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Comparative Study between Laparoscopic Anatomical Repair and Laparoscopic Hybrid Mesh Repair for Ventral Hernias

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I. INTRODUCTION

Hernia is defined as an 'abnormal protrusion of an organ or tissue through a defect in its surrounding walls'. The word hernia is derived from the Greek term 'Hernios'- meaning 'a bud'.

Types of hernia :

1. Groin : i. Inguinal – Direct
Indirect
Femoral
ii. Femoral
2. Anterior: I. Umbilical
II. Epigastric
II. Spigelian
3. Pelvic : I. Obturator.
II. Sciatic
III. Perineal
4. Posterior: Lumbar – Superior

Inferior

A ventral hernia is defined by protrusion through the anterior abdominal wall fascia. These defects can be classified as spontaneous or acquired or by their location on the abdominal wall.

The various types of ventral hernias included in our study include :

1.Epigastric Hernia
2. Umbilical hernia
3. Paraumbilical or Hypogastric hernia
4. Incisional Hernia

Epigastric hernia :

They classically appear between xiphoid process to the umbilicus.

Umbilical hernia :

They usually occur at the umbilicus.

Hypogastric hernias :

Those hernias which occur below umbilicus are termed hypogastric or paraumbilical hernias.

Incisional hernias :

These hernias are of the acquired type. They occur after surgical incisions and are termed as incisional hernia.

Umbilical hernias may be congenital or acquired. They are common in newborns, especially in premature infants. In adults, umbilical hernias occur due to increased intra-abdominal pressure due to pregnancy, obesity or ascites. Females are at higher risk than men.

Conventionally, these hernias are repaired by open techniques which involved both anatomical repairs and mesh repairs. Later on laparoscopic approaches made the surgery more effective by reducing the post-operative pain, hospital stay, avoidance of scar and early return to work and daily activities.

The study is designed to compare the laparoscopic hybrid technique of ventral hernias with polypropylene mesh with laparoscopic anatomical repair.

II. AIMS AND OBJECTIVES

AIM :

The study was undertaken to compare the techniques of laparoscopic hybrid repair of ventral hernias using polypropylene mesh with conventional laparoscopic anatomical repairs.

PRIMARY OBJECTIVE:

To derive the advantages of Laparoscopic Hybrid repair vs conventional laparoscopic anatomical repair with respect to pain after surgery , wound infection, early recurrence and seroma formation.

III. REVIEW OF LITERATURE

There is an increase in incidence of ventral hernias particularly incisional hernias due to increase in elective and emergency surgeries. Incisional hernias account for 15% to 20% of all abdominal wall hernias. Umbilical and epigastric hernias account for 10% of hernias. As a result of increase in laparotomies of almost 4 million performed annually the rate of incisional hernia repair is on the high.

The following are the factors related to ventral hernia formation :

1. Obesity
2. Older age
3. Males
4. Sleep apnoea
5. Emphysema
6. Prostatism

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Wound infection has also been linked to formation of hernia.

The use of suture material to wound length ratio of 4:1 has been shown to significantly reduce incisional hernia formation.[8]

The relationship between initial abdominal incision and incisional hernia formation remains controversial.

1. Midline laparotomy – 3% to 20%
2. Transverse – 7.5%
3. Paramedian – 2.5%

The rate of incisional herniation increases after an operation and doubles if it is associated with wound infection.

The natural history of uncomplicated ventral hernias are variable. Asymptomatic or minimally symptomatic hernias are purposefully observed during two years have a low incidence of complications. Most surgeons recommend that these hernias be repaired when discovered.

ANATOMY OF ANTERIOR ABDOMINAL WALL

The anterior abdominal wall is a complex musculoaponeurotic structure which has attachments to the ribs superiorly, with the vertebral column posteriorly and the bones of the pelvis inferiorly. The blood supply, the lymphatic drainage and the innervation bears the segmental development of the anterior abdominal wall. The occurrence of ventral hernias crucially depend upon the strength of anterior abdominal wall.

Anterior abdominal wall consists mainly of nine layers which is mentioned below :

1. Skin
2. Subcutaneous tissue
3. Scarpa's and Camper's fascia
4. External oblique muscle
5. Internal Oblique muscle
6. Transverse abdominis muscle
7. Transversalis fascia
8. Extraperitoneal adipose tissue
9. Peritoneum

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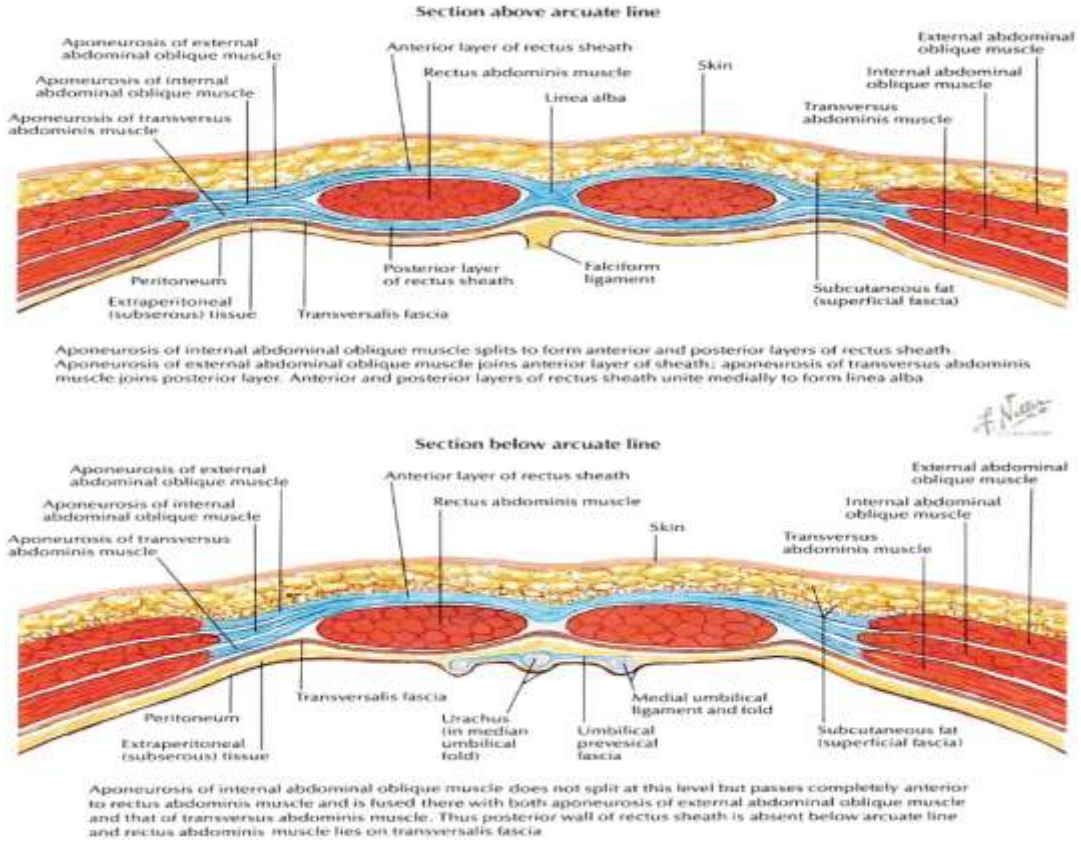

Fig: anatomy of anterior abdominal wall[2]

Ventral hernias occur when there is a weakness in anterior abdominal wall which can be due to a number of factors. Consequently each of the repair measures are aimed at correcting these factors which are responsible for the occurrence of ventral hernias. Their significance increases to a bigger heights while recurrent hernias are taken into account.

In the midline of abdomen the layers of rectus sheath and the muscle are replaced by a thick cord of connective tissue , forming the lilnea alba , which at the umbilicus may reach 1cm in breadth. The umbilical scar contain four of the following fetal structures :

1. The umbilical vein – which passes along the liver along the Suspensory ligament.
2. Two umbilical arteries – passing downward and outward to theBladder.
3. The urachus - passes to the bladder

ANATOMY OF UMBILICAL REGION

The umbilicus represents a midline defect in the linea alba and is one of the potentially weak areas of the abdomen and a relatively common site of herniations.

The typical umbilicus presents a circular cushion or base, which forms the elevated outer margin of an area showing a hollow, from the bottom of which arises an elevation which Catteau known as 'the mamelon'. Situated in or near this elevation is the umbilical scar. Between the mamelon and the umbilical cushion is a definite furrow. The umbilicus is a depression in the skin, at the bottom of which is concealed the cicatrix left by the throwing off of the cord. This cicatrix is drawn inward by the retraction of the umbilical vessels and of the special tissue Whartons jelly which surround them.

The base, cushion, or umbilical hollow is open in front and continuous with the skin of the abdomen in something like 18.75 per cent of the cases. When the surrounding skin inclines gradually toward the umbilical depression by a gentle slope, no prominence can be distinguished. In such cases we are dealing with an umbilicus without cushion. More frequently the base of the umbilical depression is surrounded by a circular elevation, a veritable cutaneous cushion. In about 6

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per cent of the cases this cushion is complete and forms a uniform elevation, completely surrounding the cutaneous orifice of the umbilical depression. Ordinarily it is incomplete and occupies only a portion of the circumference of the umbilicus; for example, half of the circumference, the superior or inferior, or one of its lateral walls. This cushion then takes the form of a halfmoon, a crescent, etc., and gives rise to numerous varieties in the appearance of the umbilicus.

Umbilicus is joined superiorly by round ligament(ligamentum teres) and paraumbilical veins and inferiorly by median umbilical ligament(obliterated urachus).

The bottom of the umbilical depression, despite Catteau's description, is not always occupied by an eminence carrying the cicatrix.

(a) A smooth depression: the bottom absolutely smooth, without any trace of elevation or mamelon. In these cases the umbilical depression was also regular and infundibular in form. They observed two varieties : In the first the umbilical orifice may be large, widely open, presenting at its extreme bottom the cicatrix, smooth or depressed, and having a stellar or linear aspect; in the second the opening is narrow, and one has to separate the folds in order to see the cicatrix which occupies the bottom of the depression.

(b) The mamelon or elevation: In about two-thirds of the cases the bottom of the umbilical depression is occupied by an eminence or mamelon. The form of the eminence shows an infinite variation: sometimes—and this is the rule—it is single, sometimes double, occasionally triple. When the mamelon is double, the two elevations may be juxtaposed, so that a vertical or median depression separates them. When superimposed, the superior elevation is separated from the inferior by a small transverse depression. Usually, however, when the mamelon exists, it is single.

