



# Technical points of the laparoscopic transabdominal preperitoneal (TAPP) approach in inguinal hernia repair

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**Abstract:** Laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair is one of the most commonly used approaches in the treatment of hernia. However, the techniques were usually mastered improperly. This manuscript is to improve surgical skills by concluding the techniques and complications of TAPP.

**Keywords:** Transabdominal preperitoneal (TAPP); inguinal hernia

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Currently, the primary methods of inguinal hernia treatment used internationally include open tissue or mesh repair, a total extraperitoneal (TEP) approach, and a transabdominal preperitoneal (TAPP) approach. Among these approaches, the TAPP approach is widely used for inguinal hernia repair. The evaluation and preparation of patients and improvement of the surgical technique are important for preventing postoperative complications after TAPP surgery. The Hernia Center of Fudan University was established in 2008, with over 1,000 cases of inguinal hernia surgeries each year. Therefore, we have extensive experience in the diagnosis and treatment of inguinal hernias. Here, we discuss the technical points of TAPP surgery according to the international TAPP surgery guidelines and our years of surgical experience in this center.

## Surgical indications

All patients with inguinal hernias can be treated with TAPP surgery. Additionally, in the treatment of bilateral hernias and recurrent hernias after previous anterior approach and in patients who require another concurrent laparoscopic surgery, TAPP should be considered as the first option for hernia repair.

Before surgery, the general condition of the patient should be evaluated. The following should be assessed:

(I) the ability to tolerate general anesthesia; (II) the presence of an empty bladder; (III) absolute contraindications, such as peritoneal infection and peritonitis; (IV) relative contraindications, such as clotting disorders, ascites, and history of surgery in the pubic posterior region. Preoperative evaluation is the foundation of a successful surgery, and errors in evaluation can cause difficulties during and after surgery. Hence, attention should be paid to evaluation and preparation before surgery.

## Anesthesia method

TAPP surgery is generally carried out under general anesthesia. Patients with poor lung function, who can undergo gasless laparoscopic surgery, can be administered spinal anesthesia or epidural anesthesia before gasless laparoscopic surgery.

## Location of the patient and surgeons

The Trendelenburg position is generally used (head positioned low and legs positioned high) for surgery in order to reduce the influence of abdominal organs on the surgical procedure. The chief surgeon stands on the contralateral side of the hernia, while the assistant surgeon stands on the homolateral side. The screen is placed at the

feet of the patient.

### Position and placement of the puncture device

A 10-mm incision is made along the umbilical striae, and a 10-mm puncture cannula is inserted to allow the laparoscope to enter the abdominal cavity for exploration. This allows examination of the presence of any damage, intra-abdominal adhesions, and abnormalities. Under direct view, two 5-mm incisions are made on two sides of the rectus abdominis muscle for the insertion of two 5-mm puncture cannulas. These three cannulas are inserted at an angle of 60° to facilitate manipulation.

### Surgical process

- (I) Abdominal exploration: this is performed to confirm the presence of an inguinal hernia (including evaluation of occult defects) and pathological changes in other organs, in order to evaluate potential factors for recurrence and infection, before deciding on whether to proceed with surgical repair;
- (II) Creation of a preperitoneal space: monopolar electrocoagulation is used to cut and open the peritoneum at the medial umbilical ligament, 3 cm above the hernia ring, and to enter the preperitoneal space, taking care to protect the inferior epigastric vessels. At this time, dissociation of the hernia sac should not be rushed. The space before the pubic bone and bladder (Retzius' space) is first separated by making it 3 cm above the incision, down to the pubic pectineal ligament and pubic tubercle, and outer to the inferior epigastric vessel, taking care not to damage the bladder below. Then, Bogros' space is separated below inferior epigastric vessels, laterally to the anterior superior iliac spine, with exposure of the iliopsoas muscle;
- (III) Reduction of the hernia sac: generally, direct hernias can be directly reduced, while indirect hernias require stripping of the hernia sac. During the excision of the hernia sac, care must be taken to protect the spermatic cord and vas deferens and to avoid damaging the iliac vessels, particularly the iliac vein. Generally, small hernia sacs can be reduced easily, while large hernia sacs can be transected depending on the actual condition,

taking care not to include the spermatic vessels during transection;

