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Laparoscopic Transabdominal Preperitoneal (TAPP) Repair: Review Article

Gamal Osman, Ali Amir Ali, Tamer Elshahidy, Abd Elwahab M. Hamed

General Surgery Department, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Ali Amir Ali

Abstract:

Background: Inguinal hernia is one of the most common conditions encountered in general surgical practice, representing the majority of abdominal wall hernias and accounting for a large number of elective surgical procedures worldwide. Although many inguinal hernias progress slowly and may initially cause only mild discomfort, untreated cases can lead to complications such as obstruction, incarceration, or strangulation. Mesh-based repair has become the standard treatment because it reduces recurrence and improves postoperative recovery compared with traditional tissue repair. Laparoscopic approaches, particularly transabdominal preperitoneal (TAPP) repair, have gained increasing acceptance due to their advantages in bilateral and recurrent hernias, reduced postoperative pain, faster return to normal activity, and the ability to inspect both groins through the same access. TAPP repair involves entering the abdominal cavity, creating a preperitoneal flap, dissecting the hernia sac, placing a large mesh over the myopectineal orifice, and closing the peritoneum securely. However, the technique requires detailed anatomical knowledge and adequate surgical experience to avoid complications such as vascular injury, bowel injury, bladder injury, chronic groin pain, urinary retention, mesh-related complications, and recurrence. Therefore, proper patient selection, meticulous technique, and awareness of potential complications are essential for optimal outcomes.

Keywords: Inguinal hernia; Laparoscopic hernia repair; TAPP repair; Mesh repair; Preperitoneal space; Postoperative complications.

Introduction:

Abdominal wall hernia is a common clinical manifestation in general surgery, with a prevalence of 4% for people over 45 years of age and 1.7% for all ages. Seventy-five percent of abdominal wall hernias are inguinal hernias. While most inguinal hernias have a slow natural course and result in mild to moderate discomfort. However, occasionally they may cause severe complications such as bowel obstruction or strangulation. Inguinal hernia repair ranks among the most performed surgical procedure in general surgery, with up to 80,000 procedures per year in the UK alone, and over 20 million procedures worldwide **(1)**.

The treatment of choice in hernia repair involving the placement of a mesh performed either through open or laparoscopic surgery. The use of mesh varies worldwide from 0 to 5% in low-resource countries to 95% in high-resource countries. Mesh repairs offer established advantages such as lower incidence of chronic groin pain, faster convalescence and fewer hernia recurrences **(2).**

Indications:

The general indications for laparoscopic inguinal hernia repair as opposed to watchful waiting are the same as those for open inguinal hernia repair. Classically, the existence of an inguinal hernia has been considered sufficient reason for operative intervention. However, studies have shown that the presence of a reducible hernia is not, in itself, an indication for surgery and that the risk of incarceration is less than 1% **(3)**.

Symptomatic patients (with pain or discomfort) should undergo repair however, as many as one third of patients with inguinal hernias are asymptomatic. The issue of observation versus surgical intervention in this asymptomatic or minimally symptomatic population was addressed in two randomized clinical trials, both of

which found that there were no significant differences in hernia-related symptoms after long-term follow-up and that watchful waiting did not increase the complication rate **(4)**.

In one study, a substantial proportion of patients initially managed with watchful waiting eventually crossed over to surgical repair, suggesting that observation may delay but not prevent surgery, particularly in younger or minimally symptomatic patients. Moreover, many patients with asymptomatic inguinal hernias develop symptoms over time, warranting elective surgical repair in medically fit individuals **(5).**

Some reports have listed specific indications for laparoscopic repair over open repair, including recurrent hernias, bilateral hernias, and the need for earlier return to full activities. Several studies have demonstrated favorable outcomes for laparoscopic repair of recurrent hernias. Recurrence rates may decrease to 3–5% with laparoscopic repair, compared with rates up to 15–20% for anterior open repair techniques **(6).**

The reduced pain after laparoscopic inguinal hernia repair compared with conventional anterior repair makes laparoscopy the approach of choice for bilateral hernias. A particular advantage of TAPP repair in a patient with bilateral inguinal hernias is that both sides can be repaired via the same laparoscopic port sites. **(7).**

Although the hospital costs of laparoscopic repairs are generally higher than those of open repairs, these costs may be offset by societal benefits such as earlier return to work and daily activities. Patient preference is a major factor in choosing the type of repair, but surgical expertise also plays a critical role. Data indicate that recurrence rates decline as surgeons gain experience with laparoscopic techniques. Recent studies suggest that the learning curve for TAPP repair is comparable to or slightly longer than that for open repair, depending on surgeon experience and institutional training programs **(8).**