(c)The umbilical cicatrix occupies the bottom of the umbilical depression when the latter is smooth. In the umbilicus with a mamelon in the depression it occupies sometimes the central point; at other times it is on one side of the mamelon. The cicatrix may be punctiform and hardly visible; at other times it is linear and branches in different directions. It may be vertical or more frequently transverse. Sometimes it has a stellar arrangement with a variable number of branches.

(d) The walls of the umbilical depression may present as many variations as the other elements constituting the umbilicus. These variations are chiefly dependent on the depth of the umbilical depression, which itself depends upon the degree of development of the subcutaneous adipose tissue. Hence we find an explanation of the fact that a deep umbilicus is more frequent in women and in stout people

The umbilical cavity varies in size and in form. It can readily be understood that the degree of depth of the umbilical depression, the presence or absence of the central mamelon, and the larger or smaller opening at the base of theskin, will modify entirely the form and dimensions of the cavity of the umbilicus.

There are certain facts worthy to be noted about some of the aspects of umbilicus which can point towards the possible aetiological factors regarding the development of herniations in and around the umbilicus in the paediatric and adult population, namely :

(1) The umbilicus in the coloured race is usually larger than that in the white race. This may be due to the fact that the negro's skin is thicker than that of the white,or possibly to the lack of proper medical attention during labor, resulting in a larger scar.

(2) The umbilicus in the infant is much larger in proportion to the body weight than is that of the adult.

(3) There is no definite relation between the size of the adult and the size of the umbilicus. A small person may have a large umbilicus, and vice versa.

(4) In the adult the depressed umbilicus is far more frequent than the elevated or button-shaped type.

(5) The button is the infantile form.

(6) A large umbilicus of the horizontal type is associated with a wide linea alba,also with diastasis of the recti abdominis muscles. Diastasis of the recti is especially pronounced in infants and children. It is also found at the end of pregnancy when it may lead to the formation of a small hernia.

(7) The linea nigra in a multipara may be in the mid-line or bilaterally displaced at the umbilicus.

(8) The umbilicus of a multipara is, as a rule, more wrinkled, and the periumbilical skin more relaxed in character than in a nullipara

(9) Except for the growth of hair around the navel in the adult male, there are no sexual differences between it and the navel in a nullipara.

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(10) Obesity has a tendency to produce the funnel-shaped umbilicus which is prone for weakness.

HISTOLOGIC APPEARANCE OF THE UMBILICUS :

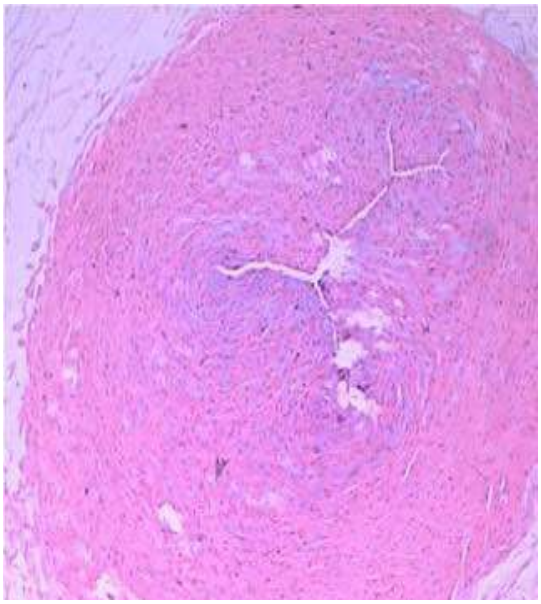

Fig: Histology of umbilicus [7]

As pointed out by Hertz and others, the umbilical pit is at first covered over with squamous epithelium, but is devoid of papillae. Later the epithelium is identical with that of the outer skin. The scar, however, is usually lacking in sebaceous or sweat-glands. According to Hertz, Pernice was able to detect in three infants the remnants of the omphalomesenteric duct in the scar, it being recognized as a canal lined with cylindrical epithelium.

Umbilical hernia occurs when the umbilical scar closes incompletely in the child or fails and stretches in later years in the adult patient. The hernia becomes readily apparent once the abdominal contents move through the umbilical opening given the relative lack of soft tissue in the anterior body wall at the site of the umbilicus.In the adults,however,most of the clinically detected umbilical hernias would be paraumbilical hernias which are usually detected only during the time of the surgery.

Umbilical hernias have been documented throughout history with the first references dating back to the ancient Egyptians with the first known record of a surgical repair by Celsus in the first century AD.

The ebers papyrus ,from approximately 1500 BC detailed the use of truss. The observations in this papyrus are " when you judge a swelling on the surface of the belly ..... what comes out ...caused by coughing ."Umbilical hernias were first described in the first century ,but only in 1740 William Cheslden reported the first repair.

Mayo in 1901 reported the first series of patients to undergo the classic overlapping fascia operation through a transverse umbilical incision using non-absorbable sutures.

Estimates of umbilical hernia present at birth have a wide range. In Caucasian babies, the incidence has been reported at 10-30%, although for unknown reasons it may be several times greater in African-American children.

Umbilical hernia common in premature infants of all races and there is a tendency for familial inheritance.

Strangulation is unusual in most patients. In chronic conditions like chronic ascites strangulation or rupture can occur. This can result in peritonitis and death. Classically, repair was done using vest over pants repair proposed by Mayo. Then, it changed to open mesh repair and now recently laparoscopic repairs.

The laparoscopic repairs requires general anaesthesia and is reserved for large defects and recurrent umbilical hernias.

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EPIGASTRIC HERNIA

These hernias constitute about 3% to 5% of the population. Epigastric hernias are two to three times more common in males. These hernias are located between the xiphoid process and the umbilicus. They are usually within 5 to 6 cm of umbilicus. Epigastric hernias are more common in persons with single aponeurotic decussation.

The defects are small and will cause pain out of proportion because of incarceration of preperitoneal fat. They are multiple in 20% of the patients presenting with anterior abdominal wall swellings. And in those with epigastric hernia approximately 80% are in midline.

Fig: A 72-year-old lady with Epigastric hernia

Fig: A 45-year-old male patient with umbilical hernia

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INCISIONAL HERNIA

Incisional hernias are of great importance which are the result of recent increase in laparotomies. These hernias are most cumbersome to the surgeon and difficult to treat. Incisional hernias occur as a result of excessive tension and inadequate healing of a previous incision, which is associated with wound infection. These hernias enlarge over time leading to ,

1. Pain
2. Bowel obstruction
3. Incarceration
4. Strangulation

The causatives factors for incisional hernias are the Following :

1. Obesity
2. Advanced age
3. Malnutrition
4. Ascites
5. Pregnancy
6. Chronic pulmonary disease
7. Diabetes mellitus
8. Medications (corticosteroids and chemotherapeutic agents)
9. Surgical site infections.

Large hernias often result in loss of abdominal wall domain and make repair difficult. Loss of domain indicate that the abdominal contents are no longer within the abdominal cavity. These make the closure very difficult and the inability is due to :

1. Bowel edema
2. Abdominal packing
3. Peritonitis
4. Repeated laparotomy

With loss of domain the natural rigidity of the abdominal wall is lost and the abdominal wall musculature is retracted. The loss of domain hernias may also result in

1. Bowel edema
2. Stasis of splanchnic venous system
3. Urinary retention and constipation.

The replacement of bowel into the peritoneal cavity may result in many complications including life threatening respiratory dysfunction. The three major complications are:

1. Increased abdominal pressure
2. Abdominal compartment syndrome
3. Acute respiratory failure.

The incisional hernias are staged using a limited number of preoperative variables to accurately predict the two meaningful surgical outcomes: i. surgical site occurrence and

ii. long term recurrence rates.

Fig: A 53-year-old lady with incisional hernia through a PS scar

Incisional hernia staging system:

Stage	Risk	Description
I	Low recurrence Low SSO	< 10 cm clean
II	Moderate recurrence Moderate SSO	< 10 cm , contaminated 10-20 cm , clean

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III	High recurrence High SSO	>/= 10cm contaminated Any >/= 20cm

Types of Operative Repair of Ventral Hernias

There are various approaches of ventral hernia repair. They are broadly classified into two:

1. Open
2. Laparoscopic

Open approaches involves both anatomical closure of the defect and also placement of a mesh. The mesh placement has undergone various modifications in the evolution of ventral hernia repair. The criteria which defines the modality of treatment is

1. If defect is small </= 2 to 3 cm in diameter primary repair can be done.
2. If the defect is large like > 2 to 3 cm in diameter should be repaired with a prosthesis like mesh. If they are closed primarily they have high chances to recur.

Recurrence rate are usually 10% to 50% and are typically reduced by more than 50% by using a prosthetic mesh. The mesh can be placed as an onlay patch to buttress a tissue repair, interposed between fasciae defect or put in a sub lay fashion.

PROSTHETIC MATERIALS FOR VENTRAL HERNIA REPAIR.

The materials used as prosthesis for ventral hernia repair are usually of either of the following two types.

1. Synthetic materials
2. Biological materials.

SYNTHETIC MATERIALS :

There are various synthetic materials are available for reinforcement of anterior abdominal wall after ventral hernia repair. The desirable characteristics of a synthetic mesh should include

1. Being chemically inert.
2. Resistant to mechanical stress.
3. Should maintain compliance
4. Sterilisable
5. Non carcinogenic
6. Hypo allergenic
7. Minimal inflammatory reaction.

Mesh constructs can be classified on the basis of

- Weight of the material
- Pore size
- Water angle

(hydrophobic or hydrophilic)

Presence or absence of anti adhesive barrier

In our thesis we are using a large size macro-porous polypropylene mesh for hybrid reconstruction.

Polypropylene mesh is used because we are placing a mesh in extra peritoneal position without the risk of bowel erosion for which macro-porous mesh would be appropriate. It is semi rigid , flexible and porous. Recently lightweight polypropylene mesh are used.

The definition of light weight mesh is was chosen at less than 50g/m^2 with heavyweight mesh ranging more than 80g/m^2. The lightweight mesh products often have an absorbable component with them like Vicryl or Monocryl. The recurrence rate in the light weight group was more than twice that in the heavyweight group.

Studies also prove that the high rates of bacterial clearance with large pore synthetic mesh when it is exposed to GI flora and methicillin resistant staphylococcus aureus. Another synthetic component is the polyester mesh.

