

REVIEW

TEP, STEP BY STEP

Samir Delibegovic^{1,2}

Received: 30 November 2022; Accepted: 15 February 2023

ABSTRACT

TEP is endoscopic surgery, recommended by many associations as the method of choice in the treatment of primary unilateral inguinal hernias. However, due to the limitations of space, and the complexity of the anatomy of the posterior wall of the inguinal region, it involves a somewhat steeper learning curve. Some steps in the surgical procedure are not simple, therefore we would like to point out and explain the more difficult aspects of dissection during a TEP, and facilitate the acceptance of this excellent technique in the repair of inguinal hernias.

Keywords: inguinal hernia, laparoscopic total extraperitoneal, mesh repair

¹ Clinic for Surgery, University Clinical Center Tuzla, Bosnia and Herzegovina

² Faculty of Medicine, University of Tuzla, Tuzla, Bosnia and Herzegovina.

Samir Delibegovic

Email: sam.delibey@gmail.com

ORCID 0000-0003-0525-3288

Introduction

TEP, or the total extraperitoneal laparoscopic technique for repair of hernias, is an endoscopic technique that follows the principles of the Stoppa technique, which consists of strengthening the abdominal wall using a mesh within the preperitoneal space, in order to completely cover the entire myopectineal orifice¹.

In order to perform TEP we have to understand the anatomy of the myopectineal orifice.

The Anatomy of the Myopectineal Orifice

The concept of a critical view of the myopectineal orifice has been introduced to help us better understand the anatomy of the posterior inguinal wall². We can define it as the appropriate exposure of the anatomical area which must be undertaken before placing the mesh itself.

The Y concept and the 5-triangle concept (Figure 1) serve as guides for safe laparoscopic and robotic repair of inguinal hernias³.

Therefore, it is very important to visualize the lower epigastric vessels, which are located vertically in the field of vision (they help a beginner in orientation using the top to bottom line), and the Y concept indicates the position of the vas deferens and the spermatic vessels. The epigastric blood vessels divide the parts of the lateral and medial inguinal fossa, the place where direct and indirect hernias occur. Beneath the iliopubic tract is the site where femoral hernias occur, and the doom triangle, which we must always be wary of.

It is very helpful to divide the operating field into 3 zones (Figure 2). Zone 1 corresponds to the area from the lateral to the deep inguinal ring and the spermatic vessels, Zone 2 is from the medial line to the lower epigastric vessels, and Zone 3 is the operating field that requires particular care, because it includes the lower epigastric vessels, the deep inguinal ring and the spermatic elements, and the external iliac blood vessels⁴.

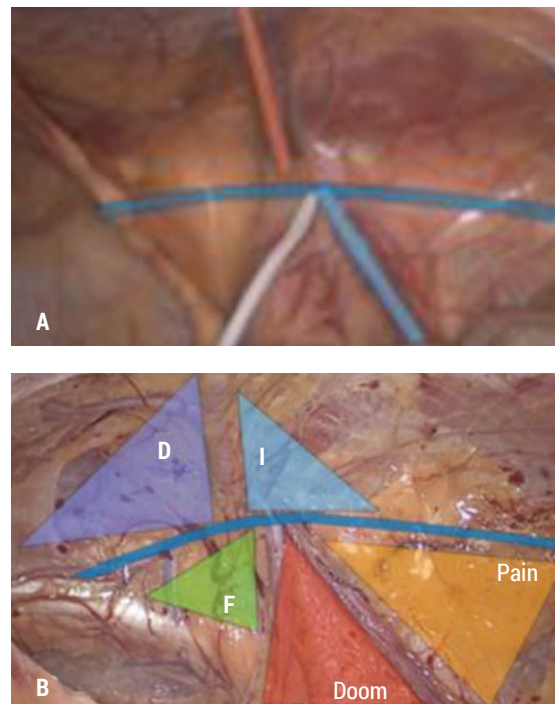


Figure 1: A. Inverted Y: inferior epigastric vessels (red—superiorly), vas deferens (white—medially), and spermatic vessels laterally (blue—laterally); B. Iliopubic tract (represented in dark blue) that passes horizontally through the deep inguinal ring at the center of the inverted Y and enables visualization of five areas in the MPO known as the “Five Triangles” (Right groin).

