"A RANDOMIZED CONTROLLED TRIAL OF LAPAROSCOPIC TRANS-ABDOMINAL PRE-PERITONEAL (TAPPU-PLUS) REPAIR VS LAPAROSCOPIC INTRA-PERITONEAL ONLAY MESH (IPOM-PLUS) REPAIR FOR SMALL-SIZED UMBILICAL HERNIAS AT A TERTIARY CARE HOSPITAL"

BY

REG NO.BH0122004

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BELAGAVI, KARNATAKA

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A RANDOMISED CONTROLLED TRIAL OF LAPAROSCOPIC TRANS ABDOMINAL PRE-PERITONEAL (TAPPu-plus) REPAIR vs LAPAROSCOPIC INTRA-PERITONEAL ONLAY MESH (IPOM-plus) REPAIR FOR SMALL SIZED UMBILICAL HERNIAS AT A TERTIARY CARE HOSPITAL",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonoli)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
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LIST OF ABBREVIATIONS

TAPPu : Trans-Abdominal Pre-Peritoneal Umbilical repair

TAPPu+ : Trans-Abdominal Pre-Peritoneal Umbilical repair with Defect Closure

IPOM : Intraperitoneal Onlay Mesh repair

IPOM+ : Intraperitoneal Onlay Mesh with Defect Closure

ABSTRACT

Background: Umbilical hernias are frequently encountered in clinical practice, necessitating effective surgical management to prevent complications such as incarceration and strangulation. Laparoscopic techniques, including Trans-Abdominal Pre-Peritoneal (TAPPu-plus) repair and Intra-Peritoneal Onlay Mesh (IPOM-plus) repair, are widely used for their minimally invasive advantages. While IPOM-plus is associated with shorter operative times, TAPPu-plus has been proposed to reduce postoperative pain, minimize intra-abdominal adhesions, and lead to faster recovery. This study aims to compare these two techniques in small-sized umbilical hernias, assessing their impact on operative time, postoperative pain, hospital stay, and complications.

Material and Methods: A randomized controlled trial was conducted at a tertiary care hospital, enrolling 44 patients with small-sized umbilical hernias. Patients were randomized into two groups: TAPPu-plus (n=22) and IPOM-plus (n=22). The primary outcomes assessed included operative time, postoperative pain (measured at 6 hours, Day 1, Day 2, 1 week, and 4 weeks using the Visual Analog Scale), hospital stay, and complications such as seroma formation and wound infections. Statistical significance was set at $p<0.05$.

Results: A total of 44 patients were included, equally divided between TAPPu-plus (n=22) and IPOM-plus (n=22). Operative time was longer in TAPPu-plus (117.27 ± 14.94 min) vs. IPOM-plus (80.50 ± 19.67 min, $p < 0.05$), while blood loss was lower (1.68 ± 0.72 vs. 2.55 ± 0.96 gauze units, $p = 0.002$). Pain scores were lower in TAPPu-plus at all intervals ($p < 0.05$), with shorter analgesic use (2.86 ± 0.77 vs. 4.27 ± 0.63

days, $p < 0.05$). Hospital stay was also shorter (5.41 ± 1.37 vs. 6.91 ± 1.31 days, $p < 0.05$). Complications, including seroma (9.1% vs. 13.6%) and wound infections (4.5% in both), were comparable, with no recurrences.

Conclusion: This study demonstrates that TAPPu-plus repair offers significant advantages over IPOM-plus, including lower postoperative pain, shorter hospital stays, and comparable complication rates. While IPOM-plus remains a faster procedure, the benefits of TAPPu-plus in postoperative comfort and recovery make it the preferred choice for small-sized umbilical hernias. Future studies with larger sample sizes and long-term follow-up are needed to further validate these findings and refine patient selection criteria for optimal surgical outcomes.

Keywords: Umbilical hernia, laparoscopic surgery, TAPPu, IPOM+, minimally invasive surgery, postoperative pain.

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INTRODUCTION

Laparoscopic ventral and umbilical hernia repair have evolved significantly since the introduction of minimally invasive techniques in the early 1990s[1]. Traditionally, the **Laparoscopic Intraperitoneal Onlay Mesh (IPOM)** technique has been widely used due to its effectiveness and simplicity[2]. However, it is associated with drawbacks such as increased postoperative pain, adhesion formation, and risk of mesh-related complications[3].

To address these concerns, **Laparoscopic Transabdominal Preperitoneal (TAPPu-plus) repair** has emerged as an alternative technique[4]. This approach places the mesh in the preperitoneal space rather than directly in the intraperitoneal cavity, potentially reducing the risks associated with bowel adhesions and mesh-related complications[5]. However, the TAPPu-plus technique is technically more demanding and may lead to increased operative time[6].

Recent studies comparing **TAPPu-plus and IPOM-plus** techniques have suggested that TAPPu-plus may offer advantages in terms of reduced postoperative pain, lower risk of adhesions, and improved long-term outcomes[7]. However, limited data is available on the feasibility and safety of TAPPu-plus compared to IPOM-plus in small-sized umbilical hernias, particularly in the Indian population[8].

This randomized controlled trial aims to compare the **feasibility, operative time, safety, and overall outcomes of Laparoscopic TAPPu-plus repair versus Laparoscopic IPOM-plus repair** for small-sized umbilical hernias at a tertiary care hospital. By evaluating postoperative pain, complications, recurrence rates, and hospital stay duration, this study seeks to provide evidence on the optimal surgical approach for this subset of patients[9].

AIMS AND OBJECTIVES

Primary objective:

- To compare the feasibility of Laparoscopic TAPPu-plus as compared to Laparoscopic IPOM-plus.

Secondary objective:

- To compare operative time and safety of Laparoscopic TAPPu-plus as compared to Laparoscopic IPOM-plus.

REVIEW OF LITERATURE

A hernia is defined as the **protrusion of an organ** or part of an organ **through the body wall** that normally contains it. Abdominal wall hernias are commonly classified based on their anatomical location or etiology. Upon diagnosis, a surgeon's evaluation is crucial to determine the optimal repair technique, which depends on the size, location, and severity of the hernia[8].

The term "hernia" originates from the Greek word *Hernias*, meaning "bud," referring to an outgrowth, protrusion, or bulge. The Latin term *hernia* translates to "rip" or "rupture." Historically, hernias have been documented for over a millennium, likely arising due to mankind's evolutionary upright posture. Before the advent of modern surgery, hernias were managed with rudimentary methods such as bandages, ointments, poultices, and other localized applications. In ancient civilizations like India, China, and Japan, surgical techniques for treating hernias were already in practice long before Hippocrates introduced his methods[9].

One of the earliest recorded descriptions of umbilical hernias dates back to **Ambroise Paré**, who detailed *omphalocele* in his 1634 publication *The Works*. In 1804, **Astley Cooper** pioneered the one-stage repair for minor omphalocele and was the first to introduce an effective surgical approach for exomphalos[9]. Cooper also identified the **transversalis fascia**, recognizing it as the primary structure preventing herniation. Later, in 1891, **Lucas Championnière** was among the first to advocate for the overlapping fascia method in hernia repair. A randomized clinical study by **Arroyo et al.** involving 200 patients demonstrated that primary suture repair had a higher recurrence rate compared to tension-free mesh repair, where recurrence was only 1%[10], [11].

Epidemiology and Risk Factors

Hernias are commonly seen in adults, particularly in individuals with obesity and multiparous women, where increased intra-abdominal pressure weakens the umbilical ring. Over time, these hernias may progressively enlarge, necessitating surgical intervention. Small, asymptomatic umbilical hernias may be monitored in select patients, particularly those with significant medical comorbidities that increase surgical risks. However, complications such as **incarceration** (trapped bowel or fat), **strangulation** (loss of blood supply), and **intestinal obstruction** can occur if left untreated. Strangulation, in particular, requires emergency surgery due to the risk of ischemic damage to the bowel, which can present as bluish discoloration, nausea, and vomiting[12].

Surgical repair remains the definitive treatment for umbilical hernias, particularly for symptomatic or enlarging defects. The use of mesh reinforcement has become the preferred approach in hernia repair, as it considerably lowers recurrence rates when compared to primary suture closure[13]. However, synthetic mesh use is not without complications. Infection remains a major concern, even with rigorous aseptic techniques and perioperative antibiotic prophylaxis. Studies report that **polytetrafluoroethylene (PTFE) mesh** hernia repair carries an infection risk of up to **10%**, often necessitating additional surgical interventions[14].

Postoperative complications of **mesh hernioplasty** include **seroma formation** (fluid accumulation at the surgical site) and **surgical site infections**. Several risk factors influence complication rates, including diabetes mellitus, obesity, smoking, malnutrition (hypoproteinemia), and the size or number of fascial defects[15]. Smaller

umbilical hernias (≤2 cm) can often be repaired with primary suture closure, whereas **larger hernias (>2 cm) require mesh reinforcement** to minimize recurrence[16].

This growing body of evidence has led to continuous refinements in surgical techniques. While **IPOM-plus** has been a widely used approach, concerns about **mesh-related adhesions, pain, and intra-abdominal complications** have prompted the exploration of alternative methods, such as TAPPu-plus, which places the mesh in the preperitoneal space, potentially reducing adhesion-related complications[17]. This study aims to contribute to the growing debate on the optimal approach for laparoscopic umbilical hernia repair, particularly in small-sized hernias.

Brief Anatomy of the Abdominal Wall

The abdominal wall is a complex structure composed of multiple layers of muscles and connective tissue, which serve to protect abdominal organs while enabling flexibility for movement and respiration[17]. Abdominal wall primary function includes providing structural integrity, assisting in forced expiration, and increasing intra-abdominal pressure during activities such as coughing, defecation, and labour.

Structurally, the abdominal wall is categorized into anterior, lateral, and posterior components. The anterior abdominal wall stretches from the costal margins and xiphoid process at the top to the iliac crests and pubic symphysis at the bottom. Lateral abdominal wall consists of three layers of muscles—the external oblique, internal oblique, and transversus abdominis, which contribute to core stability and flexion of the torso[18].

At the midline, the rectus abdominis muscles, which run longitudinally, are separated by the linea alba, a fibrous band composed of interwoven aponeuroses from the lateral abdominal muscles. Rectus muscle is encased in rectus sheath, the composition of which varies along its length. The superior part of the rectus sheath consists of contributions from the transversus abdominis and internal oblique, while lower portion is characterized by all three layers of muscle aponeuroses lying anterior to the rectus muscles, leaving the posterior rectus sheath deficient below the arcuate line[18].

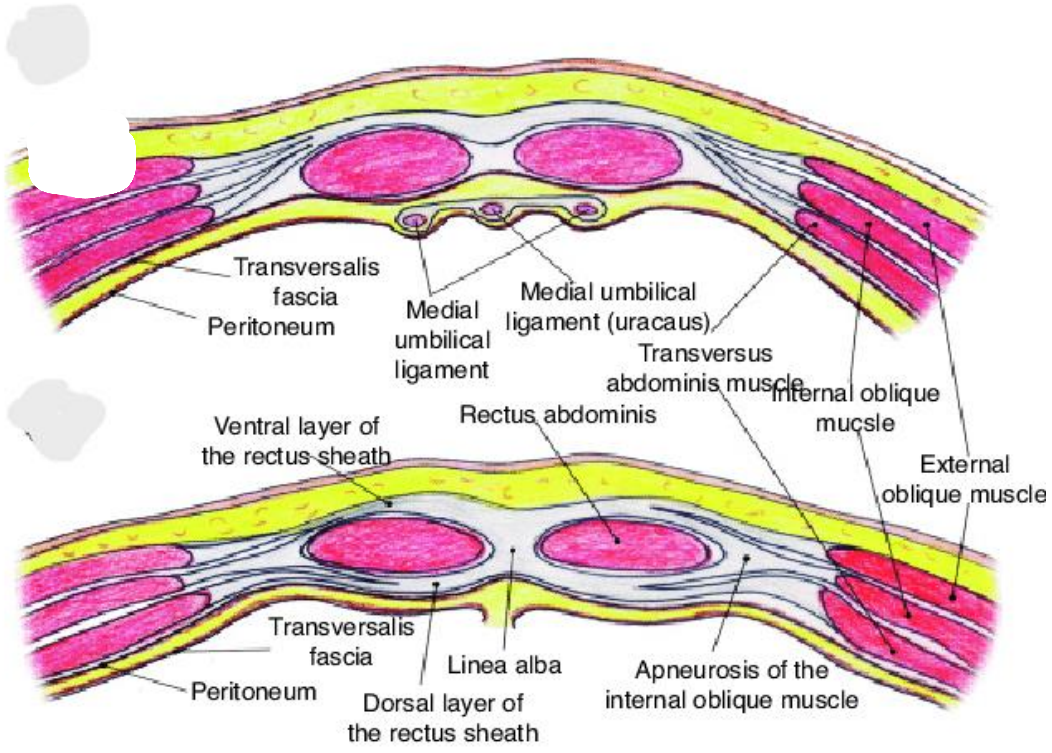


Figure 1: Abdominal Wall - Anatomy

The neurovascular supply of the abdominal wall is derived from the lumbar and intercostal arteries, along with branches from the deep circumflex iliac artery. Sensory and motor innervation is provided by subcostal nerve (T12), intercostal nerves (T7-T11), and the iliohypogastric and ilioinguinal nerves (L1), which course between the internal oblique and transversus abdominis muscles[19].

Classification of Abdominal Wall Hernias

Hernias of the abdominal wall are classified based on their location and etiology.

By Location

1. **Ventral hernias** – Occur in the anterior abdominal wall, including umbilical, epigastric, and incisional hernias.
2. **Groin hernias** – Comprise femoral and inguinal hernias, which are among the most frequently occurring types.
3. **Pelvic hernias** – Less common, involving obturator or perineal hernias.
4. **Flank hernias** – Located at the lateral abdominal wall, including lumbar hernias.

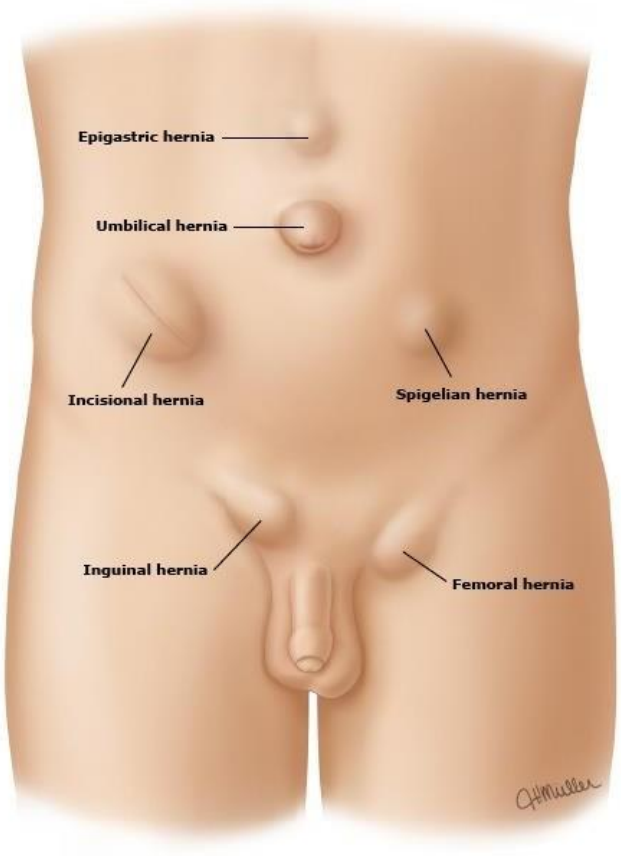


Figure 2: Classification of Hernias by Location

By Etiology

1. **Congenital hernias** – Present from birth due to incomplete closure of abdominal wall structures.

2. **Acquired hernias** – Develop due to weakened fascia or musculature secondary to increased intra-abdominal pressure, trauma, or previous surgery.

Among congenital defects, **gastroschisis and omphalocele** are the most prevalent abdominal wall anomalies. Gastroschisis is characterized by a full-thickness abdominal wall defect without a peritoneal sac, exposing abdominal contents to the external environment. In contrast, omphalocele presents with herniation of intra-abdominal organs through the umbilical ring, enclosed within a sac composed of peritoneum and amnion[20].

Primary hernias, such as umbilical and epigastric hernias, arise independently and are not associated with prior surgical incisions. Incisional hernias, however, develop as a result of surgical wound dehiscence or fascial weakening postoperatively, with risk factors including obesity, wound infection, steroid use, and poor collagen synthesis[21].

The intricate structure of the abdominal wall is a key factor in selecting the most suitable surgical technique for hernia repair. Understanding these classifications is essential for optimizing treatment strategies, such as Laparoscopic IPOM-plus and TAPPu-plus techniques, in hernia management.

Umbilical Hernias

An **umbilical hernia** is a type of **ventral hernia** that occurs at the **umbilical ring** (also called a periumbilical hernia). It is one of the most common abdominal wall hernias and results from the failure of the umbilical opening to completely close after birth or due to acquired weaknesses in the abdominal fascia[17].

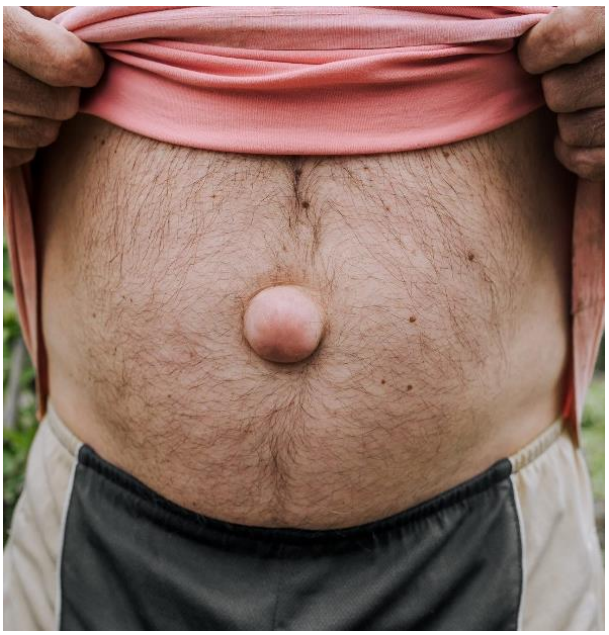


Figure 3: Umbilical Hernia

In **adults**, umbilical hernias are largely **acquired**, primarily caused by increased **intra-abdominal pressure** due to obesity, pregnancy, ascites, chronic cough, or abdominal distension. Additionally, some structural differences in the umbilical ring's configuration might contribute to an increased risk of hernia development[18], [19].