Polyester mesh is composed of polyethylene terephthalate and it is a hydrophilic, heavyweight, macroporous mesh. This mesh has several different weaves that can yield a two-dimensional flat screen like mesh and three-dimensional multifilament weave. When it is placed in the pre-peritoneal position in complex ventral hernia repairs, complication reports are low.

When mesh is placed in an intraperitoneal position, several options are available. A single sheet of mesh with both sides constructed to reduce adhesions and a composite-type mesh with one side made to promote tissue ingrowth and the other to resist adhesion formation are available. Single-sheet mesh is composed of expanded polytetrafluoroethylene (ePTFE). This prosthetic has a visceral side that is microporous (3 µm) and an abdominal wall side that is macroporous (17 to 22 µm) and promotes tissue ingrowth. This product differs from other synthetic meshes in that it is flexible and smooth. Some fibroblast proliferation occurs through the pores, but PTFE is impermeable to fluid. Unlike polypropylene, PTFE is not incorporated into the native tissue. Encapsulation occurs slowly, and infection can occur during the encapsulation process. When it is infected, PTFE almost always must be removed. To promote better tissue integration, composite mesh was developed. This product combines the attributes of polypropylene and PTFE by layering the two substances on top of one another.

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The PTFE surface serves as a permanent protective interface against the bowel and the polypropylene side faces superficially to be incorporated into the native fascial tissue. These materials have variable rates of contraction and, when placed together, can result in buckling of the mesh and visceral exposure to the polypropylene component. Other composite meshes recently have been developed that combine a macroporous mesh with a temporary, absorbable antiadhesive barrier. Basic constructs of these mesh materials include heavyweight or lightweight polypropylene or polyester.

Absorbable barriers are typically composed of oxidized regenerated cellulose, omega-3 fatty acids, or collagen hydrogels. A number of small animal studies have validated the antiadhesive properties of these barriers, but currently no human trials exist evaluating the ability of these composite materials to resist adhesion formation.

BIOLOGICAL MATERIALS:

Biologic prostheses for ventral hernia repair are nonsynthetic, natural tissue mesh. There are numerous biologic grafts available for abdominal wall reconstruction (Table 44-4). These products can be categorised on the basis of the source material (e.g., human, porcine, bovine), post-harvesting processing techniques (e.g., cross-linked, non–cross-linked), and sterilisation techniques (e.g., gamma radiation, ethylene oxide gas sterilisation, non sterilised). These products are largely composed of acellular collagen and theoretically provide a matrix for neo-vascularization and native collagen deposition. These properties may provide advantages in infected or contaminated cases in which synthetic mesh is thought to be contraindicated. Ideal placement techniques are yet to be defined for these relatively new products; however, some general principles apply. These products function best when used as a fascial reinforcement rather than as a bridge or interposition repair.51 The long-term durability of biologic mesh has recently been questioned in the largest series of biologic mesh use in a contaminated setting.52 There are no prospective randomized data comparing the effectiveness of these natural tissue alternatives with that of synthetic mesh repairs in various settings of complex hernia repairs.

OPERATIVE REPAIRS:

There are various techniques of mesh placements in open technique. They are mentioned as follows used as per surgeon's convenience.

1. Onlay or Overlay
2. Inlay
3. Underlay
4. Retrorectus
5. Preperitoneal
6. Inter muscular

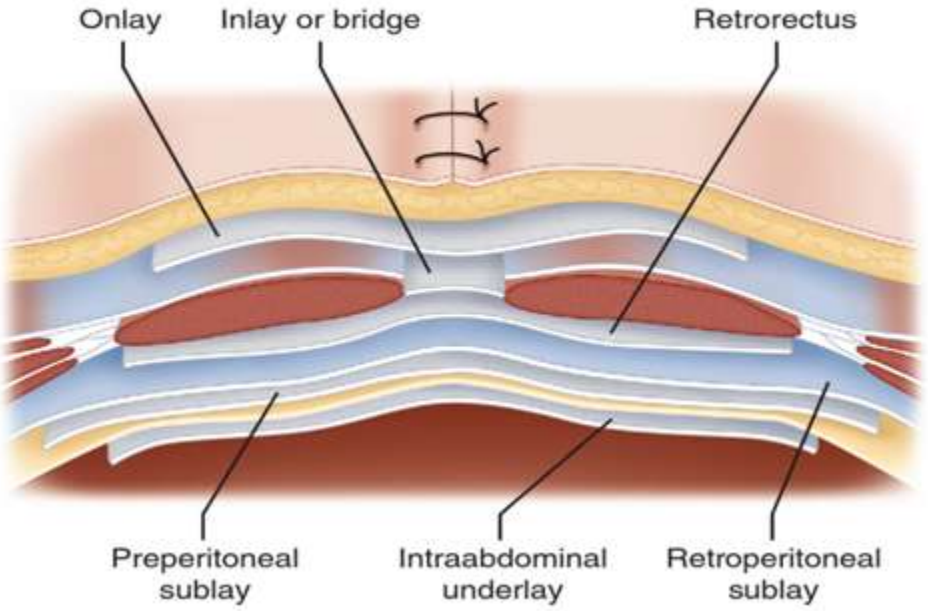

Fig: showing various placements of mesh[5]

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It is generally agreed that all but the smallest incisional hernias can be repaired with mesh, and the surgeon has various options for placing the mesh. The on lay technique involves primary closure of the fascia defect and placement of a mesh over the anterior fascia. The major advantage of this approach is that the mesh is placed outside the abdominal cavity, avoiding direct interaction with the abdominal viscera. However, disadvantages include the large subcutaneous dissection, the increased likelihood of seroma formation, the superficial location of the mesh (which places it in jeopardy of contamination if the incision becomes infected), and the repair is usually under tension. Prospective analysis of this technique is not available, but a retrospective review has reported recurrence rates of 28%.53 Interposition prosthetic repairs involve securing the mesh to the fascial edge without overlap. This results in a predictably high recurrence rate; the synthetic often pulls away from the fascial edge because of increased intra-abdominal pressure. A sub lay or underlay technique involves placing the prosthetic below the fascial components. The mesh can be placed intraperitoneally, preperitoneally, or in the retrorectus (retromuscular) space. It is highly desirable to have the mesh placed beneath the fascia. With a wide overlap of mesh and fascia, the natural forces of the abdominal cavity act to hold the mesh in place and prevent migration. This can be accomplished by several techniques.

After reopening of the prior incision and with the use of available dual-type mesh or composite mesh, the mesh can be placed in an intraperitoneal position at least 4 cm beyond the fascial margin and secured with interrupted mattress sutures. This technique requires raising subcutaneous flaps, and the mesh may be in direct contact with the abdominal contents. The laparoscopic approach for ventral hernia repair relies on the same principles as the retro rectus repair; however, the mesh is placed within the peritoneal cavity. This repair is useful, particularly for large defects. Trocars are placed as far laterally as feasible based on the size and location of the hernia. The hernia contents are reduced, and adhesions are lysed. The surface area of the defect is measured, and a barrier-coated mesh is fashioned with at least 4 cm of overlap around the defect. The mesh is rolled, placed into the abdomen, and deployed. It is secured to the anterior abdominal wall with preplaced mattress sutures that are passed through separate incisions; tacking staples are placed between these sutures to secure the mesh 4 cm beyond the defect. There are fewer incisional complications with the laparoscopic approach because large incisions and subcutaneous undermining are avoided.

For loss of domain incisional hernias or incisional hernias with large defects component separation techniques can be used to repair the defects.

There are two types of component separation:

1. Anterior component separation
2. Posterior component separation

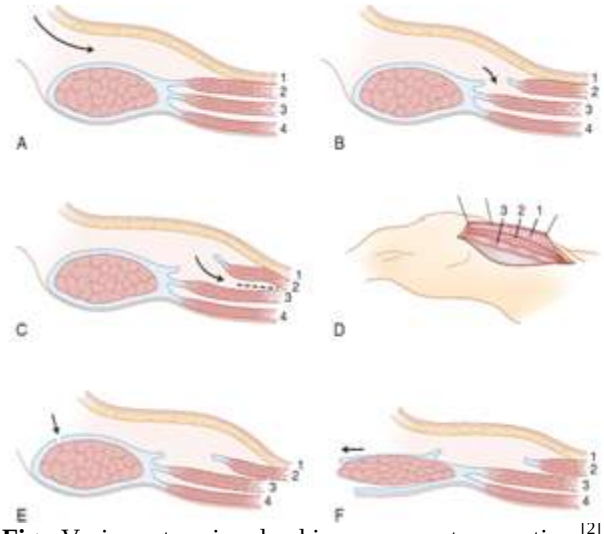

Fig : Various steps involved in component separation.[2]

Posterior component separation. The retro rectus space is bordered laterally by the linea semilunaris. In very large hernias or in those patients with atrophic narrowed rectus muscles, this

might prevent adequate mesh overlap. Further advancement can be obtained by incising the posterior rectus sheath approximately 1 cm medial to the linea semilunaris. At this location, the posterior leaflet of the internal oblique and the transversus abdominis muscle are incised to gain access to the preperitoneum. This plane can be extended to the retroperitoneum and eventually to the psoas muscle if necessary.54 Very large sheets of prosthetic mesh can be placed in this location with wide defect coverage.55 A retrospective review from the Mayo Clinic, with a median follow-up of 5 years, has documented a 5% overall hernia recurrence rate in 254 patients who underwent complex ventral hernia repair during a 13-year period.43 In one comparative analysis of posterior and anterior component separation, similar amount of fascial advancement was reported with a significant reduction in wound morbidity with use of the posterior approach.55 Anterior component separation. Another option for the repair of complex or large ventral defects is the anterior component separation technique (Fig. 44-12). This involves separating the lateral muscle layers of the abdominal wall to allow their advancement. Primary fascial closure at the midline is often possible. The procedure is performed by raising large subcutaneous flaps above the external oblique fascia. These flaps are carried laterally past the linea semilunaris. This lipocutaneous dissection itself can provide some advancement of the abdominal wall. Large perforating subcutaneous vessels can be preserved to prevent ischemic necrosis of the skin flaps. A relaxing incision is made 2 cm lateral to the linea semilunaris on the lateral external oblique aponeurosis from several centimeters above the costal margin to the pubis. The external oblique is then bluntly separated in the avascular plane, away from the internal oblique, allowing its advancement. Further relaxing incisions have been described to the aponeurotic layers of the internal oblique or transversus abdominis, but this can result in problematic lateral bulges or herniation at this site. Additional release can be safely achieved by incising the posterior rectus sheath. These techniques, when applied to both sides of the abdominal wall, can yield up to 20 cm of mobilization. Although this technique often allows tension-free closure of these large defects, recurrence rates as low as 20% have been reported with the use of prosthetic reinforcement in large hernias.56 It is important that patients understand that a lateral bulge can occur after release of the external oblique aponeurosis. Recognizing the high recurrence rates with component separation alone, several authors have reported small series of biologic mesh reinforcement of these repairs.51 To date, no randomized controlled trials have supported a lower recurrence rate with biologic prosthetic reinforcement. If a bioprosthetic is placed, it can be secured with an underlay or onlay technique. No comparative data exist demonstrating the superiority of either repair technique.57 Endoscopic component separation. One of the major limitations of open component separation is that large skin flaps are necessary to access the lateral abdominal wall musculature. Recognizing these limitations, innovative, minimally invasive approaches to component separation have been described.58 The basic principle of a minimally invasive component separation is to gain direct access to the lateral abdominal wall without creating a lipocutaneous flap. Typically, this is performed by a direct cutdown through a 1-cm incision off the tip of the 11th rib overlying the external oblique muscle . The external oblique is split in the line of its fibers, and a standard bilateral inguinal hernia balloon dissector is placed in between the external and internal oblique muscles, toward the pubis. Three laparoscopic trocars are placed in the space created, and the dissection is carried from the pubis to several centimeters above the costal margin. The linea semilunaris is carefully identified, and the external oblique is incised from beneath the muscle, at least 2 cm lateral to the linea semilunaris. The muscle is released from the pubis to several centimeters above the costal margin. This procedure is performed bilaterally. Synthetic or biologic mesh can be used to reinforce the repair of the midline closure. These relatively new techniques are feasible, but long-term data demonstrating equivalency to open techniques are lacking.