Contra-indications:

General contraindications for laparoscopic herniorrhaphy are similar to those of open repair. Inguinal hernia repair itself has few absolute contraindications; as with any elective procedure, patients should be medically optimized, and any acute illnesses or poorly controlled chronic conditions should be managed appropriately before surgery **(9).**

Absolute contraindications for TAPP repair are few. In general, the inability to tolerate general anesthesia is considered an absolute contraindication, Other absolute contraindications are coagulopathy (because bleeding in the preperitoneal space can be difficult to assess and control postoperatively) and intra-abdominal infections that limit the use of prosthetic meshes. Relative contraindications include previous abdominal surgery, especially pelvic surgery and depend on the type and degree of expected adhesions, the surgeon's level of comfort with adhesiolysis and the nature of the hernia **(10)**.

Trans Abdominal Pre-Peritoneal Technique:

A. Anesthesia and operative room set-up instruments

General anesthesia is mandatory. The patient is placed in a supine position with a 15º Trendelenburg tilt, and both arms adducted along the body. The surgeon stands on the side opposite the hernia, the surgical nurse in front of the surgeon, and the camera assistant near the patient's head on the same side as the surgeon. Alternatively, the assistant may stand on the ipsilateral side if the camera port is placed accordingly. The monitor is placed at the foot of the operating table. Three trocars are typically used: one 10 mm and two 5 mm ports, with standard laparoscopic instruments (fenestrated graspers, scissors, hook, needle holder). A 30º laparoscope is preferred for optimal visualization **(11).**

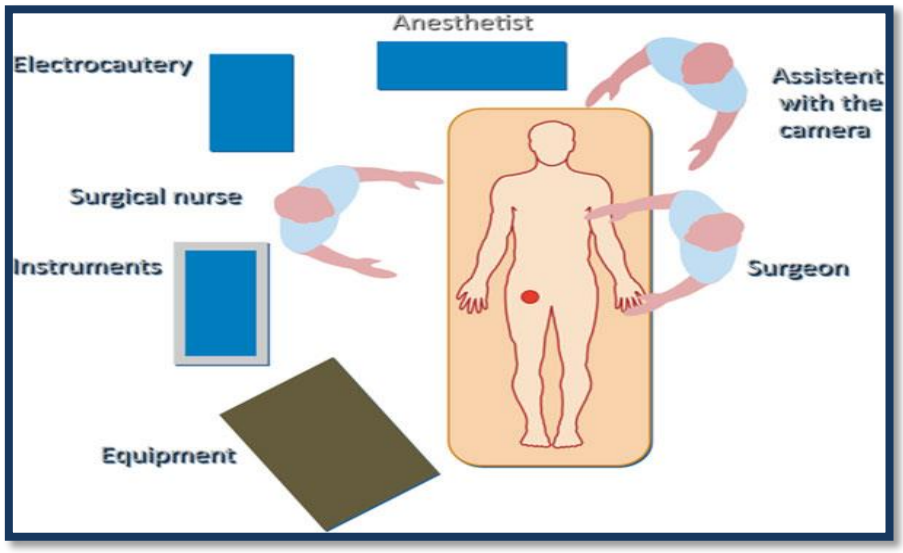

Figure (1): Operative room set-up **(12).**

B. Surgical Procedure:

1. Trocar Placement and pneumoperitoneum:

Usually, the pneumoperitoneum is established using a Veress needle. The open (Hasson) technique is preferred in patients with previous abdominal surgery or an umbilical hernia. A three-port technique is typically employed: a 10 mm umbilical port for the camera and mesh/suture passage, and two 5 mm accessory ports placed in each flank along a horizontal line with the umbilical port. Ports should be positioned at least "one hand" distance from the umbilical port to maintain adequate ergonomics **(11).(**fig.2)