This hernias are relatively frequent, detected in 23% to 50% of cases during physical examinations or ultrasonographic evaluations[20]. The condition exhibits a higher prevalence in females compared to males, with a reported **3:1 female-to-male**

ratio[21]. If left untreated, there is a risk of **hernia incarceration**, where a portion of bowel or fat gets trapped, potentially leading to intestinal obstruction or ischemia, necessitating emergency surgical intervention[22].

Embryology of the Umbilicus

During early fetal development, the umbilical cord is compact and dense, encapsulating the following structures:

- **Ductus omphaloentericus** (connects the midgut to the yolk sac)
- **Vitelline vessels** (supply the yolk sac)
- **Umbilical coelom** (extra-embryonic body cavity)

By week four of gestation, the trilaminar embryonic disc folds into a cylindrical shape, reducing the yolk sac connection and forming the umbilical region[25]. The umbilical arteries, urachus, and omphalomesenteric duct pass through the constricted umbilical ring.

- The **omphalomesenteric duct** connects the developing intestine to the yolk sac.
- The **urachus** (remnant of the allantois) connects the umbilicus to the developing bladder.

Umbilical Cord Closure at Birth

At birth, natural occlusion of the umbilical cord occurs due to arterial vasoconstriction and Wharton's jelly collapse, which clamps the blood flow.

- The ductus venosus closes, becoming **ligamentum venosum**.
- The umbilical vein undergoes closure, forming **round ligament of the liver**[26].
- Within 7–10 days postnatally, the umbilical cord gradually shrinks and separates, resulting in a healed umbilicus.
- Any **infection (umbilical sepsis)** during this stage can result in weakening of the umbilical ring, increasing the risk of umbilical hernia formation[27].

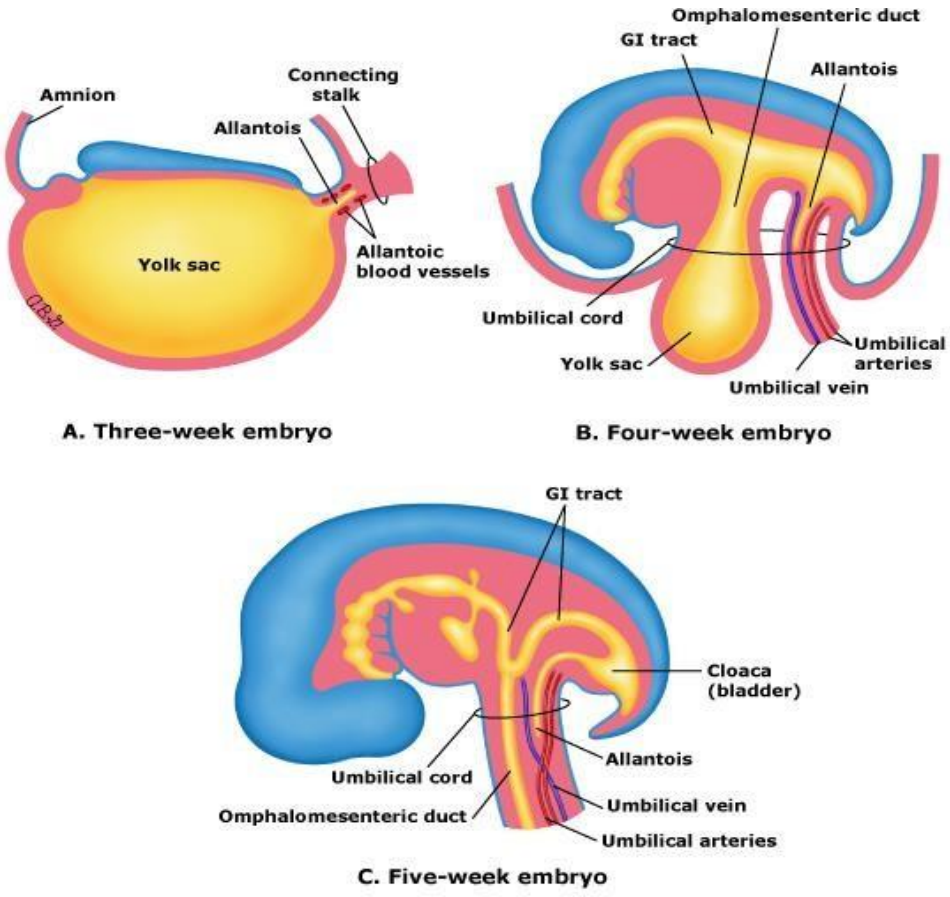


Figure 4: Embryology of the Umbilicus

Layers of the Umbilicus

The umbilicus consists of multiple layers of the **anterior abdominal wall**, including:

1. **Subcutaneous layer of fat**
2. Superficial fatty layer **(Camper's fascia)**
3. Deep membranous layer **(Scarpa's fascia)**

These layers contribute to the structural integrity of the abdominal wall and are important considerations in hernia repair to ensure appropriate closure and reinforcement.

Etiology of Umbilical Hernia

Umbilical hernias can be classified based on their origin:

1. **Acquired (90%)** – More commonly seen in adults due to progressive weakening of the **aponeurotic structures** surrounding the umbilicus.
2. **Congenital (10%)** – Persistent from birth due to incomplete closure of the umbilical ring.

Risk Factors for Acquired Umbilical Hernias:

- **Women** (especially multiparous)
- **Obesity** (increased intra-abdominal pressure)
- **Ascites** (hepatic cirrhosis-related umbilical herniation)
- **Chronic abdominal distension** (e.g., prolonged constipation, chronic cough)
- **Weakened aponeurosis** (aging-related connective tissue degeneration)

While most umbilical hernias are asymptomatic, larger hernias may present with skin changes (erythema, ulceration, ischemia) due to persistent pressure and compromised blood flow[23].

Pathophysiology of Umbilical Hernia

Umbilical hernias develop due to inherent weakness in the umbilical region, particularly at sites where the **umbilical veins involute**. Anatomically, the umbilical vein or weakened umbilical fascia (Richet's fascia) is often implicated in hernia formation[23]. The layers surrounding the umbilical ring—including the epidermis, subcutaneous tissue, superficial fascia, and peritoneum—become attenuated and fuse together. Additionally, in most individuals with an umbilical hernia, the umbilical fascia is absent, and the round hepatic ligament **(ligamentum teres hepatis)** is not attached to the lower margin of the umbilical ring[25].

Umbilical hernias may also arise result of **chronic intra-abdominal pressure**, which progressively weakens abdominal wall. Common causes include:

- **Pregnancy** (especially multiple pregnancies)
- **Ascites** (common in cirrhotic patients, affecting nearly 20% of cases)
- **Peritoneal dialysis**
- **Obesity** (increased mechanical strain on the umbilical fascia)
- **Malnutrition-related connective tissue weakening** (as seen in cirrhosis or protein deficiency) [26], [27]

In patients with ascites, continuous stretching of the umbilical veins and abdominal wall musculature can lead to progressive herniation. These changes are

exacerbated by nutritional deficiencies, impaired collagen synthesis, and fibrosis, making cirrhotic patients more prone to umbilical hernias.

Types of Umbilical Hernia

Umbilical hernias are classified based on age of onset and pathogenesis:

1. **Exomphalos (Omphalocele)** – Congenital herniation of abdominal contents due to failure of the midgut to fully return to the abdominal cavity during fetal development.

2. **Infantile Umbilical Hernia** – Occurs in newborns due to a weak umbilical scar; often resolves spontaneously within the first few years of life.

3. **Paraumbilical Hernia in Adults** – Acquired hernia that occurs above or below the umbilical ring through the linea alba, commonly associated with obesity and multiparity.

Exomphalos (Omphalocele)

Exomphalos is a developmental anomaly that results when the midgut fails to return to the abdominal cavity during fetal development. The herniated abdominal organs remain externalized and are enclosed by a protective membrane composed of:

- **Peritoneum** (inner layer)
- **Wharton's jelly** (middle layer, providing structural support)
- Amniotic membrane (outer layer) [28]

In surgical management, the subcutaneous tissue on both sides of the herniated sac is undermined to create skin flaps. These flaps can be used to cover the sac. In

severe cases, relaxing incisions in the flanks may be necessary to reduce tension. Postoperatively, gastric suction is maintained to prevent abdominal distension, and in some cases, a secondary procedure is required to close the abdominal defect in layers.

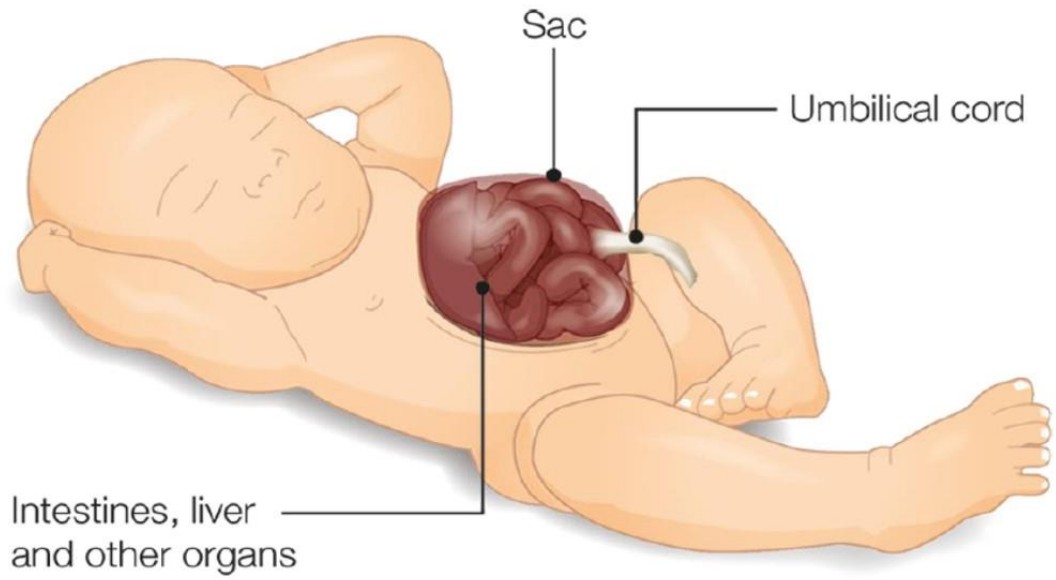


Figure 5: Exomphalos

Umbilical Hernias in Infants and Children

Umbilical hernias in newborns and infants result from weak umbilical scarring, which can be exacerbated by **neonatal sepsis** or **connective tissue disorders**. These hernias tend to enlarge with crying or straining and typically exhibit a male-to-female ratio of 2:1[29].

Key Characteristics:

- Small hernias are **spherical** in shape.
- Larger hernias may become **conical**.
- **Strangulation** is rare in infantile umbilical hernias, as the umbilical ring is more elastic than in adults.

Most cases resolve spontaneously within the first 2–5 years of life. Surgical intervention is considered if the hernia persists beyond five years or if it causes pain, skin changes, or incarceration.

Paraumbilical Hernia in Adults

A paraumbilical hernia occurs slightly above or below the umbilicus and protrudes through the linea alba, rather than directly through the umbilical ring. Unlike congenital umbilical hernias, the umbilical cicatrix does not protrude. This type is acquired, commonly affecting obese and multiparous individuals.

Common Hernia Contents:

- **Omentum** (most frequently)
- **Small intestine**
- **Transverse colon** (in rare cases)

In many cases, the omentum adheres to the sac, causing the hernia to become loculated, which makes spontaneous reduction difficult. For this reason, paraumbilical hernias are seldom reversible and often require surgical repair.

Risk Factors for Umbilical Hernia

Certain genetic and acquired factors predispose individuals to umbilical hernias.

Congenital Risk Factors

- Low birth weight
- **Chromosomal abnormalities** (Trisomy 13, Trisomy 18, Trisomy 21)

- Congenital hypothyroidism
- **Mucopolysaccharidoses**
- Marfan's syndrome
- **Beckwith-Wiedemann syndrome**
- Umbilical sepsis (leading to fascial weakening)

Acquired Risk Factors

- **Obesity** (excessive intra-abdominal pressure)
- **Smoking** (impaired collagen synthesis and wound healing)

Multiple pregnancies (abdominal wall stretching and weakening)

Clinical Presentation of Umbilical Hernia

Small **(<1 cm) and asymptomatic** umbilical hernias **may be monitored** without immediate intervention. However, **medium (1–4 cm) and large (>4 cm) hernias** typically require surgical repair to prevent complications[21].

A five-year study on umbilical and epigastric hernias found that 16% of patients required elective repair, while 4% required emergency surgery due to complications[24].

Clinical Features of Umbilical Hernia

Umbilical hernias present with a variety of symptoms, ranging from asymptomatic bulges to painful, irreducible masses with skin changes.

Common Symptoms:

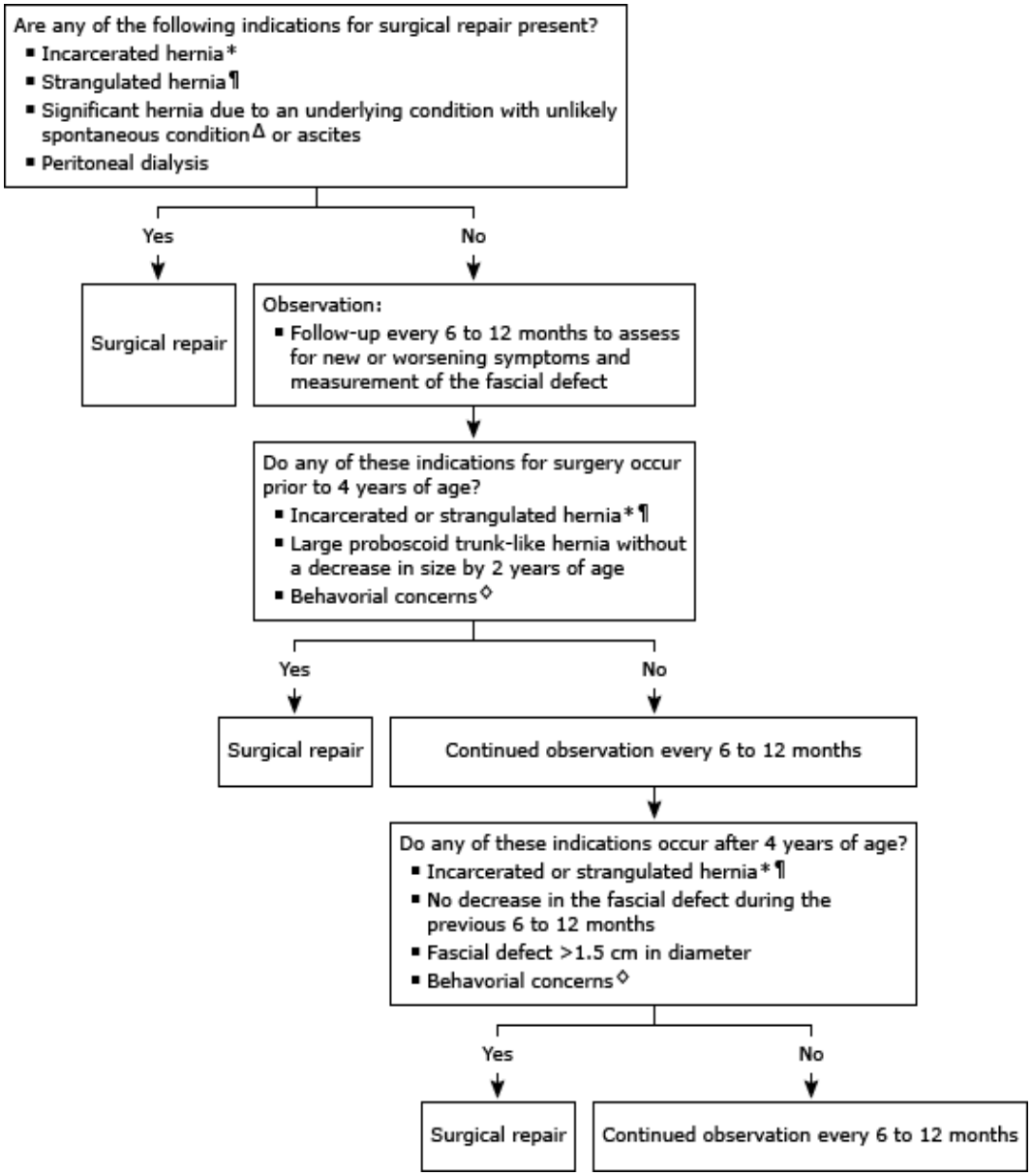
- **Swelling at the umbilicus** (often reducible in early stages)
- **Pain or discomfort**, especially with straining or coughing
- **Redness, ulceration, or skin thinning** in large, chronic hernias
- **Infections** (secondary to pressure necrosis or contamination)
- **Umbilical drainage** (suggestive of an **umbilical fistula**)
- **Incidental findings** on abdominal imaging for unrelated conditions

Asymptomatic or small hernias (<2 cm) can be monitored, while larger or symptomatic hernias usually require surgical intervention to prevent complications such as incarceration and strangulation.

Management of Umbilical Hernia

Most umbilical hernias in infants resolve spontaneously as the umbilical ring closes. The decision for surgical intervention is based on hernia size, symptoms, and risk of complications. In asymptomatic children with small, shrinking umbilical rings, a watchful waiting approach is preferred. Surgery before the age of four years is generally discouraged, as studies indicate an increased risk of recurrence, emergency room visits, and postoperative complications in early childhood[30].

Figure 6: Overview of Management of Umbilical Hernia in Children



Surgical Techniques for Umbilical Hernia Repair

Several surgical techniques exist for umbilical hernia repair, selected based on hernia size, patient characteristics, and recurrence risk.

1. Mayo Technique

- Traditional **open repair** for umbilical hernias.
- Uses **overlapping fascial closure** with non-absorbable sutures.
- Limited by **higher recurrence rates** in large hernias.

