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# Management of Complications in Laparoscopic Inguinal Hernia Repair

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## ABSTRACT

Inguinal hernia requires surgery for treatment, and it is one of the most performed surgeries worldwide. Open, laparoscopic, and robotic techniques are widely performed all around the world and with different superiorities over each other. Despite the advancements in the laparoscopic and robotic techniques, open surgery still holds its place as the safe reference method. In many centers, minimal invasive techniques are applied as the standard care with their benefits of less postoperative pain, early discharge, and quicker return to work. There are two main alternative techniques in laparoscopy: transabdominal preperitoneal hernia repair (TAPP) and the totally extraperitoneal hernia repair (TEP), both with comparable advantages. However, despite all the advancements in minimal invasive surgery, adoption of laparoscopy in inguinal hernia repair has not been at the expected rate. We believe that for a wider adoption of laparoscopic technique, understanding of the posterior inguinal anatomy carries utmost importance, which is the origin point of all complications. In this literature review we investigate complications after laparoscopic inguinal hernia by dividing into early perioperative (bleeding, perforation of intestines, bladder injury, seroma, scrotal edema, urinary retention, wound infection, bowel obstruction, nerve injury, cardiovascular events) and late postoperative complications (chronic persistent pain, testicular complications, sexual dysfunction, mesh infection, mesh migration, recurrence). After listing common complications seen after laparoscopic inguinal hernia surgery with recent literature, we also aim to present the most effective management techniques suggested for those complications.

## KEYWORDS

Inguinal hernia; Laparoscopic; Robotic; Surgery; Management; Complications

## INTRODUCTION

Inguinal hernia can be a debilitating disease which ultimately requires surgery for treatment. It is one of the most performed surgeries worldwide estimated to be more than 20 million annually [1]. Currently repair techniques range from open surgery to laparoscopic and robotic repairs. All techniques have specific advantages and therefore reasons for preference.

Minimal invasive approaches provide less postoperative pain, better cosmetic outcome, quicker discharge from the hospital and return to work. The choice of optimum technique depends on the patient as well as the preference of the surgeon.

Open surgery is still the go-to classical technique for cases in which minimal invasive techniques cannot be used

either due to limitations from a complicated patient or limitations from environmental factors such as lack of equipment in the hospital or increased costs. Robotic surgery has been shown to be a safe and efficient technique, with minimal complications yet with a significantly longer operative time [2,3].

Opposite to the open surgery, in the laparoscopic technique the hernia defect is fixed by approaching the site from its posterior. In 1988, Ger et al. performed the first laparoscopic inguinal hernia repair via applying a patch to the defect [4]. Learning curve and increased costs compared to open surgery create a barrier for wider adoption of this technique [5]. There are two alternative techniques in laparoscopy: transabdominal preperitoneal hernia repair (TAPP) and the totally extraperitoneal hernia repair (TEP). Both require a well understanding of the groin anatomy and in both techniques the mesh is placed preperitoneal in a tension free fashion. However, TAPP requires entering the peritoneal cavity while TEP stays in the preperitoneal space developed between the anterior abdominal wall and peritoneum.

Prospective trials comparing open and laparoscopic techniques for bilateral inguinal hernia repairs showed laparoscopic techniques were associated with significantly less pain, necessity for analgesics, and less time to return to work [6]. Also, another study of 10,120 patients compared bilateral TAPP repair with open Lichtenstein repair and it was showed that there was not any increase in morbidity or risk of recurrence [7]. Another recent study comparing bilateral TAPP repair with bilateral open mesh plug repair concluded similar findings. It was seen that laparoscopy provided better results than open mesh plug technique [8]. Patients who underwent TAPP had fewer postoperative pain with less need of pain medication with similar postoperative complication rates between two groups.

A very recent meta-analysis of thirty-five randomized control trials including 7,777 patients compared open Lichtenstein tension-free repair, TAPP repair, and TEP repair [9]. It was concluded that TAPP and TEP techniques were associated with significantly reduced postoperative pain, earlier return to work, less chronic pain, less hematoma, and less wound infection compared to the open Lichtenstein technique. The rates of hernia recurrence, seroma formation, and hospital length of stay were found similar between treatment groups.

