

Laparoscopic Groin Hernia Repair with Fixation through Transabdominal Polypropylene Stitches: A Randomized Prospective Study

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Background: Laparoscopic repair of inguinal hernias is associated with less postoperative pain and a faster rehabilitation, but its high cost was a changeling matter.

Patients and methods: We performed a randomized prospective study in Ain Shams University hospitals from July 2012 and April 2014 in which 50 male patients with primary unilateral or bilateral inguinal hernia were treated by laparoscopic transabdominal preperitoneal repair (TAPP) and mesh fixation through transabdominal polypropylene sutures. We recorded information about operative details, operative time, intraoperative complications, postoperative recovery, postoperative complications, and long term follow-up for one year after surgery.

Results: No major intra or postoperative complications had occurred, only 2 patients were converted to open Lichtenstein's repair. Mean operative time was significantly accepted. Hospital stay, recovery period were excellent. Only one patient had unacceptable postoperative pain which decreased over a year during his follow up. After a 1 year follow up period, only in single case of recurrence has been diagnosed.

Conclusion: Laparoscopic transabdominal preperitoneal repair (TAPP) and mesh fixation through transabdominal polypropylene stitches when efficiently experienced and mastered is an accepted and excellent surgical choice for inguinal hernia repair because of its cost effectiveness and less incidence of chronic pain syndrome.

Key words: Inguinal hernia, laparoscopic transabdominal preperitoneal repair (TAPP), transabdominal polypropylene stitches

Introduction:

Repair of inguinal hernia is one of the commonest surgical procedures performed world wide.¹

Over the past 20 years, several hernia repair techniques have been introduced.

The ideal treatment to inguinal hernia should have the least per- and post operative morbidity; it should be the least traumatic as regards the requested type of anesthesia.² It should offer the shortest hospital stay, the earliest recovery period and the least post-operative pain; it should be the least expensive and more importantly, it should have the least recurrence rates. The chosen technique should be also the easiest to learn

and to perform.

The introduction of the Lichtenstein's tension-free repair has greatly decreased recurrence rates. Furthermore, it is a relatively easy to learn technique with no serious complications.³

Laparoscopic inguinal hernioplasty was first described by Ger⁴ in the early 1990s. Thereafter, laparoscopic repair of inguinal hernia has undergone many changes.⁵

The most widely accepted laparoscopic techniques nowadays are the transabdominal preperitoneal (TAPP) repair that was introduced by Arregui⁶ and Dion⁷ in the early 1990s and the total extraperitoneal (TEP) repair introduced by Phillips⁸ and

McKernan⁹ in 1993. Both techniques evolved from Stoppa's concept of preperitoneal reinforcement of fascia transversalis over myopectineal orifice by a prosthetic mesh.¹⁰

The development of the laparoscopic hernia procedure has been accompanied by a continuing search for mesh placement alternatives without mechanical fixation,¹¹ including attempts to use fibrin glue.¹²

The potential complications related to fixation of mesh prosthesis using staples (especially postoperative neuralgia) prompted us to conduct this randomized prospective study and the use of this new technique of mesh fixation, through transabdominal polypropylene stitches.

Patients and methods:

This prospective randomized study was conducted in Ain Shams University hospitals from July 2012 and April 2014. A total of 50 male patients, 18-60 years old with clinically diagnosed primary direct or indirect inguinal hernia (5 of them were having the hernia bilateral) were eligible for tension free laparoscopic repair using transabdominal preperitoneal approach (TAPP) with mesh fixation by transabdominal polypropylene stitches.

Four exclusion criteria for the participation were defined: (1) patients with huge, irreducible, or complicated hernia, (2) elderly patients with comorbidity (patients in American Society of Anesthesiologists "ASA" class 3, 4, and 5) where it was preferable to perform surgery with intravenous sedation and local anesthesia, (3) patients who had extensive lower abdominal or pelvic surgery in the past which would have made the laparoscopic dissection difficult or even impossible, and (4) patients' choice for a non-laparoscopic operative approach.

