

Laparoscopic Transabdominal Pre-Peritoneal (TAPP) Procedure - Step-by-Step Tips and Tricks

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Rezumat

Abordul laparoscopic transabdominal pre-peritoneal - pas cu pas

Abordul minim invaziv pentru tratamentul herniei inghinale este încă controversat, dar în ultimul deceniu, tinde să se impună ca procedură standard pentru chirurgia ambulatorie. Prezentul articol își propune să prezinte tehnica transperitoneală (TAPP - Trans Abdominal Pre Peritoneal approach). Tehnica chirurgicală este prezentată "pas-cu-pas", insistându-se asupra diferitelor puncte cheie ale intervenției (de exemplu recunoașterea reperelor anatomice, diagnosticul herniilor "oculte", disecția pre-peritoneală și a sacului herniar, plasarea și fixarea protezei, sutura peritoneului); sunt descrise și discutate în detaliu sfaturi practice care permit obținerea unor bune rezultate postoperatorii.

Concluzii: Tehnica transperitoneală este o metodă fezabilă pentru tratamentul herniei inghinale și are o rată scăzută a morbidității postoperatorii și a recidivei. Reperele anatomice sunt facil de recunoscut, iar abordul laparoscopic permite atât tratamentul herniilor încarcerate/strangulate cât și diagnosticul herniilor oculte.

Cuvinte cheie: hernia inghinală, chirurgie minim invazivă, abordul transabdominal pre-peritoneal, TAPP

Abstract

Minimally invasive approach for groin hernia treatment is still controversial, but in the last decade, it tends to become the standard procedure for one day surgery. We present herein the technique of laparoscopic Trans Abdominal Pre Peritoneal approach (TAPP). The surgical technique is presented step-by-step; the different procedures' key points (e.g. anatomic landmarks recognition, diagnosis of "occult" hernias, pre-peritoneal and hernia sac dissection, mesh placement and peritoneal closure) are described and discussed in detail, several tips and tricks being noted and highlighted. **Conclusions:** TAPP is a feasible method for treating groin hernia associated with low rate of postoperative morbidity and recurrence. The anatomic landmarks are easily recognizable. The laparoscopic exploration allows for the treatment of incarcerated / strangulated hernias and the intraoperative diagnosis of occult hernias.

Key words: inguinal hernia, minimally invasive surgery, trans abdominal pre peritoneal approach, TAPP

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Background

Hernia repair is the most common surgical procedure. (1)
The place of laparoscopic approach for the treatment of

groin hernia is still a subject of debate even if its advantages have been demonstrated for more than 10 years. (2,3) Furthermore, the type of minimally invasive approach [Trans Abdominal Pre-Peritoneal (TAPP) versus the Totally Extra-Peritoneal (TEP)] is controversial too. (4) We present herein the TAPP procedure focusing on tips and tricks for better outcomes.

Definition

In the guidelines, the TAPP approach is defined as “trans-abdominal pre-peritoneal endoscopic inguinal hernia operation in which the approach to the inguinofemoral region is trans-abdominal, and the final placing of the prosthesis is extra-peritoneal”. (5)

Surgical technique

Indication and contraindication for TAPP approach

TAPP approach can be performed in theory for any hernia, even in strangulated or incarcerated cases; however the indication depends on the surgeon's clinical judgment and skills.

The guidelines formally contraindicate TAPP for large scrotal hernia and after radical prostatectomy. (5,6) As the other mesh repairs, TAPP is also contraindicated in children. However, it is recommended in young men (aged 18-30 years) and women due to the low rate of recurrence. (5) Furthermore, laparoscopic the laparoscopic approach is mandatory for the recurrence after open repairs. (5,6) General (different comorbidities which contraindicate general anesthesia – cardio vascular, pulmonary etc.) or local (peritoneal adhesions) contraindications for laparoscopy approach are well known.