Although TAPP and TEP have certain advantages and disadvantages over each other, a recent study comparing these two techniques concluded that both have similar, overall complication risks, operation durations, postoperative acute and chronic pain incidence, and recurrence rates [10].

| Early Complications | Late Complications |
|---|---|
| Bleeding | Chronic Persistent Pain |
| Perforation of Intestines | Testicular Complication |
| Bladder Injury | Sexual Dysfunction |
| Seroma | Mesh Infection |
| Scrotal Edema | |
| Urinary Retention | |
| Wound Infection | |
| Bowel Obstruction | |
| Nerve Injury | |
| Cardiovascular Events | |

**Table 1:** Evaluated the complications in two groups such as perioperative and late postoperative.

In this review article, we evaluated the complications of laparoscopic inguinal hernia and the management strategies to intervene with these complications. We evaluated the complications in two groups such as perioperative and late postoperative (Table 1).

## COMPLICATIONS AND MANAGEMENTS

### *Perioperative Complications*

#### *Bleeding*

The operation field of preperitoneal retropubic space is rich of vascular structures. Intraoperative bleeding can occur via vessel dissection or by misplacement of the tackers during mesh fixation from the cremasteric artery,

the internal spermatic artery, branches of the inferior epigastric vessels, deep circumflex artery and the external iliac vessels, iliac circumflex vessels, and obturator vessels [11].

There have been case reports of patients with sudden drop in hemoglobin, and tachycardia in the immediate postoperative period showing signs of life-threatening hemorrhagic shock [12,13]. CT scans revealed venous hemorrhage in the retropubic space. Emergent surgical re-exploration is necessary to establish hemostasis and can be done via laparoscopy as well.

Corona mortis or pubic branch of inferior epigastric artery can be injured during TEP surgery as well. An in vivo study showed small caliber (<2 mm) vessels are more likely to be injured and to prevent injuries pressure in the workspace should be kept at minimum while placement of tacks should be onto the Cooper's ligament near to symphysis pubis [14].

Another study on vascular anatomy during TEP surgery suggested defining aberrant obturator artery and vein which lie cross the superior pubic rami. These aberrant vessels can be missed and therefore injured during dissection of the Bogros space or stapling of the mesh onto Cooper's ligament [15]. In another study of 90 patients, two patients who underwent TAPP surgery had intraoperative bleeding [10]. In both cases laparoscopic vessels sealer was sufficient to control the bleeding.

During the operation, use of low pressure in the working space as well as decreasing the pneumoperitoneum at the end of the procedure to observe any venous bleeding should be integrated to the practice. Like all laparoscopic procedures, trocars should be removed under direct vision and bleeding through the port site, as well as route of inferior epigastric vessel should be checked. Especially in TEP procedure, anterior rectus sheath should be sutured with absorbable 2/0 sutures.

Swelling of the hernia site postoperatively can be due to both seroma and hematoma. In a study, routine ultrasound examination has been performed to identify any early hematoma formation, however it was advised that it should be performed only when there isa clinical suspicion in patients [16]. In clinically suspected patients computed tomography can also be useful in determining the characteristics of the collection.

***Perforation of intestines***

Although it is a very rare complication, in the TAPP technique intraabdominal access is necessary and in the literature incidence of intestinal damage during TAPP surgery has been reported as 0.09% [17-20].

Perforation of intestines can occur during many steps including entry to the abdomen via trocarsor veress needle, manipulation of intestines for positioning, separation of adhesions of intestines from the peritoneum or adhesiolysis between intestines, hernia sac reduction or mesh fixation [21-23].

Also, a case has been reported in which a displaced spiral tacker has been stuck in mesentery and caused small bowel perforation [24]. Vigilance when placing tackers for mesh is necessary and at the end of the operation any loose or free tackers should be collected.

Intestinal perforations have been reported during TEP surgery as well. Two perforations of the small intestines resulting from thermal injury have occurred in a study of 4565 patients who underwent TEP [25].

Upon detection of an intestinal injury a safe approach can be to defer mesh placement or conversion to the open anterior approach [21,22]. However, in patients who had bowel preparation and when there isn’t any sign of abdominal contamination, immediate repair with suturing can also be an effective strategy [26].

During the surgery, use of the Trendelenburg position to position the bowel away from the operation site, as well as placement of intraabdominal gauze to cover the intestines can be helpful for protecting from bowel injury [27]. In a postoperative patient when signs of peritonitis and rise in acute phase reactants are present clinical suspicion for intestinal injury should be high and early CT scan with use of oral contrast can be helpful to detect any perforation.