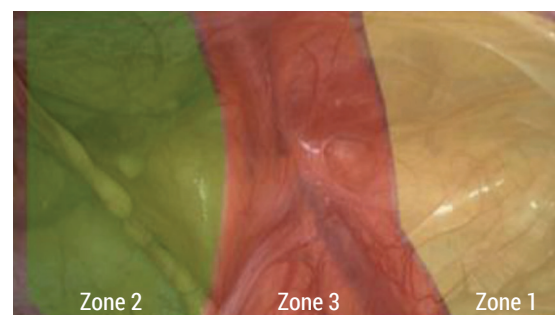


Figure 2: Three zones of dissection of the pre-peritoneal space following the tactical proposal for standardization of MIS techniques (Right groin).

In TEP dissection, Zone 2 is created either by the trocar balloon or by blunt dissection using a telescope, and this is followed by dissection Zone 1. Dissection Zone 3 or the central zone is created

last because it is the most important and the most difficult part of the surgical procedure.

After dissection of these three zones we are able to visualize the elements of the myopectineal orifice.

We define the 9 vital steps to establish a CV of the MPO as follows⁵:

1. Across the midline and Cooper ligament (CL), visualize and dissect the pubic tubercle. If the hernia is large and direct, the dissection should be right up to the contralateral CL.
2. Ensure it is not a case of a direct hernia. In order to notice a direct hernia before dissection, consider the anatomy. If there is any excess fat in the Hasselbach triangle, remove it.
3. In order to avoid mesh displacement when the bladder distends, dissect no less than 2 cm between the CL and the bladder to ease insertion of the medial and inferior edges of the mesh towards the space of Retzius
4. In order to identify the femoral orifice and ensure there is no femoral hernia, dissect between the CL and the iliac vein.
5. To parietalize the elements of the cord, dissect the indirect sac and the peritoneum. To avoid missing any tail on the sac, note the psoas muscle and iliac vessels, lift the sac and peritoneum, but avoid moving the elements of the cord and dissect between them.
6. Visualize and reduce cord lipomas. In most cases it is not necessary to remove lipomas, but they should be moved above the mesh to stop them moving upward.
7. The peritoneum should then be dissected laterally, along the elements of the cord, beyond the ASIS (the anterosuperior iliac spine), moving it back inferiorly, a good distance from the inferior edge of the mesh.
8. The dissection should now be performed, the mesh placed as cover, and then it is necessary to make sure the mesh and its fixation are well above

the imaginary inter-ASIS line and any defects that may be present, to prevent recurrence and injury to the nerves, especially the ilioinguinal nerve.

9. The mesh should not be placed until all these procedures are complete and hemostasis is confirmed. The mesh should be no less than 15 x 10 cm, but occasionally it is necessary to use a larger mesh in order to cover the MPO. Ensure there are no folds or creases. Make sure the lateroinferior corner is inserted deep on the wall, and that it will not roll up when the space is deflated.

Implementing the CV of the MPO concept through education and training will standardize MIS inguinal hernia repair and facilitate teaching of this excellent technique.

Indications

The open Lichtenstein and endoscopic technique are recommended in the European Hernia Society (EHS) guidelines as the option with the best evidence for repair of a primary unilateral inguinal hernias, providing the surgeon is sufficiently experienced in the specific procedure, but also by American Hernia Society, and the Society of American Gastro-intestinal and Endoscopic Surgeons SAGES⁶⁻⁸.

TEP is the method of choice in women, since they have a greater risk of recurrence than men after open surgery for inguinal hernias, due to the greater incidence of femoral hernias.

For experienced surgeons, the endoscopic technique can also be used for incarcerated hernias in the absence of contamination of the surgical field. Diagnostic laparoscopy at the beginning of the procedure enables examination and an attempt to reduce the hernia content under visual control¹. In fact, after a period of reperfusion, it is possible to repeat exploration of the compromised intestine, which may reduce the need to resect the bowel.

TEP is probably the most cost-effective method for employed patients, especially for bilateral hernia⁹. Moreover, for recurrent hernias after conventional

open procedures, the endoscopic technique results in less post-operative pain and faster recovery than the Lichtenstein technique¹⁰.

TEP completely avoids entry into the abdomen, which can be an advantage in patients who have undergone previous surgery. TEP also avoids the problem of peritoneal closure and problems related to closure. TEP can also be performed without using electrocauterization, which leads to less post-operative pain. Using TEP it is possible to explore the possible existence of femoral, obturator and direct hernias, which are difficult to recognize by viewing from the peritoneal side¹¹.

However, the TEP technique is more difficult to learn because of the limited working space, differences in anatomical characteristics (we can say that it is difficult because of the failure to emphasize when teaching anatomy, the anatomical landmarks which are important for performing this procedure).

