Comparison of laparoscopic TAPP and TEP

Ahmed Nafei, MD; Ahmed H Ali, FRCS; Ali Anwar, MD
Department of General Surgery, Ain Shams University, Cairo, Egypt

Abstract

Background: Laparoscopic repair of inguinal hernias is performed nowadays either by transabdominal preperitoneal approach (TAPP) or by total extraperitoneal approach (TEP). Few trials had directly compared both of them.

Methods: We performed a randomized, prospective trial in which 80 male patients with primary unilateral inguinal hernia were treated laparoscopically. 40 patients were treated by transabdominal preperitoneal repair and the other 40 patients were treated by laparoscopic total extraperitoneal repair. We recorded information about preoperative data, operative details, operative time, intraoperative complications, postoperative recovery, postoperative complications, and long term follow–up. We examined the patients for follow-up one and six weeks, six months, and one year after surgery.

Results: Small intestinal injury occurred in 1 patient in TAPP group. Extraperitoneal bleeding occurred in 3 patients in each group. 4 patients in TAPP group were converted to open Lichtenstein repair. TEP procedure failed in 5 patients, 4 of them were converted to open repair. In the remaining patient, TEP procedure was converted to TAPP technique that was successfully performed without conversion to open repair. No major vessel, bladder or spermatic cord injury had occurred in any patient in either group. Operative time was slightly longer in TEP group. Hospital stay, recovery period, postoperative and chronic pain were nearly the same in both groups. After a 1 year follow up period, recurrence has been diagnosed in 2 patients; one in each group. No cases of port-site hernia, internal hernia or intestinal obstruction were reported in either group.

Conclusion: When performed correctly, both techniques can produce satisfactory results. The learning curve in TEP approach is longer, but it is safer to be performed as the abdominal cavity virginity is intact. TEP when efficiently experienced and mastered is the procedure of choice in laparoscopic repair of inguinal hernia. However, surgeons who choose TEP must know well how to do TAPP technique since conversion of TEP to TAPP is possible; otherwise conversion to open technique is mandatory.

Key words: Inguinal hernia - Laparoscopic transabdominal preperitoneal repair (TAPP) - Laparoscopic total extraperitoneal repair (TEP).

Introduction:

Inguinal hernia repair is one of the most common surgical procedures performed worldwide.

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

The excellent results obtained with laparoscopic cholecystectomy since its introduction in 1988 have encouraged surgeons to introduce laparoscopic surgery for many applications, including inguinal hernia repair.

Laparoscopic inguinal hernioplasty was first described by Ger[1] in the early 1990s. Thereafter, laparoscopic repair of inguinal hernia has undergone many changes.

The most widely accepted laparoscopic techniques nowadays are the transabdominal preperitoneal technique (TAPP) described by Arregui[2] and Dion[3] in the early 1990s and the total extraperitoneal technique introduced by Phillips[4] and McKernan[5] in 1993. Both techniques evolved from Stoppa's concept of preperitoneal reinforcement of fascia transversalis over myopectineal orifice by a prosthetic mesh.[6]

Many trials had compared laparoscopic inguinal hernia with open repair. However, studies directly comparing both techniques of laparoscopic repair (TAPP and TEP) are scanty and therefore, satisfactory results are not sufficient.[7]

We conducted this study to directly compare TAPP and TEP techniques to determine which method is associated with better outcomes, less morbidity, and is easier to be learned and safely applied.

Patients and methods:

This study is a prospective randomized study. Male patients with primary, unilateral inguinal hernia who presented in the outpatient clinic at Ain Shams University Hospitals at the period between October 2005 and June 2008 were allocated to either laparoscopic transabdominal preperitoneal repair (TAPP) or to laparoscopic total extraperitoneal repair (TEP) by unrestricted randomization in a 1: 1 ratio.

To be eligible, patients were required to be healthy (American Society of Anesthesiology {ASA} group 1 or 2), male, and 18-60 years old.