- (IV) Parietalization of the cord: this is the process of stripping of peritoneum from the spermatic cords. The range should be 6 cm below the internal ring. Female patients require stripping of the peritoneum from the round ligaments of the uterus, and currently, there is no evidence on whether dissected round ligaments of the uterus affect the functions of the reproductive system. When the peritoneum cannot be stripped from the round ligaments of the uterus, there is a need to dissect the round ligaments. Both direct and indirect hernias require this manipulation step. The previous method of hernia reduction that does not require parietalization of the cord and directly bypasses the spermatic cord by cutting the mesh is no longer recommended. The aim of parietalization of the cord is to establish a large enough space for the mesh to cover the entire myopectineal orifice in order to decrease the recurrence of inguinal hernias;
- (V) Placement of the mesh: after separation of a space of at least 15 cm × 10 cm for mesh placement, a mesh measuring 15 cm × 12 cm is generally used for hernia repair, and the size of the preperitoneal space is adjusted accordingly. Regardless of whether the hernia is a direct hernia, indirect hernia, or femoral hernia, the mesh should fully cover the myopectineal orifice and be medial to the pubic symphysis, with the lower end passing 2 cm through the pectineal ligament. At the same time, the mesh should be placed flat, without wrinkles or folds, and the reduced hernia sac should be placed above the mesh. For bilateral hernias, mesh repair should be carried out using two meshes that intersect and overlay at the pubic front line;
- (VI) Fixation of the mesh: normally, the mesh does not require fixation. However, in the case of a direct hernia or large indirect hernia, it is recommended to use staples and glue to fix the mesh on Cooper's ligament in order to effectively reduce the risk of recurrence. However, this will increase the risk of postoperative pain, damage to the corona mortis, and bleeding, requiring a balance between the benefits and risks. The covering of direct hernias can be purse-string sutured to ensure better adhesion of the mesh and the abdominal wall,

which will help reduce recurrence;

- (VII) Re-approximation of the peritoneum: this can be carried out using sutures, staples, glue, and other such materials. Currently, the suturing method is the most cost-effective and reliable approach, and continuous suturing can be performed. In the suturing methods, length between two suturing should not be too large, and examinations should be performed after sealing to ensure that sealing is complete, in order to avoid intestinal adhesion or intestinal obstruction due to a large peritoneal opening that can cause intestinal embedding. Before removal of pneumoperitoneum, an aspirator can be used to remove the gases inside the hernia sac under direct view, in order to reduce the incidence of early relapse due to scrotal emphysema that can cause the mesh to shift out of place.

### Post-operative complications and management

- (I) Bleeding and hematomas: to prevent bleeding and hematomas, it is important to ensure a good laparoscopic manipulation technique, familiarity with anatomical landmarks of the inguinal area, a correct surgical layer, and reasonable and careful use of the electrosurgical unit. Most instances of bleeding are associated with an incorrect surgical layer or rough manipulation, while few cases show delayed bleeding from damaged blood vessels that can normally self-resolve. The current guidelines do not recommend the use of a hemostatic after surgery, and careful evaluation of the risk of bleeding in patients is required before deciding on the use of such a treatment. Generally, postoperative bleeding is not accompanied by pain and is commonly self-limiting. Hence, only few cases require drainage. However, if there is a large amount of bleeding or a large hematoma, puncture can be performed for drainage or re-operation can be performed for investigation, hemostasis, and drainage;
- (II) Scrotal emphysema: this is caused by the removal of pneumoperitoneum without expelling the gas inside the hernia sac before sealing the peritoneum. Hence, before the end of surgery, it is necessary to examine the condition of the scrotum and promptly expel the gas inside;
- (III) Seroma: it presents as masses that cannot be

reduced into the original hernia sac. It is caused by fluid accumulation in the original hernia sac associated with surgical trauma or stimulation by the mesh. A report of 3,017 cases showed that the incidence of postoperative seroma and hematoma was 8% (1). Most seromas are self-limiting; however, some patients require puncture and aspiration, and the seromas disappear after successful aspiration;