Preoperative patient's preparation

The patient has to be carefully prepared for the operation. The evaluation of comorbidities as well as an adequate skin preparation is mandatory. The patient has to be informed about the details of the surgical procedure and the possible negative outcomes, as the latest guidelines recommended. (6)

Tips and tricks:

- We evaluate the operative risk using ASA (American Society of Anesthetists) score. From the point of view of comorbidities, there are no “absolute” contraindications for TAPP. For the patients receiving chronic anti-coagulant therapy, the anti-vitamin K drugs are replaced by low molecular weight heparins (LMWH) and the procedure is usually performed at least 12 hours after the last LMWH dose. (7,8) For the patients under LMWH therapy the procedure can be usually performed at least 12 hours after the last LMWH dose. The new anticoagulant oral drugs (e.g. dabigatran etexilate – Pradaxa®) have to be stopped and replaced by LMWH at least 5 days before the procedure. (7,8) For patients with antiplatelet therapy it is stated that the procedure can be performed under low dose of

aspirin; therefore clopidogrel or ticlopidine are stopped and replaced by aspirin 5 to 7 days before the procedure and higher doses of aspirin are reduced to 75 mg/day 3 to 7 days before the operation. (7,8)

- The skin is prepared as follows: a preoperative antiseptic shower is performed on the eve of the intervention; the hair is removed, one hour before the procedure, from middle thorax until the upper third of the thigh using a barber clipper. The inguinal and pubic regions have to be well prepared for an eventual conversion. Shaving is avoided due to the risk of skin injuries with consecutive surgical site infections. (9) Alcohol based solutions (iodine or chlorhexidine gluconate in case of iodine allergy) are used for skin preparation after anaesthetic induction.
- It is mandatory that the patient urinate just before the procedure to completely empty the bladder to facilitate the dissection in the Retzius space and to avoid bladder injuries. (6) A urinary catheter can be inserted in case of urinary retention.

Anesthesia and the operative room set-up

The patient is in supine position, in a 15° Trendelenburg tilt with both arms in adduction along the body, even for unilateral hernia.

General anesthesia is performed. We don't use routine antibiotic prophylaxis as the latest guidelines recommended. (10) However, we completely agree with European guidelines which noticed the use of antibiotic prophylaxis „in the presence of risk factors for wound infection based on patient (recurrence, advanced age, immunosuppressive conditions) or surgical (expected long operating times, use of drains) factors”. (5)

The laparoscopic equipment is placed at the feet of the patient, as the display to be located on the hernia's site. The surgeon operates from the opposite side of the hernia near the patient's shoulder, and the assistant stands opposite to the surgeon (Fig. 1).

Tips and tricks:

- The arms' position is very important because it allows performing hernia repair on both sides; given the rate of contralateral occult hernia from 15% (11) to 22% (12) this is a very important tip.
- The use of two display laparoscopic equipment, with displays focusing on both inguinal regions can simplify the room set-up during the procedure for bilateral hernia, avoiding the changing of the entire laparoscopic column position; it is also more ergonomic for the surgeon's assistant.

Trocars and instruments

Three trocars are necessary [one of 10 mm (optical) and two of 5 mm (for the instruments)], as well as common laparoscopic instruments (laparoscope, monopolar scissor, monopolar hook, two atraumatic fenestrated graspers, needle holder and a 5 mm disposable absorbable screw type

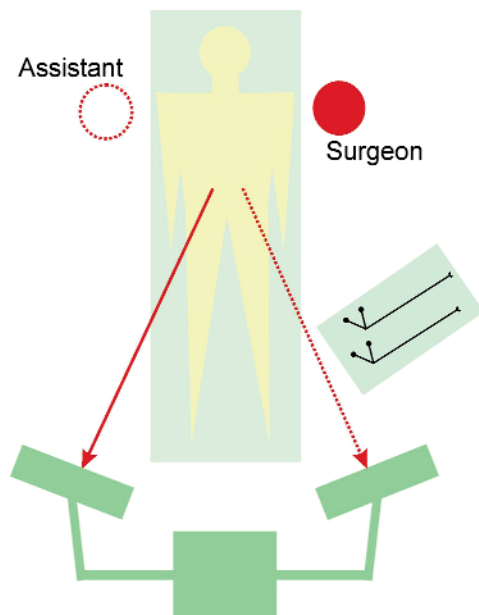


Figure 1. Operating room set-up; right side groin hernia

stapler device) and “classical” instruments (graspers (two Kelly and two Halsted), Farabeuf retractors, scissors and Hegar needle-holder). A bipolar grasper and a suction-irrigation device could be also necessary. Usually we use a 30° laparoscope, but a 0° is also feasible.

Tips and tricks

- The use of 30° laparoscope is mandatory in our opinion because it allows a better abdominal exploration and visualization of the superficial and deep anatomical landmarks.