Preoperative Preparation:

All patients were informed that conversion to open surgery might be required and a written consent was taken. All patients were asked to micturate before the operation. They all received prophylactic 3rd generation cephalosporin.

Operative techniques:

A Veress needle was used to induce pneumoperitoneum at the umbilical site and then was replaced by one 10-12mm optical trocar. A 5mm trocar was positioned unilaterally on the umbilical line and a 10-mm trocar was positioned in the iliac fossa contralateral to the hernia. In the presence of a bilateral hernia, both umbilical trocars were positioned bilaterally in the iliac fossa **Figure (1)**. An incision of the wall of the peritoneum was made starting at the level of the superior margin of the internal inguinal ring at the level of the epigastric vessels **Figure (2)**. It was dissected medially up to the residue of the umbilical artery and laterally for 3 to 4 cm past the inguinal ring for a total length of 7 to 8 cm. In the presence of direct hernias, the hernial sac was directly isolated and reduced. In the case of indirect hernias, the preperitoneal parapubic adipose tissue was carefully dissected medially to expose the horizontal pubic ramus and Cooper's ligament. Accurate dissection of the preperitoneal retrovesical tissue permits easier positioning of the mesh. The internal inguinal ring was then explored, isolating and reducing the hernial sac; this maneuver was performed to reveal the presence of perihernial lipomas, which could then be removed.

Once the spermatic cord had been freed from the peritoneal wall, the prosthesis was positioned. A monofilament polypropylene mesh with large pores was used. The mesh was cut to a dimension of 10-15 cm and 2 separate 2/0 polypropylene stitches with straight needle transfixing the abdominal wall from outside to inside **Figure (3)** then dragged to outside the abdomen through a 10-mm trocar then we tie the 2 polypropylene stitches to the center of the mesh separately and 2 cm away from the lateral borders of the mesh then we drag the mesh to inside the abdomen with the help of polypropylene stitch and placed in the preperitoneal space such that it was in medial contact with the paravesical area, covering Cooper's ligament, resting on the inguinal region, and extending laterally over the epigastric vessels. At the end we tie the

prolene stitch over the skin of inguinal region **Figures (4,5).**

The peritoneal flaps were then closed using small, continuous, resorbable 2/0 sutures or by using surgical clips **Figure (6).**

In patients with bilateral hernias, the same procedures were performed sequentially to repair the hernia on the other side (generally smaller).

Post-operative care:

During the period of hospital stay, all patients were given diclofenac sodium (75 mg IM /12 hours) as well as 3rd generation cephalosporin (1 gm IV /12 hours).

The time of hospital discharge was depending on two factors: 1) absence of serious operative and post operative complications. 2) good response to the injectable analgesic used in our protocol with no further need for other extra-analgesics. The medication described was the same for all patients at time of hospital discharge: Amoxicillin / clavulanic acid (2gm/day) for 1 week and diclofenac potassium (50mg tablet) taken only on demand for 1 week. The severity of pain during the 1st post-operative week was assessed by the dose of diclofenac potassium calculated by the number of tablets (50 mg) taken every day during that week.

Data collection and follow up:

1. Preoperative parameters:

The following parameters were recorded: Age, body mass index (BMI), type, ASA, and duration and size of hernia. All patients were asked before surgery to rate their pain or discomfort on a visual analog scale (VAS) from 0 (none) to 10 (worst).

2. Intraoperative parameters:

The following parameters were recorded: Type of hernia, the operation time, (skin to skin) in minutes, operative complications such as, bowel perforation, urinary bladder injury, spermatic cord or vas injury, vascular injury and bleeding, peritoneal defects, and conversion of TAPP technique to open repair. The cost of the procedure was also recorded.

3. Postoperative parameters:

Post-operatively all early potential complications, such as urinary retention, hematoma, seroma, bleeding and wound infection were assessed and documented.

4. Follow up measures:

All patients were encouraged to return to work and normal activities as soon as possible. Time to full recovery was noted by the patient and was recorded. It was defined as the number of days between the day of surgery and the first day a patient was able to perform full daily activities. Time of return to work was also recorded.