The learning curve related to this surgery is 50-65 operations¹²⁻¹⁴, but we are sure that a young surgeon who performs standard laparoscopic appendectomy and cholecystectomy will have a shorter learning curve than that given in the literature.

Contraindications

The contraindications are: previous surgery in the lower right or left quadrant, prostatectomy, classical appendectomy, surgical procedures that prevent the creation of a preperitoneal space due to the rupture of the peritoneum itself, and large irreducible scrotal hernias^{1,11}.

The technique

Patient Position and Room Set Up

The patient is on their back in the Trendelburg position, which enables the bowels to move away from the pelvis, and the surgeon stands on the opposite side to the hernia. It is necessary to insert a Foley catheter in order to liberate the preperitoneal space (alternatively the patient can empty their bladder

immediately before the procedure). The monitor stands at the foot of the operating table.

Surgical Steps

1. Create an incision in the skin immediately below the umbilicus. After cutting the skin and the subcutaneous tissue by electrocautery, we reach the anterior sheath of the rectus muscle. After opening the sheath on the same side as the hernia, by pulling the rectus laterally we reach the posterior sheath of the rectus muscle (Figure 3).

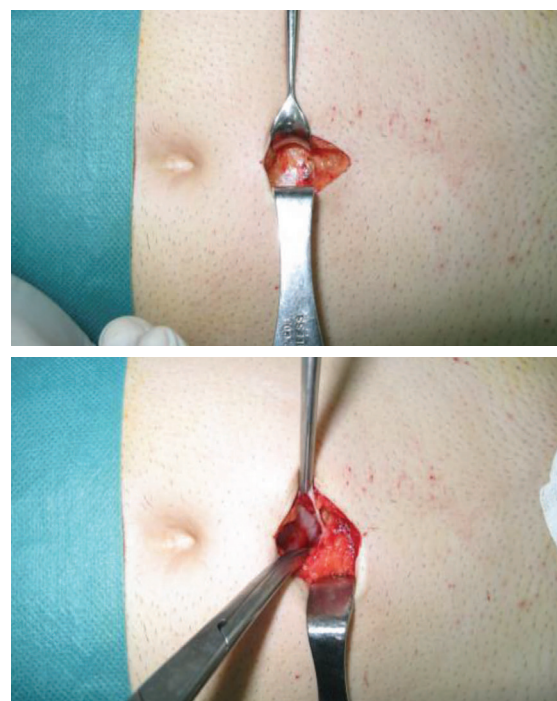


Figure 3: A. Incision in the skin immediately below the umbilicus. B. After opening the sheath of the rectus muscle on the same side as the hernia, by pulling the rectus laterally we reach the posterior sheath of the rectus muscle.

In the posterior of the sheath we can place a swab, a finger or a pean clamp, and gently move towards the symphysis.

2. We then insert the dilation balloon in the space towards the symphysis, and inflate the dilator moderately, monitoring the inflation or widening of the inguinal space (Figure 4). We must not inflate the space excessively because this may cause the rupture of the peritoneum, which would prevent us from creating a working space and performing the TEP procedure.



Figure 4: The dilation balloon.

Creation of this space may also be achieved using the camera alone, without the balloon dilation, that is, under direct control. We make a blunt dissection of the retromuscular space up to the pubic symphysis.

Mistakes in preparation and presentation of the posterior rectus sheath lead to the opening of the peritoneum and entry into the peritoneal cavity (Figure 5).



Figure 5: Opening the peritoneum.

3. After preparation of the working area with balloon dilation, we place a 12 mm trocar with a cuff. It is better to use a trocar with a cuff, but in countries with limited resources, we can use a standard 12 mm trocar, and close the incision using sutures.
4. We begin insufflation with CO₂ up to 12 mmHg pressure. As we have said, the patient is in the Trendelburg position. It is better to use a 10 mm camera at an angle of 30°. We enter the space we have created with the camera. We must not be afraid of unfamiliar images, but gently, using the camera, break up any growths we may see (Figure 6).

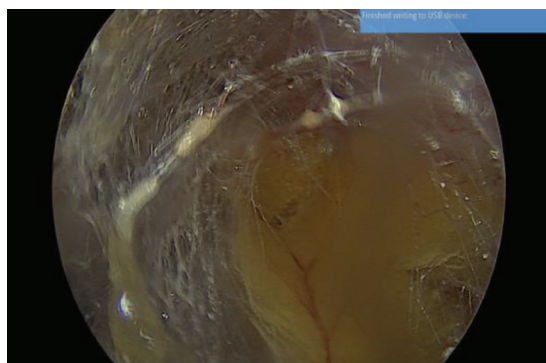


Figure 6: Entering the space we have created using a dilatation balloon.