Pneumoperitoneum and trocar placement

We start the procedure by performing the carbon dioxide pneumoperitoneum using the Verres needle. The open technique is also used in patients with previous operations and/or umbilical hernia. Then, we place the 10 mm optical trocar usually in umbilical position and the other two 5 mm operating trocars, to the midclavicular line, 1 to 2 cm under the level of the horizontal line from the umbilicus (Fig. 2). The operating trocars were inserted under laparoscopic view control to avoid visceral or vascular (epigastric vessels) injuries.

Tips and tricks

- We insert the 5 mm trocars laterally from the epigastric vessels to improve the triangulation and the ergonomics during dissection of the pre-peritoneal space and especially, during the peritoneal close.

Exploration and anatomical landmarks

The aim of laparoscopic exploration is to identify the superficial anatomical landmarks (urachus, umbilical folds, epigastric vessels, spermatic vessels, vas deferens or uterine

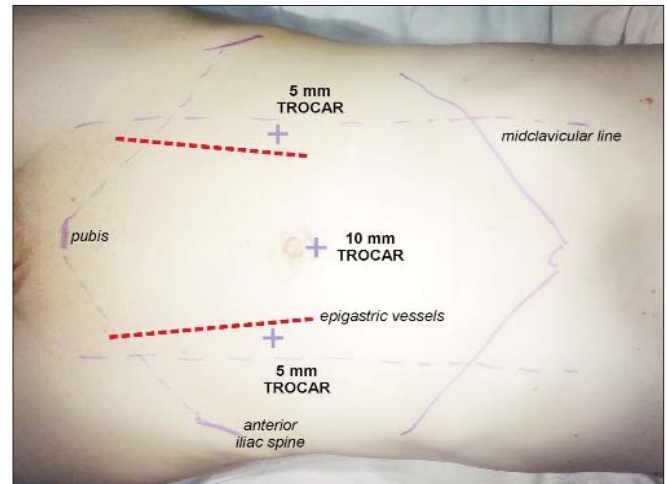


Figure 2. Trocars placement



Figure 3. Superficial anatomic landmarks. 1 urachus; 2 umbilical medial ligament; 3 epigastric vessels; 4 projection of inguinal ligament (iliopubic tract); 5 testicular vessels; 6 external iliac artery; 7 external iliac vein; 8 vas deferens; 9 urinary bladder. A internal inguinal region; B middle inguinal region with large direct hernia; C external inguinal region (deep inguinal ring); D pain triangle; E vascular triangle

round ligament) and the site and type of hernia (Fig. 3). The anatomic landmarks were already described in detail in a previous work. (13) The two “dangerous triangles”, “vascular (doom) triangle” and “pain triangle” (1,13,14) have to be correctly recognized (Fig. 3).

Tips and tricks

- To perform the exploration and to ensure a good exposure of the inguinal region it is useful to increase the patient tilt to 20-30° and to slightly turn the patient on the surgeon's side.
- The NYHUS classification of groin hernia is simple but allows only a “superficial” description of hernia

type; therefore for an accurate description, especially for multiple and recurrent hernias we prefer the use of Zollinger classification (11,15,16).

Peritoneal incision

The TAPP procedure starts with peritoneal cut from the antero-superior iliac spine until the medial umbilical ligament (umbilical artery cord), with a large opening of the preperitoneal space.

Tips and tricks:

- The peritoneal incision starts 2 cm above and 1 cm medial from the iliac spine and is made using the monopolar hook or scissors.
- After the first peritoneal cut, the CO₂ pneumoperitoneum will enter into the preperitoneal space, facilitating the dissection.
- It is recommended to perform an “L” or “T” shape peritoneal incision along the medial umbilical ligament and not to cut it (1,17,18); however in difficult cases, especially in obese patients, the medial umbilical ligament can be divided for a better exposure of the Retzius space (11).

Preperitoneal and hernia sac dissection

The step's main goal is to provide a wide space to allow a correct mesh placement. The dissection is conducted into the Retzius and Bogros (retroinguinal) spaces cutting the lax conjunctive fibres (“angel hair”) (1); then we continue with hernia sac dissection. The anatomical landmarks (epigastric vessels, Cooper and Gimbernat ligaments, the corona mortis and external iliac vessels) have to be identified and well exposed.