***Bladder injury***

Like bowel injury, bladder injury can occur rarely during TAPP surgery [28]. Bladder injuries can occur during repair of incarcerated scrotal hernias [29].

Injury to the bladder has also been reported in two patients who underwent TEP surgery. One of these patients had undergone previous prostatectomy and the other was a thin patient with fragile tissues [28].

In a study of 9395 patients who underwent TEP surgery, 6700 had unilateral and 2695 had bilateral hernia repair. It was found that in the bilateral TEP group urinary bladder injury was significantly higher with 0.28%, while this was 0.04% in the unilateral TEP group ($p = 0.008$) [30].

In case of a bladder injury, suturing of the bladder and maintaining of catheters for a week can be sufficient. Although many surgeons don't use bladder catheters as a routine, in patients who are suspected to undergo long surgeries due to adhesions or patients with large scrotal hernias, catheters can be useful, and they can be removed at the end of the operation [31].

***Seroma***

Seroma has been one of the most common complications following laparoscopic inguinal hernia repair. During the follow up for 7 days, seroma can develop with both TEP and TAPP surgeries mimicking early recurrence of hernia. Many techniques have been suggested to decrease the formation of seroma. Inversion of transversalis fascia with tacking, endo loop closure of transversalis fascia, barbed suture closure of transversalis fascia, using fibrin sealant or surgical drains all have been suggested as effective methods to reduce seroma [32].

A small study has shown TEP to have higher rates of seroma formation, although factors like age, operative time, type of hernia, and mesh size were not correlated with seroma [33].

Another study of TAPP investigated correlation between transection of an indirect inguinal hernial sac and postoperative seroma formation. Incidence of seroma was 12.6% and it was found that risk of postoperative seroma formation was greater after transection of the hernia sac compared with complete dissection of the hernial sac [34].

Fixation method of the mesh during TAPP surgery and amount of seroma has also been investigated. It has been found that glue fixation led to most seroma formation followed by tack fixation, with no fixation having the least seroma [35].

Use of preperitoneal drains was also suggested as an effective method to decrease seroma formation after TEP surgery [36]. In most patients, seroma does not get infected and resolve within days to couple weeks by expectant management but for the persistent cases aspiration can be performed.

***Scrotal edema***

In the immediate postoperative period, swelling or ecchymotic color change can be seen in the scrotum. In a study comparing TEP and TAPP, it was seen that the TAPP group had a higher incidence of scrotal edema [33]. There was not any correlation of scrotal edema development with age, operative time, mesh type, and type of hernia.

Extensive dissection of cord structures might cause disruption of the lymphatic drainage and thus cause hydrocele formation as well. In another study, scrotal edema was found to be associated with a large hernia defect, inguinoscrotal hernias where extension of hernia to the scrotum was present, and when there was a residual distal indirect sac [37]. Elevation of the scrotum, topical mannitol application via pads, oral lysozyme, wearing athletic tight underwear, and cold application can help alleviate scrotal edema.

***Urinary retention***

Urinary retention can occur after both open and laparoscopic surgeries. When the patient cannot urinate although the bladder is full, immediate bladder catheterization is required. In addition to its discomfort, it creates potential risk for urethral trauma, urethral stricture, and catheter related infections. It might delay discharge from the hospital and increase overall expenses related to the surgery.

In a study of 300 patients who underwent TEP surgery, overall incidence of urinary retention was 4% (n = 12). Clinical factors did not have any significant association with urinary retention [38]. During TEP, dissections in the preperitoneal space near the urinary bladder, and manipulations during the surgery have been suggested for the cause of postoperative urinary retention [39]. In another study, 25 patients out of 192 (13%) developed postoperative urinary retention. Bilateral hernia repairs, BMI $\geq$ 35 kg/m [2], and operative time were found as significant predictors of urinary retention [40]. Another study has found use of narcotic analgesia and the volume of intravenous postoperative fluid administered as significant risk factors for postoperative urinary retention [41].

Patients who had urinary retention have been found more likely to develop urinary tract infection in the following thirty-day period [42]. Non-steroidal anti-inflammatory drugs, acetaminophen, or regional anesthetic blocks have been suggested to avoid retention due to use of narcotic analgesics [43].

***Wound infection***

A network analysis revealed that risk of wound infection after the Lichtenstein procedure was higher than that for TEP [0.33 (0.09-0.81)]. Between TAPP and TEP no significant difference was found [0.66 (0.15-2.2)] [44].