Results of open hernia repair :

The results tend to favour laparoscopic repair of ventral hernias over open repairs. They result in fewer post operative complications, lower infection rates and decrease. Until an appropriately powered prospective randomized trial is performed, the ideal approach will largely be based on surgeon expertise and preference. In addition, these trials will need to provide guidance on the most appropriate hernia size to be repaired by either an open or a laparoscopic approach.

The laparoscopic ventral hernia repairs are the recent modality of approach to the treatment of ventral hernias. They are of different types

1. Laparoscopic anatomical closure of fasciae defect without prosthesis

2. Laparoscopic ventral hernia repair with prosthesis(usually IPOM)

Laparoscopic ventral hernia repair (LVHR) was described by Le Blanc and Booth in 1993 and was rapidly adopted by laparoscopic surgeons and used to repair all types of hernias. In fact, LVHR had emerged as the preferred and even "gold standard" minimally invasive technique for many patients with small-to-medium-sized umbilical and ventral hernia defects. It has been touted for its low wound morbidity because it avoids large abdominal incisions, and results in a decreased length of stay. [23,24] Since then, the literature comparing open and laparoscopic ventral/incisional hernia repair is scarce and the debate over superiority continues. In 2011, a Cochrane review was only able to conclude that laparoscopy for incisional hernias was a promising approach with some emphasis on improvement of short-term outcomes.[25] This has been mirrored in a number of later studies that have compared laparoscopic to open ventral hernia repair and found no difference in recurrence rates and similar quality of life after 6 months.[26] The short-term improvements after laparoscopy include less postoperative pain, quicker rehabilitation and return to work, decreased wound infection rates, and better cosmetic outcomes. The frequently discussed downsides of laparoscopic ventral hernia repair are increased risk of incidental enterotomy during lysis of adhesions, increased seroma and hematoma development, and increased development of intraabdominal adhesions due to an intraperitoneal prosthetic; potentially longer operative times, and persistent bulging at the site of defects with bridged techniques.[24,26] In addition to these potential complications, traditional LVHR technique leaves mesh intraperitoneally, in close proximity to bowel, thus requiring the use of a covered mesh, which is more expensive and more likely to harbor infection due to the barrier coating. The overall impact of mesh placed in direct contact with bowel is unclear. Additionally, the goal of avoiding intraperitoneal mesh in minimally invasive repairs has further motivated hernia specialists across the globe to innovate. Prasad et al. compared a laparoscopic transabdominal preperitoneal (TAPP) technique using simple polypropylene mesh for ventral hernia repair with LVHR and were able to show cost efficacy, decreased seroma formation, and decreased recurrence for the laparoscopic TAPP approach.41 Predictably, this study showed equivalent pain scores across both groups, which was to be expected because the meshes were secured using both transfascial sutures and tacks for both groups. The laparoscopic TAPP approach to ventral hernia repair is a time-consuming and technically challenging procedure with a significant learning curve. Other innovations in laparoscopic hernia repair are the extended-view totally extraperitoneal (eTEP) hernia repair, originally developed by Daes for complex inguinoscrotal hernias and modified as an approach for ventral hernia. eTEP for ventral hernias includes extraperitoneal balloon dissection in the subcutaneous, retro muscular, or preperitoneal planes, and allows for defect closure, component separation if needed, and wide prosthetic reinforcement in a sub lay position. Yet another approach is the endoscopic-assisted trans hernia mini-open sub lay repair (MILOS) developed in Germany. MILOS achieves wide dissection using endoscopic or direct visualization with a lighted trocar through small incisions. Even coated mesh confers increased risk for intraabdominal adhesions, with some studies showing one-third of patients having significant adhesions at reoperation, the potential for harboring infection, and increased cost. Additionally, standard methods of fixation necessitate an expensive laparoscopic tacking device, and both permanent and absorbable tacks are correlated with increased postoperative and chronic pain. Finally, intraperitoneal mesh is often anchored with trans fascial sutures to stretch the mesh and limit shrinkage and hernia recurrence. Trans fascial sutures have been shown to cause ischemia of the abdominal wall and are correlated with increased postoperative and prolonged pain and potentially incite recurrent hernias. Despite its myriad disadvantages, the LVHR technique has evolved very little since it initially gained acceptance and popularity in the early 1990s. More recently, however, it has been suggested that defect closure prior to mesh placement could alleviate some of the shortfalls of the traditional LVHR. Potential benefits of defect closure include reduced wound morbidity by reducing potential space for seroma and hematoma formation, lower rates of recurrence, improved abdominal wall functionality by reapproximating linea alba, and better cosmesis.

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OPERATIVE TECHNIQUE OF LVHR :

The patient is positioned supine on the operating table and the arms are tucked. Preoperative antibiotics and venothromboembolism (VTE) prophylaxis are given prior to incision. Orogastric tubes are placed, as we reserve nasogastric patients for those with an extensive adhesiolysis or bowel congestion from incarceration. A urinary catheter is placed in all patients; in those with infraumbilical extensions of the hernia defect, we place a three-way catheter to allow for instillation of saline to facilitate intraoperative bladder identification. The abdomen is sterilized and draped using an iodophor-impregnated drape as an extra layer of protection against mesh contamination. We typically enter the abdomen using an optical trocar in the subcostal region; however, access should be individualized according to the surgeon's comfort. Additional 5-mm ports are placed laterally on the side of entry and another two 5-mm ports are placed on the

contralateral side to aid in the placement and securing of the mesh. Adhesiolysis is carried out sharply, minimizing the use of electrocautery or energy devices to prevent burn injuries to underlying bowel. Contents of the hernia are reduced using two atraumatic graspers, and the hernia sac is typically left intact. We then measure the defect intracorporeally using transabdominal spinal needles placed at each edge. We routinely close fascial defects during laparoscopic hernia repairs. This is a widely debated topic among hernia surgeons and thus far the literature has shown a trend toward improved outcomes with primary fascial closure during laparoscopic hernia repair, citing lower recurrence rates, lower rates of seroma formation, and improved patient satisfaction.[27,28] However, the data are sparse and a randomized controlled trial comparing bridged laparoscopic repair to defect closure with synthetic mesh is ongoing. We use a laparoscopic "shoe lacing" technique of figure-of-eight permanent sutures to close our defects. Briefly, a vertical line is drawn down the middle of the defect, 3-cm intervals are marked (beginning at the upper edge of the defect), and stab wounds are created. The figure-of-eight trans fascial sutures are placed using a suture passer with monofilament permanent sutures. Each suture incorporates 1 to 2 cm of fascial edge and the sac is left in situ. After all sutures are placed, the pneumoperitoneum is released and the sutures are tied from outside in, leaving buried subcutaneous knots. The abdomen is re insufflated and the defect closure is confirmed. The mesh is introduced through a 12-mm port placed near the midline and/or near the closed defect, in a location where it will be subsequently covered with mesh. We use a covered mesh in an underlay position and often have the luxury of a mesh deployment device. If this is unavailable, four monofilament sutures should be placed in four quadrants of the mesh prior to introduction intothe abdominal cavity. The mesh is unrolled and transfascial sutures are pulled through, keeping the mesh on stretch, with a suture passer. We recommend starting fixation by pulling the upper or lower stitch first, followed by the lateral ones. The edge of the mesh is secured with metal or absorbable tacks at 1-cm intervals. We then place trans fascial stitches on either side of the closed defect (within 2 cm of the midline) to fix the mesh, take tension off our "primary" defect closure, and redistribute the tension on the mesh . The ports are removed under direct vision, pneumoperitoneum is released, and the incisions are closed with subcutaneous sutures. The cicatricial tissue closing the umbilical ring. In children younger than 2 years old, most umbilical hernias close spontaneously; however, in adults these hernias tend to enlarge with time. Repair of an umbilical hernia, as described by William Mayo, using a vertical fascial overlap technique was discussed earlier. This operation (or simple fascial closure) is still performed frequently today by many surgeons. These repairs are effective and may be the preferred technique for small umbilical hernias with no tension after fascial approximation, but larger hernias have been shown to have a recurrence rate of up to 28%.[30] The most catastrophic potential complication of laparoscopic ventral hernia repair is small bowel injury during adhesiolysis, especially if they are missed.[29] Enterotomy has been reported in an average of 1.7% to 3.3% of patients in recent series of laparoscopic ventral hernia repairs.[29] If an enterotomy occurs, the mortality rate is reported to be 1.7% if it is recognized and repaired. However, if the enterotomy is missed, the mortality rate increases to 7.7%.[30] Management of a recognized intraoperative enterotomy varies according to the type and extent of the injured intestine and the type of mesh available. Small lacerations in the small intestine or bladder without significant contamination may not be an absolute contraindication to mesh placement either laparoscopically or by open means. In the event of fecal spillage, the bowel should be repaired and the adhesiolysis completed. A delayed hernia repair is generally warranted if a prosthetic is required. At times, the patient may be placed on antibiotics and returned to the operating room in 3 or 4 days for definitive repair. The safer option, however, is to perform a primary repair of the hernia defect or repair with a biologic mesh, but the long-term durability of these repairs is poor. We believe that placement of an intraperitoneal synthetic mesh in the presence of significant contamination is contraindicated. Another alternative that should be strongly considered is a conversion to laparotomy. This would include careful inspection of the entire bowel for other unrecognized injuries, and repair or resection of the involved segment followed by primary closure or extraperitoneal repair with mesh.