Tips and tricks:

- We start the preperitoneal dissection into the Retzius space, dividing the conjunctive fibres in contact with the rectus abdominal muscle to avoid bladder injuries; this way the bladder is detached from the abdominal rectus muscles. The dissection is conducted to the pubis, the first and one of the most important deep anatomic landmarks, until it is well exposed (Fig. 4). The dissection is then conducted laterally into the Bogros space, from the epigastric vessels until the spermatic vessels (Fig. 5); at the same time we perform the hernia sac dissection, starting from the cranial and lateral aspect of the hernia's sac to avoid the injuries of the vas deferens, spermatic and epigastric vessels. We complete the hernia sac dissection using traction contra-traction maneuvers, sharp and blunt dissection and fine coagulation; it is mandatory to find the avascular plane to preserve the spermatic fascia and to protect the fragile parietal structures (vas deferens, vessels and nerves) (6) (Fig. 5).
- The dissection is completed when all deep anatomic landmarks (Cooper, Gimbernat ligaments, corona mortis and external iliac vein) are well exposed (Fig. 6). It is important to avoid aggressive and sharp

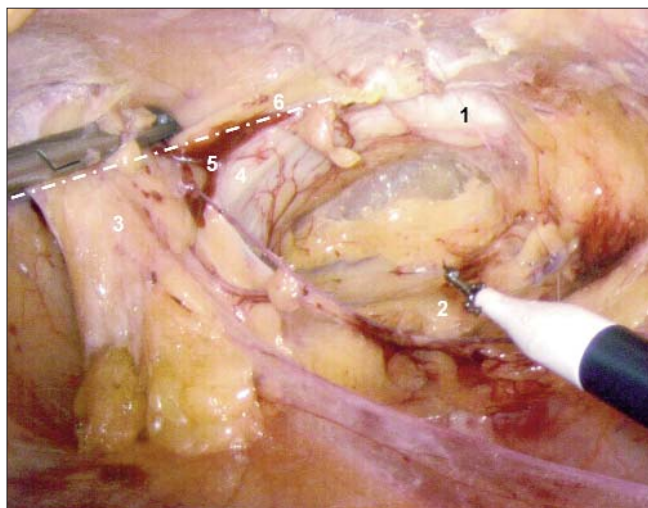


Figure 4. Complete exposure of the pubis. 1 pubic symphysis; 2 bladder; 3 left direct type hernia; 4 Cooper ligament; 5 Gimbernat ligament; 6 iliopubic tract

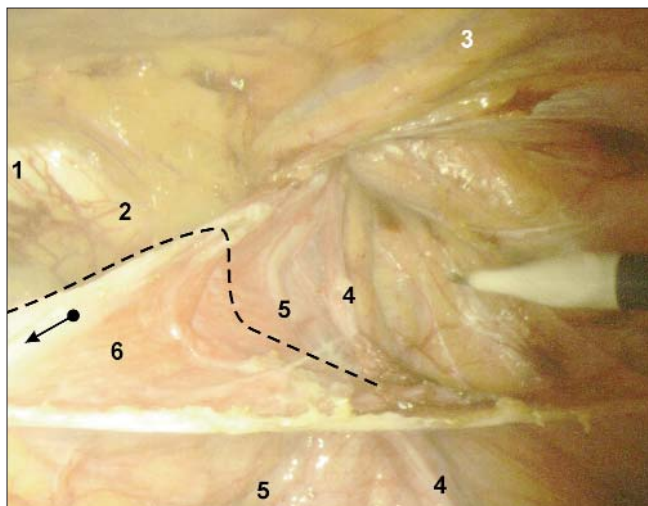


Figure 5. Hernia sac and Bogros space dissection (indirect type right hernia) 1 pubis; 2 Cooper ligament; 3 epigastric vessels; 4 spermatic vessels; 5 vas deferens; 6 hernia sac; arrow indicates the traction direction; dotted line indicates the dissection plane

dissection in the proximity of these vessels due to the risk of thermal injuries. It is important to perform a wide dissection of the pre peritoneal space to allow mesh deployment and parietalization (Fig. 7).