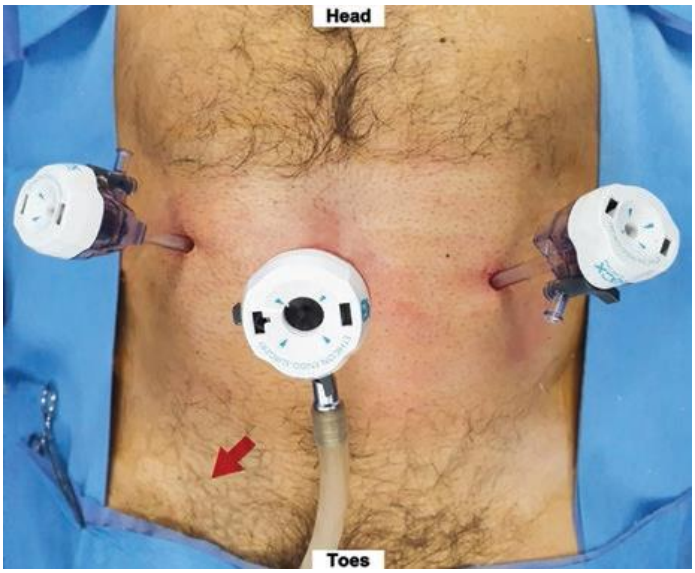

Figure (2): Trocar placement with a three-port technique in a right hernia repair (red arrow) **(13).**

The procedure begins with careful exploration of the abdomen, identifying superficial anatomical landmarks such as the urachus, umbilical folds, inferior epigastric vessels, spermatic vessels, vas deferens, or round ligament of the uterus, along with the site and type of hernia. Proper identification of these landmarks is crucial to ensure safe dissection and mesh placement **(14). (Fig.3).**

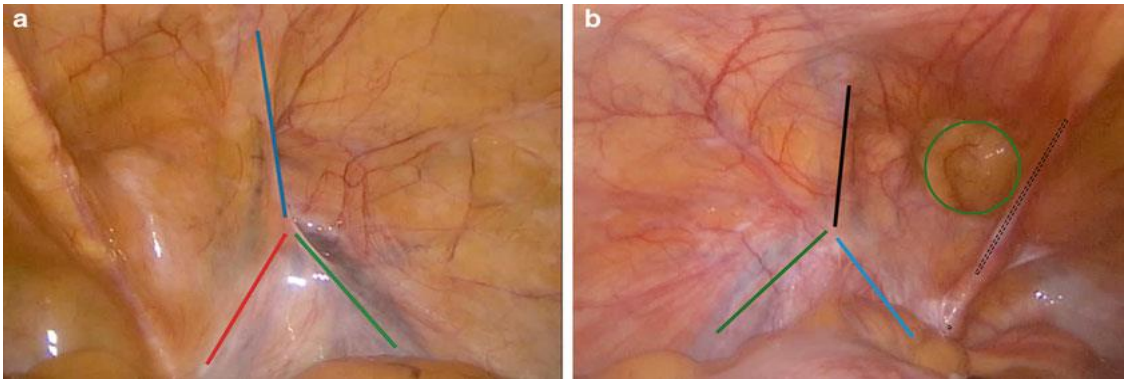

Figure (3): (a) Right side—inferior epigastric vessels, spermatic vessels, and the vas deferens ("Mercedes-Benz star"). (b) Left side—inferior epigastric vessels, spermatic vessels, vas deferens, median umbilical ligament, and direct hernia **(12).**

2. Division of the Peritoneum:

The peritoneum is incised 4–5 cm above the hernia defect or internal ring, the extension should be planned as an imaginary line from the anterosuperior iliac spine until the lateral umbilical ligament (umbilical artery cord). The dissection starts in Retzius space, in contact with abdominal rectus muscles, from laterally to medial and from cranial to caudal, "targeting" the pubic bone, dividing the fine conjunctive fibers ("angel hair"). Then, the dissection is conducted from medial to lateral into the Bogros space, from epigastric vessels to spermatic vessels. **(13). (Fig.4)**