Ecchymosis around the trocar ports can be seen just as in most laparoscopic surgeries. However, umbilical port is manipulated for a longer period with an S retractor during TEP surgery, which might be a site for ecchymosis after these surgeries. These ecchymoses usually disappear during the first month. Topical heparinoid cream preparations can be effective in relieving these symptoms.

***Bowel obstruction***

A less common complication of laparoscopic inguinal hernia is small bowel obstruction in the early postoperative period. It is more frequently seen in TAPP surgery and in multiple early reports this has been attributed to the adhesions, or entrapment under the mesh through the open peritoneum or adherence to the peritoneal closure site [45-48]. Although it was believed this complication would not be seen after TEP since abdominal cavity is not entered [49]. it was also reported after TEP [45,49]. An unnoticed peritoneal defect might enlarge postoperatively, and small intestines can be strangulated herniating through this defect.

These unnoticed tears in the peritoneum can cause intestinal obstruction, incarceration and late fistulization [45].

***Nerve injury***

Compared to open approach, genital or scrotal numbness is seen less common after TAPP procedures. Ilioinguinal

or genitofemoral injuries are more prone to injury during open surgery [50].

During TAPP procedure, a critical area called triangle of pain lies in the Bogros space which is the between anterior iliac spine and inferolateral side of psoas muscle. Ilioinguinal, iliohypogastric and genital and femoral branches of genitofemoral nerve all pass through this triangle. Nerve injuries can be seen due to traction, trauma during dissection, thermal injury, or complete transection. Complete transection usually causes paresthesia however it does not cause neuralgia.

If tackers are placed along the course of nerves during the surgery, these tackers should be removed, and local anesthetic should be injected to this area. Also, in patients with persistent pain at the postoperative period, local anesthetic infusion should be considered.

***Cardiovascular events***

Patients with multiple comorbidities and who are evaluated as high risk for general anesthesia are considered more suitable for open surgery under local anesthesia. Although laparoscopic TEP surgery can be performed under spinal anesthesia, it is associated with longer operation time and increased postoperative morbidity, limiting its use to selected patients [51].

In TAPP surgery, pneumoperitoneum might cause secondary hypercarbia and hypotension and especially in older patients, and in patients American Society of Anesthesiologists (ASA) class III or above, signs for myocardial infarction, stroke or pulmonary emboli should be closely monitored.

***Late Postoperative Complications***

***Chronic persistent pain***

Chronic pain that changes in intensity over time can occur after both open and laparoscopic surgery [52,53]. In TEP surgery, mesh can be laid without the need for fixation; however, in TAPP surgery mesh is fixated via tackers or glues. In addition, tackers are used for peritoneum closure as well, although barbed sutures are preferred by some surgeons. The method for fixation has been found a contributory factor to postoperative chronic pain after laparoscopic inguinal surgery and non-traumatizing fixation methods have been suggested without any increase in rate of recurrence [54,55].

In a recent study of 960 patients, it was reported that 6% of patients experienced chronic pain. The multiple predictors for chronic pain were age, female sex, preoperative pain visual analog scale ≥1, prior inguinal hernia, higher American Society of Anesthesiologists class, use of multifilament polyester mesh, and intraoperative placement of a urinary catheter [56]. Another recent study of 807 patients, confirmed inguinal pain before operation, younger patients, females, and using heavy weight meshas predictive factors of for chronic pain [57].

Intraoperative lidocaine infusion has been suggested to reduce postoperative analgesia consumption, pain intensity, and improve patient satisfaction [58]. Use of celecoxib has also been found as an effective preemptive analgesia agent [59].

***Testicular complications***

Dissection of indirect hernia from the cord structures in both open and laparoscopic surgeries might result in injury to the blood supply of the testicle [60]. This injury presents itself as painful and edematous testes at 1-3 postoperative days and may lead to transient testicular pain, testicular inflammation followed by ischemic orchitis, or testicular atrophy.

Although venous pampiniform plexus injury is more common testicular artery can be directly injured as well. A case has been reported, in which a patient who underwent TAPP had testicular artery injury resulting in

bilateral retroperitoneal hematoma [61]. After thirteen days of conservative treatment the patient was discharged. The period of testicular pain may be extended up to six weeks, however conservative treatment is sufficient in most patients, while the use of antibiotics is controversial. Special care should be given during the dissection of indirect hernia sac, and cord structures should be visualized and protected with least amount of manipulation.