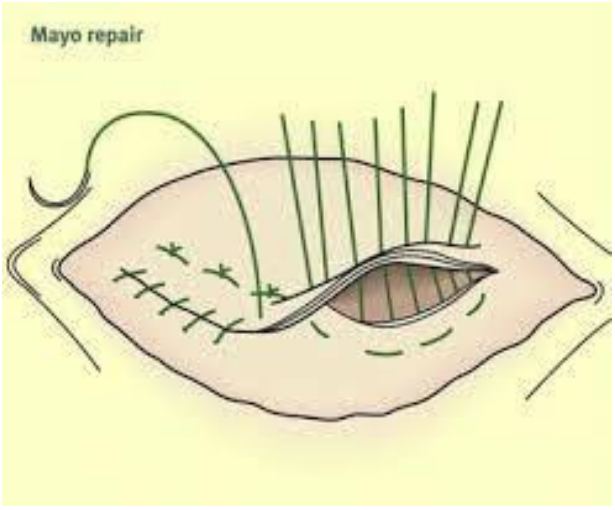


Figure 7: Mayo Repair of Umbilical Hernia

2. Umbilical Repair with Primary Closure

- Suitable for **small defects (<2 cm)**.
- The hernia sac is dissected, removed, or inverted, & fascial defectclosed with sutures.
- **High tension** in larger defects may increase recurrence risk.

3. Open Mesh Repair

- Recommended for **larger hernias (>2 cm)** or recurrent cases.
- A **vertical or curvilinear incision** is created next to the hernia sac.

- The hernia sac is separated, adhesions are removed, and the sac is either removed.

- Fascial defect is secured with non-absorbable sutures, and a mesh is placed if the defect is large or under tension[31].

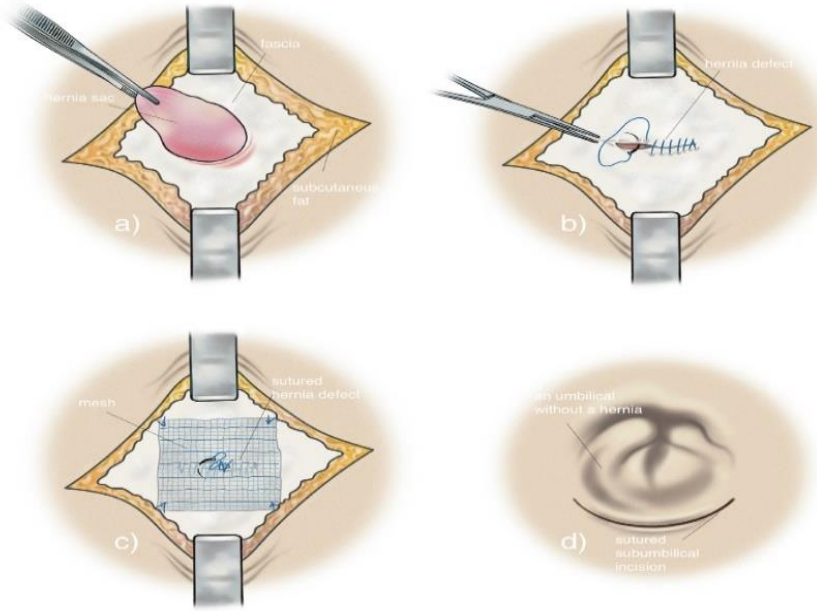


Figure 8: Open Mesh Repair

Mesh Placement Techniques in Open Repair

A comprehensive review of umbilical hernia management suggests that mesh reinforcement significantly reduces recurrence rates compared to primary suture repair, making it the preferred choice in defects larger than 2 cm[37].

Mesh reinforcement is used in **large or recurrent hernias** to reduce **recurrence rates**.

- **Sublay (Underlay):** Mesh is placed beneath the rectus sheath, offering strong reinforcement and lower recurrence rates.

- **Onlay:** Mesh is positioned above the fascial closure, but has a higher risk of migration.
- **Plug Mesh:** Used for small defects, reinforcing the repair.
- **Hybrid Techniques:** Incorporate skin tacking to improve cosmetic outcomes, particularly in umbilical reconstruction[32].

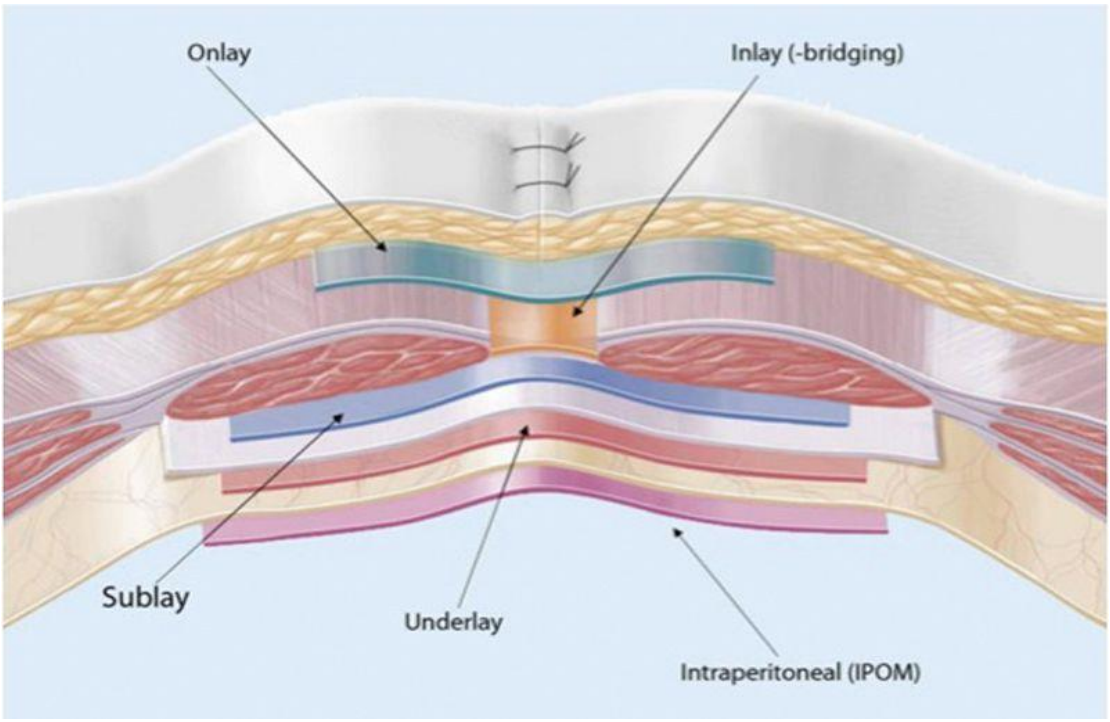


Figure 9: Mesh Placement Techniques in Open Repair

For hernias >4 cm, laparoscopic repair is preferred, particularly in obese patients or those with multiple hernias. Although laparoscopy is more invasive for small hernias, it is often the better option for large, complex defects.

Laparoscopy also allows for assessment of bowel viability in incarcerated hernias (e.g., Richter's hernia) and adhesiolysis if necessary. The same laparoscopic principles apply to umbilical hernia repair as for other ventral hernias[33], [34].

Complications and Considerations in Mesh Hernioplasty

Postoperative complications of mesh hernioplasty include **seroma formation** (fluid accumulation at the surgical site) and **surgical site infections**. Several risk factors influence complication rates, including diabetes mellitus, obesity, smoking, malnutrition (hypoproteinemia), and the size or number of fascial defects[15]. Smaller umbilical hernias (≤2 cm) can often be repaired with primary suture closure, whereas larger hernias (>2 cm) require mesh reinforcement to minimize recurrence[16].

This growing body of evidence has led to continuous refinements in surgical techniques. While **IPOM-plus** has been a widely used approach, concerns about **mesh-related adhesions, pain, and intra-abdominal complications** have prompted the exploration of alternative methods, such as TAPPu-plus, which places the mesh in the preperitoneal space, potentially reducing adhesion-related complications[17]. This study aims to contribute to the growing debate on the optimal approach for laparoscopic umbilical hernia repair, particularly in small-sized hernias.

Laparoscopic Repair Techniques for Umbilical Hernia

Recent guidelines for laparoscopic ventral and incisional hernia repair suggest that minimally invasive techniques such as TAPPu-plus and IPOM-plus improve patient outcomes while reducing recurrence rates and complications[28].

Laparoscopic approaches are preferred for larger hernias, as they offer lower recurrence rates, less postoperative pain, and faster recovery.

1. Laparoscopic Transabdominal Preperitoneal (TAPPu-plus) Repair

- A **modified approach** that avoids direct intraperitoneal mesh contact.

- Mesh is secured in **preperitoneal space**, reducing **adhesions.**

- **Technically more demanding**, requiring greater laparoscopic expertise[35].

2. Laparoscopic Intraperitoneal Onlay Mesh (IPOM-plus) Repair

- Primary defect closure with sutures, followed by **intraperitoneal mesh placement**.

- Mesh fixation is achieved using **tackers or transfascial sutures**.

- **Higher risk of adhesions** due to direct mesh contact with abdominal viscera.

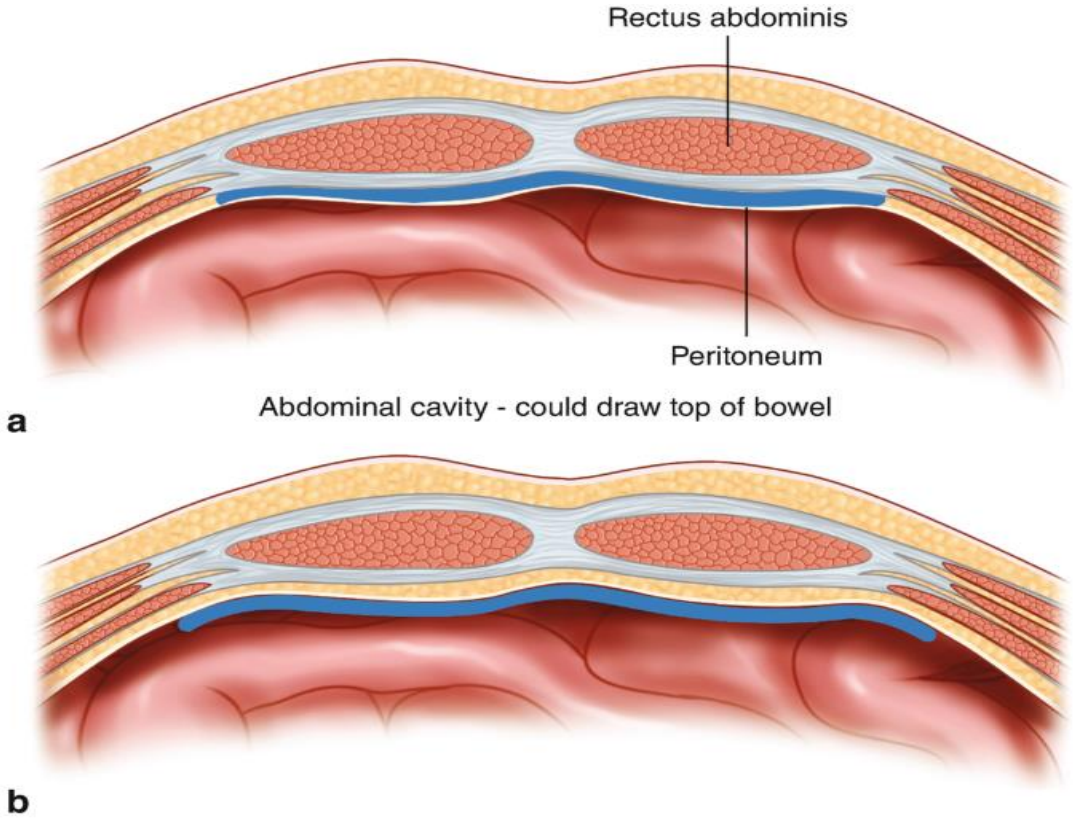


Figure 10: TAPPu vs. IPOM Repair

Transabdominal Preperitoneal (TAPPu-plus) Repair with Primary Defect Closure

TAPPu-plus is a laparoscopic hernia repair technique designed to offer preperitoneal reinforcement while reducing intraperitoneal complications. Unlike IPOM-plus, which places the mesh inside the peritoneal cavity, TAPPu-plus allows for primary suturing of the hernia defect accompanied by preperitoneal mesh reinforcement, reducing adhesion-related issues.

Advantages of TAPPu-plus Repair

- Reduces risk of bowel adhesions by avoiding intraperitoneal mesh placement.
- Lower recurrence rates due to better anatomical reinforcement.
- Allows natural fascial healing by enabling primary defect closure.
- Minimizes postoperative pain by reducing nerve irritation.
- Prevents mesh migration and contraction by securing it in the preperitoneal plane.

Surgical Steps of TAPPu-plus Repair

1. Patient Positioning and Preparation

- Supine positioning with arms tucked at the sides.
- Legs slightly abducted for optimal exposure.
- General anaesthesia administered with CO_2 pneumoperitoneum (12-15 mmHg).

2. Port Placement

- 10 mm camera port (infraumbilical).
- Two 5 mm working ports (bilateral midclavicular line).

3. Hernia Sac Reduction and Primary Defect Closure

- Hernia sac is carefully dissected and reduced.
- Adhesions are released, ensuring no bowel entrapment.
- Primary fascial closure is performed using non-absorbable sutures

4. Preperitoneal Mesh Placement

- A light-weight poly-propylene mesh is positioned in preperitoneal space.
- The mesh covers defect by at least 05 cm.
- Mesh fixation is performed with:
    - Absorbable tackers (reducing pain and chronic discomfort).
    - Minimal transfascial sutures, if additional fixation is required.

5. Peritoneal Flap Closure

- A peritoneal flap is created and closed over the mesh with absorbable sutures.
- This prevents direct contact of mesh with abdominal organs, reducing adhesion risk.

6. Closure and Final Steps

- CO_2 is evacuated, and port sites are closed.
- The fascia of ≥10 mm port is sutured to prevent port-site hernias.
- Skin is secured using absorbable sutures or glue.

Postoperative Care for TAPPu-plus Repair

- Early ambulation to reduce venous thromboembolism risk.
- Pain management using NSAIDs and local anaesthetic infiltration.
- Monitoring for complications, including:
    - Seroma formation (self-limiting).
    - Hematoma or infection (rare).
    - Recurrence, significantly lower compared to suture-only repair.
- Return to daily activities within 2–4 weeks, full recovery by 6–8 weeks.

Intraperitoneal Onlay Mesh (IPOM-plus) Repair with Primary Defect Closure

Intraperitoneal Onlay Mesh (IPOM-plus) repair is a widely used laparoscopic technique for umbilical hernia repair, combining primary fascial defect closure with intraperitoneal mesh placement to reduce recurrence rates. This method enhances abdominal wall strength while preventing herniation through residual fascial defects.

IPOM-plus is particularly useful for moderate to large umbilical hernias (>2 cm), where simple suture closure alone has a higher recurrence risk[30]. By closing the defect primarily before mesh placement, the abdominal wall maintains its natural tensile strength, and the risk of mesh bulging is minimized[31].

Advantages of IPOM-plus Repair

- Allows primary closure of the defect, restoring normal abdominal wall tension.
- Reduces likelihood of hernia recurrence comparison to suture-only repair.
- Minimizes seroma formation by avoiding dead space under the mesh.
- Laparoscopic approach results in faster recovery and less postoperative pain.

- Versatile for various defect sizes, including multiple or recurrent umbilical hernias.

Surgical Steps of IPOM-plus Repair

1. Patient Positioning and Preparation

- Patient placed in supine position with arms tucked at the sides.
- General anaesthesia administered, with CO_2 pneumoperitoneum (12–15 mmHg) established using a Veress needle or optical trocar.

2. Port Placement

- Three-port technique:
    - 10 mm telescope port (infra-umbilical placement).
    - 2 - 5 mm working ports (bilateral midclavicular line).

3. Hernia Sac Reduction and Primary Defect Closure

- The hernia sac is carefully dissected and reduced into the abdominal cavity.
- Adhesions and omental attachments are freed using laparoscopic instruments.
- Fascial defect is secured using:
    - Non-absorbable or slowly absorbable sutures (interrupted or continuous).

4. Intraperitoneal Mesh Placement

- A dual-layer composite mesh (e.g., polypropylene with anti-adhesive coating) is placed intraperitoneally.
- Mesh covers hernia by at least (five) cm to ensure proper reinforcement.
- Mesh fixation techniques:
    - Absorbable tackers (preferred to reduce chronic pain).
    - Transfascial sutures (for additional stability in larger defects).

5. Final Closure and CO_2 Evacuation

- The trocar sites are inspected for bleeding or organ injury.
- CO_2 is evacuated, and the fascia of the ≥10 mm port is closed to prevent port-site hernia.
- The skin is closed using absorbable sutures or surgical glue.

Postoperative Care for IPOM-plus Repair

- Early mobilization to prevent deep vein thrombosis (DVT).
- Pain control with NSAIDs and local anaesthetic infiltration.
- Monitoring for complications, including:
    - Seroma formation (self-limiting in most cases).
    - Hematoma or infection (rare with appropriate sterile technique).
    - Adhesion-related bowel complications, minimized with barrier-coated mesh.
- Return to routine activities within 2–4 weeks, full recovery by 6–8 weeks.

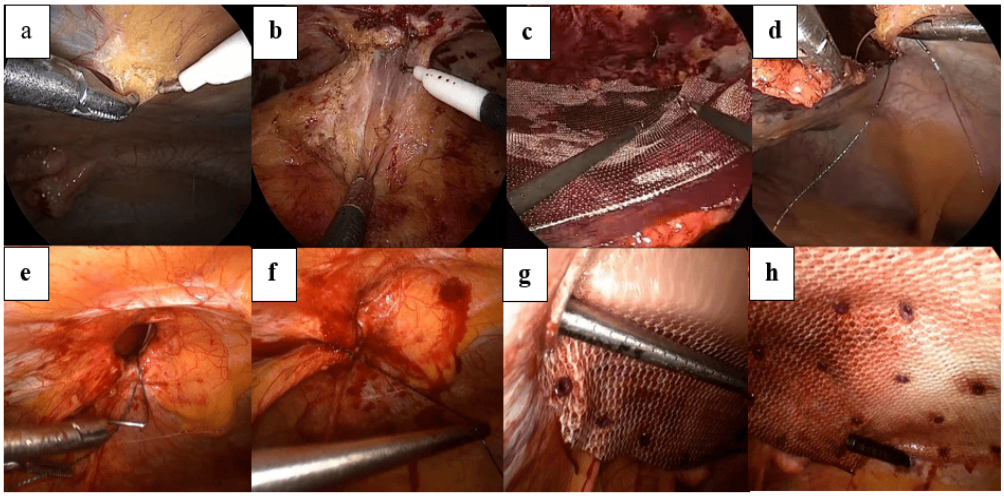


Figure 1: Intraoperative Steps
(**a-d)** TAPPu-plus repair - **a** Paramedian incision of the peritoneum **b** Dissection of hernial sac **c** Mesh placement **d** Closure of the peritoneum
(**e-h)** IPOM-plus repair - **e** Hernial contents reduced **f** Hernial defect closure **g** Mesh fixation with tacker **h** Fixed mesh with tacks

Comparison of IPOM-plus vs. TAPPu-plus		
Feature	**IPOM-plus Repair**	**TAPPu-plus Repair**
Mesh Placement	Intraperitoneal (in contact with bowel)	Preperitoneal (avoids direct bowel contact)
Defect Closure	Always performed before mesh placement	Always performed before mesh placement
Adhesion Risk	Higher (requires anti-adhesive mesh)	Lower (mesh is covered by peritoneal flap)
Postoperative Pain	More (due to tacker fixation)	Less (due to reduced mesh fixation)
Recurrence Rate	Moderate (5–10%)	Lower (<5%)
Ideal for	Small to large umbilical hernias	Small to medium-sized umbilical hernias

Table 1: Comparison of the IPOM-plus vs. TAPPu-plus

Conclusion

IPOM-plus remains one of the most widely practiced laparoscopic techniques for umbilical hernia repair, particularly for larger hernias requiring strong fascial reinforcement. Although it carries a higher risk of adhesion formation, advancements in anti-adhesive mesh technology have improved its long-term outcomes.