- (IV) Pain: this is one of the most common postoperative complications of inguinal hernia repair. The incidence of pain is higher than the recurrence rate, and the effects of pain may be more problematic than recurrence (2). The short-term incidence of pain is greater than the long-term incidence. The causes of pain include staple fixation of the mesh, heat damage, and stimulation by the mesh. Nevertheless, the incidence of pain is lower after TAPP surgery than after open hernia repair surgeries, such as the Lichtenstein, Ultrapro Plug, and modified Kugel approaches (3,4). Short-term pain can be treated during follow-up visits, and pain self-resolves in some patients. Medium to long-term pain requires appropriate treatment according to the cause, and treatments, such as the use of physiotherapy, use of analgesics, neurolysis, and resection, are available. Avoiding mesh fixation at the “triangle of pain,” using staples for fixation, using glue for fixation, and using self-fixation meshes can help reduce the incidence of postoperative chronic and acute pain. It was encouraged to give up fixation in repair of hernia with a defect size less than 4.0 cm in diameter (5);
- (V) Urinary retention: because of the effects of anesthesia and manipulation of the preperitoneal space on urinary reflex, some patients experience difficulty in urination. Incidence of urinary retention was 36% in TAPP with spinal anesthesia (6) while it was much lower in surgeries with general anesthesia (7). Urinary catheters can be used according to the situation, and normally, these can be removed on the second day after surgery;
- (VI) Infection: this is generally the most challenging postoperative complication, as it can affect recovery. There was no difference in incidence of infection after surgery between TAPP (3/316) and open approaches (7/300) (4). Mesh infection

mostly requires a re-operation to remove the infected mesh. If infection of the surgical site is not managed properly, it can cause mesh infection. Therefore, postoperative evaluation of infection status is important. However, there is a debate on whether prophylactic use of antibiotics can decrease the risk of infection. Studies have shown that prophylactic use of antibiotics in high-risk populations can significantly reduce the risk of infection (8);

- (VII) Intestinal obstruction and internal hernias: these are generally associated with incomplete sealing of the peritoneum, resulting in the intestinal segment protruding out from the defect causing incarcerated or internal hernias, which can result in obstruction. There was only 1 in 88 patients who suffered obstruction after surgery (9). Nevertheless, careful suturing of the peritoneum, keeping a reasonable length between two suturing, suturing of a peritoneal rupture, re-ensuring that the peritoneum is completely sealed before removal of surgical equipment, and other such measures are important for the prevention of intestinal obstruction. If intestinal obstruction is confirmed after surgery and cannot be resolved after treatment, prompt surgical investigation using an endoscope is necessary;
- (VIII) Injury: injury to the vas deferens normally occurs during stripping of the hernia sac and separation from the spermatic cord. Hence, during these manipulations, care must be taken to protect the vas deferens. Grasping of the vas deferens and blood vessels should be avoided, and the electro-surgical unit should be carefully used, especially in unmarried male patients. Injury to the abdominal organs and peritonitis is usually associated with inappropriate use of the electro-surgical unit. Hence, during the surgery, care is needed, and the electro-surgical unit should not be used outside the field of view in order to avoid accidentally damaging the bowels or blood vessels. Damage to the bladder mainly results from unfamiliarity with the anatomy of the preperitoneal space;
- (IX) Recurrence: the recurrence rate after TAPP surgery is around 0–13%. According to statistics, the recurrence rate of TAPP and open mesh repair did not show any significant differences. The main reasons for recurrence include the size of the mesh and the experience of the chief surgeon (10).

Therefore, using appropriately sized meshes and improving surgical techniques are important for preventing recurrence.

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