All patients gave written informed consent. Patients who had an irreducible, huge or complicated hernia were not eligible for the study. Other exclusion criteria included morbid obesity (BMI > 40), and/or previous lower abdominal surgery.

Preoperative preparation:

Patients were informed that conversion to open surgery might be required and a written consent was taken.

All patients were asked to pass urine just before shifting to the operation theatre. Perioperative prophylactic antibiotics were administered. All operations were done under general anesthesia.

Operative techniques:

1- Transabdominal preperitoneal technique (TAPP):

TAPP was performed through three abdominal ports: a 10mm umbilical port was used for the laparoscope. Two ports were placed one on each side, at the level of umbilicus in the midclavicular line. The ipsilateral port was10mm and the contralateral one was 5mm.

The hernia orifices were identified **Figure(1)**. The peritoneum was incised 2 to 4cm above the peritoneal defect at the lateral edge of the median umbilical ligament and extending toward the anterior superior iliac spine far enough to assure wide dissection of the myopectineal orifice **Figure(2)**. During the course of preperitoneal dissection, direct sacs were reduced and indirect sacs were either dissected from the cord structures and reduced or divided circumferentially at the internal ring, leaving the distal part in situ. Preperitoneal dissection was carried across the midline for 2-3 centimeters as widely laterally, and posteriorly to provide room for a large piece of mesh. A (15cm transverse x 12cm vertical) polypropylene mesh was then inserted crossing the midline covering the cord structures and extending laterally to the internal ring. The mesh was fixed to Cooper's ligament as well as superomedially and superolaterally. Because of the potential of nerve injury, staples or sutures were not placed in the inferolateral region below the iliopubic tract. Finally the peritoneum flap was closed over the mesh to prevent bowel and omental adhesions **Figure(3)**.

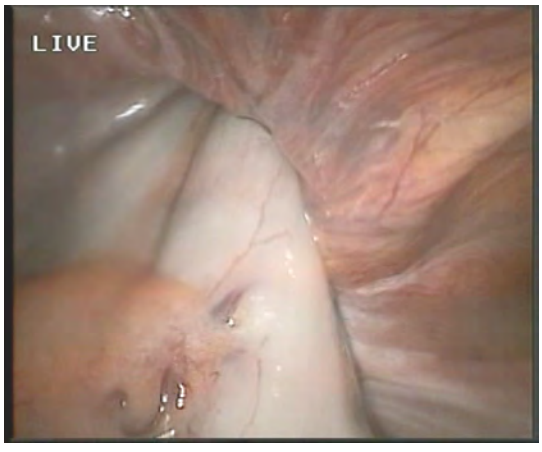

Figure (1): Indirect inguinal hernia seen in TAPP.

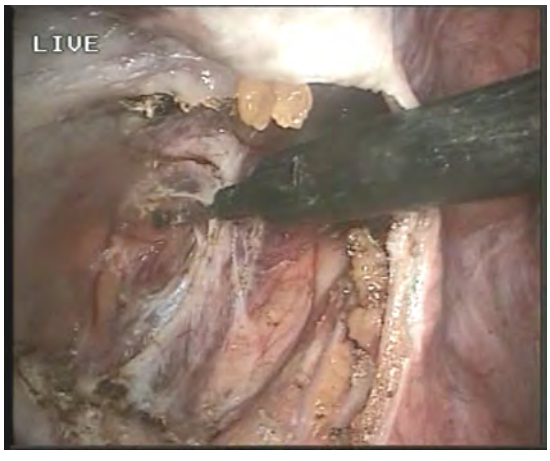

Figure (2): Extraperitoneal dissection after opening the peritoneum in TAPP approach.