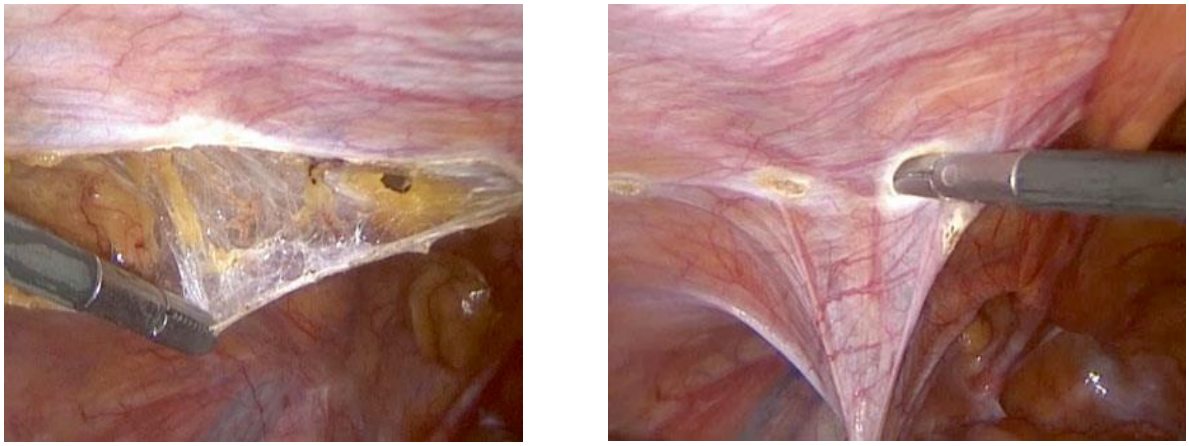

Figure (4): Left side, opening of the peritoneum. **(12).**

3. Making the peritoneal flap and dissection of the sac:

In the same time, we start the dissection of hernia sac. The hernia sac is completely dissected using traction contra-traction maneuvers, sharp and blunt dissection and fine coagulation, it is mandatory to find the avascular plan to preserve the spermatic fascia and to protect the fragile parietal structures (vas deferens, vessels and nerves). The dissection has to be conducted in obturator fossa to identify the occult obturator hernias (type I obturator hernia). The dissection is completed when all the deep anatomic landmarks (Cooper, Gimbernat ligaments, corona mortis and external iliac vein) are well exposed and the pre peritoneal space is wide opened (at least 12 x 15 cm) to allow the correct mesh deployment and parietalization. It is important to search, dissect and remove the cord or pre peritoneal lipoma, because the overlooked lipomas could be misdiagnosed as recurrent hernia or seroma **(13). (Fig.5&6)**

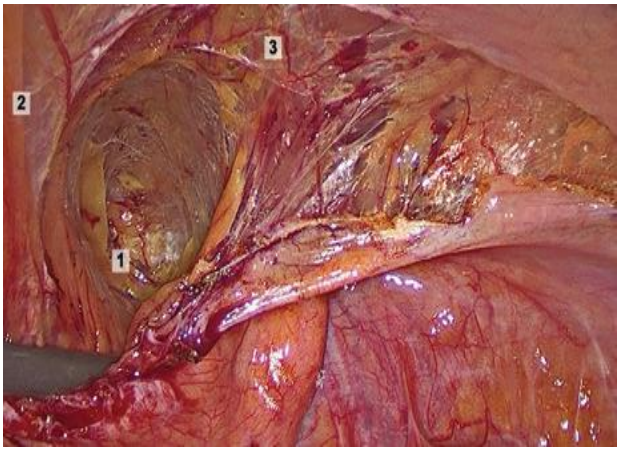

Figure (5): Making the Peritoneal Flap. Cooper's ligament (1), medial umbilical ligament (2) and inferior epigastric vessels (3) are visualized **(13).**

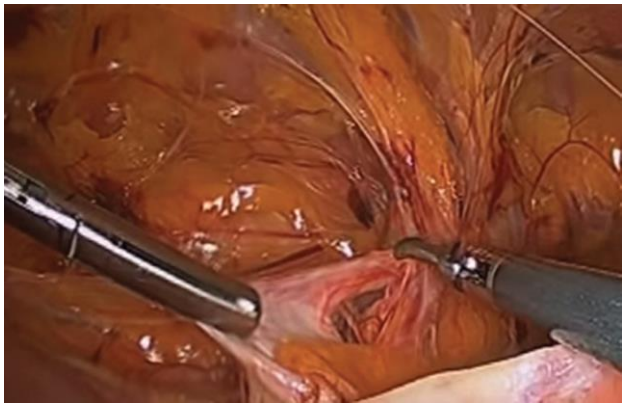

Figure (6): Dissection of the sac. **(15).**

4. Mesh Placement:

A large (12 x 15 cm) light weight mesh is deployed in pre peritoneal space, positioning to cover all the parietal defects and fixed in appropriate position using (staples or fibrin glue). For the bilateral hernia two overlapping mesh are used, stapled together on the midline. In case of large hernia or after difficult dissection or in patients with risk of hemorrhage a suction drain is inserted in Retzius space, it will be removedafter12 to 24 hours postoperatively **(13)** (**fig.7&8).**