While TAPPu-plus provides better anatomical placement, IPOM-plus remains a versatile option, especially for patients with a history of abdominal surgeries or large fascial defects. The choice between IPOM-plus and TAPPu-plus should be determined by hernia size, patient specific considerations, & surgeon expertise.

According to the Asia Pacific Hernia Society, laparoscopic techniques, including IPOM-plus and TAPPu-plus, reduce long-term recurrence rates and improve patient outcomes in ventral hernia repair[35].

Comparison of TAPPu-plus vs. IPOM-plus for Umbilical Hernias

The effectiveness of TAPPu versus IPOM-plus for umbilical hernia repair has been the subject of multiple clinical studies, comparing **surgical outcomes, pain levels, recurrence rates, and postoperative recovery**. Below is a summary of the most relevant studies analyzing these two techniques.

1. Study by Leque B et al., (2017)

A comparative study involving 39 patients in the IPOM-plus group and 40 in the TAPPu group examined operative and postoperative outcomes.

- No notable variation in hernia types, mean defect size, or mesh area.
- Seroma rates were lower in the TAPPu group.
- TAPPu had longer operative times, whereas IPOM-plus had longer hospital stays.
- Postoperative pain was significantly lower in the TAPPu group on days 1, 7, and 30.
- At 30 and 180 days, the TAPPu group had better cosmetic outcomes and fewer activity restrictions.
- Hernia recurrence: 1 recurrence in the IPOM-plus group, none in the TAPPu group[39].

2. Study by Jain M et al., (2022)

A randomized controlled trial evaluating TAPPu versus IPOM-plus for primary and incisional hernias.

- TAPPu patients had lower postoperative pain and seroma rates ($p < 0.05$).
- Earlier return to activity was observed in the TAPPu group.
- TAPPu repair was 2.4 times more cost-effective than IPOM-plus.
- Conclusion: TAPPu is the preferred approach for small and medium-sized umbilical hernias, offering reduced pain and faster recovery[40].

3. Study by Bui NH et al., (2022)

This study analyzed 72 patients (43 IPOM-plus, 29 TAPPu) and compared demographics and surgical outcomes.

- No differences in age, BMI, smoking status, or comorbidities.
- IPOM-plus was more commonly used for incisional hernias, while TAPPu was used for primary hernias.
- TAPPu had shorter hospital stays, whereas IPOM-plus had shorter operative times.
- A higher percentage of IPOM-plus patients required postoperative analgesia (TAP block or epidural) (33% vs. 0%, $p = 0.002$) [41].

4. Study by Elrifai A et al., (2022)

This study compared laparoscopic IPOM-plus with open hernioplasty for ventral hernias.

- Mean age: 41 ± 10.6 years (70% male patients).
- Mean BMI: 29 kg/m², with a mean defect size of 2.5 cm.
- Patients undergoing laparoscopic IPOM-plus had lower postoperative pain scores and earlier return to work.
- No notable differences in complications across the groups.
- Operative time and hospital stay are shorter in laparoscopic group (67.5 min vs. 71.6 min) [42].

5. Study by Arish H et al., (2023)

A study evaluating 66 patients (40 IPOM-plus, 36 TAPPu), assessing surgical time, pain levels, and hospitalization duration.

- TAPPu required significantly longer surgery times (121.6 min vs. 85.6 min, $p < 0.05$).
- Postoperative pain was lower in the TAPPu group on days 1 and 3 (VAS score: 3.8 vs. 7.5).
- Hospital stays were shorter in the TAPPu group (3.1 vs. 5.3 days).
- On day 30, both groups had similar pain scores (IPOM-plus: 1.2 vs. TAPPu: 1.1).
- Conclusion: TAPPu provides less postoperative pain and shorter hospitalization, but requires more operative time[43].

6. Study by Tasdelen HA et al., (2023)

A study assessing TAPPu vs. IPOM-plus in midline incisional hernia repair.

- No significant differences in age, sex, BMI, ASA score, or smoking status.
- TAPPu patients had larger mesh-to-defect (M/D) ratios, ensuring better reinforcement.
- TAPPu had significantly lower pain levels on days 1 and 10.
- No significant differences in recurrence or intraoperative complications.
- Conclusion: TAPPu offers faster recovery and less pain but requires longer surgery time[44].

7. Study by Yasin F et al., (2024)

A study comparing IPOM hernioplasty vs. IPOM-plus.

- 7.14% of patients in the IPOM-plus group developed seromas vs. 23.81% in the IPOM group ($p = 0.035$).
- Recurrence rate was lower in the IPOM-plus group (4.76% vs. 21.43%) ($p = 0.024$).
- Conclusion: IPOM-plus reduces recurrence risk compared to IPOM without defect closure[45].

8. Study by Sholapur S et al., (2024)

A study comparing IPOM-plus vs. TAPPu-RS for primary hernia repair.

- TAPPu required longer operative time (192.3 min vs. 102.6 min, $p = 0.001$).
- Hospital stays were shorter in the TAPPu group (4.6 vs. 5.9 days, $p = 0.02$).
- Postoperative pain scores were higher in the IPOM-plus group at day 1, 7, and 90 ($p = 0.001$).
- Conclusion: TAPPu offers better long-term outcomes, but IPOM-plus is technically simpler[46].

9. Study by Sehsah TM et al., (2024)

A study assessing TAPPu vs. IPOM in ventral hernia repair.

- TAPPu required longer operative time but had lower hospital costs and shorter stays.
- TAPPu patients had lower post-operative pain levels and early start of daily activity.
- Cosmetic outcomes were similar between both groups.
- No notable differences in reappearance or major complications.
- Conclusion: Both techniques are safe and effective, but TAPPu offers superior recovery and pain control[47].

Conclusion

The comparison of TAPPu vs. IPOM-plus highlights the advantages and trade-offs of both techniques.

- TAPPu offers superior outcomes in terms of:
    - Lower recurrence rates
    - Reduced postoperative pain
    - Shorter hospital stays
- IPOM-plus remains advantageous for:
    - Shorter operative times
    - Technical simplicity
- While TAPPu requires more operative time and surgical expertise, it provides better long-term outcomes with faster patient recovery. The choice between TAPPu and IPOM-plus should be determined by hernia characteristics, patient-specific considerations, & surgeon proficiency.

MATERIALS AND METHODS

Source of Data: Study were be conducted among patients of age 18 & above, of either sex, diagnosed to have an umbilical hernia and planned for Laparoscopic Hernia Repair, who fulfilled the inclusion & exclusion criteria, admitted in KAHER'S Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi and KLES Dr. Prabhakar Kore Hospital and Medical Research Centre.

Study Design: Randomised Controlled Trial.

Study Period: 1 year [September 2023 - September 2024].

Sample Size:

Standard deviation in the 1st group, SD_1= 0.59

Standard deviation in the 2nd group, SD_2= 0.89

Mean of 1st group, $\bar{x}_1$=2.26

Mean of 2nd group, $\bar{x}_2$=2.90

$Z_{1-\alpha/2}$= 1.96

$Z_{1-\beta}$= 0.85

Sample size formula-

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2(SD_1^2+SD_2^2)}{(\bar{x}_1-\bar{x}_2)^2}$$

$$n = \frac{(1.96+0.85)^2(0.59^2+0.89^2)}{(2.26-2.90)^2}$$

n = 22 in each group

The sample size is calculated with a 95% confidence interval at 80% power.

Sampling technique: After having met inclusion and exclusion criteria and obtaining informed consent, patients were be randomly divided into 2 groups using SNOSE (Sequentially numbered, opaque, sealed envelope) technique: the randomly assigned group is recorded on paper and placed inside a sealed, opaque envelope, where envelope is labelled with a unique number, and the investigator unseals the envelope after obtaining the patient's consent and allocates the treatment group accordingly.

Group A - Patients in this group were undergo Laparoscopic TAPPu-plus.

Group B - Patients in this group were undergo Laparoscopic IPOM-plus.

Inclusion Criteria:

- Patients with hernia within 3cm above and below the umbilicus, i.e. Umbilical Hernias (EHS classification M3).
- Patients with a hernia of size <4cm, i.e. Small sized Umbilical hernia (EHS classification W1).
- Patients fit to undergo Laparoscopic surgery.
- Patients who are wereing to give informed consent.

Exclusion Criteria:

- Patients with liver disease with ascites.
- Patients with peritonitis.
- Patients with intestinal obstruction.
- Patients with hollow viscus perforation.

Study protocol: Consort flow chart for RCT:

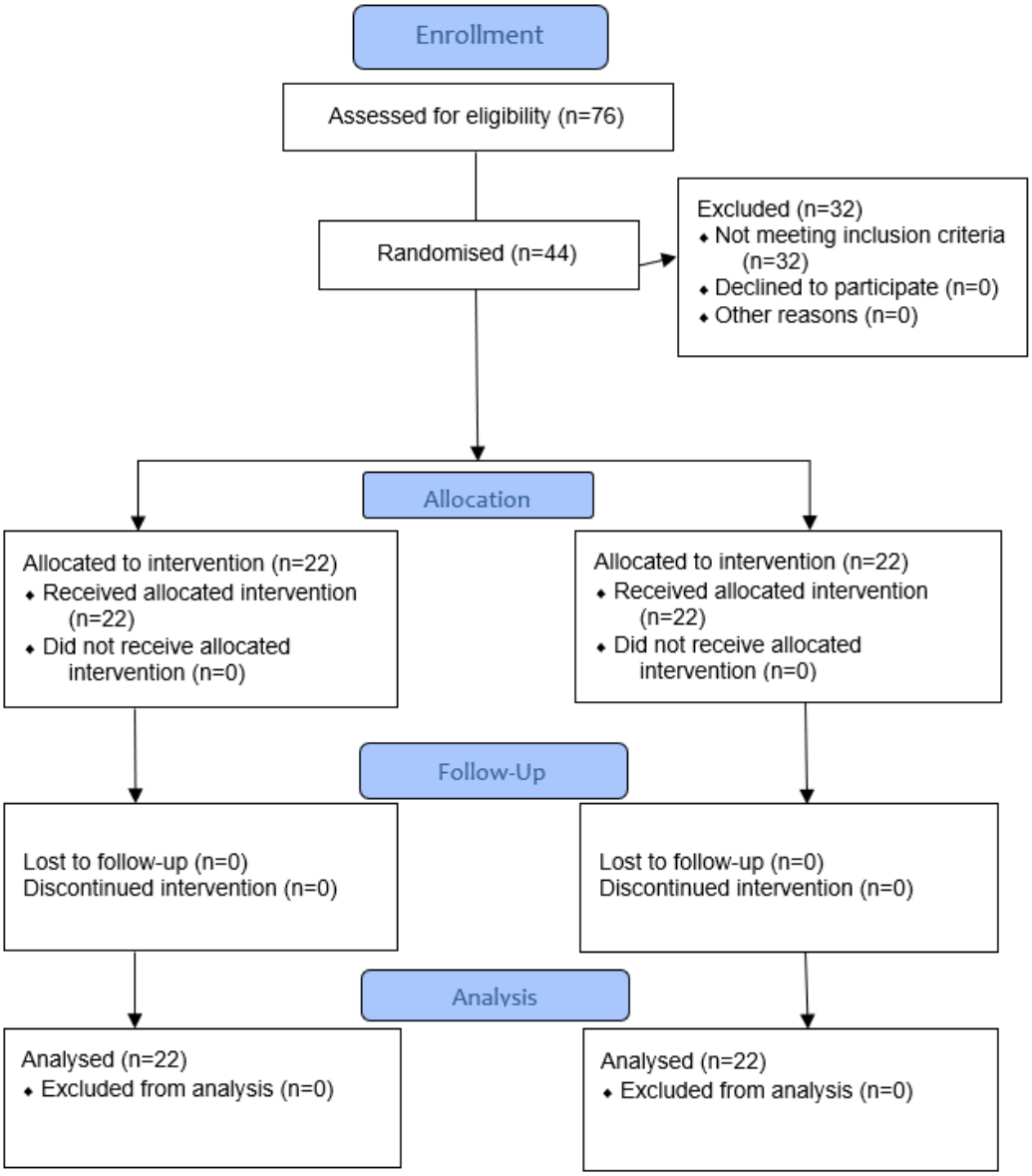


Figure 12: Consort Flow Chart

Data collection procedure: After obtaining the approval of the ethical committee, all patients were be recruited as per the inclusion and exclusion criteria after taking valid informed consent. The patient's socio-demographic details were be collected using a predesigned proforma. After having met inclusion and exclusion criteria, detailed history of patients were be taken, and thorough clinical examination and routine investigations were be done to rule out any clinical abnormality. Patients were be

randomised based on the SNOSE technique into one of two groups. In group(A), patients were undergo Laparoscopic TAPPu-plus, whereas, in group(B), patients were undergo Laparoscopic IPOM-plus. Among the two groups, the following are compared:

- Operative Time: From the time of induction to the entrance of the recovery room using anaesthesia chart time.
- Blood Loss: A visual analogue scale was utilized to assist in estimating the volume of blood absorbed by standard surgical gauze, ensuring a more accurate assessment of blood loss. Various degrees of staining were documented through photographs to develop a reference guide for quantifying the amount of blood retained in the gauze.
- Postoperative Pain: After the surgery, an assessment of pain were be done after 6 hours, 24 hours, 48 hours, 1 week and 4 weeks post-surgery using Visual Analogue Scale.

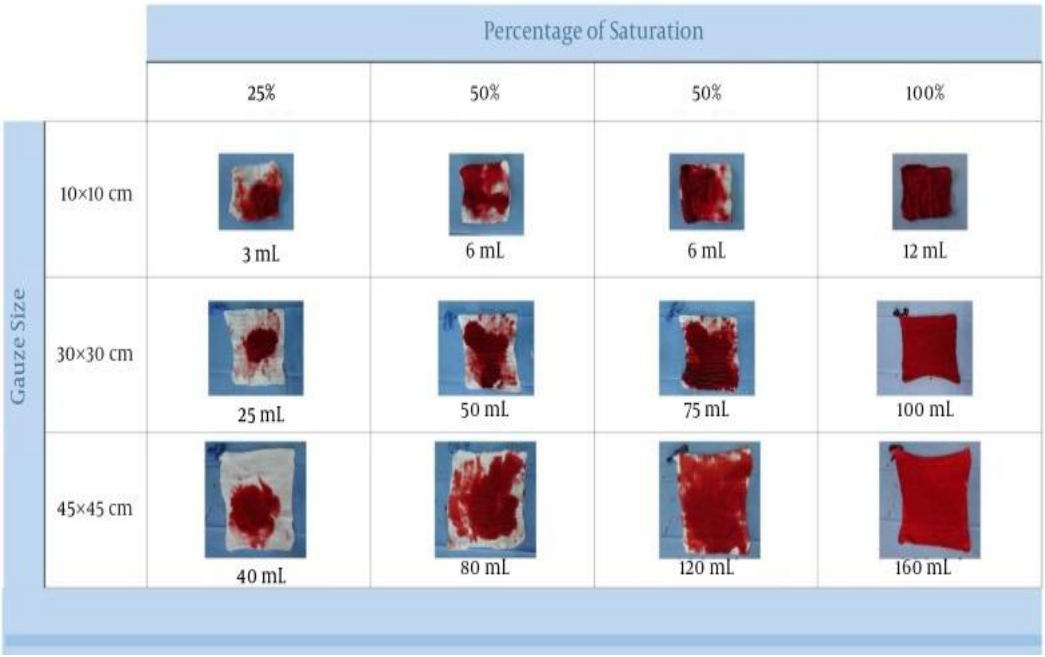


Figure 13: Estimation of Blood Loss

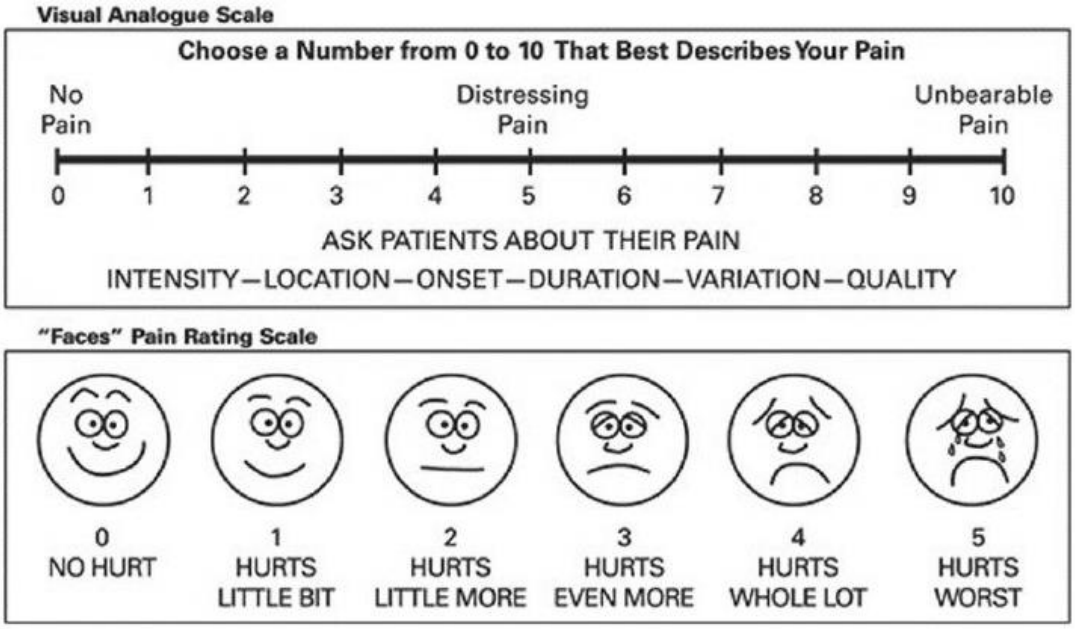


Figure 14: Visual analogue scale (VAS)

- Analgesic Intake: The dosage, drug strength and the number of doses given to the patient post-operation are considered.
- Hospital Stay: From the day of surgery, which is represented as POD-0(Post Operated Day) and the next day as POD-1 to the day of discharge.
- Complications and Recurrence: Are estimated during the follow-ups post-discharge up to a period of 1 year.