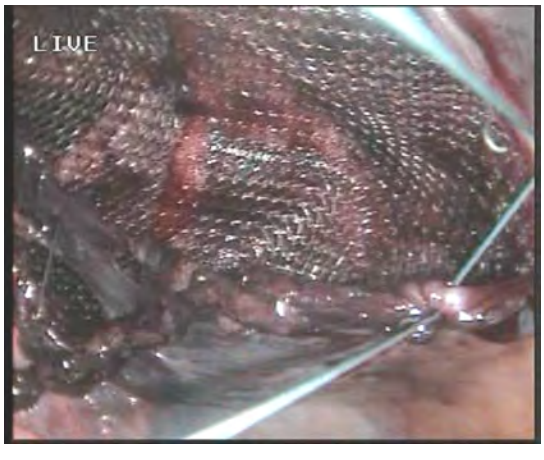

Figure (3): Closure of the peritoneal defect after inserting and fixing the mesh.

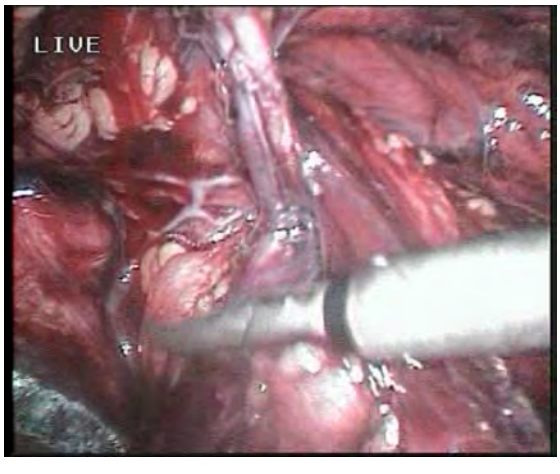

Figure (4): Reduction of a direct inguinal hernia during extraperitoneal dissection in TEP.

2- Total extraperitoneal technique (TEP):

An infraumbilical incision (1 cm) was made extending laterally on the side of the hernia. The anterior rectus sheath was incised. The rectus muscle was then retracted laterally. A blunt digital dissection was made in the preperitoneal space beneath the rectus muscle and anterior to the peritoneum. A blunt trocar 10mm with carbon dioxide insufflation was inserted and the laparoscope was introduced, dissecting bluntly to open up the space. Once the space was enlarged sufficiently, a 2nd midline 10 mm trocar was inserted midway between the umbilicus and the symphysis pubis and a 3rd midline 5mm trocar was inserted one finger breadth above the pubis. Care was taken not to penetrate the peritoneal cavity otherwise the procedure would be converted to TAPP technique. Dissection proceeded until the area of the hernia defect was encountered **Figure(4)** and the procedure including mesh fixation continued in an identical fashion to the aforementioned TAPP operation.

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. Patients were discharged after 24 hours if the above conditions were fulfilled.

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.

Data collection and follow up:

1- Preoperative parameters:

The following parameters were recorded: Age, BMI, ASA classification, and duration and size of hernia.

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, conversion of TAPP technique to open repair, and conversion of TEP to open repair or to TAPP approach. Patients in whom the laparoscopic repair was converted to open repair as well as patients in whom TEP approach was converted to TAPP technique, were subsequently excluded from the study.

3- Post-operative parameters:

Post-operatively all early potential complications, such as urinary retention, hematoma, seroma, bleeding and wound infection were assessed and documented. Post-operative groin, thigh, and scrotal pain and its response to analgesics as well as the duration of hospital stay were also recorded.

4- Follow-up measures:

The patients were asked to return to the outpatient clinic at one week and six weeks; at six months and at one year for a standardized history taking and physical examination of the wound, testis, and port-site to detect wound tenderness, wound/mesh infections, umbilical fistula, port-site hernia, hydrocele, orchitis, testicular atrophy, chronic pain and most importantly recurrence which was defined as a clinically detectable reducible swelling in the treated groin. When recurrence could not be surely diagnosed clinically and was suspected, ultrasonography of the groin was performed. 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.

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

Patients who experienced groin, scrotal, or thigh pain at operative site 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.