A) Primary outcome:

The primary outcome of the trial was early and late postoperative neuralgia, defined by the presence of intermittent hyperesthesia, burning sensation and/or jabbing pain in the ipsilateral inguinal area nerves (genitofemoral nerve, lateral cutaneous femoral nerve, ilioinguinal and iliohypogastric nerves).

The patients were asked to assess the pain severity and its site every day for the first week and to record the number of diclofenac potassium tablets (50mg) taken every day during the first post operative week.

Postoperatively, patients were examined at 1, 3, 6 and 12 months to determine the presence or absence of postoperative neuralgia using the visual analog scale (VAS).

Patients who experienced groin, scrotal, or thigh pain at 6 months after surgery were considered to have chronic pain. These patients were asked to describe the character, site, and severity of the pain. Patients were also asked about whether pain was affecting their normal daily and / or work / sporting activity.

B) Secondary outcomes:

The patients were asked to return to the outpatient clinic at one week and then at 1, 3, 6 and 12 months for a standardized history taking and physical examination of the wound, testis, nerve sensation, port-site to detect wound tenderness, wound/mesh infections, port-site hernia, hydrocele, orchitis, testicular

atrophy, sensory loss, and most importantly recurrence which was defined as a clinically detectable reducible swelling in the treated groin. In doubtful cases, ultrasonography of the groin was performed.

Results:

Patients flow:

50 male patients with inguinal hernia (5 of them were bilateral) were included in the study. Their mean age was 32 ± 10 (range: 18-60) years.

Preoperative parameters:

The demographics of the patients regarding age, BMI, ASA classification, and duration and size of hernia as shown in **Table (1)**.

Intraoperative parameters:

Intraoperative data are shown in **Table (2)**. Operative time was around 74 minutes (range 62-109 minutes).

Injury of the inferior epigastric vessels occurred in 2 cases (4%); the injured vessel has been clearly identified and ligated by clips in 1 patient while in the remaining patient bleeding was not controlled and it obscured the field completely; conversion to open repair and controlling of the bleeder has been therefore performed.

Large peritoneal tears occurred in 4 cases (8%). Failure of closure of the peritoneal defect occurred in 1 of them who was converted to open Lichtenstein's technique.

A small intestinal injury (small electrocautery burn not perforating the mucosa) occurred in 1 patient and has been primarily sutured laparoscopically and the repair procedure has been successfully continued without conversion to open repair. This patient passed a nice postoperative period and has been discharged on the 5th day after the operation. No bladder, or cord injury were recorded in any patient.

Early Post-operative parameters:

Early post-operative complications are shown in **Table (3)**. Urinary retention occurred in 2 patients (4%), the condition

was transient and was managed by urinary catheterization.

Umbilical port site seroma occurred in 3 patients (6%), 2 of them were complicated by wound infection, one of them was complicated by umbilical granuloma that necessitated surgical excision and curettage performed 42 days after the repair. Scrotal hematoma occurred in 4 patients (8%) and they were successfully managed conservatively.

The mean hospital stay was 2 days (range 1-5days) with 80% of patients were discharged after 24 hours of the procedure. The mean time to return to normal activities was 7 days (range 5-15 days); and the mean time to return to work was 12 days (range 10-25 days).

Long term follow up:

Long term complications are shown in **Table (4)**. During a period of 1 year follow up, recurrence occurred in 1 patient (2%), this patient had undergone open Lichtenstein's repair.

A single case of post repair moderate hydrocele occurred in one patient and it was planned to treat him surgically. No cases of postoperative orchitis, testicular atrophy, port-site hernia, internal hernia or postoperative adhesive intestinal obstruction have been recorded in any patient after a 1 year of follow up period.

Evaluation of perioperative and long-term postoperative pain:

This is one of our primary outcomes of the study. Average pain score preoperatively on the VAS was (5.5) and averaged (3.5) immediately postoperatively and at time of hospital discharge with only 1 patient required extranalgesia in the first postoperative week. VAS decreased to (0.5) at 1-month follow-up with only 1 patient rating his pain (3). And at one year follow up, all patients were free of pain.