- Usually, in contact with the pubic bone there are several fine vessels originated from the corona mortis. We prefer to coagulate them to avoid further bleeding during the dissection or mesh stapling.
- When the hernia sac is very large we prefer to cut and leave it in situ to avoid spermatic vessel and ductus deferens injuries (6,19).
- We always check for hernia lipoma (funicular or pre-peritoneal) as recommended in the literature (6); once diagnosed, it is completely dissected and divided,

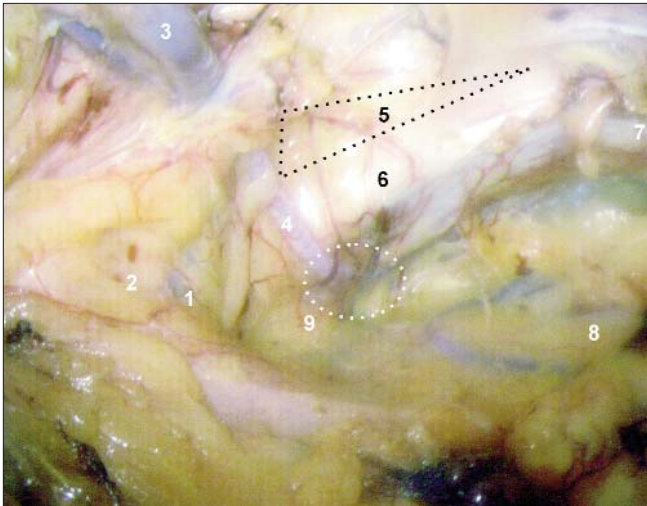


Figure 6. Deep anatomic landmarks. 1 external iliac vein; 2 external iliac artery; 3 inferior epigastric vein; 4 corona mortis; 5 projection of Gimbernant ligament; 6 Cooper ligament; 7 pubic symphysis; 8 bladder; 9 obturator foramen

because overlooked lipomas could be misdiagnosed as recurrent hernia or seroma (20).

- We prefer not to visualize the femoral nerve, to avoid accidental injuries, even if different authors recommend it (21).
- It is necessary to extend the dissection caudally to the obturator fossa to identify eventual occult obturator hernia especially in women (“skinny old ladies”); however is important to avoid “aggressive” dissection and coagulation to avoid injuries of the obturator nerve and vessels. (22,23) For large parietal defects, the transversalis fascia has to be inverted and stapled to the Cooper ligament. This simple maneuver seems to decrease the postoperative seroma rate. (24)
- For incarcerated / strangulated hernias, we prefer to perform hernia reduction before the peritoneal incision; when the reduction is not possible, we perform the preperitoneal dissection and kelotomy of the hernia ring under direct view control.

Mesh deployment and fixation

We use a large non cutting mesh (120 x 150 mm) which is inserted from the optical trocar. The mesh is then placed in the appropriate position, parietalized, and fixed using absorbable staples. It is mandatory not to staple the mesh at the level of dangerous triangles and epigastric vessels.

Tips and tricks:

- The use of large meshes (at least 100 x 150 mm) is recommended to reduce the recurrence rate. (1,5,6,19, 25,26).
- The mesh has to be very well deployed and parietalized to avoid the “up-rolling” phenomenon, one of the main cause of recurrence; this way the preperitoneal dissection has to be large enough to allow the complete

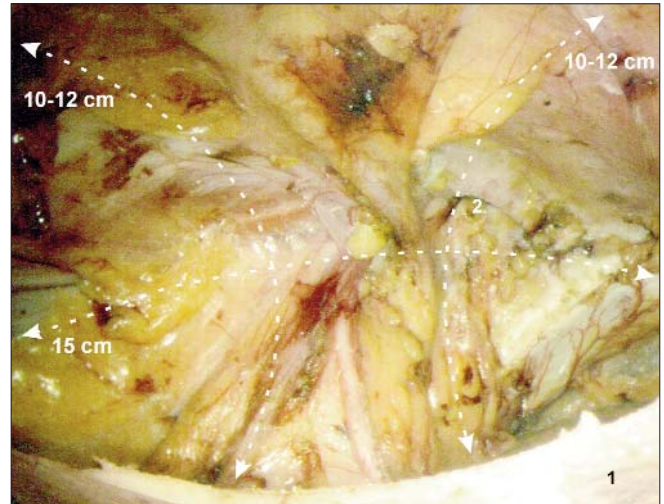


Figure 7. Pre-peritoneal dissection
1 peritoneal flap; 2 direct type hernia parietal defect