Results:

Patients flow:

80 eligible male patients with unilateral primary inguinal hernia were randomized into the study. 40 patients underwent laparoscopic transabdominal preperitoneal (TAPP) repair and the other 40 patients underwent laparoscopic total extraperitoneal (TEP) repair. The patients ranged in age from 18 to 60 years.

Preoperative parameters:

The two groups were well balanced regarding age, BMI, ASA classification, and duration and size of hernia as shown in **Table(1)**.

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

	TAPP	TEP
Mean Age (years)	43.1	40.9
BMI	32.6	33.9
ASA classification:		
I	32/40	31/40
II	8/40	9/40
Duration of hernia(%)		
<2 months	7.5	10
2-12months	45	42.5
>12months	47.5	47.5
Size of hernia(%)		
• Bulges only when straining	37.5	35
• Visible bulge when standing but not extending to scrotum	35	40
• Scrotal but not huge	27.5	25

Intraoperative parameters: Table(2)

In TAPP group, 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. Injury of the inferior epigastric vessels occurred in 3 cases; the injured vessel has been clearly identified and ligated by clips in 1 patient while in the other 2 patients 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. Failure of closure of the peritoneal defect occurred in 2 of them which were converted to open Lichtenstein technique. No bladder, or cord injury were recorded in any patient in either group. In TEP group, during extraperitoneal dissection, bleeding completely obscuring the anatomy occurred in 3 patients, 2 of them were due to inferior epigastric injury. The repair in these 3 patients was converted to open Lichtenstein repair. Peritoneal tears occurred in 2 patients during extraperitoneal dissection. The approach was then converted to TAPP and was successfully performed in 1 patient while in the other patient the defect was too large, and the repair was converted to open Lichtenstein technique. No other operative complications occurred in TEP group. Operative time was slightly longer in TEP group as shown in **Figure(5)**.

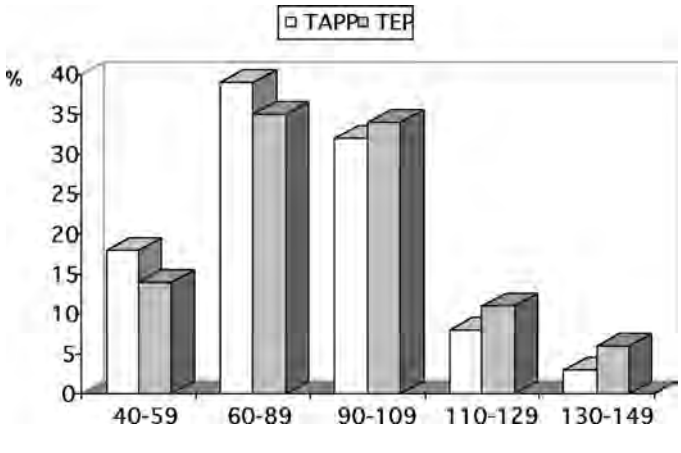

Figure (5): Operative time in both groups (in minutes).

Table (2): Characteristics of surgery and operative complications.

	TAPP	TEP
Mean operative time (mn)	87	94
Type of hernia (%)		
• Direct	22.5	27.5
• Indirect	65	62.5
• Dual	12.5	10
Operative complications (n):		
• Conversion to open technique	4	4
• Conversion to TAPP	-	1
• Vas deferens injury	0	0
• Bowel injury	1	0
• Urinary bladder injury	0	0
• Inferior epigastric v. injury	3	2
• Major vessel injury	0	0

Post-operative parameters:

Early post-operative complications were noted in **Table(3)**. Urinary retention occurred in 2 patients in TAPP group and in 3 patients in TEP group. In all patients, the condition was transient and was managed by urinary catheterization.

The duration of hospital stay was nearly the same in both groups **Figure(6)**.