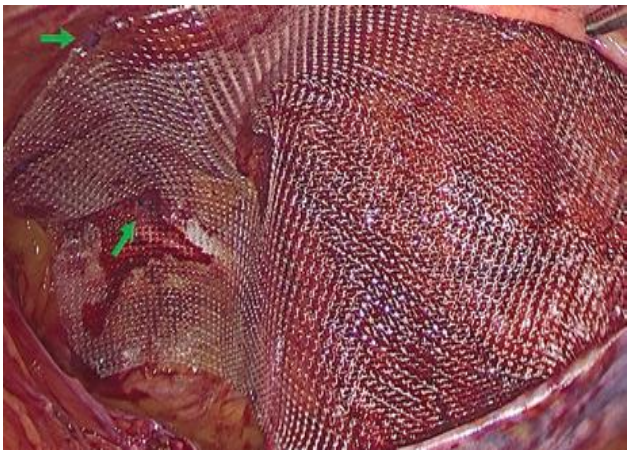

Figure (7): Mesh positioning with a 4 cm overlap for all hernia sites and fixation with tackers (green arrows) **(13).**

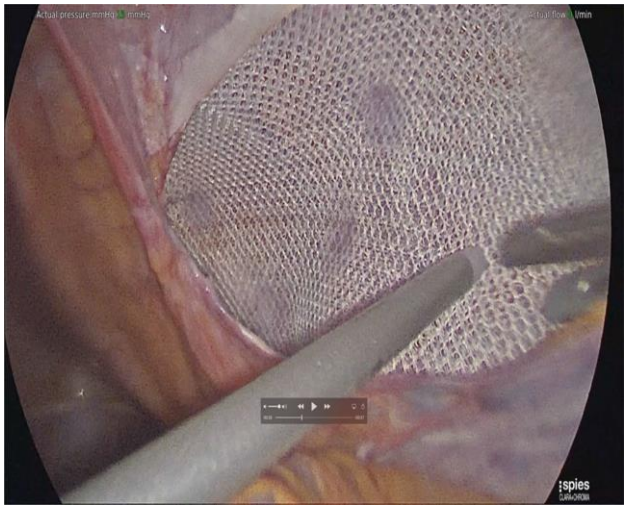

Figure (8): Mesh position and fixation by fibrin glue**. (16).**

5. Peritoneal closure:

The peritoneum is then carefully closed using continuous non absorbable suture secured with an extracorporeal knot; the closure using staples or absorbable sutures is also possible. The closure has to be "waterproof" to avoid small bowel herniation. The trocars are then removed under laparoscopic control view. Usually the trocar sites are infiltrated using ropivacaine under laparoscopic view. The pneumoperitoneum is then exsufflated and the trocars wounds are closed **(13) (fig.9).**

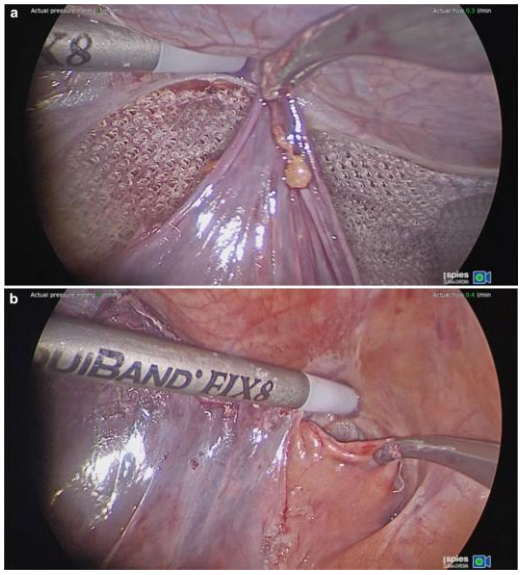

Figure (9): (a) Initial peritoneal closure using fibrin glue central fixation point. (b) peritoneal closure using fibrin glue Medial border **(16).**

Complications related to laparoscopic technique:

i. Intra operative complication:

1. Vascular injury:

The most serious injuries occur to vessels that reside in the retroperitoneum. For all laparoscopic procedures, the risk for major vascular injury that requires operative intervention is 0.05% **(17).**

The vessels most at risk are the distal aorta, common iliac arteries, veins and inferior vena cava. Injuries to the renal vessels have also been reported. These vessels are fixed and may be penetrated even if the safety

mechanisms of the needle or trocar are working properly. The mesenteric and omental vessels are also at risk, especially in the presence of adhesions. The epigastric arteries may be injured with secondary cannula placement. The mortality associated with retroperitoneal injury secondary to trocar insertion ranges from 9% to 36%, even with rapid identification and repair. When suspected, immediate conventional laparotomy is almost always indicated **(18).**