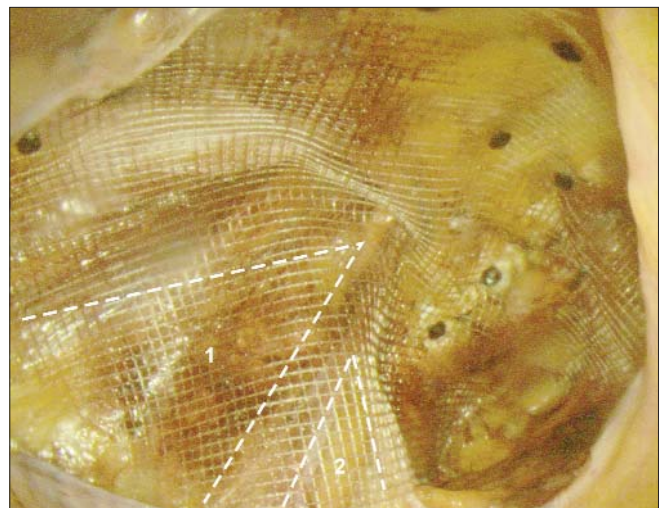


Figure 8. The mesh is completely deployed, parietalized and fixed using absorbable staples (left indirect hernia; the 30° laparoscope is slightly turned to the right). There are no staples in the dangerous areas: pain triangle (1) and doom triangle (2)

prosthesis deployment (Fig. 7). (6)

- Usually we use large no slit/keyhole lightweight mesh [120 x 150 mm polypropylene mesh (F polypropylen + porcine collagen + polyethylene terephthalate)] fixed using absorbable tacking staples (Fig. 8). We prefer to put the first staple above the iliac spine to avoid the injury of the lateral femoral cutaneous nerve; then, the mesh is fixed on the upper and medial edge, as well as at the level of the pubis and Cooper ligament. For bilateral hernia we use two separate meshes covering the bilateral defects overlapping and stapled together on the median line; this technique is technically easier than the deployment of one single very large mesh and is associated with good short and long term results. (27) If

an obturator hernia is diagnosed, the mesh has to be descended in the obturator fossa covering the obturator foramen.

- For the large direct type hernia we also staple the mesh to the conjoint tendon.
- Some alternatives to staple fixation are noted in the literature: the use of fibrin glue (28), the auto adhesive (29) or auto gripping mesh (30), transparietal sutures (31) or, even, no fixation technique (19).

Drainage

The use of suction drains is controversial. (6) Some authors emphasize the role of suction-draining in decreasing postoperative seroma and hematoma rates, as the release of carbon dioxide pressure is followed by bleeding from capillaries, resulting in “unpredictable amount of blood collecting in the preperitoneal space”. (32) The drainage also allows for a complete deflation of the pre-peritoneal space. (32)

Tips and tricks:

- We use 12 to 24 hours closed suction-drainage for selected cases: difficult dissection, anticoagulant and/or antiplatelet therapy, intraoperative hemorrhage etc.; we insert a 8 or 10 Ch/Fr drain through a 5 mm trocar placed 1 to 2 cm cranially from the iliac spine.

Peritoneal closure

The peritoneum can be closed using staples, stitches or running suture. (1,5,6,17,18,19)

Tips and tricks:

- Usually we perform a running suture with extracorporeal knot using 2-0 monofilament non absorbable suture. As we are right handed, we always start the suture from right to left; this way the suture is more ergonomic and the stitch is maintained tensioned (Fig. 9). The detachment of peritoneum is mandatory to ensure a tension free suture. To diminish the parietal tension and to facilitate the suture, we decrease the pneumo-peritoneum pressure to 8 mmHg. In cases with fragile and thin peritoneum we recommend the use of barbed knotless sutures or stapled peritoneal closure.
- It is mandatory to carefully close all the peritoneal defects larger than 5 mm to avoid internal hernia and the mesh contact with abdominal viscera (Fig. 10). In the same way, in cases with fragile peritoneum and large peritoneal defects a composite mesh can be used. (6)

Abdominal closure

After the careful examination of the peritoneal closure, the trocars are removed under endoscopic control. Then, the operative wounds are infiltrated with long-acting anesthetics (e.g. bupivacaine), as guidelines recommend, for a better control of postoperative pain (5,6); we prefer to perform the infiltration of all the abdominal wall layers, from the skin to the peritoneum, under laparoscopic view control.