Patients' satisfaction:

The patient satisfaction at 1-month follow-up was categorized as either really satisfied with 80% (n=40/ 50), satisfied with 18%



Figure (1): Trocars positioning

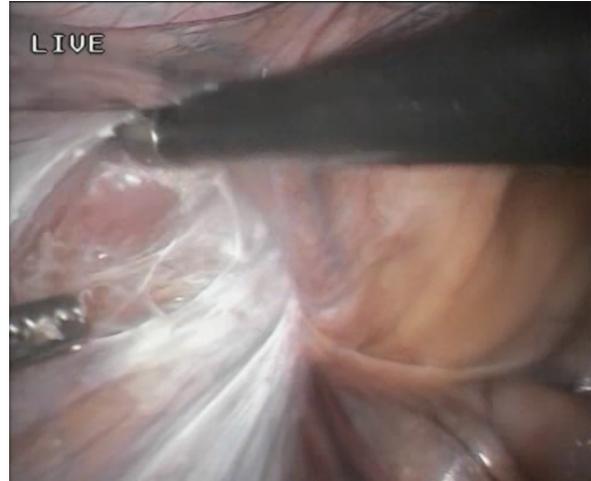


Figure (2): Peritoneum is incised

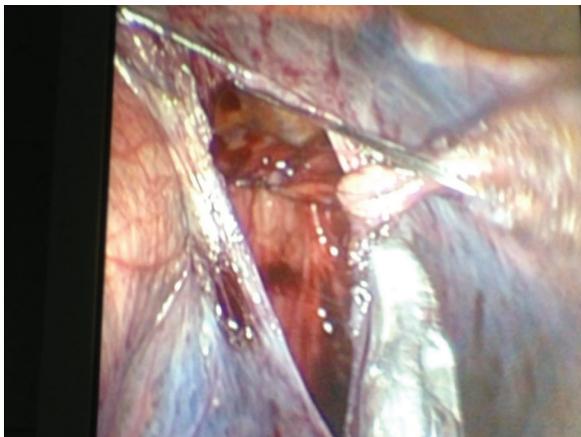


Figure (3): A polypropylene suture on a straight needle passing transabdominal



Figure (4): Transabdominal mesh fixation



Figure (5): Transabdominal mesh fixation

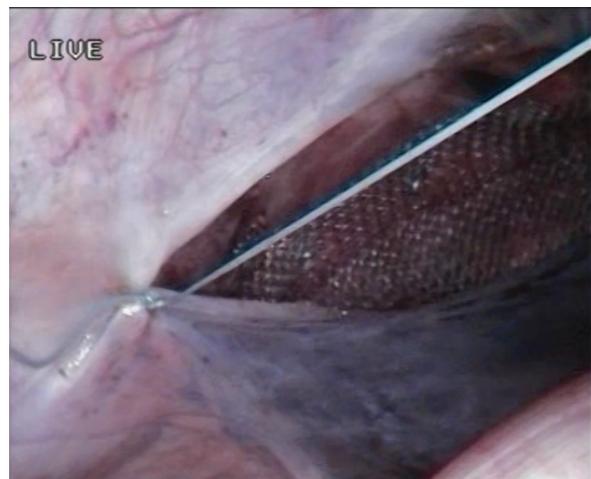


Figure (6): Closure of the peritoneum

(n=9/50), and not really Satisfied with 2% (n=1/50).

The patient who was not really satisfied had persistent postoperative pain at 1-month follow-up with a VAS pain of (3), which decreased to (0) at 1-year follow-up

evaluation.

Cost evaluation of TAPP using our technique versus open Lichtenstein's hernioplasty & other TAPP techniques:

This is one of our primary outcomes

Table (1): Baseline characteristics of the patients according to treatment group.