5. We then place two additional trocars in the central line under direct vision: one 5 mm trocar above the symphysis, and the other in the middle between that one and the camera (Figure 7). During this step and the further dissection, care should be taken not to damage the epigastric vessels.



Figure 7: Positions of the trocars.

Alternative Trocar Positions

The first trocar is made just below the navel on the contralateral side of the hernia (then a 10 mm trocar is inserted bluntly), a second reusable 5 mm trocar is inserted under direct vision about three finger widths directly below the first trocar. The 3rd trocar, also 5 mm and reusable, should ideally be inserted at the level of the navel, cranially and medially to the anterior superior iliac spine).

Instrumentation

All dissections are performed through the 5 mm trocar, 30° camera.

6. Dissection to Bogros' Space. In order to find the right plane, it may be necessary to cut through some of the fibers of the arcuate line of Douglas. The correct plane for preperitoneal dissection is easy to find thanks to the appearance of the so-called "angel hair". Dissection is performed immediately laterally and as close as possible to the anterior abdominal wall, between the hernia sac below and the epigastric vessels above. Also laterally, it is very important to remain in this plane. Dissection continues bluntly towards the lateral abdominal wall and the anterior superior iliac spine. This may be confirmed by lateral transillumination. Remain in this plane and do not dissect the lateral abdominal wall itself. Dissect all growths as close as possible to the navel and move them laterally. The purpose here is to remove the peritoneum from the posterior rectal sheath sufficiently to leave enough space for the upper edge of the mesh. Finally we have a view of the anatomy of the extraperitoneal space (Figure 8).

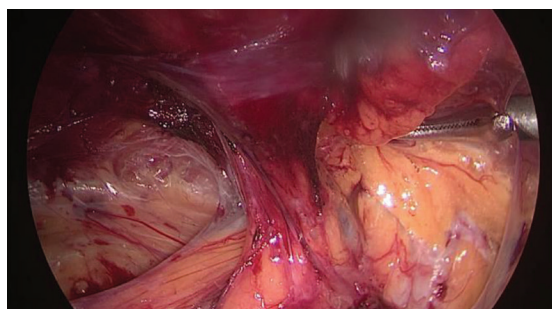


Figure 8: View of the posterior abdominal wall after creation of the space.

7. We perform an inspection of the inguinal space, identify the medial umbilical ligament (the remnant of the urachus), the medial umbilical ligament (the remainder of the umbilical artery) and the epigastric inferior artery, which is the most important marker. We use it for orientation up and down, where it must be vertical on the monitor image.

The epigastric artery divides the medial inguinal fossa, the site where direct hernias occur, and the lateral inguinalis lateralis, the site where indirect hernias occur (Figure 9).

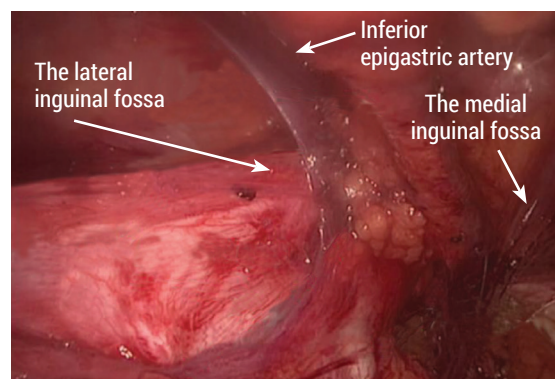


Figure 9: The epigastric artery with the sites of formation direct and indirect hernias.

After this, we prepare the structures of the funiculus and separate the indirect hernia sac (Figure 10).

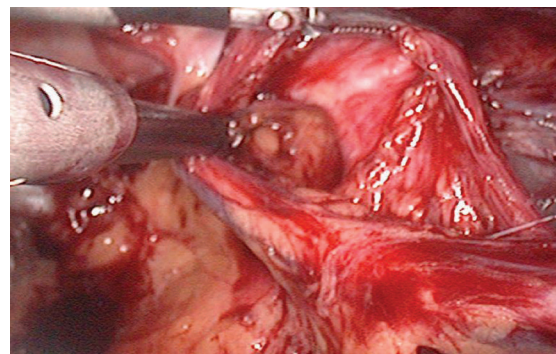


Figure 10: An indirect hernia sac separated from the structures of the funiculus.

