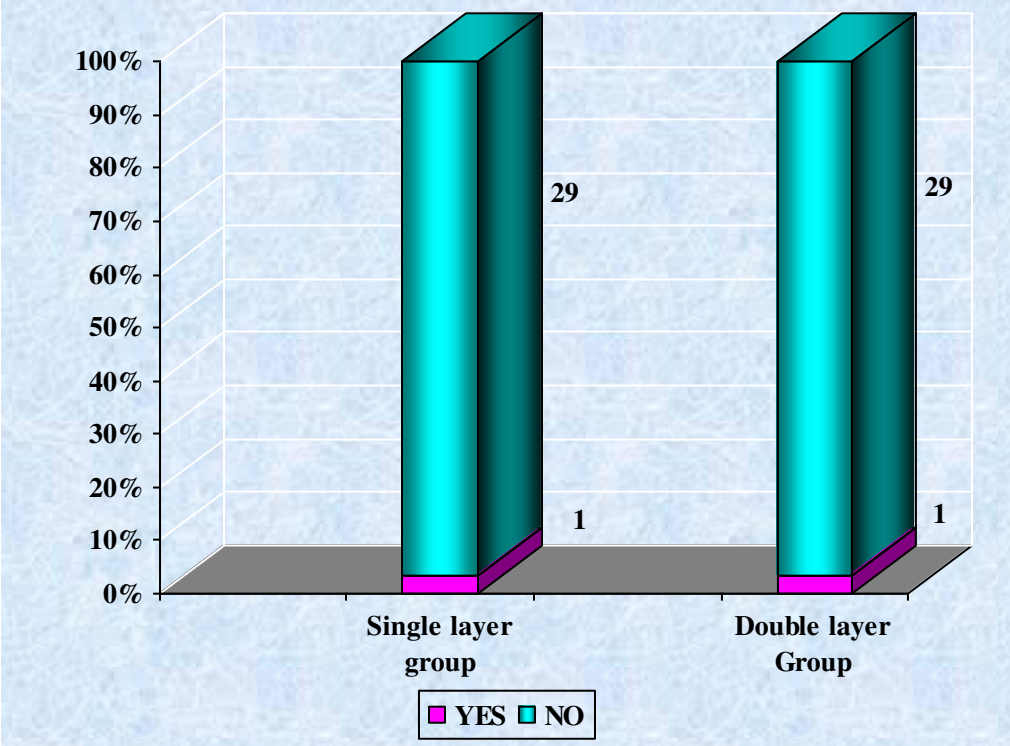
Fistulae formation in Emergency cases

Fistulac	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Yes	2	10.00	2	10.00
No	18	90.00	18	90.00
Total	20	100.00	20	100.00
P'	0.6975 Not significant			



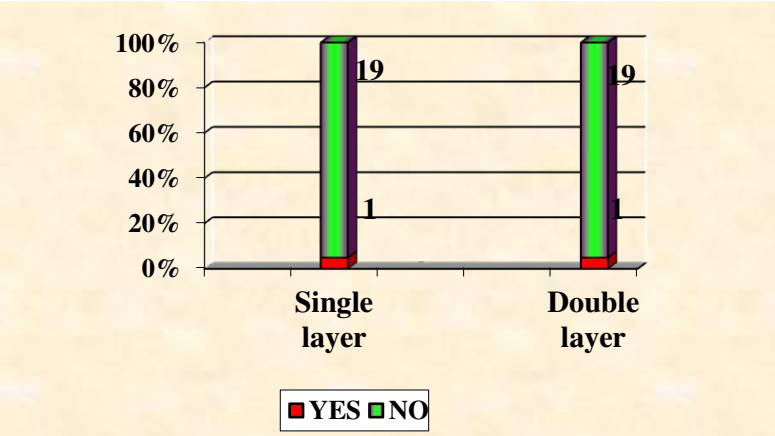
Intra abdominal abscess formation

Abscess	Single Layer		Double Layer	
	No.	Percentage	No.	Percentage
Yes	1	3.30	1	3.30
No	29	96.70	29	96.70
P	0.7542 Not significant			