The location of the inferior epigastric vessels, the most common cause of bleeding during laparoscopic hernia repair, may vary. Therefore, surgeons must stay lateral to the rectus muscles when placing lateral trocars in the TAPP approach to avoid vessel injury. Injuries caused during trocar insertion may not be immediately evident, necessitating careful inspection under laparoscopic visualization as trocars are removed. If hemorrhage occurs, it should be controlled promptly, often by removing the trocar and placing a figure-of-eight suture around the vessels before reinsertion. Significant blood loss can occur if these vessels are not controlled immediately **(14).**

In contrast, hemorrhage from the iliac vein is a life-threatening complication if it occurs. Immediate compression of the vein is required to control bleeding and prevent CO_2 embolism. While the vein is compressed, a third port can be added to suture-ligate the injury, or the procedure may need to be converted to open repair for definitive hemostasis **(19).**

The presence of an aberrant obturator artery originating from the deep inferior epigastric artery can be the source of bleeding when tacks or staples are anchored to the ligament of Cooper. Care must be taken, and acknowledgment of its existence underneath the mesh is very important. If this bleeding is managed poorly, the result can be a bloody operative field that can be an obstacle to the completion of the procedure. This dangerous injury must be avoided. This complication has earned the artery the unenviable designation of the 'artery of death' **(20).**

Injuries to the spermatic vessels are more common during the learning curve for TAPP procedures. The aggressiveness of the dissection and complete parietalization of the cord structures is the probable cause **(21).**

2. **Bowel injury:**

Injury to the bowel is rare and usually occurs during creation of the pneumoperitoneum with frequency 0.1-0.27%. Pneumoperitoneum may be administered by closed technique, using the Verees needle or by open technique using a blunt-tipped trocar. Use of the open technique doesn't eliminate bowel injuries but it does facilitate immediate identification and repair. Patients who had prior abdominal surgery are at increased risk of accidental enterotomy when the pneumoperitoneum is created Previous abdominal surgery is a relative contraindication to laparoscopic hernioplasty **(22).**

3. **Carbon dioxide embolus:**

The incidence of clinically significant CO_2 embolism is very low, although recent reports using sensitive monitoring techniques suggest that microbubbles of CO_2 may be commonly present in the right heart during laparoscopic procedures. Clinically important CO_2 embolism may present with unexplained hypotension and hypoxia intraoperatively. A characteristic mill-wheel murmur can sometimes be auscultated, resulting from right ventricular contraction against the blood-gas interface. Management includes immediate evacuation of the pneumoperitoneum, placing the patient in left lateral decubitus with head-down position, administration of 100% oxygen, hyperventilation, and, if available, aspiration of gas through a central venous line **(23).**

4. **Bladder injury:**

Bladder injury during laparoscopic hernia repair is rare, usually occurring during peritoneal access or trocar placement. Predisposing factors include a distended bladder or, less commonly, congenital bladder anomalies. Open access techniques are not typically associated with bladder injury. When injury occurs, it is often immediately apparent, with urine leakage, blood, or gas observed if the patient is catheterized. Minor injuries can be managed conservatively with postoperative bladder decompression via an indwelling catheter, whereas injuries caused by trocars often require formal surgical repair **(11).**

ii. Post-operative complication:

1. Post-hernioplasty groin pain:

Now that the recurrence rate has been reduced to a minimum using modern hernioplasty techniques, chronic postoperative groin pain has emerged as a significant concern in inguinal hernia surgery. Recent systematic reviews and meta-analyses indicate that the prevalence of chronic groin pain ranges from 10% to 15%, with moderate to severe pain occurring in approximately 5–10% of patients after laparoscopic repair. These findings highlight the importance of careful mesh fixation and nerve preservation during surgery **(8).**

True post-hernioplasty groin pain should be divided into two types:

(a) Nociceptive pain, which is caused by tissue damage and is further sub divided into somatic and visceral pain.

(b) Neuropathic pain, which means direct nerve damage.