Investigations or Interventions conducted on patients:

Investigations: Complete Blood picture, Liver Function Test, Renal Function Test, PT-INR, APTT, ECG, Chest X-Ray (PA) view for general & anaesthetic fitness of surgery.

Intervention: The study comparing lap. TAPPU-plus to lap. IPOM-plus repair were be performed under general anaesthesia by intubation. A total of three trocars were be used (two working ports and a single camera port) in both the groups.

STATISTICAL ANALYSIS

The study aims to compare two groups. For continuous quantitative variables, the **mean and standard deviation** were be determined. Intergroup comparisons of continuous variables were be analyzed using statistical methods such as the **unpaired Student's t-test**, while comparisons of two quantitative variables within the same group were be conducted using the **paired Student's t-test**.

Categorical data were be represented as ratios, **rates, and percentages**. The relationship between the outcome, clinical factors, and demographic characteristics were be assessed using the **Chi-square test or Fisher's exact test**, depending on the data distribution.

Apart from the above suitable tools like ANOVA, correlation, regression etc. were be used according to need.

Discrete variables were be represented by the median. Non-parametric tests were be used for comparing discrete variables. Suitable graphs were be used to depict the comparison. For all the tests, p-value less than 5% (0.05) were be considered significant.

RESULTS

Present study included total of 44 patients fulfilling inclusion criteria. Patients were divided into two groups as:

Group A: Patients in this group were undergo Laparoscopic TAPPu-plus.

Group B: Patients in this group were undergo Laparoscopic IPOM-plus.

Table 2: Comparison of the Mean Age among groups

	Group A		Group B		p-value
	Mean	SD	Mean	SD	
Age	45.68	12.98	47.41	9.68	0.62

Mean age of patients between the groups are comparable with overall mean age of 46.55yrs.

Figure 15: Comparison of the Mean Age between the groups

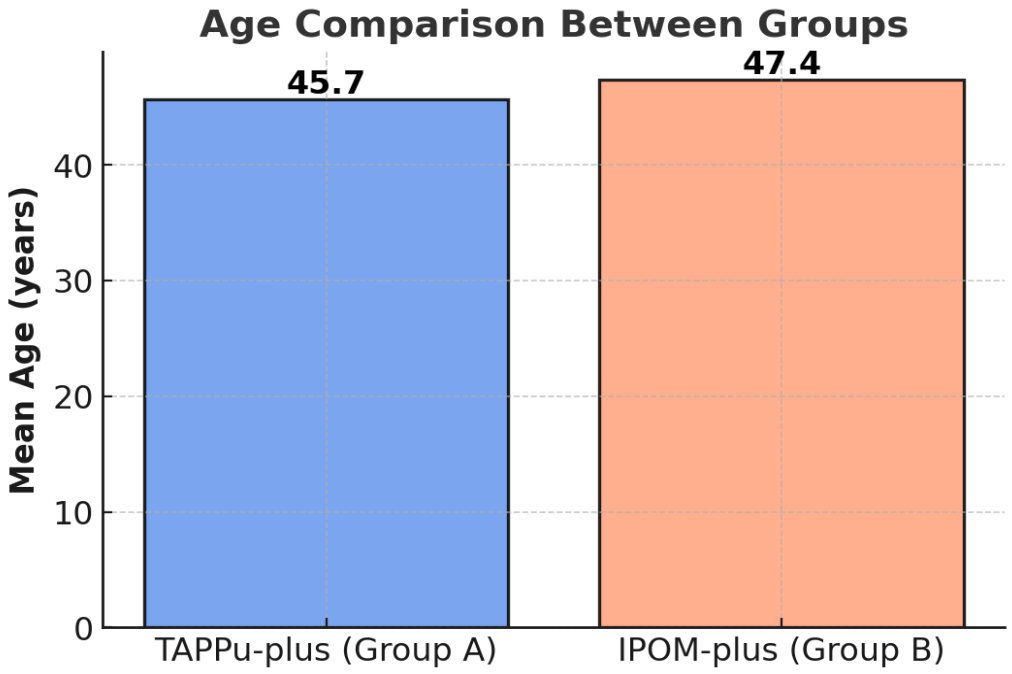


Table 3: Comparison of the Gender Distribution between the groups

		Group A		Group B	
		Count	N %	Count	N %
Gender	Female	7	31.8%	6	26.1%
	Male	15	68.2%	16	69.6%

Among the gender distribution, there is no significant difference noted between thegroups, however overall, there is male preponderance in the study.

Figure 16: Evaluation of the Gender Distribution between the group

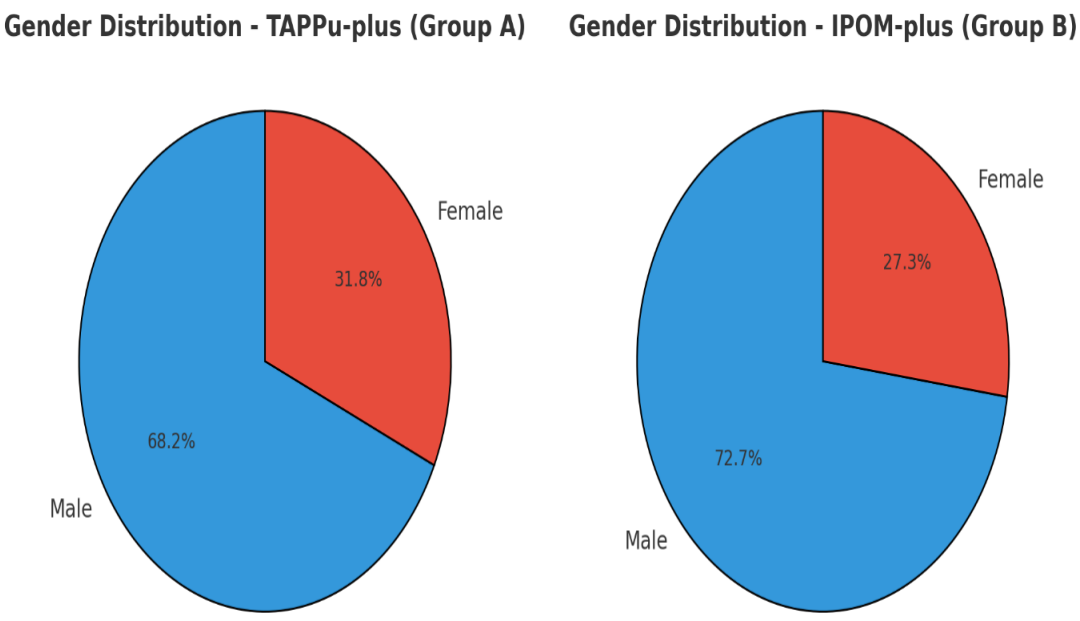


Table 4: Evaluation of the Operative Time between the groups

	Group A		Group B		
	Mean	SD	Mean	SD	p-value
Operation time (mins)	117.27	14.94	80.50	19.67	2.21

The operative time among the groups was significantly different. Mean time of operation was significantly shorter in the IPOM-plus group (Group B) compared to patients in the TAPPu-plus group (Group A) ($p < 0.05$).

Figure 17: Evaluation of the Operative Time among groups

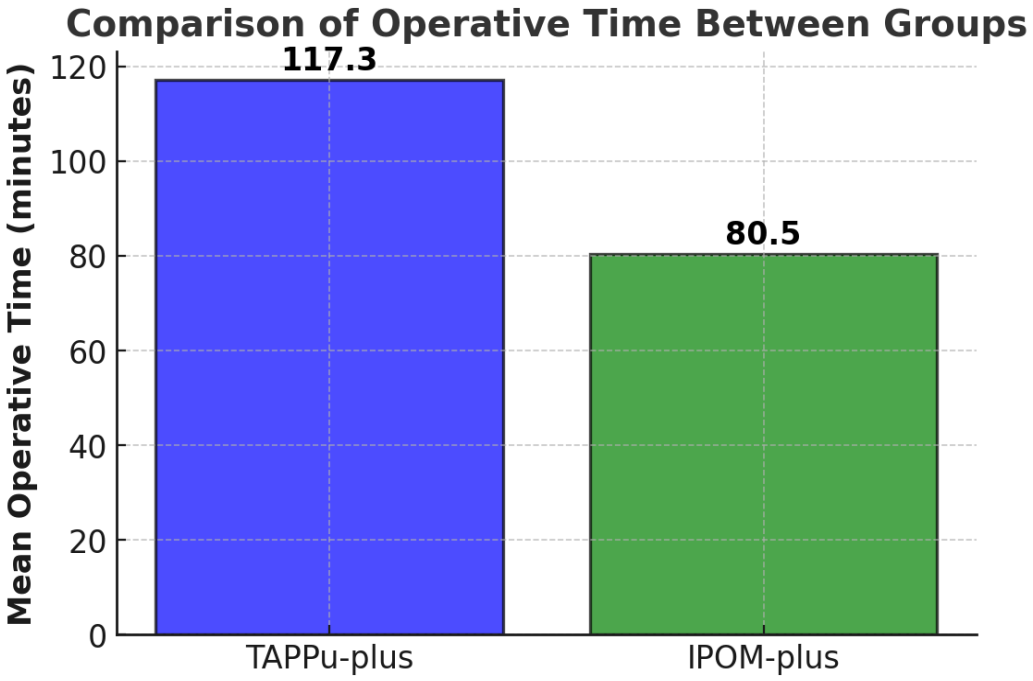


Table 5: Comparison of the Blood Loss between the groups

	Group A		Group B		
	Mean	SD	Mean	SD	p-value
Blood Loss (6*6 gauze)	1.68	0.72	2.55	0.96	0.00168

The blood loss between the two groups was significantly different. The mean blood loss was significantly lower in the TAPPu-plus group (Group A) compared to patients in the IPOM-plus group (Group B) (p = 0.002).

Figure 18: Evaluation of the Blood Loss among groups

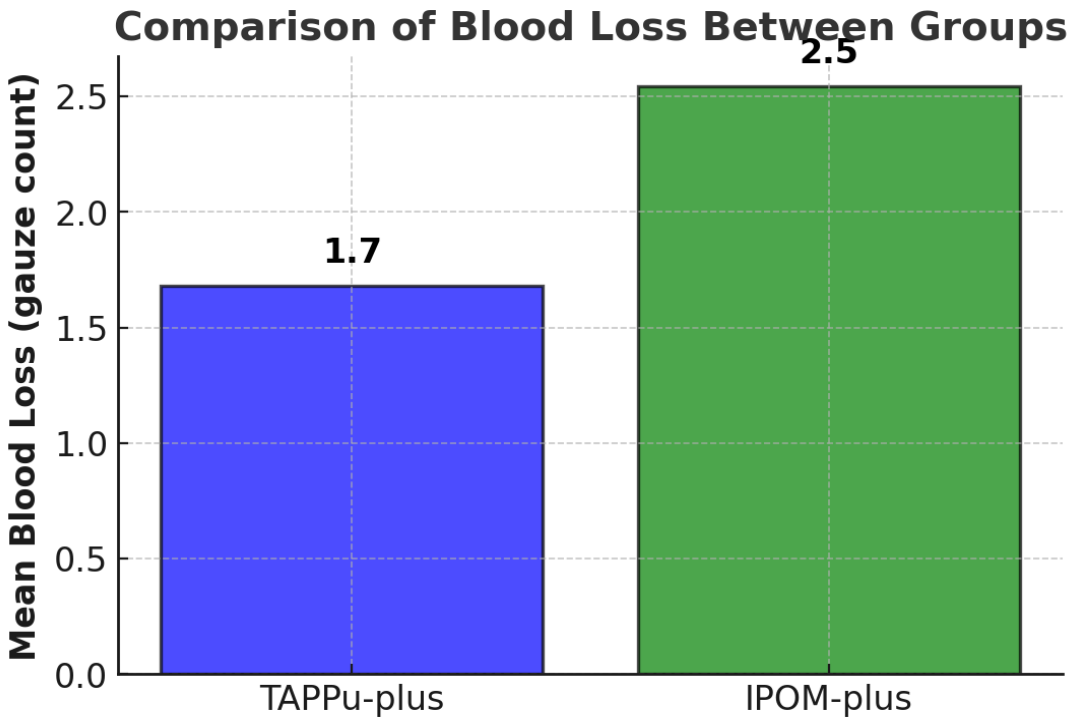


Table 6: Evaluation of the Pain Score among groups

Pain	Group A		Group B		
	Mean	SD	Mean	SD	p-value
6 hours	7.41	0.8	8.27	0.88	0.0014

On assessment of the pain score between the groups, there was a significantly lower mean pain score among the patients in Group B (IPOM-plus) compared to the patients in Group A (TAPPu-plus) ($p < 0.05$). The pain score in Group B was significantly lower on post-operative day 1 ($p = 0.000$), day 7 ($p = 0.000$), 1st month ($p = 0.158$), and 4th week ($p < 0.05$).

1 day	4.36	0.90	6.23	1.11	3.19
2 days	2.00	0.69	3.77	0.69	9.71
1 week	0.55	0.67	1.73	0.63	3.79
4 weeks	0.14	0.35	0.32	0.48	0.158

Figure 19(a): Evaluation of the Pain Score among groups

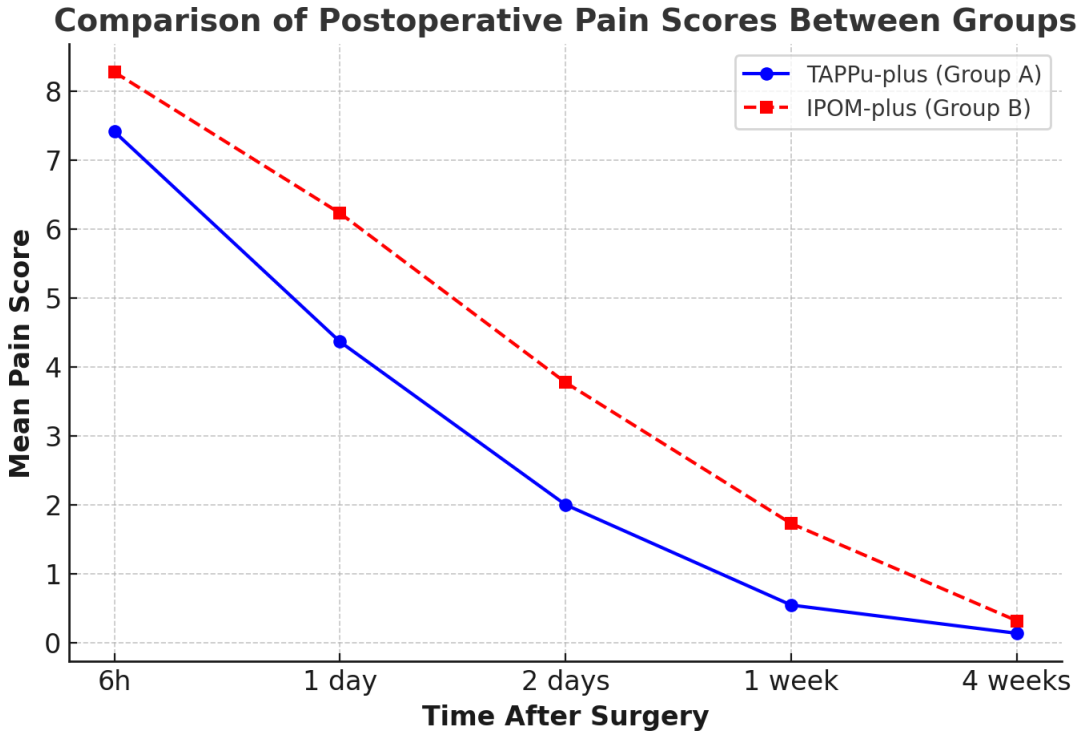


Figure 19(b): Evaluation of the Pain Score among groups

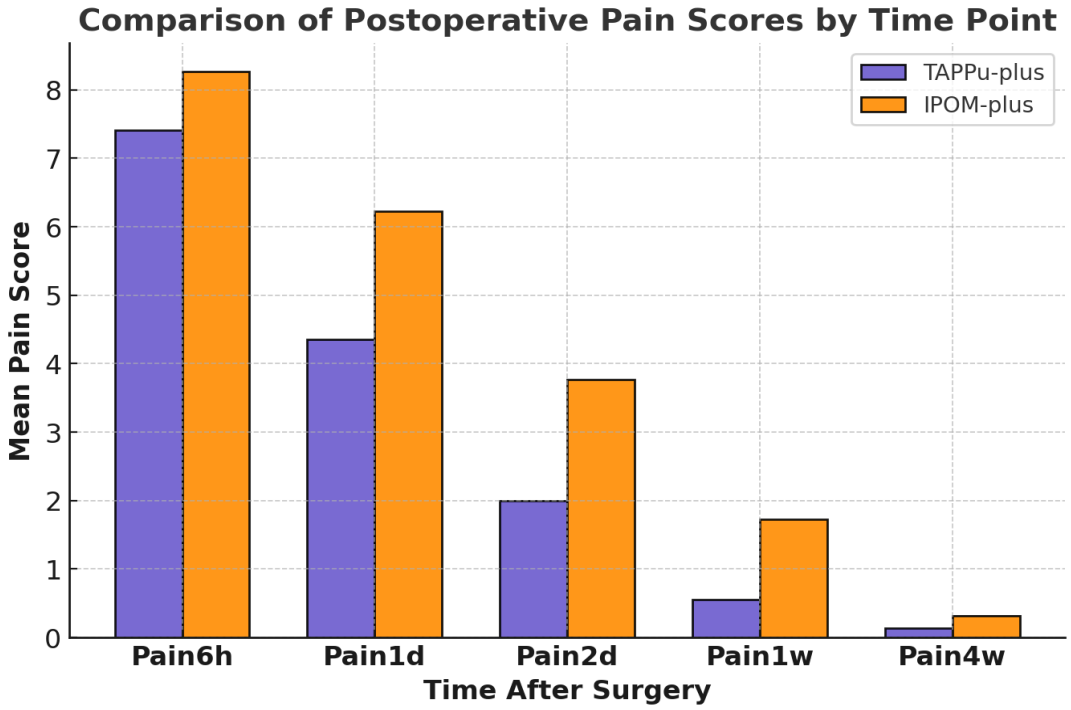


Table 7: Evaluation of the Analgesics among the groups

	Group A		Group B		
	Mean	SD	Mean	SD	p-value
Analgesics (days)	2.86	0.77	4.27	0.63	6.18

The duration of analgesic use among groups was significantly different. Mean duration of analgesic use was significantly shorter in the TAPPu-plus group (Group A) compared to patients in the IPOM-plus group (Group B) ($p < 0.05$).