We can dissect the herniated sac in congenital or large inguinal-scrotal hernias. The proximal end is ligated, separated from the funiculus and dissected, and then pulled back (Figure 11).

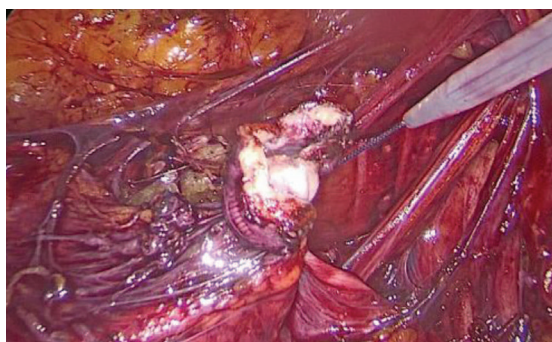


Figure 11: Proximal end of a hernia sac.

We find direct hernias medially to the epigastric blood vessels. In the case of direct hernias, very often the mere creation of extraperitoneal space leads to resolution of a direct hernia. If a direct hernia is present, we withdraw the preperitoneal fatty tissue and separate it from the accentuated fascia of the direct space.

8. A large mesh is placed 10 cm craniocaudally and 15 cm mediolaterally, in order to conceal the myopectineal orifice (Figure 12). Direct, indirect and femoral triangle should cover with an overlap of at least 3 to 4 cm.

The mesh should reach the pubic symphysis medially and the anterior-superior iliac spine (ASIS) and m. iliopsoas laterally. In a direct hernia, it is desirable for 1 to 2 cm of mesh to pass over to the contralateral side to achieve a minimum of 3 cm of medial overhang from the direct defect. Inferiorly, it must reach 1 to 2 cm below the pubis and superiorly cover 3 to 4 cm of the anterior abdominal wall in relation to the deep inguinal ring.

The surgeon must ensure that the peritoneum has not been left behind the mesh, in order to avoid it folding and/rolling up during evacuation of the gas. A medial mesh should be placed between the pubic bone and the urinary bladder in the Retzius space, laterally to the iliopsoas. The mesh must be placed without puckering or overlap.

It is possible to fix the mesh in several ways, but in most hernias, fixation is not needed.

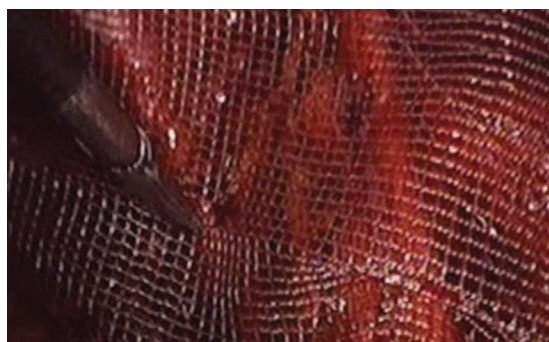


Figure 12: The mesh placed in the extraperitoneal space.

Fixation of the mesh is only recommended in large, and especially direct hernias. If we decide on fixation using a stapler, tacks or sutures, the recommendations are:

- Avoid the bone structures, placement of tacks must be above the pubic bone, in the Cooper's ligament, avoiding the risk of chronic osteitis.
- Take care of the inferior epigastric vessels.
- Fixation should avoid the space below the ilio-pubic tract and potential injuries to the triangle of doom.
- Five or six points are sufficient for efficient fixation of the mesh.
- Bimanual palpation of the abdominal wall is useful while we fix the mesh.

It is important to underline that fixation of the mesh with tacks, sutures, glue, or if we use self-fixing mesh, does not protect us from the problems of unsuitable dissection or incorrect placement of the mesh.

Conversion

The reasons for conversion may be laceration of the peritoneum, or vascular incidents. In smaller lacerations of the peritoneum, it is possible to place a Veress needle in Palmer's point, which maintains the creation of the preperitoneal space. Individually, small lacerations can be closed using a stapler or sutures.

Conversion of TEP may be into a TAPP, Stoppa or Lichtenstein procedure, depending on the surgeon's preference.

Learning Curve

Since the working space in the TEP procedure is limited, it requires a higher level of skill in manipulating the instruments for tissue dissection. Although the data on the TEP learning curve are limited, the guidelines suggest that the range is between 50-65 operations²⁻¹⁴.