Somatic pain is the most common and is usually caused by damage to ligaments, tendons and muscles. Visceral pain refers to that which is related to a specific visceral function such as urination or ejaculation. Neuropathic pain is much less common but is important to recognize because surgical treatment is possible if the cause is incorporation of a nerve in staples or suture material. The nerves that are usually involved are the ilioinguinal nerve, the iliohypogastric nerve, both the genital and femoral branches of the genitofemoral nerve and the lateral cutaneous nerve of the thigh. The former two are especially prone to injury during a conventional herniorrhaphy, whereas the latter are most likely damaged during laparoscopy. A femoral nerve injury is extremely rare and is usually the result of a gross technical misadventure. Pain or paraesthesia in their distribution characterize patient's symptoms for the more common nerves. There is significant overlap of these nerves and therefore it is common difficult to sort out exactly which nerve is damaged **(24).**

The pain scale:

Visual analogue scale (VAS).

A Visual Analogue Scale (VAS) is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. Operationally a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end, as illustrated in Fig. (10).

The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left-hand end of the line to the point that the patient marks **(24)**.

0 Pain free.

Mild Pain–Nagging, annoying, but doesn't really interfere with daily living activities.

1. Pain is very mild, barely noticeable. Most of the time you don't think about it.
2. Minor pain. Annoying and may have occasional stronger twinges.
3. Pain is noticeable and distracting, however, you can get used to it and adapt.
4. Moderate pain. If you are deeply involved in an activity, it can be ignored for a period of time, but is still distracting.
5. Moderately strong pain. It can't be ignored for more than a few minutes, but with effort you still can manage to work or participate in some social activities.
6. Moderately strong pain that interferes with normal daily activities. Difficulty concentrating.

7. Severe pain that dominates your senses and significantly limits your ability to perform normal daily activities or maintain social relationships. Interferes with sleep.

Severe Pain – Disabling; unable to perform daily living activities.

8. Intense pain. Physical activity is severely limited. Conversing requires great effort.

9. Excruciating pain. Unable to converse. Crying out and/ or moaning uncontrollably.

10. Unspeakable pain. Bedridden and possibly delirious. Very few people will ever experience this level of pain.

(24)

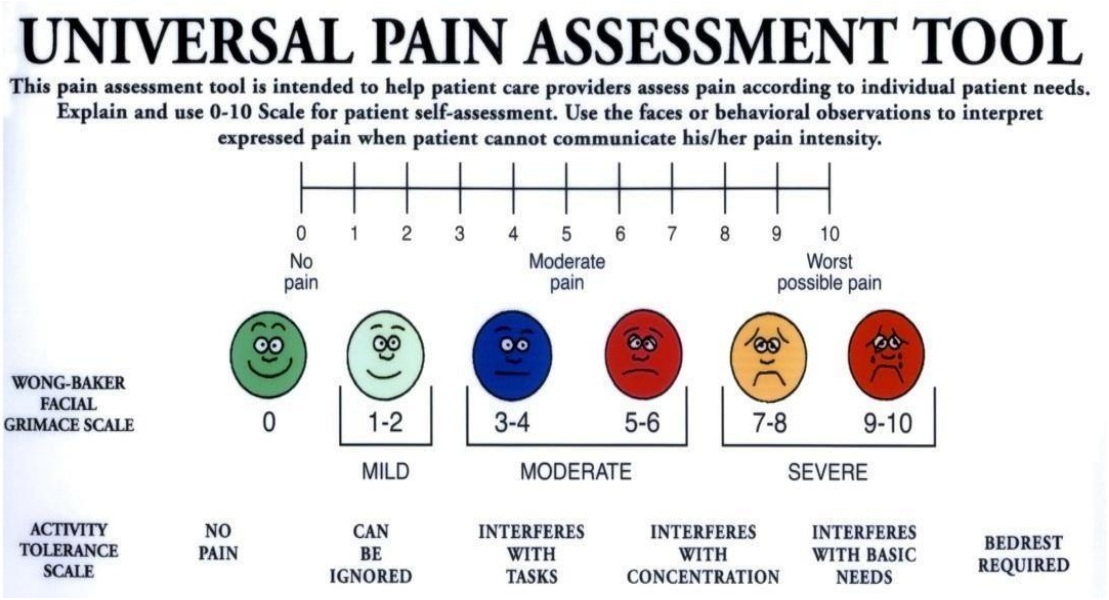

Figure (10): Pain assessment tool**. (24).**

2. **Urinary retention:**

Postoperative urinary retention is a relatively common complication after inguinal hernia repair. Older age, preexisting urinary symptoms, effects of general anesthesia, intravenous fluid overload, and opioid use are known predisposing factors. Untreated retention may prolong hospitalization and increase the risk of urinary tract infection. Management typically involves intermittent or indwelling catheterization until normal voiding resumes **(25).**