Figure 20: Comparison of the Analgesics between the groups

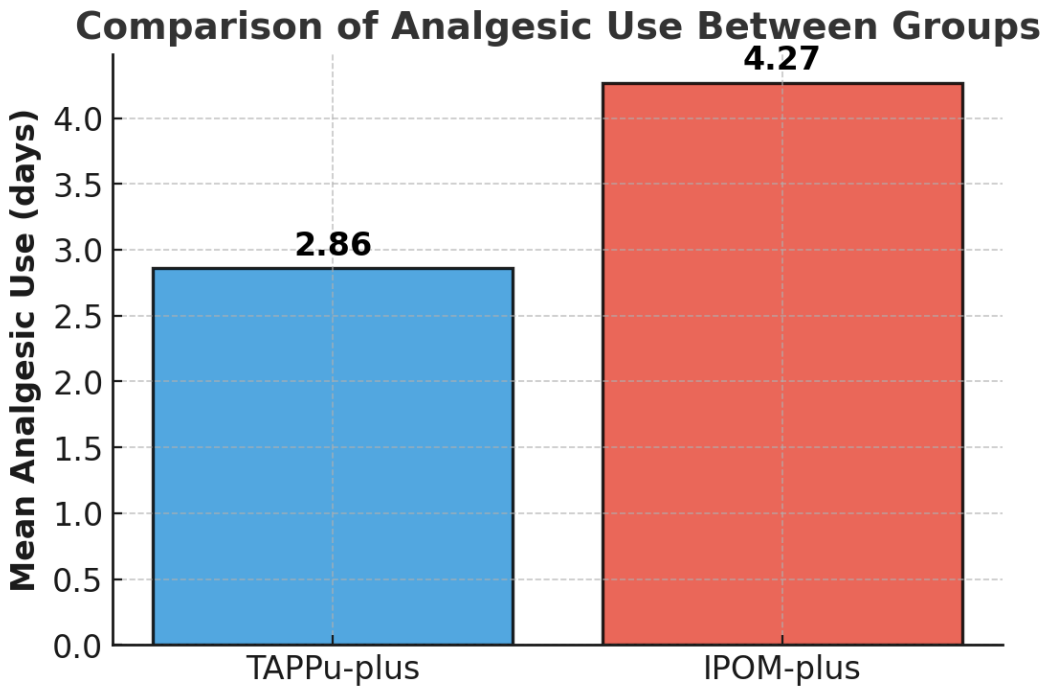
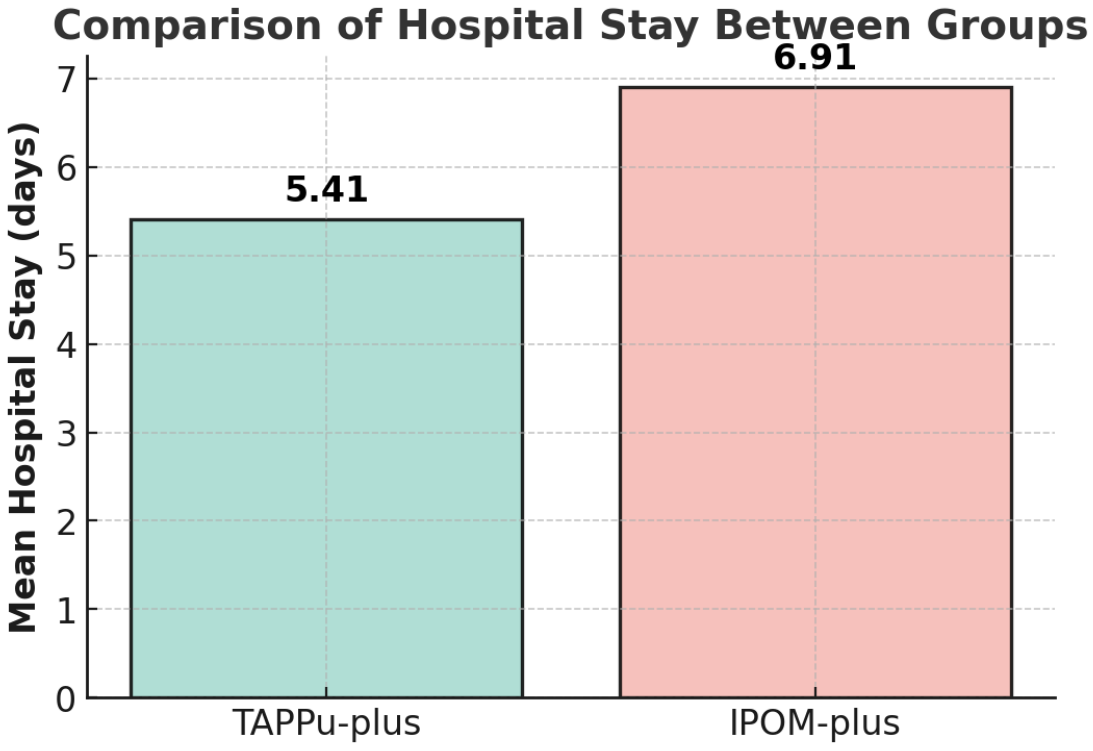


Table 8: Comparison of the Hospital Stay between the groups

	Group A		Group B		
	Mean	SD	Mean	SD	p-value
Hospital Stay (days)	5.41	1.37	6.91	1.31	0.000587

The duration of hospital stay between the two groups was significantly different. The mean hospital stay was significantly shorter in the TAPPu-plus group (Group A) compared to patients in the IPOM-plus group (Group B) (p = 0.000587).

Figure 21: Comparison of the Hospital Stay between the groups



DISCUSSION

Umbilical hernias remain a prevalent condition in abdominal surgery, requiring effective repair strategies to prevent complications and recurrence. The shift towards minimally invasive techniques has led to improved patient outcomes, with Trans-Abdominal Pre-Peritoneal Repair with Defect Closure (TAPPu-plus) and Intraperitoneal Onlay Mesh Repair with Defect Closure (IPOM-plus) being two widely utilized approaches[1]. Our study aimed to compare these techniques based on operative time, intraoperative blood loss, postoperative pain, analgesic use, hospital stay, and complications.

Operative Time

A notable difference in operative duration was observed among two groups ($p < 0.05$). TAPPu-plus required a longer operative duration (117.27 ± 14.94 minutes) compared to IPOM-plus (80.50 ± 19.67 minutes). The increased time in TAPPu-plus is attributed to the additional step of recto-rectus plane dissection required for mesh placement. Similar findings were reported by Sehsah TM et al.[16], who observed that TAPPu-plus had longer operative times but yielded better postoperative recovery and shorter hospital stays. Likewise, Arish H et al.[12] found that IPOM-plus patients had significantly shorter surgery times (85.6 minutes) compared to TAPPu-plus (121.6 minutes).

Intraoperative Blood Loss

Blood loss was substantially lower in TAPPu-plus compared to IPOM-plus ($p = 0.002$), with mean blood loss of 1.68 ± 0.72 gauze units in TAPPu-plus and 2.55 ± 0.96 gauze units in IPOM-plus. The controlled dissection in the preperitoneal plane in

TAPPu-plus likely contributed to reduced vascular trauma, whereas IPOM-plus necessitates peritoneal incisions, increasing vascular exposure and intraoperative bleeding. Even though meticulous hemostasis was ensured, the higher blood loss in IPOM-plus may be attributed to bleeding from 8-9 transfascial fixation sutures or during tacker application. These findings align with Yasin F et al.[13], who similarly reported higher intraoperative blood loss in procedures involving direct peritoneal entry compared to preperitoneal approaches, reinforcing the advantage of TAPPu-plus in minimizing surgical bleeding.

Postoperative Pain and Analgesic Requirement

Pain assessment at different postoperative time points revealed that IPOM-plus patients experienced significantly higher pain levels compared to TAPPu-plus patients ($p < 0.05$). Pain scores were highest at 6 hours postoperatively (TAPPu-plus: 7.41 ± 0.80, IPOM-plus: 8.27 ± 0.88, $p = 0.0014$) and progressively declined over time. On postoperative day 1, pain remained significantly higher in the IPOM-plus group (6.23 ± 1.11) compared to TAPPu-plus (4.36 ± 0.90, $p = 3.19$). A similar trend was observed at 2 days (IPOM-plus: 3.77 ± 0.69 vs. TAPPu-plus: 2.00 ± 0.69, $p = 9.71$) and 1 week (IPOM-plus: 1.73 ± 0.63 vs. TAPPu-plus: 0.55 ± 0.67, $p = 3.79$). By 4 weeks, pain scores in both groups had significantly declined, with no major differences noted (TAPPu-plus: 0.14 ± 0.35 vs. IPOM-plus: 0.32 ± 0.48, $p = 0.158$).

The higher pain scores in IPOM-plus patients can be attributed to the use of transfascial sutures and tackers for mesh fixation, which are known to contribute to postoperative discomfort. Our findings align with those of Sholapur S et al.[21], who reported lower VAS pain scores in TAPPu-plus patients compared to those who underwent IPOM-plus. Similarly, Sehsah TM et al.[16] found that TAPPu-plus patients

experienced faster postoperative recovery and less pain due to preperitoneal mesh placement.

The duration of analgesic use was also significantly different between the two groups ($p < 0.05$), with IPOM-plus patients requiring longer analgesic support (4.27 ± 0.63 days) compared to TAPPu-plus patients (2.86 ± 0.77 days). This further supports the observation that TAPPu-plus provides superior pain control and recovery outcomes.

Hospital Stay and Recovery

A statistically significant reduction in hospital stay was observed in the TAPPu-plus group (5.41 ± 1.37 days) compared to the IPOM-plus group (6.91 ± 1.31 days) ($p = 0.000587$). The shorter hospital stay in TAPPu-plus patients can be attributed to reduced pain, faster mobilization, and lower incidence of postoperative complications. Sholapur S et al.[21] similarly reported longer hospitalization in IPOM-plus patients, attributing it to higher postoperative pain and prolonged analgesic use. Additionally, Arish H et al.[12] found that TAPPu-plus not only shortened hospital stay but also reduced the risk of postoperative complications.

Complications and Recurrence

Seroma formation and wound infection rates were similar between the two groups, showing no statistically significant difference. Similarly, no recurrences were recorded in either group during the follow-up period. These findings suggest that both techniques are effective in preventing recurrence when defect closure and appropriate mesh placement are performed.

According to Yasin F et al.[13], IPOM-plus with defect closure significantly reduces recurrence rates (4.76%) compared to IPOM without closure (21.43%), emphasizing the importance of complete fascial closure in hernia repair. The preperitoneal mesh placement in TAPPu-plus may offer better long-term reinforcement of the abdominal wall, potentially reducing recurrence rates over time.

Strengths Of Our Study

- **Randomized Controlled Design**: Ensures minimal bias and robust comparison between the two surgical techniques.
- **Uniform Sample Size and Selection**: Equal number of participants in both groups (n=22), with randomization using SNOSE for fairness.
- **Multiple Outcome Measures**: Comprehensive assessment: operative time, blood loss, pain scores, analgesic use, hospital stay, and complications.
- **Objective Measurement Tools**: Use of Visual Analogue Scale (VAS) and standardized gauze-based blood loss estimation enhances data reliability.
- **Well-Defined Inclusion/Exclusion Criteria**: Carefully selected population (EHS M3, W1 hernias) makes findings highly relevant to small-sized umbilical hernia repairs.

Limitations Of This Study

- **Small Sample Size (n=44):** Limits the statistical power and generalizability to a wider population.
- **Short-Term Follow-Up**: No long-term recurrence rates or mesh-related complications beyond one year were evaluated.

- **Single-Center Study**: Findings may not be generalizable to other healthcare settings or regions with differing surgical practices.

- **Operative Time Not Adjusted for Surgeon Experience**: The longer TAPPu-plus duration may reflect the learning curve rather than inherent procedural complexity.

- **Lack of Quality-of-Life Assessment**: No standardized tools (like SF-36 or Carolinas Comfort Scale) were used to assess patient satisfaction post-surgery.

Future Implications

- **Larger Multicentric Trials**: Expanding to multiple centers with a larger cohort would validate and generalize the findings.

- **Long-Term Follow-Up**: Tracking patients beyond 1 year would help assess recurrence, chronic pain, and mesh-related complications.

- **Cost-Effectiveness Analysis**: Incorporating economic evaluation could guide health policy and resource allocation.

- **Quality of Life Assessment**: Including patient-reported outcomes can provide insight into postoperative satisfaction and recovery.

- **Stratified Patient Selection**: Further research could identify specific subgroups (e.g., obese, diabetic patients) that benefit most from each technique.

CONCLUSION

In conclusion, this study demonstrates that TAPPu-plus provides notable advantages over IPOM-plus for umbilical hernia repair. TAPPu-plus was associated with significantly less postoperative pain at multiple time points, lower intraoperative blood loss, and shorter hospital stays, all without increasing the risk of seroma formation or wound infections. Although IPOM-plus offers a shorter operative time, the enhanced patient comfort and recovery associated with TAPPu-plus suggest it may be the more favorable approach in carefully selected cases. Further research involving larger sample sizes and longer follow-up periods were be crucial to confirm these findings and guide surgical decision-making in the treatment of umbilical hernias.

SUMMARY

- A total of 44 patients met the inclusion criteria and were divided into two groups:
- **Group A (TAPPu-plus):** Laparoscopic Trans-Abdominal Pre-Peritoneal Repair.
- **Group B (IPOM-plus):** Laparoscopic Intraperitoneal Onlay Mesh Repair.
- **Mean Age:**
- The overall mean age was 46.55 years, with no statistically significant difference between the groups ($p = 0.62$).
- **Gender Distribution:**
- Both groups showed male predominance, with no significant gender differences noted between Group A and Group B.
- **Operative Time:**
- Group B (IPOM-plus) had a significantly shorter mean operative time (80.50 minutes) compared to Group A (TAPPu-plus) (117.27 minutes), $p < 0.05$.
- **Blood Loss:**
- Blood loss was significantly lower in Group A (TAPPu-plus) (1.68 gauze units) than in Group B (IPOM-plus) (2.55 gauze units), $p = 0.002$.
- **Pain Scores at Different Time Points:**
- At 6 hours postoperatively, patients in Group B reported higher mean pain scores (8.27) compared to Group A (7.41), $p = 0.0014$.
- On postoperative day 1, Group B continued to experience more pain (6.23) compared to Group A (4.36), $p = 3.19$.
- By day 2, Group B still had higher pain levels (3.77) than Group A (2.00), $p = 9.71$.

- At 1 week, Group B patients showed more pain (1.73) compared to Group A (0.55), p = 3.79.
- By 4 weeks, pain scores in both groups had declined significantly, with Group B at 0.32 and Group A at 0.14, p = 0.158.
- **Analgesic Use:**
- The mean duration of analgesic use was shorter in Group A (TAPPu-plus) (2.86 days) compared to Group B (IPOM-plus) (4.27 days), p < 0.05.
- **Hospital Stay:**
- Group A (TAPPu-plus) had a shorter hospital stay (5.41 days) compared to Group B (IPOM-plus) (6.91 days), p < 0.05.
- **Complications and Recurrence:**
- No statistically significant differences in seroma formation or wound infection rates were noted between the groups.
- No recurrences were observed in either group within the follow-up period.

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ANNEXURE

ANNEXURE – I - INFORMED CONSENT FORM

INFORMED CONSENT FORM

"A RANDOMISED CONTROLLED TRIAL OF LAPAROSCOPIC TAPPu-plus vs. LAPAROSCOPIC IPOM-plus FOR SMALL-SIZED UMBILICAL HERNIAS AT A TERTIARY CARE HOSPITAL"

Name of Student/Principal Investigator: _____

Name of Guide/Co-Investigator: _____

Introduction: We are doing research on feasibility & safety of a newer umbilical hernia repair technique. Umbilical hernias are one of the most common types of hernias. Among the popular surgical hernia repair techniques, laparoscopic closure of the abdominal wall defect with the placement of mesh inside to the abdominal wall (lap. IPOM-plus) is the most frequently used technique. But recent studies reported some complications like abdominal adhesions and pain post-surgery, so the need for a new technique like the placement of mesh between the abdominal wall layers after closing the abdominal wall gap (lap. TAPPu-plus) was introduced.

We are giving you information and inviting you to be part of this research study. Before you agree to participate in this study, you can talk to anyone you feel comfortable with about the study as it is important that you read and understand the following explanation of the proposed study. This document describes the purpose, risks, and precautions of the study. You also have the right to withdraw from the study at any time. No guarantee or assurances can be made as to the results of the study.

If you are completely truthful regarding your health history, you may harm yourself by participating in this study. After you completely review each page of the document you should personally put your initials and the date in this document. If you do not understand any part of this document, you may clarify your doubts.

Explanation of procedure: If you agree to enroll in the study, you were be asked about the history of presenting complaints. A clinical examination were be done. You were be allotted into one of the two groups randomly using the closed envelope technique.

Group A - Patients in this group were undergo Laparoscopic TAPPu-plus.

Group B - Patients in this group were undergo Laparoscopic IPOM-plus.

A comparison between Operation time, Blood loss, Postoperative pain & Hospital Stay.

Withdrawal from participation in the study: Participation in this study is voluntary. You were be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: The study were benefit you by decreasing

the operation time, blood loss during the surgery, and postoperative pain after the surgery, and preventing the use of higher analgesics, which in turn decreases the hospital stay and hospital costs. The data gathered were help the population at large.

Possible risks from participating in the study: There is a surgical risk like blood loss during surgery & need for transfusion of blood products, injury to bowel during surgery & need for resection and anastomosis, mesh infection & need for use of use of higher antibiotics and extended hospital stay, chance of recurrence & need for revision of surgery. The risk involved in this study is shared commonly among two groups, with a higher chance of mesh infection in the lap. IPOM-plus & in turn in increasing hospital stay and cost expenditure.