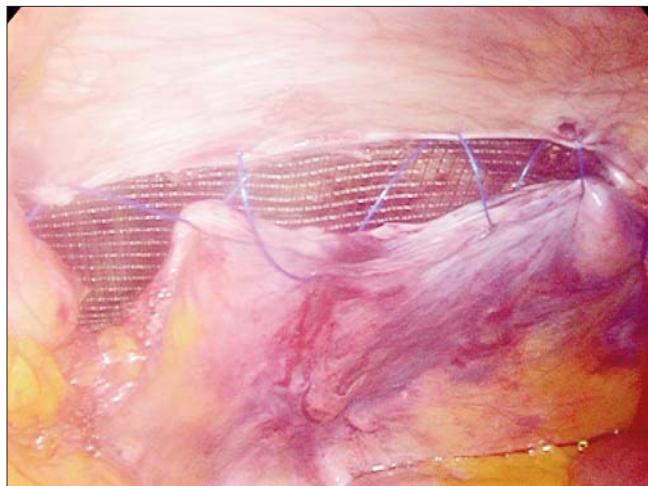


Figure 9. Peritoneal closure using a running suture (non absorbable; extracorporeal knot)

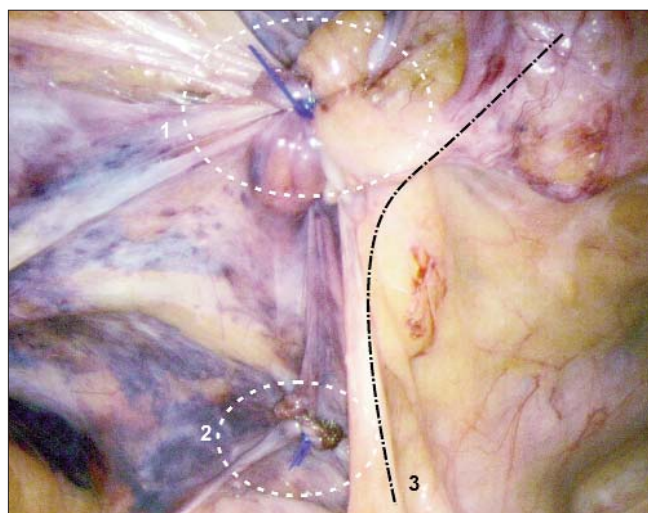


Figure 10. Final aspect after peritoneal closure (left direct type hernia); peritoneum was sutured using a non-absorbable running suture and extracorporeal knot tying (1); an additional peritoneal lesion was also sutured (2); the lateral umbilical ligament is used to close the peritoneum and retracted to the left (3)

The aponeurosis is closed at the umbilical site (10 mm trocar) with absorbable suture. The skin is closed using interrupted non-absorbable sutures or staples.

Postoperative period

The immediate postoperative analgesic therapy consists in Paracetamol 1000 mg x 4/day (“perfusette” /100 mL) associated with Ketoprofen 100 mg x 2/day. When necessary we can supplement with Nefopam (Acupan®) 20 mg x 2/day and/or Tramadol (Topalgic®) 100 mg x 2/day. Most of the patients are discharged on the same day (ambulatory surgery) or during the first 24 hours (day surgery). (11) To control the pain, all the patients received a prescription with Paracetamol 500 mg x

3/day and Ketoprofen 100 mg x 2/day for the first seven days.

We also perform a routine thromboembolic disease prophylaxis with light-weight heparin therapy for seven days for all the patients, even if the subject is controversial and guidelines recommend it only for the patients with risk factors; this way, we have noted no thromboembolic complication and 1.8% rate of postoperative hematomas (11), lower than the rates reported in the literature for no thromboembolic disease prophylaxis series (4.2-13.1%). (5,6)

Postoperative complications

Different postoperative complications were noted in the literature: seroma, hematoma, chronic pain, ischemic orchitis or testicular atrophy, infertility.

Seroma is apparently the most frequent complication of endoscopic hernia repair, the only complication more frequent in endoscopic techniques than in open repairs (5); in our experience, we noted a 6% rate, close to the rate reported in literature (5.7%) (5,6). Aspiration or/drainage is recommended only in voluminous seroma. (5,6)

Hematoma is less frequent in endoscopic hernia repair than in open repairs, with a rate of about 8% and rarely requires drainage or transfusions (5,6). In our experience, hematoma was reported in only 1.8% cases, and drainage wasn't required in any patient.