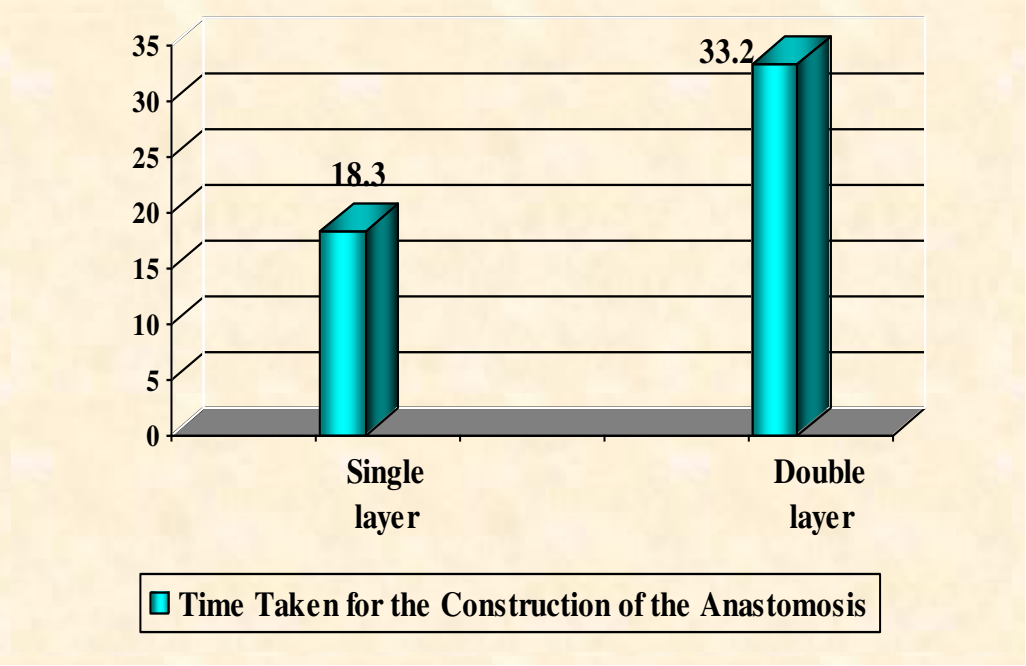
Intra abdominal abscess formation in Emergency cases

Abscess	Single Layer		Double Layer	
	No.	Percentage	No.	Percentage
Yes	1	5.00	1	5.00
No	19	95.00	19	95.00
Total	20	100.00	20	100.00
P	0.7542 Not significant			



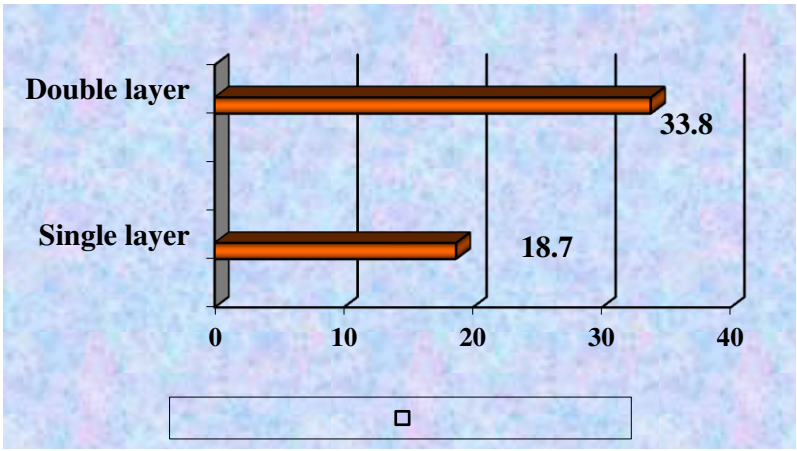
Time Taken for the construction of the Anastomosis

Layer	Time (in minutes)		
	Range	Mean	S.D.
Single	14 – 24	18.30	5.00
Double	24 – 42	33.20	2.80
P	0.0001 Significant		