***Sexual dysfunction***

A study has compared open and TAPP surgery for postoperative painful sexual activity and painful ejaculation. Patients who underwent open surgery experienced significantly higher painful sexual activity and painful ejaculation compared to TAPP group [62].

The prosthetic mesh used in the inguinal hernia surgery creates a chronic foreign-body response and creates a scar tissue. This fibrotic scar tissue might cause inguinal vasal obstruction leading to azoospermia in patients who undergo either open or laparoscopic surgery [63]. Traction of vas deferens, disruption of blood flow to the testis and obstruction by the fibrotic tissue related to the mesh reaction are among the etiologic factors.

Triangle of doom is formed by vas deferens medially, gonadal vessels laterally and the apex point superiorly. The vas deferens can be severed in this area. In a complete transection, anastomosis with 6/0 prolene is suggested. Also, care should be given to ductus deferens during manipulation with laparoscopic instruments since crushing of the duct might also lead to fibrosis leading to scar tissue and obstruction. Patients who have postoperative painful ejaculation or pain in the groin area should be evaluated by fertility and sperm count tests.

***Mesh infection***

Mesh infection is seen very rarely after the laparoscopic surgery. Kapiris et al. reported 4 patients out of 3017 (0.11%) who had mesh infection [64]. One of these patients underwent laparoscopic removal of the mesh, one open removal of the mesh, while in the other two patients, abscess was drained, and mesh was retained. In three of these patients, perioperative urinary tract and throat infection was later identified and bacterial cultures were correlated with focus of contamination.

Another study of 1182 patients reported 2 (0.17%) who had mesh infection, and one of these patients had mesh removal [65]. Bittner et al. performed 8050 TAPP repairs, and out of these 8 mesh infections (0.1%) were encountered. Five of these patients healed with revisional surgery, suction, lavage, and drainage without mesh removal and in the other three removal of mesh was required [66].

In order to prevent mesh infection, preoperative check for any source of infection and appropriate treatment of existing infections before undergoing surgery is important.

***Mesh migration***

Mesh migration is uncommon however it can present itself as an uncommon late complication after laparoscopic surgery. A study of literature review between 1992 and 2018 showed 101 clinical reports of mesh migration [67]. It was seen that laparoscopic repair had higher incidence of mesh complications compared to open repair. Also, in TAPP technique, time to event presentation was found to be shorter compared to TEP technique. Urinary bladder was the most common site of involvement.

Sigmoid colon is another site for mesh migration. A 72-years-old patient had mesh migration into the sigmoid colon, ten years after TEP surgery [68]. Another similar recent case described a 76-years-old patient who underwent three repairs for recurrent inguinal hernia, TEP being the first surgery, and had mesh infection which was removed via open approach. After four years of mesh

removal, in the colonoscopy a foreign body was observed in the sigmoid colon. Upon sigmoid resection, remnants of mesh migration and erosion into the sigmoid colon were identified [69].

Avoiding contact between the mesh and peritoneum by complete suturing of peritoneal flap in TAPP and paying attention to vascularization of the flap to prevent late ischemia and ensuring there aren't any unnoticed defects in the peritoneum and repairing these in TEP surgery are crucial to prevent mesh related events.

***Recurrence***

A meta-analysis of randomized controlled trials compared TAPP and open Lichtenstein repair and it was found that there was not any difference in terms of recurrence [70]. Likewise, a randomized controlled study of 403 patients who underwent laparoscopic and open surgery and had 5 years follow up period showed no difference in terms of recurrence [71].

The rates of recurrence after laparoscopic surgery have been considered to depend on the experience of the surgeon [72,73]. The size of the mesh is another important factor. Myopectineal orifice should be covered totally with the mesh without the medial side crossing the midline. A mesh size with a height of 10 cm and width of 15 cm can serve for this purpose. The major contributors to recurrence are non-anatomic dissection of the hernia site and inappropriate placement of the mesh.

## CONCLUSION

Laparoscopic inguinal hernia surgery is a safe technique with rare complication rates and should be presented to the patients as a standard care. There are multiple advantages over open surgery and the rates of complications are comparable to open surgery. Well understanding of posterior groin anatomy is key to avoid complications and with high clinical suspicion and understanding of these possibilities most complications can be quickly managed without extending discharge time.

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