The careful choice of patients is the first key step in mastering the learning curve¹⁵. The rate of complications and speed of learning the TEP technique can be improved by setting good patient selection criteria¹⁴.

Use of the TEP in all patients is not a good strategy for surgeons who are still in the process of learning. We need to follow the relative contraindications for TEP, which are as follows: previous TEP herniorrhaphy, a massive scrotal hernia, previous pelvic surgery, and incarcerated inguinal hernia.

Moreover, it has been shown that a patient with a BMI above 25kg/m² is a factor which may lead to technical difficulties during the learning period¹⁶. Therefore, we recommend the careful choice of patients in order to facilitate the introduction of beginners to the TEP procedure. Beginner surgeons build their experience by observing and imitating operations performed by an experienced surgeon.

Complications

As in any laparoscopic procedure, any of the complications of laparoscopy may occur, such as injury to the major blood vessels or hollow organs, or complications related to anesthesia.

Vascular Injuries

Cause and Prevention

Injuries to the inferior epigastric arteries are mentioned in the literature, but they are very rare¹⁷. Anatomical variations or confusion when creating the preperitoneal

space, in combination with a lack of experience, especially if the patient has had previous surgery in the lower quadrant, can lead to these lesions. Ligation with a 5 mm stapler will stop the bleeding.

Injury to the iliac blood vessels are possible for the same reasons. They must be repaired, which is best done in an open procedure due to the limited working space.

Recognition and Management

Bleeding is easily recognized during the surgical procedure. Delayed bleeding is manifested in the signs of haemorrhagic shock.

Urinary Complications

Cause and Prevention

Urinal retention, infection and hematuria are mentioned most often, along with injuries to the urinal bladder. They are usually the result of extensive preperitoneal dissection. Bladder injuries are most likely to occur during port placement, or when dissecting a large direct hernial sac¹⁸.

This is why previous surgeries in this area, especially prostate surgery, are considered to be relative contraindications.

Recognition and Management

Urinary catheterization and antibiotic therapy resolve the problems related to retention or infection. If any injury to the urinary bladder has occurred during the surgery, repair of the bladder is vital, whether by laparoscopy or an open method.

Pain in the lower quadrant of the abdomen, a distended bladder visible on ultrasound, dysuria, and hematuria need investigating. Placing a catheter alone may be sufficient in cases of retroperitoneal injuries to the bladder, but intraperitoneal injuries are best sutured by laparoscopy or laparotomy.

Nerve Injuries

Cause and Prevention

The femoral branches of the genitofemoral nerve and the lateral cutaneous nerve are at risk of injury, most often due to poor assessment of the anatomy of the

posterior aspect. The causes for this are difficulties in visualization of the nerves preperitoneally, variations in the course of the nerves in this region, and extensive preperitoneal dissection.

Recognition and Management

Symptoms of pain and numbness usually develop over a certain period after the surgery. In most cases, non-steroid anti-inflammatory drugs are sufficient. The need for re-exploration and removal of staplers is rare.

Testicular Complications and Damage to the Vas Deferens

Cause and prevention

Most of these complications are transitory and include pain in the testes, swelling, orchitis and epididymitis. Pain in the testes may be caused by trauma to the gentiofemoral nerve, or sympathetic innervation during dissection around the funiculus or during the separation of the hernial sac from the structure of the funiculus. A swollen testis may be due to ischemia, or interruption of the lymphatic blood vessels or veins during removal of a large indirect hernia sac.

Very rarely, in the case of large inguinal-scrotal hernias, a transient pneumoscrotum may occur.

Recognition and Management

Most of these cases can be treated with analgetics, and by limiting activity. If the vas preferens has been dissected, repair using individual 4/0 sutures is recommended.

Mesh-Related Complications

Cause and Prevention

Migration and infection of the mesh

Fixation of the mesh prevents its migration.

Recognition and Management

Complications occur weeks or years after the surgery in the form of abscesses or fistulas. They rarely

respond to conservative treatment and require an open approach.

Mesh infections are a very rare but serious complication of TEP. The source of infection is direct or indirect contamination of the wound. Most of the causes of mesh infection after laparoscopic surgery are inadequate sterilization techniques.

In rare cases, the patient has a fever, temperature, local sensitivity, redness and a swelling. Later symptoms may be chronic, recurrent or completely absent, and signs of sepsis.