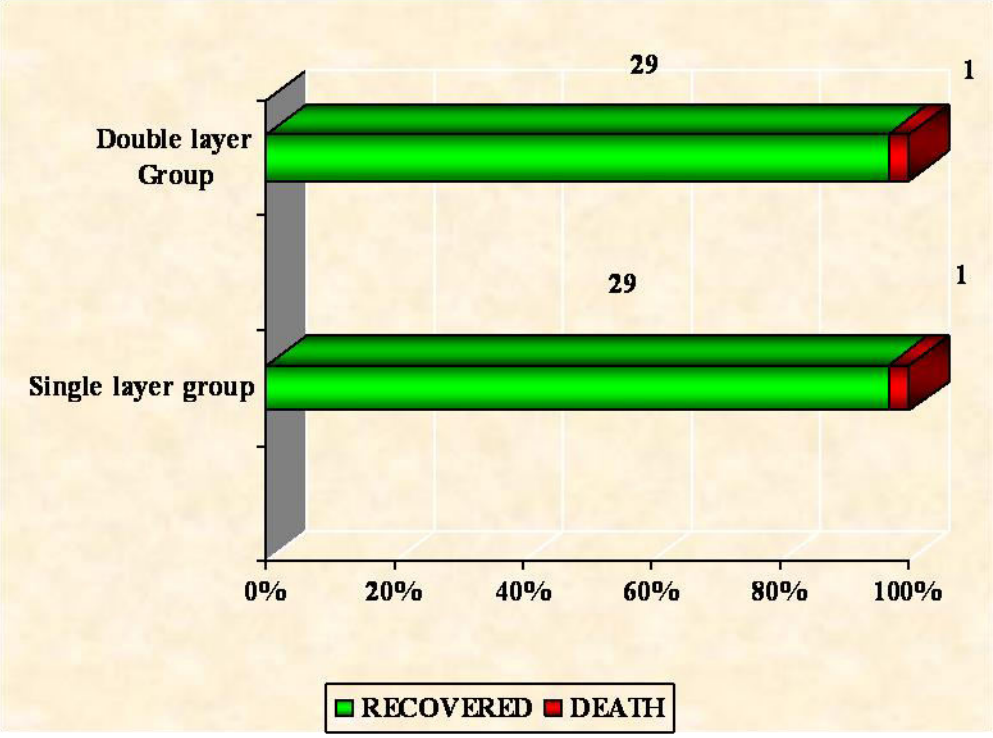
Time Taken for the construction of the Anastomosis in Emergency cases

Layer	Time (in minutes)		
	Range	Mean	S.D.
Single	14 – 24	18.70	4.70
Double	24 – 42	33.80	3.40
P	0.0001 Significant		



Outcome

Outcome	Single Layer		Double Layer	
	Nos	Percentage	Nos	Percentage
Recovered	29	96.70	29	96.70
Death	1	3.30	1	3.30
P	0.7542 Not significant			



DISCUSSION

Our study assessed the efficacy and safety of single and double layer anastomosis after intestinal resection, in emergency and elective situations.

Generally, conventional two layered technique is being practised. But this causes excessive mucosal inversion, causing narrowing of lumen and may lead to ischaemia of anastomotic site.

To overcome this problem little mucosal and complete serosal continuous suturing technique was tried.

It has the advantage of good opposition of serosal surfaces, no luminal narrowing and less damage to submucosal vascular plexus.

In our study, anastomotic leakage in single layer group was 3.3% which is consistent with the other studies which showed leakage in the range of 1.3 to 7.7%. In emergency situations the anastomotic leak rate in single layer group is 5%

The double layer group shows anastomotic leakage around 3.3% again which is consistent with the other studies. In emergency situations the anastomotic leak rate in double layer group 5%.

One intra abdominal abscess occurred (3.3%) in each group. In emergency situations the rate of intra abdominal abscess formation is 5% in each group.

Two patients in each group developed enterocutaneous fistulae.

Wound infection occurred in two patients in single layer group (6.7%) and three patients in double layer group (10%). In emergency situations wound infection rate in single layer group is 10% and that of double layer group is 15%.

One patient in each group died because of associated co-morbidity such as diabetes mellitus, ischaemic heart disease and delay in presentation.

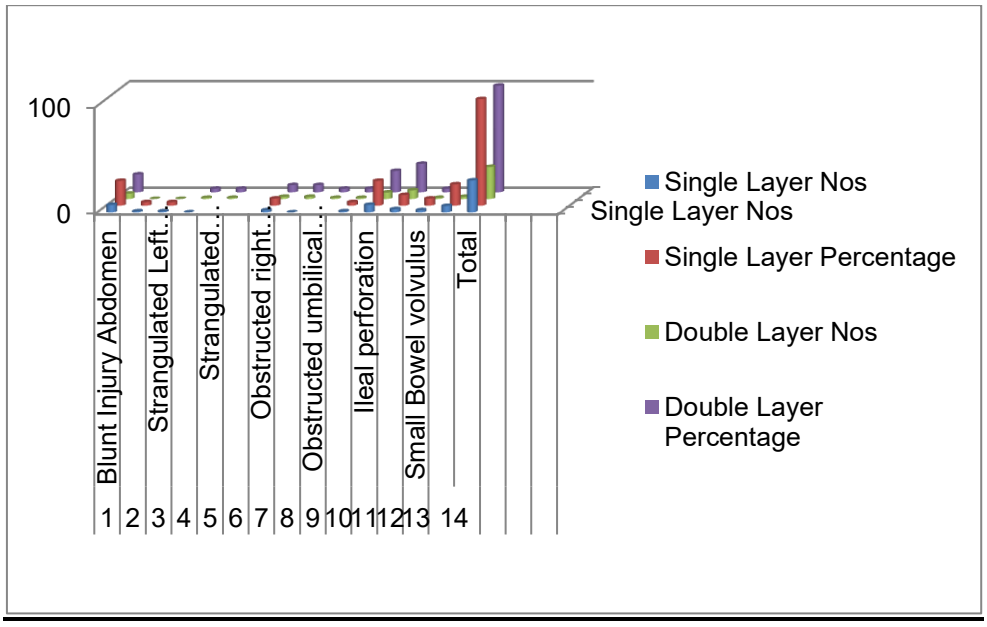
A mean of 18.3 minutes was required to construct a single layer anastomosis and a mean of 33.2 minutes was required to construct a double layer anastomosis. In emergency situations a mean of 18.7 minutes was required to construct a single layer anastomosis and mean of 33.8 minutes was required to construct a double layer anastomosis.