3. **Ileus:**

Postoperative ileus can occur after both conventional and laparoscopic inguinal hernia repair, though it is generally self-limiting and managed symptomatically. Nasogastric decompression is rarely required **(19).**

4.Bowel obstruction:

In the early stages of laparoscopic surgery, inadequate attention to closure of trocar sites—particularly those larger than 5–10 mm—resulted in cases of trocar-site hernia, which may present with bowel obstruction, incarceration, or strangulation. Proper fascial closure of larger trocar sites is therefore recommended to prevent this complication **(26).**

A second cause of postoperative intestinal obstruction after TAPP is inadequate peritoneal closure over the prosthesis, allowing small bowel to migrate into the preperitoneal space, leading to obstruction. Recent evidence shows that meticulous peritoneal closure with minimal tension, often using barbed sutures or careful approximating techniques, has significantly reduced this problem by preventing bowel herniation into the preperitoneal space **(19).**

5.Mesh Complication:

After TAPP repair, the incidence of mesh infection is very low (approximately 0.02–0.1%), whereas the risk of mesh infection is higher after open repair, with reported rates of about 0.5–2.5%. The lower risk of infection after laparoscopic repair is attributed to introduction of the mesh through trocars, minimizing skin contact, and placing the mesh deeper from the incision site, thereby reducing contamination and infection risk **(11).**

Mesh erosion and migration are particular complications following prosthetic inguinal hernia repair, the most common erosions and migrations reported are involved to urinary bladder and mesh erosion or migration into viscera although the total number of reported cases is small compared to the number of inguinal hernia repairs, the true incidence of mesh erosion and migration may be underestimated, with large series of mesh repair worldwide, the incidence of these kinds of complications will increase in the future **(27).**

6.Recurrence:

Now that the recurrence rate has been minimized using modern hernioplasty techniques, the shift from traditional tissue-based repairs to the tension-free mesh concept has significantly reduced recurrence rates **(28).**

Recurrence rates of 2% or less are now routinely reported from specialty centers performing either laparoscopic or conventional tension-free repairs. Although the recurrence rate for hernia repairs is less than 1% at the Shouldice Clinic. A recent study reported a higher recurrence rate at 2 years (4% for Lichtenstein and 10% for laparoscopy) and may be more reflective of the general population outside of specialty centers **(15).**

Cause of recurrence in TAPP:

Several factors may contribute to mesh displacement or failure after laparoscopic inguinal hernia repair, including inadequate mesh size, inappropriate material, incorrect placement, folding of the mesh, hematoma formation, urinary retention, missed cord lipomas, and insufficient tissue ingrowth. Adequate dissection of the preperitoneal space and proper positioning of a sufficiently large mesh are essential to prevent recurrence and complications. Some surgeons also recommend avoiding slitting the mesh and using a larger prosthesis to ensure adequate coverage of the myopectineal orifice **(29).**

1.Mesh Size:

The established mesh size for unilateral laparoscopic inguinal hernia repair is approximately 15 × 15 cm, with minor variations depending on the size of the defect and surgeon preference **(30).**

2.Mesh Material:

The lightweight meshes are strong enough for inguinal repair **(31)**

3.Fixation of the Mesh:

In the early years of laparoscopic hernia repair, strong mesh fixation was considered essential to prevent recurrence. However, with the introduction of larger meshes and macroporous materials, attention shifted toward reducing postoperative acute and chronic pain potentially caused by fixation, leading to ongoing debate regarding mesh fixation versus non-fixation **(32).**

4.Technical Experience:

The impact of experience on the recurrence rate was in both extremes well documented **(31)**.

5.Collagen Status:

Inborn or acquired abnormalities in collagen synthesis are associated with higher incidence of hernia formation and recurrences **(31)**

6.Other Factors:

The negative effect on healing in hernia repair is often related with malnutrition, obesity, steroids, type II diabetes, chronic lung disease, jaundice, radiotherapy, chemotherapy, oral anticoagulants, smoking, heavy lifting, malignancy and anemia **(31)**.

7.Learning Curve:

This period represents the developmental and learning curve for the consultant and the senior registrars. There have been some modifications of the technique as difficulties have been recognized. There is steep learning curve for laparoscopic repair. Initially everyone used to fix mesh with staples, but nowadays many surgeons are using sutures for it. As experience increases, our ability to recognize finer structures and to keep within the correct tissue planes, improves. This has been associated with lower minor-complication rates and higher percentage of pain-free recoveries **(31).**

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