Treatment of the infection include administration of antibiotics, local dressing of the wound and drainage. In deep infections, antibiotic therapy is indicated, in combination with percutaneous or open drainage. However, in a severe infection with limited penetration of medication into the infected regions, removal of flesh and extensive toilet of the infected region is the only option. This should be undertaken as soon as possible.

Hernia Recurrence

Cause and Prevention

Careful complete dissection of the preperitoneal space, including placement of a large mesh that covers the entire myopectineal space completely, without cutting or puckering of the mesh, is the best way to prevent recurrence. The causes are many and various: incomplete dissection, too small mesh, incomplete coverage of all defects, migration of the mesh, puckering or invagination of the mesh into the defect, and a hematoma causing the mesh to shift (Table 1).

Table 1. The causes of hernia recurrence

1	Incomplete dissection Inadequate identification of anatomical elements. The mesh curves instead of lying flat.
2	The mesh is too small Incomplete coverage of all defects
3	Bending or invagination of the mesh into the defect
4	Displacement of the mesh by a hematoma

Recognition and Management

Recurrence is noticed by the patient and doctors as a swelling in the groin. Repeat laparoscopic repair is indicated if the surgeon has sufficient experience to perform it, or otherwise conventional surgery should be performed.

Rare Complications

Pelvic osteitis pubis

Pelvic osteitis pubis is caused by placing tucks on a bone. Placing a tuck on the anterior and superior part of Cooper's ligament, or not fixing the mesh, prevents these complications. It presents as persistent pain above the pubic bone, and is treated with anti-inflammatory medication.

Seromas and hematomas occur in the groin due to extensive dissection or inadequate hemostasis. Wound infections are very rare complications.

Recognition and Management

Osteitis is difficult to diagnose and is usually concluded on the basis of exclusion. Anti-inflammatory medication and analgesics may be useful. Seromas and hematomas can imitate hernia recurrence because they palpitate as hard, non-reducible protrusions. Upon examination, they are found to be fluid and not a recurrence. Evacuation or aspiration is required. Wound infection needs a great deal of drainage, but it may be necessary to remove the mesh if the infection spreads to the groin.

In the case of an irreducible swelling in the groin in the early post-operative period, a recurrent incarcerated hernia will probably be excluded by taking a history and a physical examination; ultrasound may be useful to differentiate this from a post-operative seroma or hematoma. In the case of a swelling in the groin which is reducible, the difference is less clear, since a seroma can also "shrink". In these cases we prefer a conservative attitude in the first weeks.

Subcutaneous Emphysema

Subcutaneous emphysema, pneumomediastinum and pneumothorax are extremely rare complications

of TEP repairs and are most often related to an unintentional pneumo-peritoneum. There are some reports of this complication after TEP without rupture of the peritoneum. The cause in these cases may be excess pressure.

An increased risk of this complication is related to an extended period of extraperitoneal insufflation, which is often defined as longer than 2 hours. Moreover, it is supposed that increased insufflation pressure leads to more extensive fascial CO₂ dissection. Some surgeons advocate pressure <15 mmHg in order to reduce this complication to the minimum¹⁹, whilst other suggest using <10 mmHg²⁰. However, the limited data available leave these recommended parameters completely unclear.

Most cases of pneumomediastinum and pneumothorax after TEP repair of an inguinal hernia are treated conservatively with additional oxygen and observation. However, in view of the potential of significant morbidity, this is an important complication which surgeons and anesthesiologists should recognize. Minimizing the time of insufflation and pressure should reduce the risk of these complications, however specific limits remain unclear.

A high level of clinical suspicion is necessary and should be immediately followed by monitoring by chest auscultation, palpation for subcutaneous emphysema, and observation for signs of respiratory distress. The increasingly frequent use of laparoscopic procedures for inguinal hernias will probably lead to the increased frequency of these complications. As it is, further research is needed in order to describe the risk factors for these complications.

Postoperative Care

In order to reduce the risk of the occurrence of post-operative seromas and hematomas in the scrotum, we ask patients to wear slim fit underwear for a week.

The patient is free to continue their activities, doing whatever they feel they are able to do. It is probably

sufficient to limit lifting heavy weights for 2-3 weeks. It is necessary to encourage them to return to work quickly (2-4 weeks after the operation, depending on their physical activity). This will require a change in attitude by surgeons, general practitioners and patients, but may result in significant savings in health care expenditure.

Conclusion

In order to provide surgery adjusted to each patient, we believe that all surgeons who are qualified for general surgery not only should have a deeper knowledge of the anterior and posterior (preperitoneal) anatomy, but they must also be acquainted with the technical aspects of the anterior approach (Lichtenstein method) and the posterior approach.