The cost of one 2/0 silk pack is around Rs. 100 and the cost of one 2/0 vicryl pack is around Rs. 360. For the construction of single layer

anastomosis the cost of the material required is around Rs. 100 and that of double layer anastomosis is around Rs. 460.

The following table indicates the various conditions in which patients underwent bowel anastomosis. (Single layer / Double layer)

Sl. No	Diagnosis	Single Layer		Double Layer	
		Nos	Percentage	Nos	Percentage
1	Blunt Injury Abdomen	7	23.30	5	16.70
2	Carcinoma head of pancreas	1	3.30	0	0.00
3	Ileal perforation	14	46.70	12	40.00
4	Left Femoral Hernia	1	3.30	0	0.00
5	Obstructed incisional hernia	0	0.00	3	10.00
6	Obstructed Left inguinal hernia	0	0.00	2	6.70
7	Obstructed Right inguinal hernia	1	3.30	3	10.00
8	Obstructed Umbilical hernia	0	0.00	2	6.70
9	TB Ileal stricture	6	20.00	3	10.00
	Total	30	100.00	30	100.00



CONCLUSION

Among the two methods of small intestinal bowel anastomosis which we have studied, our observations are ;

1. There is no much difference in the development of the complication in both the methods. However the development of complications in emergency situation is more marked in both the methods.
2. The time required to construct a single layer anastomosis is lesser than that of the double layer anastomosis.
3. Narrowing of the lumen of the bowel is lesser in single layer anastomosis when compared to double layer anastomosis.
4. Bowel movements recovered early in single layer anastomosis when compared to double layer anastomosis.
5. Finally, construction of single layer anastomosis of small bowel is cost effective when compared to that of double layer anastomosis.

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PROFORMA

Name :

Age/ Sex : I.P. No.

Address :

Complaints :

H/o injury if any

Pain abdomen / Distension – Duration

Present History of Illness:

H/o fever, constipation,

Past History :

Any previous surgery

Personal History :

Known diabetic + / - , Hypertensive + / - , IHD + / -

General Examination

Pallor + / -

Per Abdomen

Soft Yes / No

Guarding Yes / No

Rigidity Yes / No

Diagnosis :

Investigations :

CXR

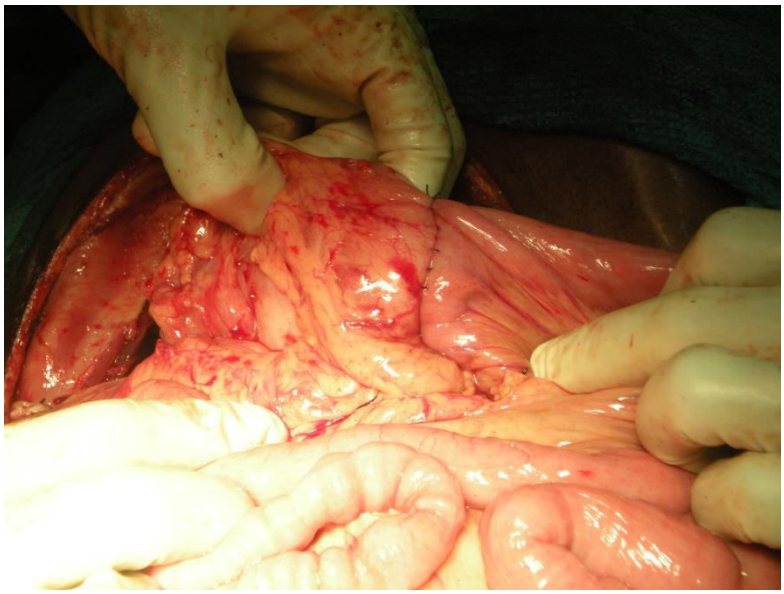
X-ray abdomen erect

USG Abdomen & Pelvis : Free fluid Yes / No

CT Abdomen & Pelvis :

Four quadrant aspiration :

Double layer anastomosis



Single layer anastomosis