Both of the above procedures are described together above. But if only anatomical closure is done it has the same rate of post operative complications as that of mesh repair and has higher early recurrence. On the other hand the IPOM mesh is too costly to be affordable for most of the population. Hence we decided to conduct a study of combining the anatomical repair and

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placement of polypropylene mesh as an onlay technique to prevent recurrence.

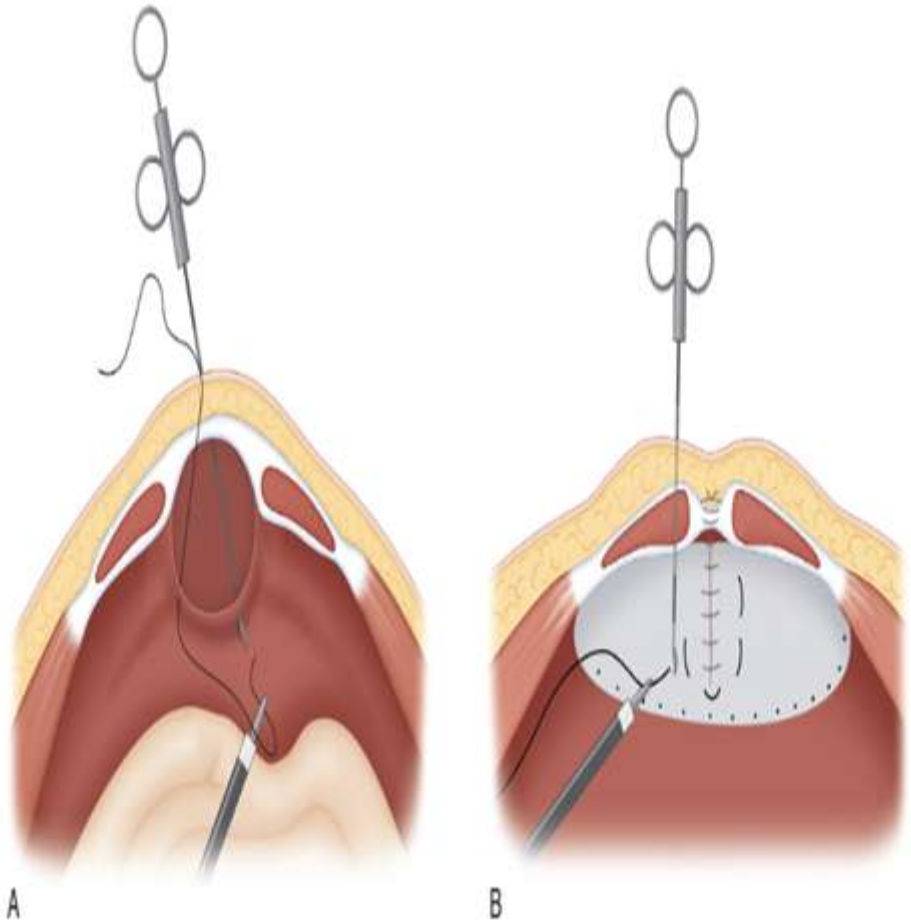

Fig: Laparoscopic anatomical closure (A) and with repair with IPOM (B) [5]

Laparoscopic hybrid repair using polypropylene mesh:

Laparoscopic hybrid repair involves repair of hernia with
obliteration of the hernial defect and reinforcement with on lay polypropylene mesh. The hernial defect is closed in such a way as it is described in the laparoscopic anatomical repair.

After anatomical repair abdomen is incised in a vertical manner parallel to the defect and after rectus sheath is reached flaps are raised. Flaps are raised in such a fashion around the anatomical closure without disturbing the suture repair. Large pore polypropylene mesh is fashioned in such a way it covers around the defect and it is fixed with 2-0 prolene sutures.

Drain is kept for three days and it is removed on fourth Post-operative day. The main principle in keeping the mesh around the defect is the recurrence after anatomical repair most commonly occurs in the areas around the previously closed defect.

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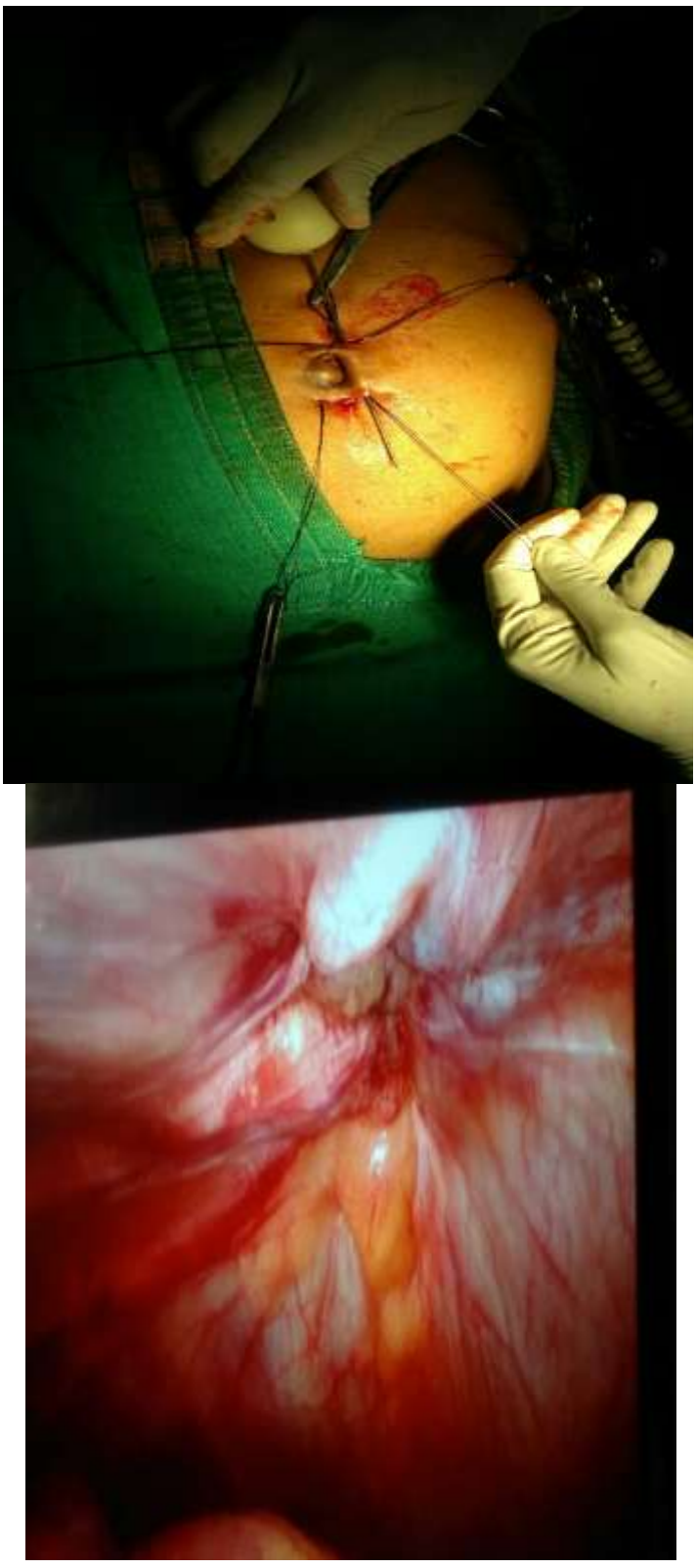

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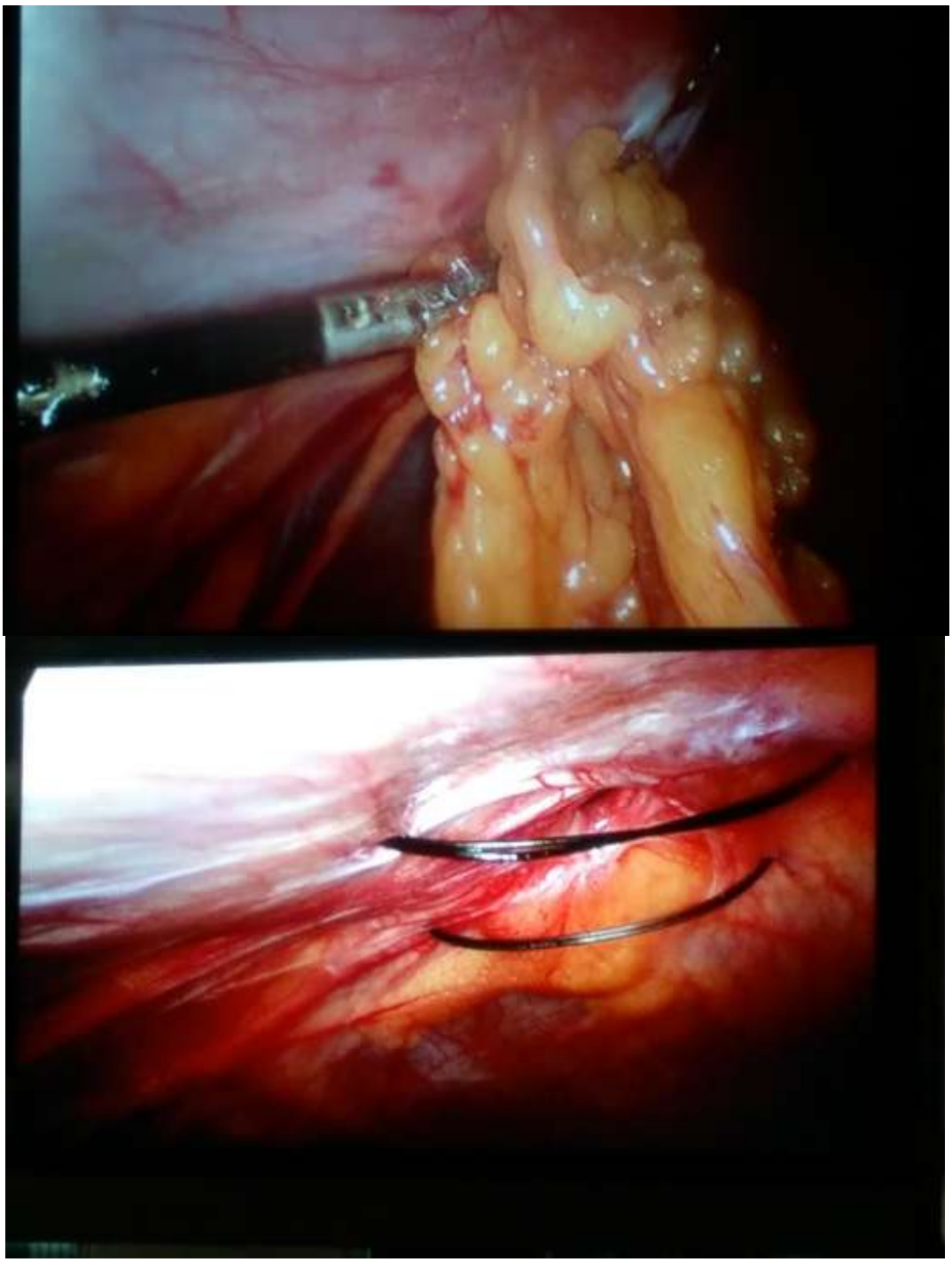

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IV. MATERIALS AND METHODS

Primary Objectives:

To derive the advantages of Laparoscopic Hybrid repair vs conventional laparoscopic anatomical repair with respect to pain after surgery , wound infection, early recurrence and seroma formation.