Variable	
Mean Age (years)	32 ± 10
BMI	30.6
ASA classification:	
I	42/50
II	8/50
Duration of hernia:	
<2 months	8/50
2-12months	20/50
>12months	22/50
Size of hernia:	
• Bulges only when straining	25/50
• Visible bulge when standing but not extending to scrotum	17/50
• Scrotal but not huge	8/50
Unilateral or bilateral:	
Unilateral	45/50
Bilateral	5/50

Table (2): Characteristics of surgery and operative complications

Variable	
Mean operative time (min)	74
Type of hernia (%)	
• Direct	22,5
• Indirect	65
• Dual	12.5
Operative complications (no):	
• Conversion to open technique	2
• Vas deferens injury	0
• Bowel injury	1
• Urinary bladder injury	0
• Inferior epigastric v. Injury	2
• Major vessel injury	0

of the study. Comprehensive evaluation revealed that institutional costs for operation room use, laboratory and other diagnostics, hospital postoperative care as well as many operation related costs, for example, gloves, disinfection, urinary catheter, steri-strips, gauze, etc, are similar or identical for our technique and open hernioplasty procedures.

Finally, the cost difference between the

2 procedures comes down to the difference in price of the mesh used, cost for an insufflation tubing and use of CO2 for the laparoscopic hernia repair and additional sutures used for the open procedure. The total cost of all nonreusable items such as drapes, suture, mesh, gowns, gloves, etc, for a 1-side TAPP repair at our ambulatory surgery facility is 550 L.E. (Livre egyptienne). Total

Table (3): Early post-operative complications

Variable	No
Related death	0
Urinary retention	2
Wound infection	2
Seroma	3
Scrotal hematoma	4

Table (4): Long term complications

Variable	No
Recurrence	1
Hydrocele	1
Port-site hernia	0
Umbilical granuloma	1
Internal hernia	0
Intestinal obstruction	0
Orchitis	0
Testicular atrophy	0

costs of disposable items for a 1-sided open hernioplasty is 250 L.E., the difference between the 2 being mainly the cost for material needed for a laparoscopic procedure.

The cost difference between our new technique of fixation using transabdominal polypropylene stitches and other way of fixation in TAPP using fibrin Glue (Tissucol) or staples for mesh fixation is that our new technique saves about 500 L.E.

Discussion:

This randomized clinical study evaluates a new technique for mesh fixation during TAPP repair of inguinal hernia through transabdominal polypropylene stitches.

In our study we have chosen TAPP technique rather than total extraperitoneal technique (TEP) because TAPP operation is easier to learn and master,¹³ and does not suffer the same risks of preperitoneal bleeding and oozing as can be seen in the TEP procedure.¹⁴ Furthermore, TAPP gives better view of the inguinal anatomy. Another advantage of TAPP approach is that it allows inspection of both groins, and identification of asymptomatic defects.¹⁵

In our study the TAPP operations caused less pain in the early post-operative period, leading to earlier mobilization, shorter hospital stay and earlier return to work than Lichtenstein's repair. This is mostly attributed to smaller incisions, the absence of muscle dissection during TAPP technique and hence rapid healing. Furthermore, laparoscopic TAPP is associated with greater patient satisfaction and better cosmetic results than its open counterpart. These results are in line with many randomized series.^{2,16,17,18,19}

The rate of conversion from TAPP to open Lichtenstein technique was 2/50. This is directly related to the learning curve as conversion occurred in 2 patients of the first 15 operations only. This rate was nearly the same as in other studies.⁵

In our study, only one case of minor intestinal injury was reported, injury of inferior epigastric vessels occurred in 2 patients, no other serious operative or life-threatening complications occurred. Though other studies have reported that intraoperative, immediate postoperative complications occur more frequent in the laparoscopic repair group than in the open repair group.^{16,20,21}

The results of our study showed that the operative time is obviously longer in TAPP procedure when compared to Lichtenstein procedure. This is clearly attributed to the learning curve as proved by the marked decrease in operative time in the last twenty repairs performed laparoscopically and also a marked decrease in the mean operative time compared to another study done in Ain Shams university hospitals previously.²² These results are in line with that obtained by many other trials.^{23,24} However, in the study carried by David,²⁵ the mean operating time for a unilateral hernia managed by TAPP was only 25 minutes. Another large series of 12678 cases of TAPP hernia repair showed a mean operative time of 40 minutes.²⁶ Furthermore, another trial carried by Roseano and others² reported shorter operative time in the laparoscopic group than in Lichtenstein's group.