Chronic pain, defined as persistence of pain 3 months after the operation (33), is less frequent in endoscopic techniques, and especially after TAPP, than in open hernia repair. In our experience we noted only a rate of 0.6%. (11)

Several other complications after endoscopic hernia repair were reported in the literature with an incidence rate of 1% or less: wound / mesh infection, urinary retention, bladder damage, mesh migration, bowel obstruction, ischemic orchitis / testicular atrophy. (5,6)

The recurrence rate varies between 0.4 to 4.8% and apparently depends on the surgeons' experience (34). For recurrence repair the guidelines recommend open repair (5,6) but some authors consider "redoing" TAPP as a valuable option for experienced surgeons. (35) We noted a 0.6% rate of recurrence and open anterior approach (Lichtenstein repair) was performed.

Discussions

Although there are a lot of debates in the literature about the best treatment for groin hernia some data are clearly noted in the literature. This way, mesh repair is mandatory for all adult patients and the non-mesh techniques have to be considered only for the cases with high risk of mesh infection. (5,36) The recommended procedures are Lichtenstein, TAPP and TEP (Totally Extra-Peritoneal) for mesh repairs and Shouldice procedure for non-mesh repairs. (5)

With regards to open versus laparoscopic approach a lot of debates were published in the literature. It is already stated that, in terms of recurrence rate, Lichtenstein procedure is similar to

laparoscopic techniques. (2,3,5,37) However, laparoscopic techniques are associated with a better immediate postoperative comfort, less chronic pain and numbness, less mesh infection, as well as a faster return to usual activities (2,3,5,6,38,39); nevertheless, Berndsen FH et al. (40) demonstrated similar results from the point of view of late postoperative pain for TAPP and Shouldice procedure. Another advantage of the laparoscopic techniques is the possibility to diagnose and to treat during the same operation the occult hernias. (5,6,34) The disadvantages of laparoscopic procedures are longer learning curve with higher risk of complications during the first 30-50 procedures and higher direct costs (general anesthesia, laparoscopic equipment, staples) (5,6); it must be noted that the direct higher costs can be recuperated decreasing the indirect costs: shorter hospital stay (day surgery) and faster return to work (11,41).

The type choice of laparoscopic hernia repair is also a subject of debate; both laparoscopic techniques are similar in terms of duration of operation, postoperative morbidity, length of stay, time to return to work and recurrence. (5,6,41,42) However, TAPP is associated with a "historical" risk of visceral injuries and port-site hernia while TEP is associated with a longer learning curve and higher rate of conversions. (5,6,41) TAPP appeared to be superior in terms of learning curve, diagnosis of occult hernia and the feasibility for incarcerated or strangulated hernias while TEP can be performed under regional anesthesia. (5,6,41)

In terms of type of mesh used in hernia repair, the guidelines recommend "synthetic non-absorbable flat meshes (or composite meshes with a non-absorbable component)". (5) To avoid recurrences the mesh has to be at least 10 x 15 cm. (5,6,34) Usually the mesh used in TAPP is not cut; several authors reported "slit" mesh series, but no advantages to non-"slit" mesh were noted. (43) For better postoperative outcomes (especially regarding chronic pain and numbness) the use of light weight meshes is advisable. (5,6,44)

Mesh fixation procedure is also a controversial subject. The non-stapled mesh technique usually performed in TEP is less used in TAPP due to a theoretical risk of mesh up-rolling. However, the recurrence rate is similar for stapled and non-stapled mesh both in TEP and in TAPP. (6,45) The stapled fixation has a higher rate of acute and chronic postoperative pain. (6,45) The risk of postoperative pain is decreased using less than 10 staples and absorbable staples. (6) An alternative to traditional stapled technique is fibrin glue fixation, which appeared to have a similar efficiency and less pain compared to the stapled technique. (6)

Conclusions

TAPP is a feasible method for the treatment of groin hernia associated with low rate of postoperative morbidity and recurrence. The anatomic landmarks are easily recognizable. The laparoscopic exploration allows for the treatment of incarcerated / strangulated hernias and the intraoperative diagnosis of occult hernias.

Conflict of interests

None to declare.

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