Eligibility Criteria:

A.Inclusion criteria:

• Age > 25 years & < 65 years.

• Those presenting with uncomplicated ventral hernia of any type.

• Patients who consented for inclusion in the study according to designated proforma.

B. Exclusion Criteria:

- Age < 25 years or > 65 years
- Patients with complications such as obstruction or strangulation
- Severe co morbid conditions
- Immunocompromised states.
- Coagulopathy
- Loss of domain hernias
- Those who did not consent to the procedure.

Methodology:

- From September 2018 to September 2020, patients presenting with ventral hernias in GRH Madurai will be recruited in this study.

• The patients were seen in surgical speciality OP in emergency and routine hours and were diagnosed on the basis of history & clinical examination.

• After obtaining consent, patients would be required to fill in a proforma (which is given below). After that patients would be randomly divided into two groups.

In the first group ventral hernia is done with laparoscopic

Anatomical repair and in the latter it is done by laparoscopic hybrid repair using both anatomical repair and polypropylene mesh placement via onlay technique.

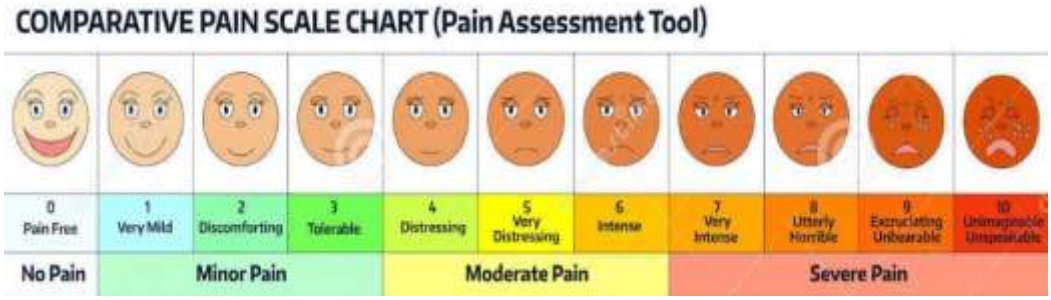
- Both groups will be analyzed for,

1. Time of Operation
2. Post operative complications :

a) Pain
b) Haematoma formation
c) Seroma formation
d) Infection
e) Foreign body sensation
f) Return to daily activities

3. Recurrence - it is a palpable hernia in the same site as the repair is done.

VISUAL ANALOG SCORE USED FOR POSTOPERATIVE PAIN ASSESSMENT



V. RESULTS

1.Age distribution:

Age	Laparoscopic anatomical repair	Laparoscopic Hybrid repair
25-40	9	6
41-60	16	19
Total	25	25
Mean	44.8	47.2
SD	10.7	7.875
P value	0.38	Not significant

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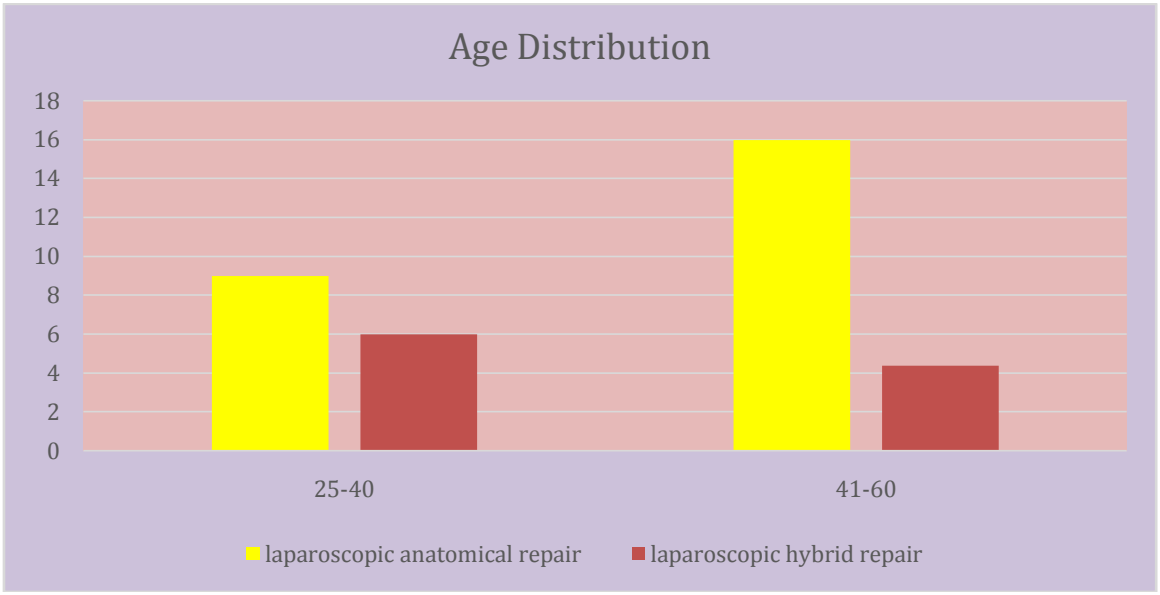
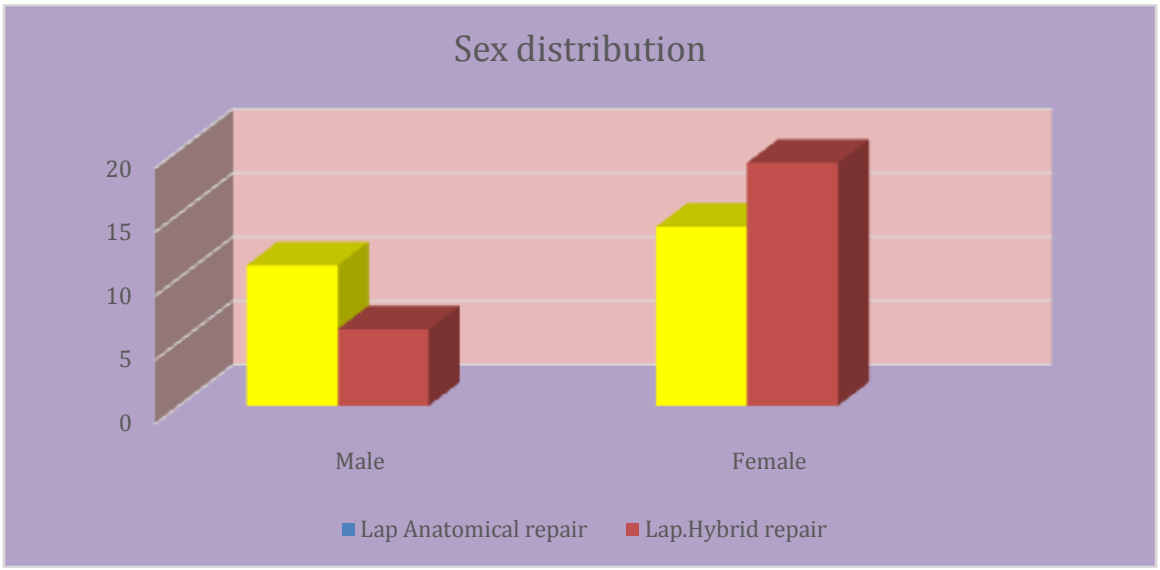


The mean age group in the anatomical repair group is 44 and hybrid repair group was 47. The age group is almost similar and the age of the patient is not statistically significant.

2.Sex Distribution:

Sex	Laparoscopic anatomical repair	Laparoscopic Hybrid repair
Male	11	6
Female	14	19
Total	25	25



In anatomical repair group, 11 patients were males and 14 were females. And in the hybrid repair group 6 were males and 19 were females.