Privacy and confidentiality: The information collected from you were be coded, to prevent any person to identify you. Your identity were never be revealed. The data collected from you were be kept confidential and only processed or aggregated data were be used for publication.

Financial incentives: You were not receive any payment for participating in this study.

The cost of investigations done during the course of the study were be paid by the principal investigator/ patient.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data were be published for scientific purposes and or presented to scientific groups. However, your identity were never be revealed.

Questions: If you have any questions or complaints with regard to your right as a study participant you may contact Dr. Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waiving any of your legal rights.

Consent Statement

I, Mr/Ms/Mrs._____ have been invited to participate in a research study titled "A Randomised Control Trial of Laparoscopic TAPPu-plus vs. Laparoscopic IPOM-plus for Small-sized Umbilical Hernias at A Tertiary Care Hospital.". I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). I consent voluntarily to be a participant in this study

Name of Participant: _____.

Signature or Left Thumb Print of Participant: _____.

Date (dd/mm/yyyy): _____.

If a patient has limited ability to read and write, In these instances the patient his/her thumb impression in the place of the signature.

Patient's Legally Acceptable Representative's Statement:

I, Mr/Ms/Mrs._____as the patient's legally acceptable representative, was present during the consenting procedure and understand the preceding information describing this study. All of the questions regarding the study and the patient's participation in it have been answered to my satisfaction and that of the patient. I state that all aspects of the study were clearly presented during the consent procedure. The patient is willing to participate in the study and I sign below on his/her behalf testifying to this effect.

Name of Participant: _____.

Name of the Legally Acceptable Representative: _____.

Relationship to the participant:_____.

Signature of the Legally Acceptable Representative:_____.

Date (dd/mm/yyyy):_____.

Statement by the researcher/person taking consent

The participant signing this consent form has fully understood the study and has been well informed about the study not well. I confirm the Participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of Researcher/person taking the consent: _____.

Signature of Researcher /person taking the consent:_____.

Date (dd/mm/yyyy): _____.

THANK YOU FOR YOUR COOPERATION

ANNEXURES – II PROFORMA

The proforma is for the study titled "A Randomised Control Trial of Laparoscopic TAPPu-plus vs Laparoscopic IPOM-plus for Small-sized Umbilical Hernias at A Tertiary Care Hospital."

Unique Participant ID: | | | | | | | | |

Informed consent taken? Y/N

Date of consent: D D M M Y Y Y Y

Demographic data:

Age: | | years old **Gender:** M/F

Height: | | | cm **Weight:** | | | kg

Address: 1-Belagavi, 2-Outside Belagavi

Occupation:

1-Unemployed,2-Unskilled, 3-Semi-skilled, 4-Skilled, 5-Professional

Education:

1-Illiiterate, 2-Primary (1st-7th std.) ,3-High school (8th-10th std.)

4-Intermediate, 5-Degree & above

Socio-economic status: 1-Low, 2-Middle, 3-High

Date of Admission: d d m m y y y y

Date of interview: d d m m y y y y

Date of Surgery: d d m m y y y y

Date of Discharge: d d m m y y y y

History:

Swelling over the Umbilicus: Y/N

If yes,

Onset of swelling: I-Insidious, II-Sudden

Is the Size of swelling gradually Progressive: Y/N

Is the swelling Reducible: Y/N

Is the swelling associated with Pain: Y/N

If yes,

Onset of pain: I-Insidious, II-Sudden

Is the pain gradually progressive Y/N

Describe the pain: I -sharp, 2-stabbing, 3-burning, 4-colicky, 5-dull

Signs Of Obstruction:

Vomiting

Constipation

Abdominal Distension

Fever

Past history of surgeries:

S. No.	Date of Surgery	Surgery Performed	Incision used	Indication for the Surgery	Scar and type of healing
1.					
2.					
3.					

On Examination:

General physical examination:

Pallor/Icterus / Cyanosis / Clubbing / Oedema / Lymphadenopathy

Vital Signs: Febrile/Afebrile; Pulse:_____ bpm, BP:_____mmHg, RR:____cpm

Abdomen:

Size of swelling: I: <0.5cms, II: 0.5-1 cm, III: 1-1.5cms, IV: 1.5-2cms, V: >2cms ☐

Consistency: I: Soft, II- doughy ☐

Abdominal distension: Y/N

Tenderness: Y/N

Local rise of Temperature: Y/N

Expansile impulse with cough: Y/N

Cardio Vascular System:

Respiratory System:

Clinical Impression:

Intro operative findings:

Operative time:

Time of induction: _____. Entrance of recovery: _____.

Total operation time: ☐ mins

Blood loss:

Total number of blood absorbed gauzes used: SIZE * NUMBER

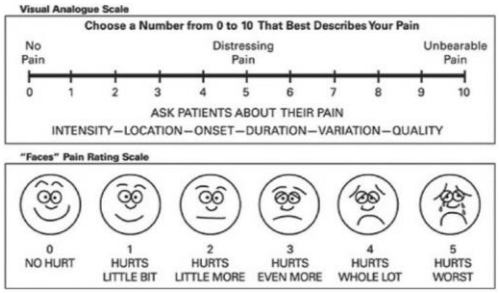
SIZE * NUMBER

Was operation converted to Laparotomy? Y/N

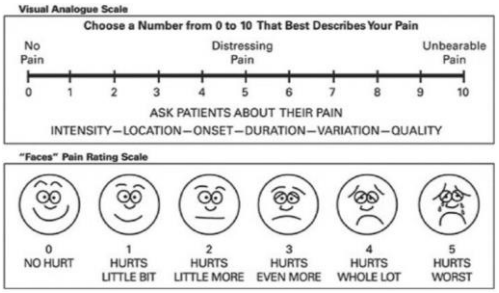
Post-operative

Post-operative Pain:

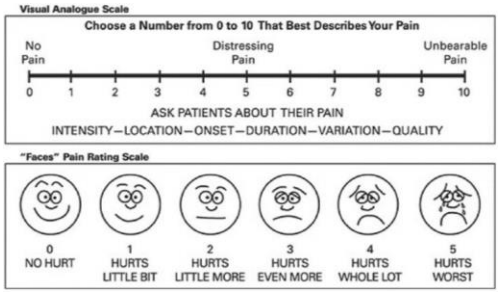
6 hours:



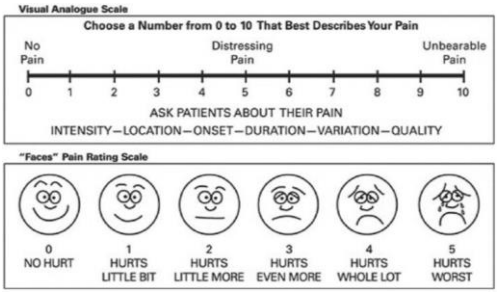
24 hours:



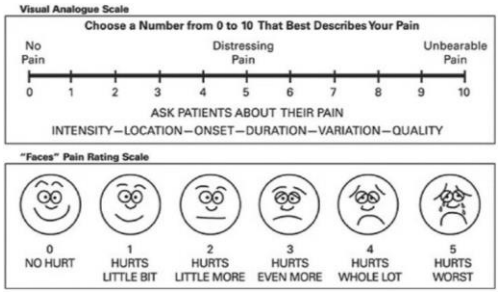
48 hours:



1 week:



4 weeks:



Analgesics Taken:

	6am	12pm	6pm	12am
POD-0:	Drugs Used	Drugs Used	Drugs Used	Drugs Used
	6am	12pm	6pm	12am
POD-1:	Drugs Used	Drugs Used	Drugs Used	Drugs Used
	6am	12pm	6pm	12am
POD-2:	Drugs Used	Drugs Used	Drugs Used	Drugs Used
	6am	12pm	6pm	12am
POD-3:	Drugs Used	Drugs Used	Drugs Used	Drugs Used
POD>3	Drugs Used			

Drugs:

1) **Paracetamol**
   a) IV Paracetamol 1g
   b) Tab. Paracetamol 500mg
   c) Paracetamol Suppository
      i) 125mg
      ii) 250mg

2) **Diclofenac**
   a) IV Diclofenac 75mg
   b) Tab. Diclofenac
      i) 50mg
      ii) 100mg
   c) Diclofenac Transdermal Patch
      i) 100mg
      ii) 200mg

3) **Tramadol**
   a) IV Tramadol 50mg
   b) Tab. Tramadol 37.5mg

1) **Buprenorphine Transdermal Patch**
   a) 5mg
   b) 10mg

2) **Epidural Analgesia**

Hospital Stay:

Date of Surgery: _____. Date of Discharge: _____.

Hospital Stay post procedure: [ ] days

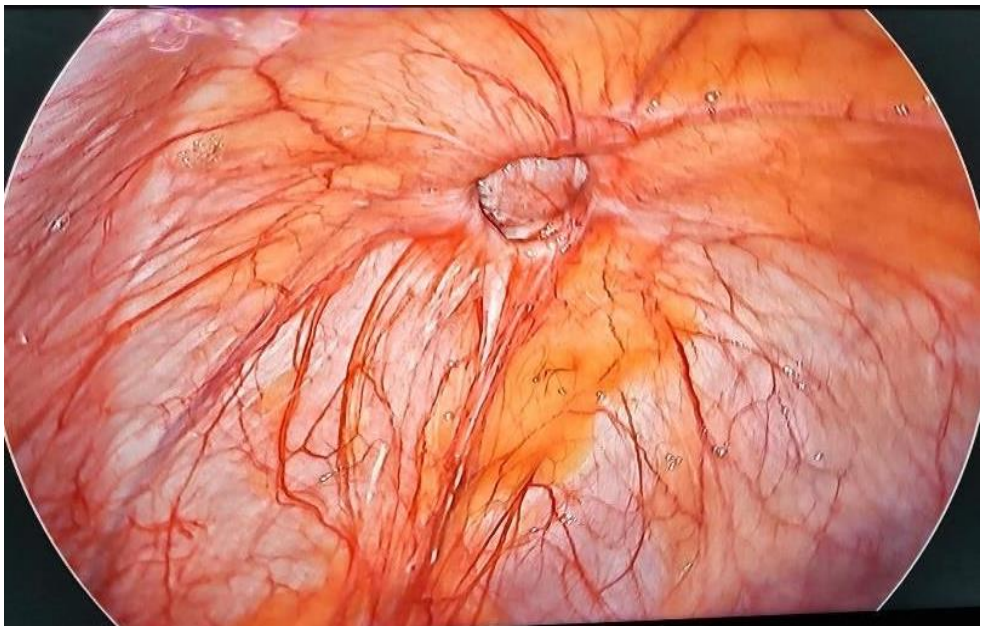
Complications (within 1 year of Surgery): [Y/N]

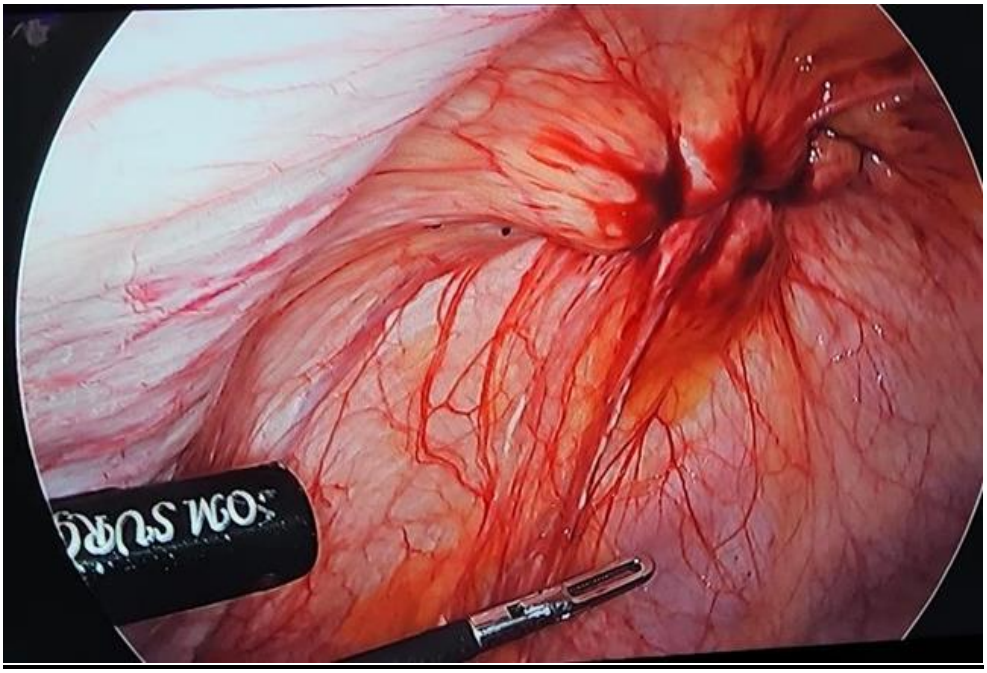
Recurrence: [Y/N]

REMARKS:

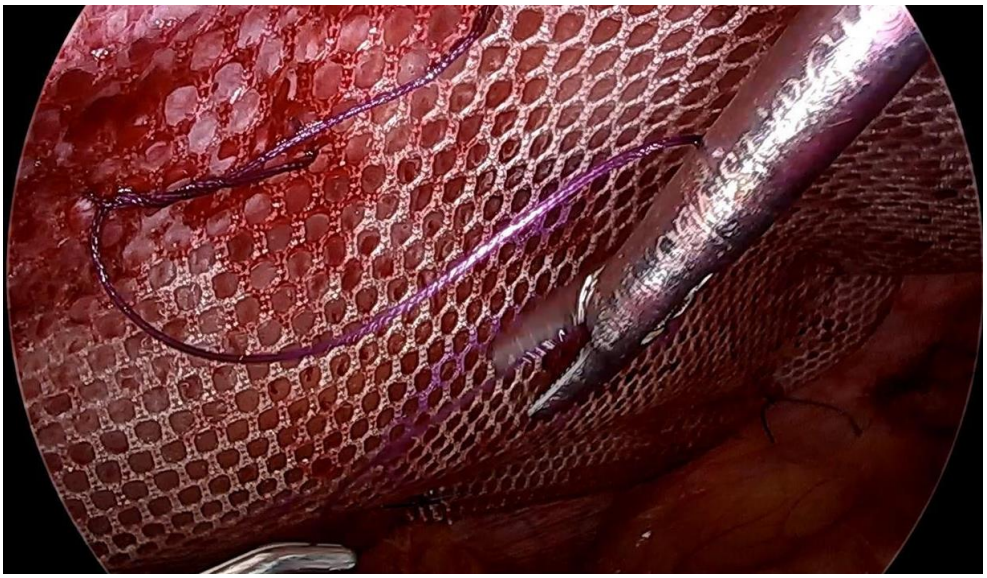
ANNEXURES – III PHOTOGRAPHS

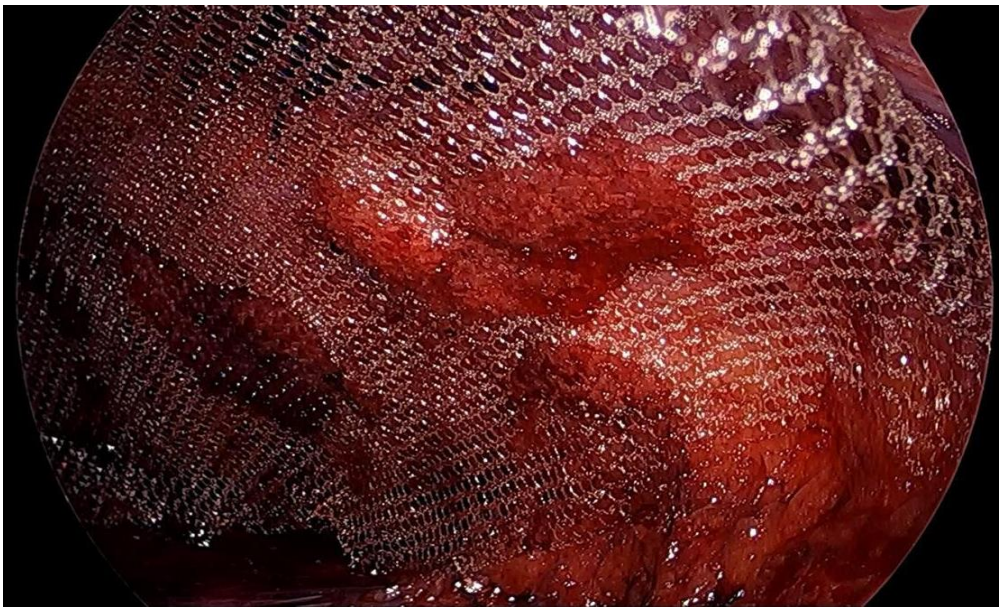
1. IPOM-plus Repair of Umbilical Hernia





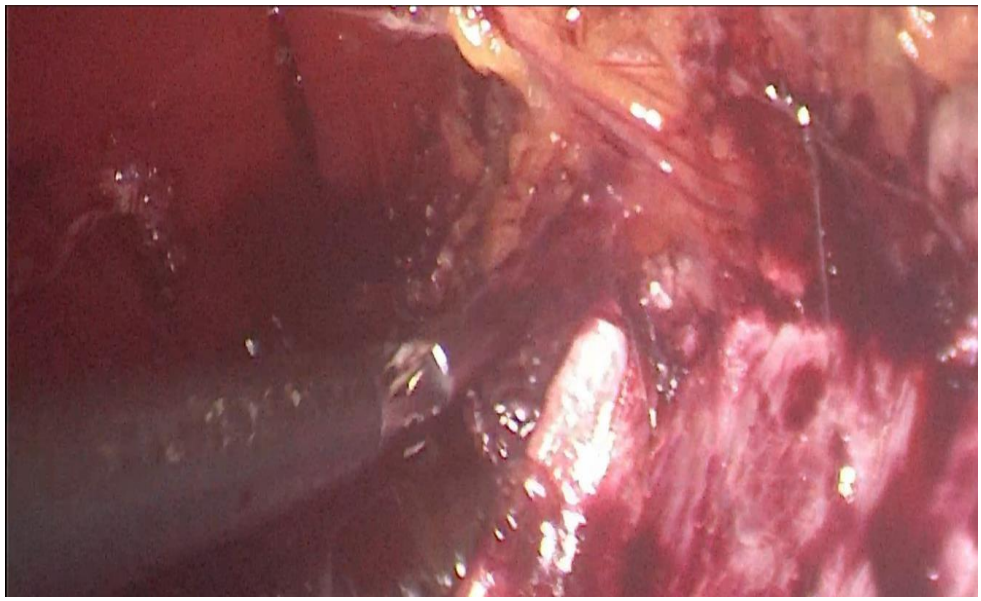
Photograph. (a)Umbilical defect; Figure 1. (b) Primary closure of the defect.