TEP surgical correction of inguinal hernias is the method of choice for unilateral or bilateral inguinal hernia surgery. The use of endoscopic hernia techniques for primary hernias makes it possible for surgical trainees to have greater access to patients, in addition to the advantages given above, under the condition that the training conditions are optimal. Only then will surgeons be sufficiently well trained to perform laparoscopy in cases of recurrent and bilateral hernias.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

References

1. Miserez MJ. Totally extraperitoneal endoscopic inguinal hernia repair. In: H. Jaap Bonjer (ed.) *Surgical Principles of Minimally Invasive Procedures*. Springer International Publishing Switzerland. 2017. P. 91-117.
2. Daes J, Felix E. Critical view of the myopectineal orifice. *Ann Surg*. 2017;266:e1-e2. <https://doi.org/10.1097/SLA.00000000000002104>
3. Furtado M, Claus CMP, Cavazzola LT, Malcher F, Bakonyi-Neto A, Saad-Hossne R. Systemization of laparoscopic inguinal hernia repair (TAPP) based on a new anatomical concept: inverted y and five triangles. *Arq Bras Cir Dig*. 2019;32:e1426. <https://doi.org/10.1590/0102-672020180001e1426>
4. Claus C, Furtado M, Malcher F, Cavazzola LE, Felix E. Ten golden rules for a safe MIS inguinal hernia repair using a new anatomical concept as a guide. *Surgical Endoscopy*. 2020;34:1458-1464. <https://doi.org/10.1007/s00464-020-07449-z>
5. Daes J, Felix E. Critical view of myopectineal orifice. *Ann Surg*. 2017;266:e1-e2.
6. Miserez M, Peeters E, Aufenacker T, Bouillot JL, Campanelli G, Conze J, et al. Update with level 1 studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2014;18:151-163.
7. Hernia Surge Group. International guidelines for groin hernia management. *Hernia*. 2018;22:1-165.
8. Bittner R, Arregui ME, Bisgaard T, Dudai M, Ferzli GS, Fitzgibbons RJ, et al. Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia [International Endohernia Society (IEHS)]. *Surg Endosc*. 2011;25:2773-2843.
9. Gholghesaei M, Langeveld HR, Veldkamp R, Bonjer HJ. Costs and quality of life after endoscopic repair of inguinal hernia vs open tension-free repair: a review. *Surg Endosc*. 2005;19:816-21.
10. Bittner R, Montgomery MA, Arregui E, Bansal V, Bingener J, Bisgaard T, et al. Update of guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endohernia Society). *Surg Endosc*. 2015;29:289-321.
11. Ferzli G, Iskandar M. Laparoscopic totally extra-peritoneal (TEP) inguinal hernia repair. *Ann Laparosc Endosc Surg*. 2019;4:35.

12. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J et al. European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2009;13:343-403.
13. Choi YY, Kim Z, Hur KY. Learning curve for laparoscopic totally extraperitoneal repair of inguinal hernia. *Can J Surg*. 2012;55:33-36.
14. Suguita FY, Essu FF, Oliveira LT, Iuamoto LR, Kato JM, Torsani MB, et al. Learning curve takes 65 repetitions of totally extraperitoneal laparoscopy on inguinal hernias for reduction of operating time and complications. *Surg Endosc*. 2017;3:3939e3945.
15. Kim DW, Park Y. First experience of junior surgeon with laparoscopic totally extraperitoneal herniorrhaphy: Comparison with experienced surgeon in single institution. *Asian Journal of Surgery*. 2022;45:844e848.
16. Park BS, Ryu DY, Son GM, Cho YH. Factors influencing on difficulty with laparo-scopic total extraperitoneal repair according to learning period. *Ann Surg Treat Res*. 2014;87:203e208.
17. The SAGES manual. Springer.1993.
18. Alam N, Sheen AJ. Total extraperitoneal hernia repair and its associated pitfalls. *Mini/invasive Surg*. 2021;5:48.
19. Harkin CP, Sommerhaug EW, Mayer KL. An unexpected complication during laparoscopic herniorrhaphy. *Anesth Analg*. 1999;89: 1576-8.
20. Ferzli GS, Kiel T, Hurwitz JB, Davidson P, Piperno B, Fiorillo MA, et al. Pneumothorax as a complication of laparoscopic inguinal hernia repair. *Surg Endosc*. 1997;11:152-3.