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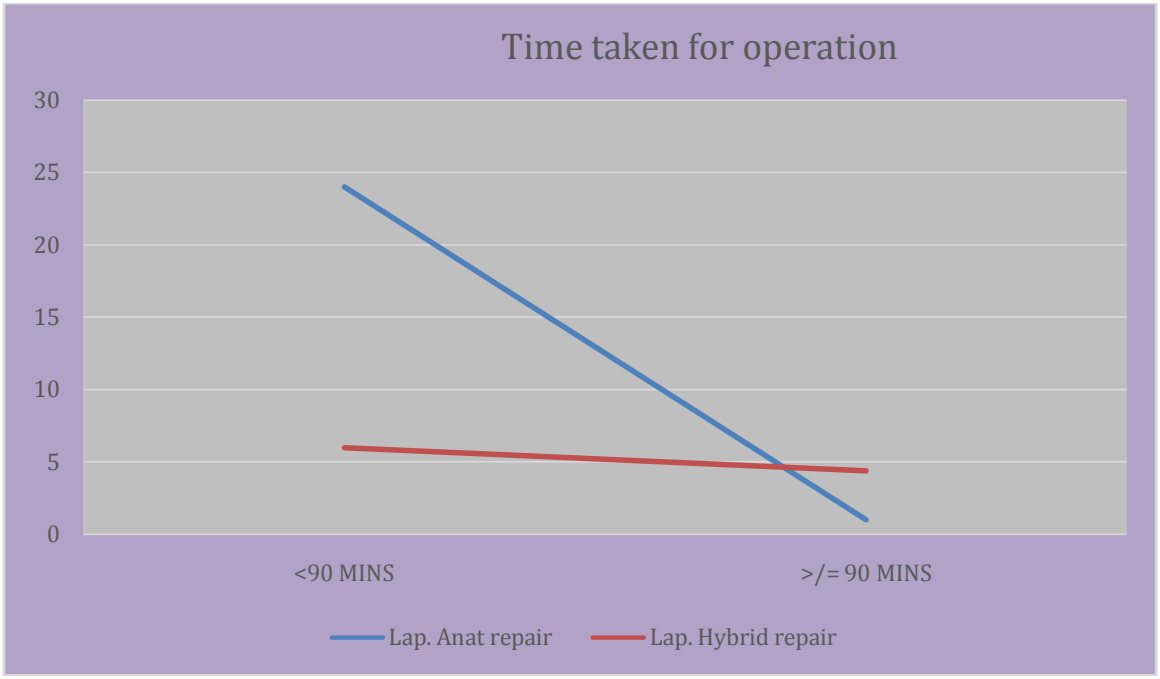
3.Time taken for completeness of Surgery :

Time taken for operation	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
<90 mins	24	6
>/= 90 mins	1	19
Total	25	25
Mean	74.2	93.2
SD	7.455423	9.451
P value	<0.0001	significant



The mean time taken for laparoscopic anatomical repair operation is 74.2 whereas for laparoscopic hybrid repair is 93.2 and the datas are statistically significant. This is obvious the placement of mesh takes extra time in hybrid repair.

4.Post operative pain:

Pain score	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
< 5	16	13
>/= 5	9	12
Total	25	25
Mean	4	4.48
SD	1.78	1.759
P value	0.342	Not sig

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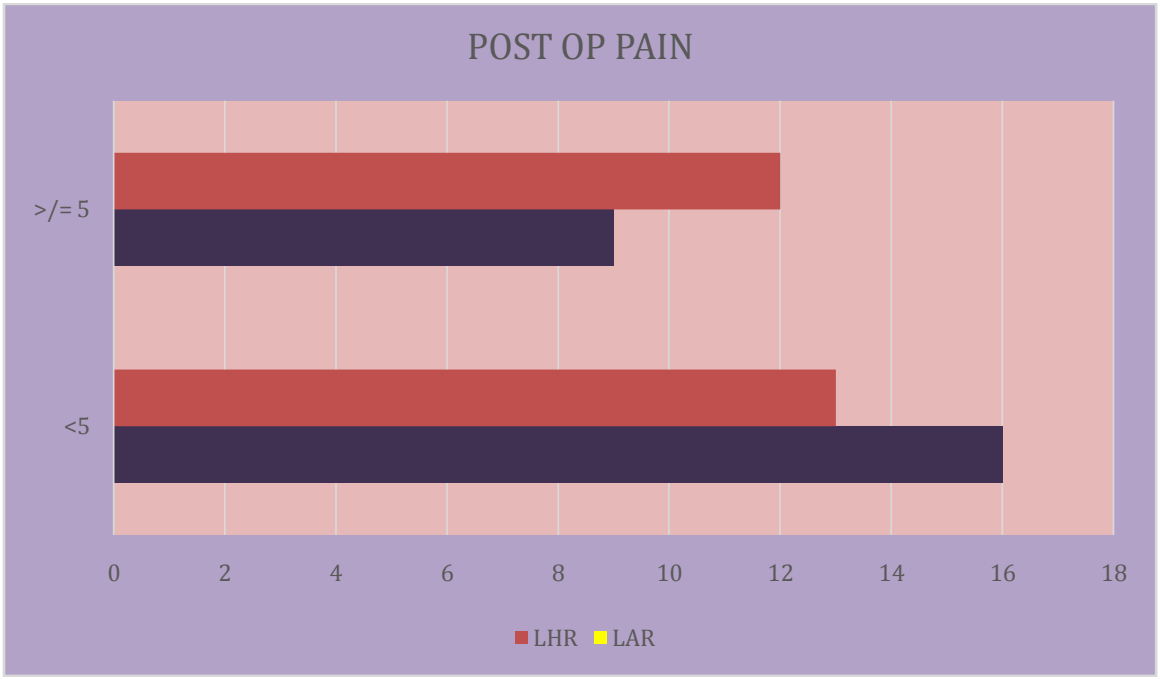
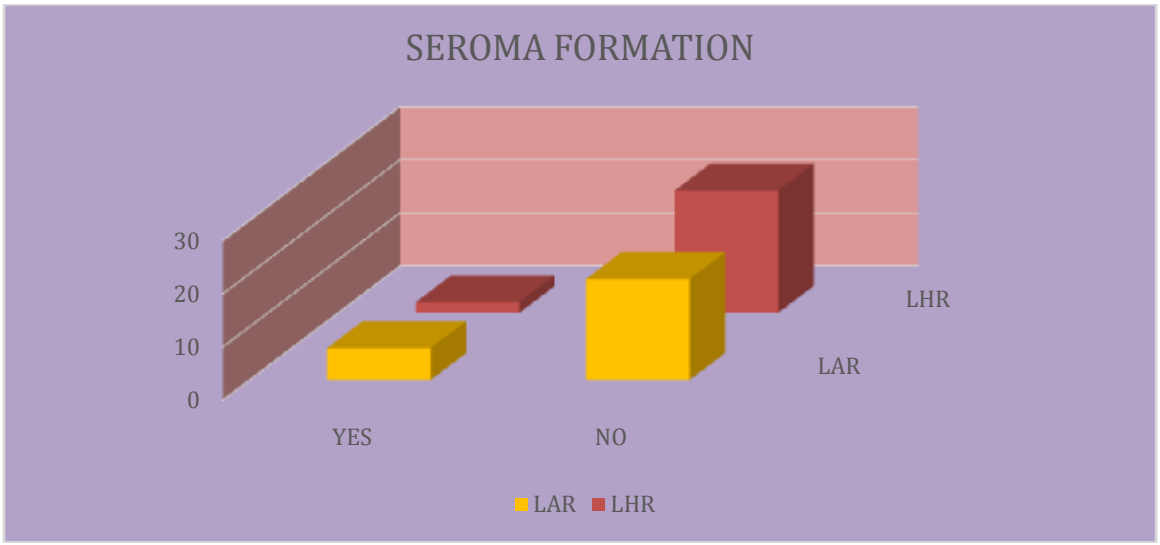


The mean post-operative pain score was similar in both the groups, when measured at POD-1 and POD-3. Both groups required analgesia

5. Seroma formation :

Seroma	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
Yes	6	2
No	19	23
Total	25	25
Percentage	24%	8%



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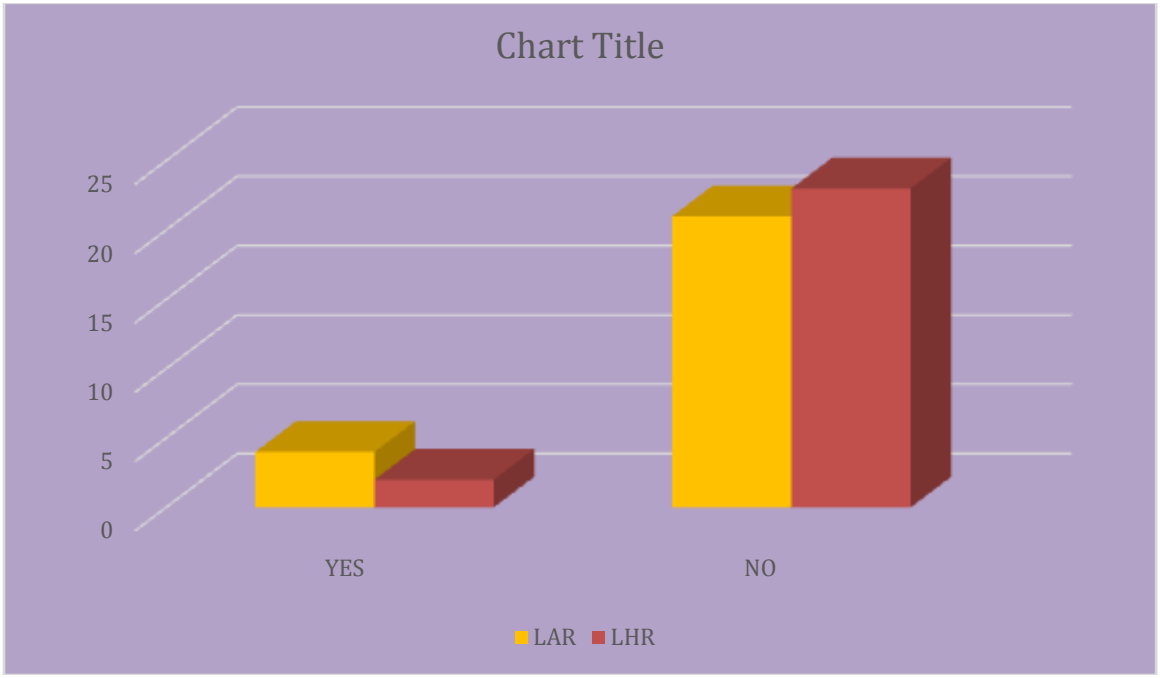
Seroma is defined as the collection of serous fluid pocket at the site of incision as a result of tissue dissection. It was observed for up to 30 days post operation. Seroma formation occurred in 6 patients with anatomical repair and only in 2 patients in Desarda's repair.(Significant)

6.Wound Infection:

Wound infection	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
Yes	4	2
No	21	23
Total	25	25
Percentage	16%	8%



It is identified by the collection of purulent material at the site of incision, associated with tenderness, erythema and edema at the incision site. It was observed for upto 6 months. Wound infection occurred in 4 cases of anatomical repair and 2 cases of hybrid repair group.