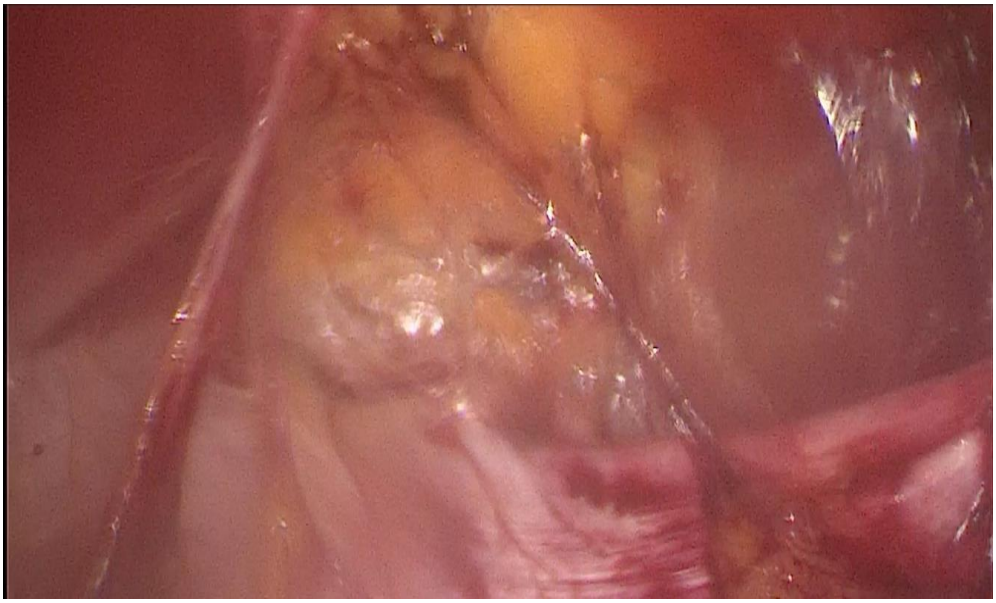




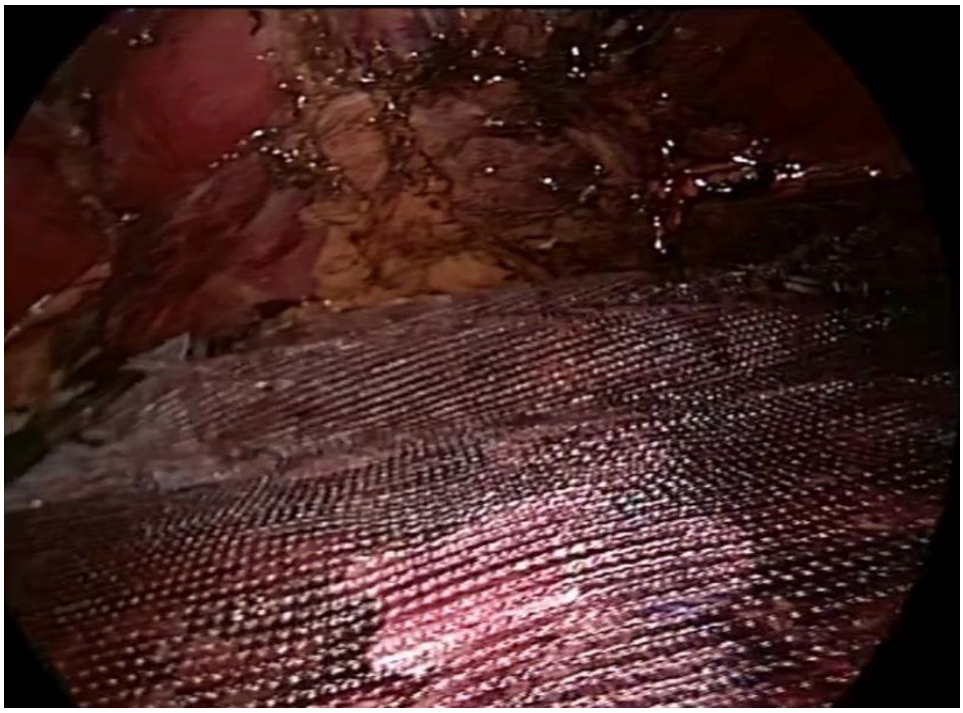
Photograph (2a) - Composite Mesh fixation with Vicryl 2-0 sutures; (2b) Post mesh fixation.

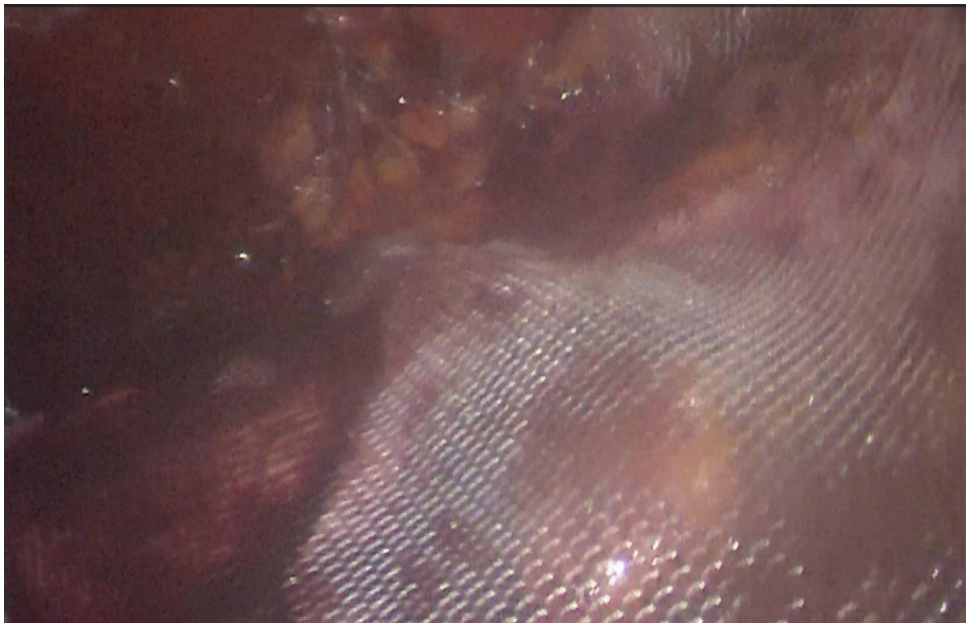
2. TAPPu-plus Repair of Umbilical Hernia



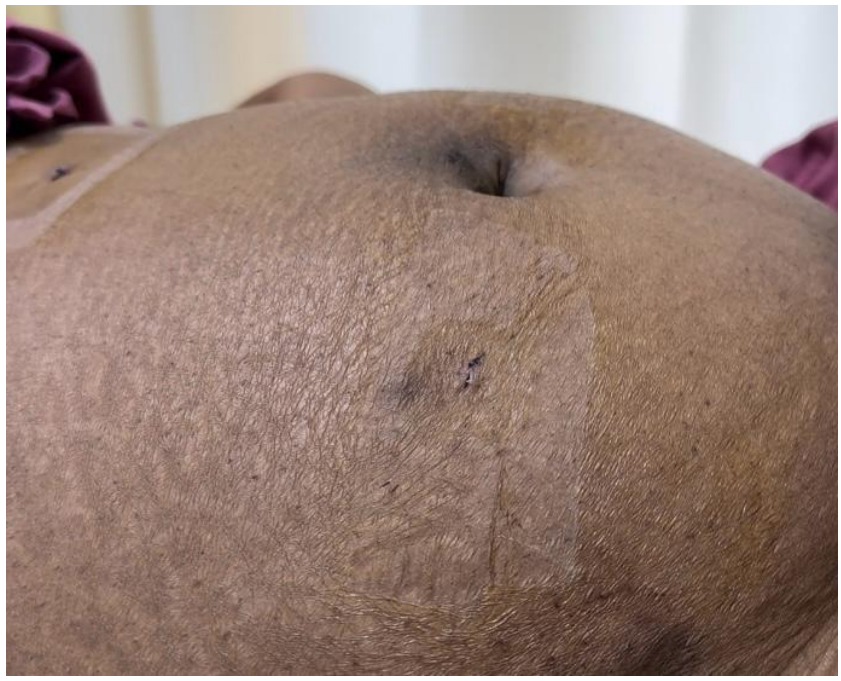


Photograph 3a,3b: Dissection of Pre-Peritoneal plain.





Photograph 4a,4b: Prolene Mesh placement in the Pre-Peritoneal plain.



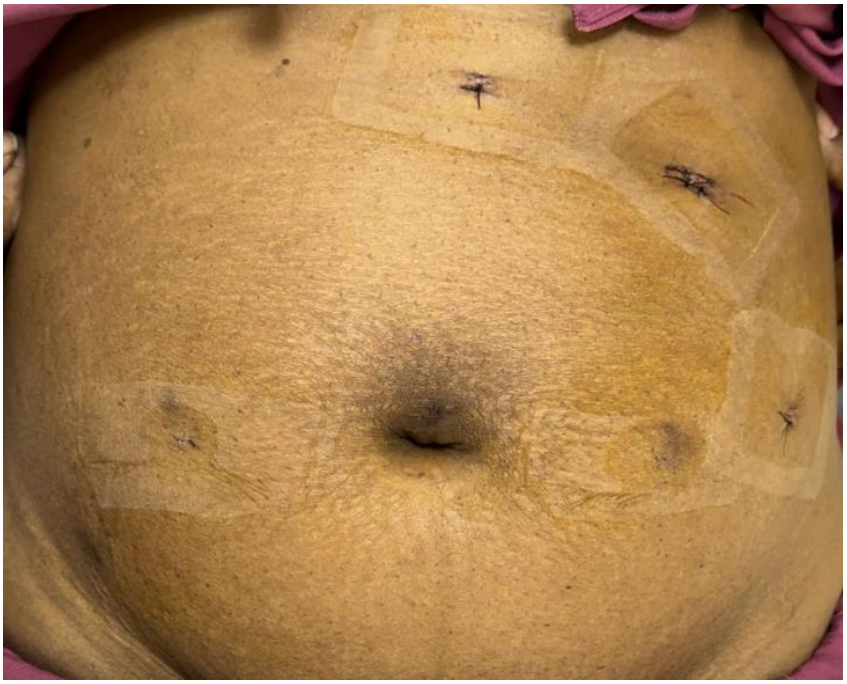


Figure 5a.5b: Post Operative Day 3.

ANNEXURES – IV MASTER CHART

GROUP A (UMBILICAL HERNIA REPAIR WITH TAPPu+)

Serial Number	Age/Sex	Unique Patient ID	Diagnosis	Date of Admission	Date of Surgey	Date of Discharge	Operation Time (In min)	Blood Loss (6*6 Gauze used)	Post-Operative Pain (6h)	Post-Operative Pain (1d)	Post-Operative Pain (2d)	Post-Operative Pain (1w)	Post-Operative Pain (4w)	Analgesics (used until POD-x)	Hospital Stay (in days)	Recurrence
1	48/M	VHM2783	Umbilical Hernia	07-09-2023	09-09-2023	14-09-2023	121	2	7	5	2	0	0	3	5	No
2	32/F	KKF7397	Umbilical Hernia	11-09-2023	13-09-2023	18-09-2023	133	1	8	4	2	1	0	2	5	No
3	56/M	MGM9657	Umbilical Hernia	20-09-2023	21-09-2023	25-09-2023	97	2	7	5	2	0	0	3	4	No
4	36/F	SHF9706	Umbilical Hernia	04-10-2023	05-10-2023	09-10-2023	116	1	6	4	1	0	0	2	4	No
5	63/M	MJM6795	Umbilical Hernia	20-10-2023	22-10-2023	27-10-2023	123	2	8	5	3	2	0	3	5	No
6	44/F	NYF2686	Umbilical Hernia	05-11-2023	07-11-2023	15-11-2023	136	2	8	6	3	1	1	4	8	No
7	34/M	MMM9743	Umbilical Hernia	11-11-2023	12-11-2023	17-11-2023	117	1	7	4	1	0	0	2	5	No
8	61/M	BGM9265	Umbilical Hernia	28-11-2023	29-11-2023	06-12-2023	109	3	8	3	2	1	1	3	7	No
9	54/F	KZF3795	Umbilical Hernia	11-12-2023	14-12-2023	19-12-2023	122	2	8	5	3	0	0	3	5	No
10	39/F	IMF5804	Umbilical Hernia	02-01-2024	02-01-2024	08-01-2024	98	1	7	5	2	1	0	2	6	No
11	50/M	MSM8433	Umbilical Hernia	15-01-2024	17-01-2024	21-01-2024	92	1	8	4	2	0	0	3	4	No
12	65/F	KBF8624	Umbilical Hernia	07-02-2024	08-02-2024	12-02-2024	127	3	8	5	2	1	0	2	4	No
13	33/M	SGM7691	Umbilical Hernia	21-02-2024	24-02-2024	29-02-2024	139	1	7	2	1	0	0	3	5	No
14	64/M	MKM7742	Umbilical Hernia	22-03-2024	22-03-2024	26-03-2024	113	2	7	4	2	1	0	3	4	No
15	47/M	MCM9658	Umbilical Hernia	02-04-2024	04-04-2024	10-04-2024	140	1	8	3	1	0	0	3	6	No
16	28/M	NIM5453	Umbilical Hernia	05-05-2024	06-05-2024	13-05-2024	99	2	7	5	2	1	0	4	7	No
17	31/M	RSM8681	Umbilical Hernia	20-05-2024	21-05-2024	26-05-2024	104	2	6	4	2	0	0	3	5	No
18	45/M	SPM7094	Umbilical Hernia	17-06-2024	19-06-2024	25-06-2024	120	1	8	5	2	0	0	2	6	No
19	33/M	RMM8636	Umbilical Hernia	22-06-2024	25-06-2024	29-06-2024	133	2	6	4	1	0	0	3	4	No
20	45/F	LKF6502	Umbilical Hernia	12-07-2024	13-07-2024	22-07-2024	116	1	9	5	3	2	1	5	9	No
21	29/M	BSM6720	Umbilical Hernia	21-07-2024	23-07-2024	28-07-2024	95	1	8	4	2	0	0	3	5	No
22	68/M	SPM9634	Umbilical Hernia	15-08-2024	17-08-2024	23-08-2024	130	3	7	5	3	1	0	2	6	No

GROUP B (UMBILICAL HERNIA REPAIR WITH IPOM+)

Serial Number	Age/Sex	Unique Patient ID	Diagnosis	Date of Admission	Date of Surgey	Date of Discharge	Operation Time (In min)	Blood Loss (6*6 Gauze used)	Post-Operative Pain (6h)	Post-Operative Pain (1d)	Post-Operative Pain (2d)	Post-Operative Pain (1w)	Post-Operative Pain (4w)	Analgesics (used until POD-x)	Hospital Stay (in days)	Recurrence
1	37/M	RPM7534	Umbilical Hernia	12-09-2023	14-09-2023	22-09-2023	60	1	7	5	3	2	1	4	8	No
2	54/M	PAM9476	Umbilical Hernia	22-09-2023	23-09-2023	29-09-2023	90	3	8	6	4	1	0	4	6	No
3	42/F	SMF6498	Umbilical Hernia	05-10-2023	09-10-2023	16-10-2023	79	2	8	6	3	1	0	4	7	No
4	57/M	BSM0620	Umbilical Hernia	19-10-2023	21-10-2023	26-10-2023	59	4	9	7	4	2	1	5	5	No
5	35/M	GPM8603	Umbilical Hernia	24-10-2023	24-10-2023	31-10-2023	68	2	7	5	3	1	0	4	7	No
6	46/F	RMF8042	Umbilical Hernia	08-11-2023	10-11-2023	18-11-2023	90	3	8	6	4	2	0	4	8	No
7	65/M	LKM8748	Umbilical Hernia	21-11-2023	21-11-2023	27-11-2023	56	4	10	8	5	3	1	5	6	No
8	43/F	SPF4390	Umbilical Hernia	17-12-2023	19-12-2023	25-12-2023	77	2	8	6	3	2	0	4	6	No
9	29/M	MBM4307	Umbilical Hernia	28-12-2023	31-12-2023	09-01-20245	123	1	7	5	3	2	0	3	9	No
10	39/M	NPM8630	Umbilical Hernia	04-01-2024	05-01-2024	10-01-2024	49	2	8	5	4	3	1	4	5	No
11	60/F	MSF4066	Umbilical Hernia	11-01-2024	14-01-2024	24-01-2024	106	4	9	7	4	2	0	5	10	No
12	49/M	NMM1329	Umbilical Hernia	15-02-2024	17-02-2024	24-02-2024	80	3	9	7	4	1	0	5	7	No
13	37/M	VKM8039	Umbilical Hernia	20-02-2024	21-02-2024	26-02-2024	62	1	8	6	4	2	0	4	5	No
14	51/M	ABM2950	Umbilical Hernia	18-03-2024	20-03-2024	26-03-2024	72	3	9	6	4	2	1	5	6	No
15	38/M	ABM7236	Umbilical Hernia	10-04-2024	13-04-2024	19-04-2024	69	2	8	5	3	1	0	3	6	No
16	41/F	SLF3361	Umbilical Hernia	03-05-2024	04-05-2024	12-05-2024	116	3	7	4	3	2	0	4	8	No
17	53/M	BPM5661	Umbilical Hernia	22-05-2024	22-05-2024	29-05-2024	70	2	9	8	5	2	1	5	7	No
18	45/M	RPM8420	Umbilical Hernia	14-06-2024	16-06-2024	24-06-2024	105	2	8	8	4	2	0	4	8	No
19	55/M	AKM7519	Umbilical Hernia	07-07-2024	10-07-2024	17-07-2024	84	3	9	7	3	1	0	4	7	No
20	50/F	VBF4342	Umbilical Hernia	12-08-2024	15-08-2024	21-08-2024	75	2	8	6	4	1	0	4	6	No
21	63/M	CGM7665	Umbilical Hernia	21-08-2024	22-08-2024	29-08-2024	84	4	10	7	5	2	1	5	7	No
22	54/M	SMM1813	Umbilical Hernia	20-09-2024	23-09-2024	01-10-2024	97	3	8	7	4	1	0	5	8	No