Chronic pain syndrome remains one of the challenging problems of inguinal hernia repair and this problem was one of the major aims of this study. The pain may be explained by: 1) Mesh induced fibrosis. 2) Nerve entrapment by a staple. 3) Extensive dissection of the sac from cord structures. 4) Injury of the genital branch of genito-femoral nerve during extensive skeletonization of the cord. 5) Compression or irritation of the nerve secondary to fibrosis around the cord. 6) Direct nerve cutting or cauterization.

In laparoscopic hernia repair, several different anchoring techniques have been used and recommended since the early 1990s such as staples, coils etc, but any mechanical anchoring carries the risk of causing temporary or permanent pain or discomfort or can even damage sensitive structures such as nearby nerves and vessels.²⁷ To avoid such risks, alternative strategies with fixation using transabdominal polypropylene stitches which prevents migration of the mesh and eliminates the use of additional anchoring techniques in our experience.

Chronic inguinal pain, its cause, and treatment have become significant issues in long-term outcome studies. Therefore, the characteristics of the mesh fixation using

transabdominal polypropylene stitches must be taken into consideration to avoid nerve entrapment, Thus far in follow-up of our experience with fixation using transabdominal polypropylene stitches, long-term pain is minimal to none and patient satisfaction is high.

A number of studies^{3,22,28} reported a higher incidence of chronic pain after open repair of inguinal hernia. One hypothesis is that the dissection and fixation in the Lichtenstein's method is more extensive than TAPP, which could increase the risk of nerve injuries leading to pain and /or sensory loss.

In our study we also reported that chronic pain is less frequent when done by our technique in comparison to another study done in Ain Shams university hospitals when mesh fixation was done by staples through TAAP approach.²²

The cost of the procedure remains also one of the challenging problems of laparoscopic inguinal hernia repair and this problem was also one of the major aims of this study. One of the most important drawbacks of TAPP is its higher cost when compared to Lichtenstein's repair. Many authors agree about this point.^{23,29} Although TAPP technique resulted in shorter hospital stay and shorter time to return to work, but this is not enough to compensate for the increased cost.²

In an attempt to evaluate the true cost to the facility, we looked at the material cost to the facility of the disposable items used and not the "charges" which we all know are different. To truly assess the difference in cost between procedures, it is also important that comparison should be made within the same facility and not between different facilities.

With a difference of only 250 L.E more than open surgery and 500 L.E. Less than TAPP with mesh fixation by staples or fibrin glue, the cost gap between laparoscopic and open hernia repair and between our technique of fixation to the other techniques is well accepted.

Recurrence is the most important parameter in the evaluation of inguinal hernia repair. However, meta-analysis of randomized controlled trials^{2,30} has demonstrated

that there was no significant difference in recurrence rate when TAPP was compared with open hernioplasty.

In our study recurrence occurred only in one patient. This is mostly attributed to technical errors such as inability to dissect enough preperitoneal space for mesh placement or due to rolling of the mesh. The learning curve is another important factor; this is proved by our results that showed that the single patient complicated by recurrence was performed in the first 3 months of our study. This recurrence rate is similar when compared to other studies.^{31,32}

Conclusion :

Laparoscopic groin hernia repair with fixation through transabdominal polypropylene stitches has been shown to have excellent long-term results regarding pain, low recurrence rate at only marginally increased costs above open hernia procedures and decreased costs below other anchoring devices.

With a low recurrence rate, acceptable cost and low incidence of long-term chronic pain, laparoscopic groin hernia repair with fixation through transabdominal polypropylene stitches is the procedure of choice for our patients at present time.

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