7. Foreign body sensation :

Foreign body sensation	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
Yes	2	7
No	23	18
Total	25	25
Percentage	8%	28%

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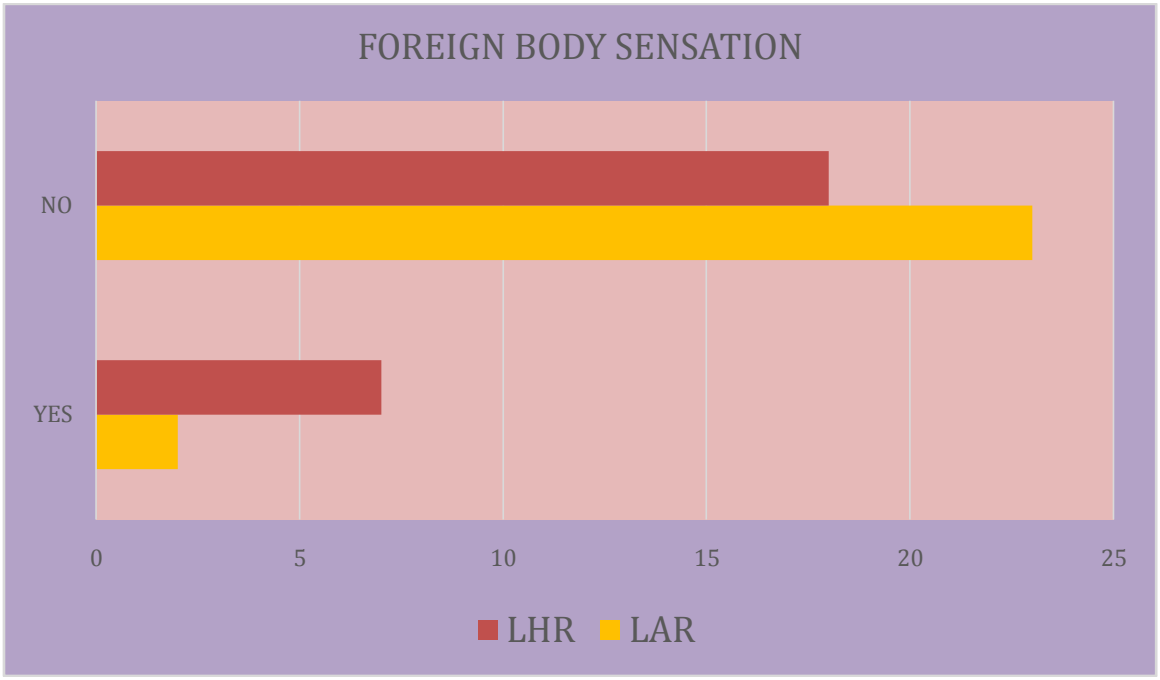
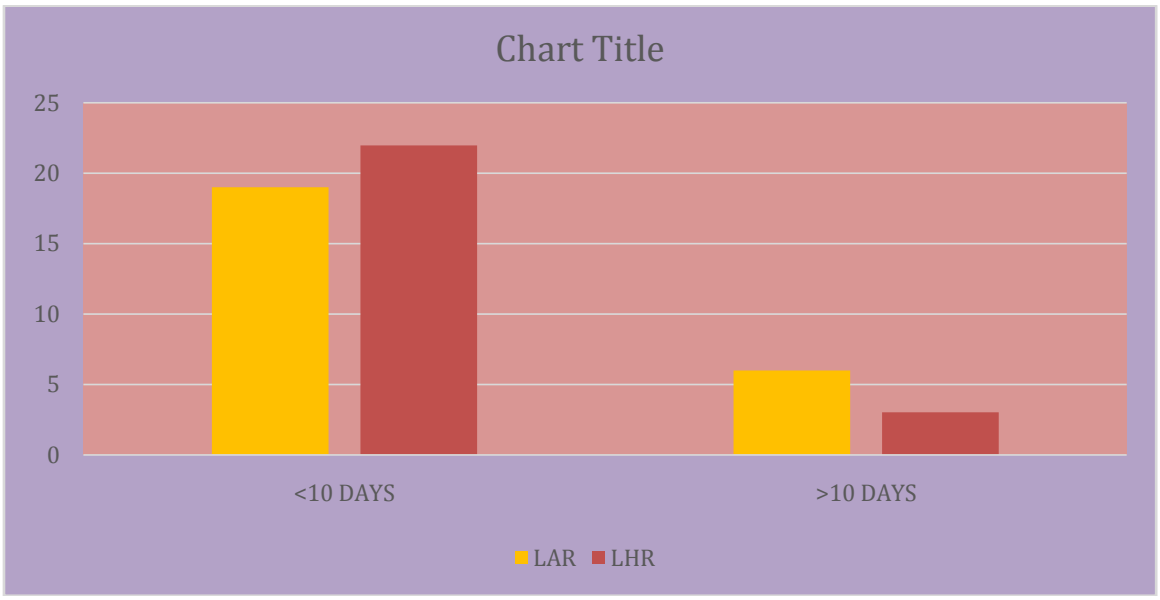


Patient was asked whether he has any perception of a foreign body being implanted in the operated abdomen was present. It was studied upto three months. It was present in 2 patients of anatomical repair and 7 patients of hybrid repair.

8.Return to work in < 10 days :

Return	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
<10 days	19	22
>10 days	6	3
Total	25	25
Percentage	76%	88%



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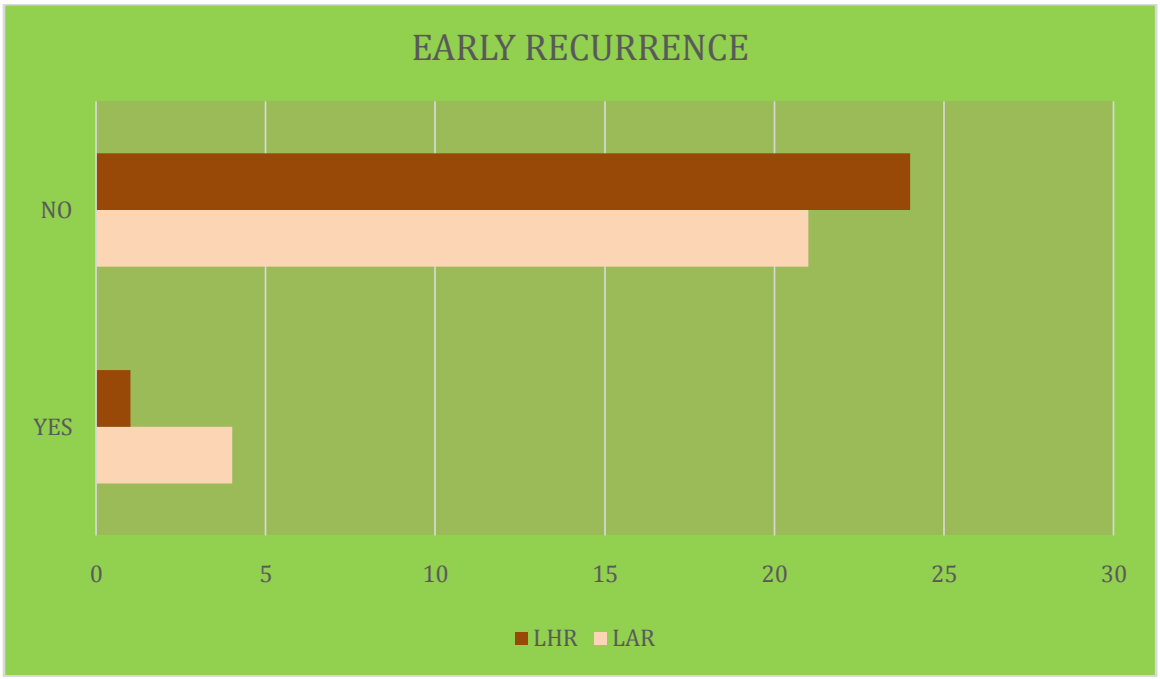
In anatomical repair 19 patients returned to work within 10 days and in hybrid repair group 22 patients(significant)

9.Early recurrence :

Early recurrence	Laparoscopic Anatomical repair	Laparoscopic Hybrid repair
Yes	4	1
No	21	24
Total	25	25
Percentage	16%	4%



Recurrence is defined as a palpable bulge on the operated site. Our patients were followed up for 10 months. Four patients of anatomical repair group developed recurrence whereas only 1 patient developed recurrence in hybrid repair group. (Significant)

VI. DISCUSSION

- In our study group the mean age for anatomical repair group is 44 and hybrid repair group was 47. The age group is almost similar and the age of the patient is not statistically significant. Also, of all the ventral hernias umbilical hernias are more common followed by incisional hernias and it also proves that Umbilical hernias are common in males and incisional hernias are common in females. (post PS scar).
- The mean time taken for operation in laparoscopic anatomical repair operation is 74.2 whereas for laparoscopic hybrid repair is 93.2 and the data are statistically significant. This is obvious that placement of mesh in the anterior abdominal wall takes some more time. This significance is understandable but due to other factors hybrid repair is preferred.
- There was no significant difference in two groups in the magnitude of post-operative pain and the incidence of post- operative pain and the incidence of wound infection.
- Patients who underwent laparoscopic hybrid repair had foreign body sensation and this is understandable because of the placement of onlay polypropylene mesh over the anterior abdominal wall. This can be managed with reassurance.
- Both of the repairs had the patients to return to their normal activity early.
- In 10 months four patients of laparoscopic anatomical repair group developed recurrence whereas only one patient developed recurrence in

laparoscopic hybrid repair group. This might be because reinforcement by placing a mesh.

VII. CONCLUSION

Thus, laparoscopic hybrid repair is associated with low recurrence and early return to work. The results are comparable with other studies. Laparoscopic hybrid repair with polypropylene mesh can be used as a safe alternative to IPOM which is costlier. The operating time is longer than the laparoscopic anatomical repair group but because of the risk of recurrence it is not preferred.

Thus, laparoscopic anatomical repair with mesh reinforcement is the ideal repair for ventral hernias and polypropylene mesh proves to be a cost-effective alternative to IPOM.

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PROFORMA :

Name :- I. P. No
Age :- Unit
Sex :- D.O.A
Occupation :- D.O.D
Address :-
Phone no :
DIAGNOSIS:
PRESENTING COMPLAINTS
Swelling
Pain
Co existing co morbidities
Treatment history
GENERAL PHYSICAL EXAMINATION
1. General survey
2. Body build and nourishment
3. Appearance
4. Dehydration: Mild/ Moderate/ Severe/ Nil
5. Anaemia/ Jaundice/ Clubbing/ Cyanosis/ Lymphadenopathy/ Pedal edema
6. Pulse
7. Temperature
8. Respiratory rate
9.Blood pressure
LOCAL EXAMINATION - groin.
1. INSPECTION
2. PALPATION
SYSTEMIC EXAMINATION
Cardiovascular system
Respiratory system
Central nervous system
Abdomen
Genito-urinary system
Per/rectal examination