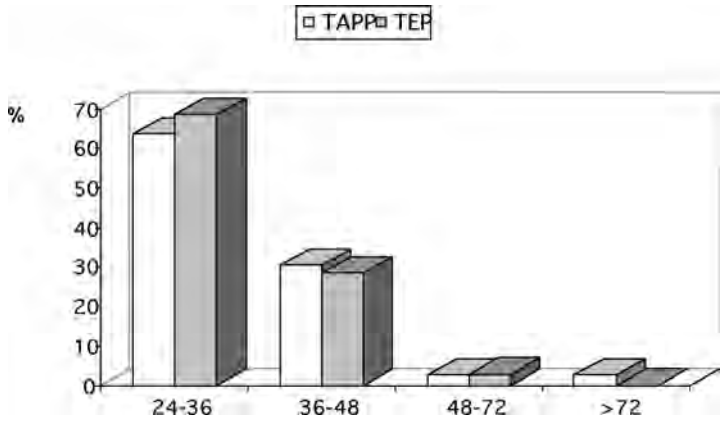

Figure (6): Duration of hospital stay in both groups (hours).

In the TAPP group, wound infection at the infraumbilical port-site occurred in 2 patients; one of them was complicated by umbilical fistula that necessitated surgical excision performed 42 days after the repair. Fortunately no port-site hernia was noted in this patient and in any patient after 1year of follow up. In the TEP group, mild wound infection at port-site occurred in 3 patients which were successfully managed conservatively.

Inspite of the two daily doses of diclofenac sodium 75mg IM given to all patients during the period of hospital stay, 7 patients in TAPP group required extranalgesia while 6 patients in TEP group required extranalgesia. 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 **Figure(7)**.

Patients in both groups had nearly the same levels of pain (at rest and during normal activities) during the first week post-operative assessment period.

Patients in the TAPP group were able to resume normal activity and to return to work nearly as fast as the patients in the TEP group **Table(4)**.

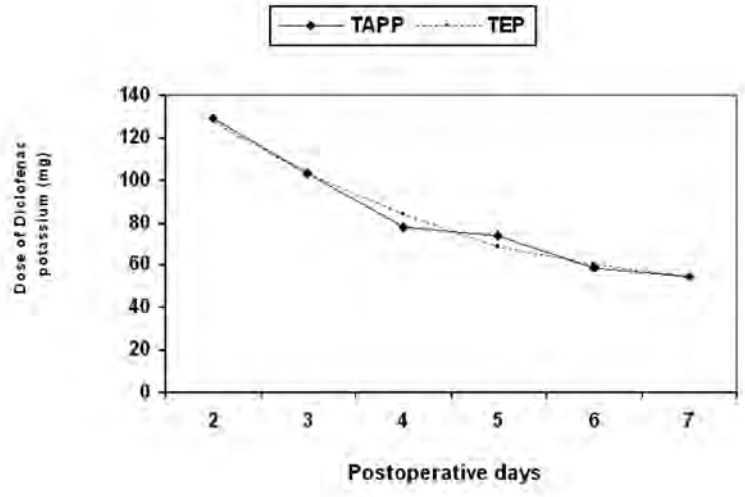

Figure (7): Mean dose of post-operative diclofenac potassium (50 mg tab) from 2nd post-operative day to day 7 after surgery.

Table (3): Early post-operative complications.

	TAPP	TEP
• Related death	0	0
• Urinary retention	2	3
• Wound infection	2	3
• Hematoma/seroma	4	5

Table (4): Post-operative recovery period in TAPP and TEP.

Variable (days)	TAPP	TEP
• Time to return to normal activity	7	7
• Time to return to work	12	10

Long term follow up:

Long term complications are shown in **Table(5)**. At 6 months of follow up, 3 patients in TAPP group complained of chronic pain. The site of pain is shown in **Table(6)**. 2 patients in the TEP group experienced pain at 6 months of follow up. At 1 year follow up these patients were all pain free.

During a period of 1 year follow up, recurrence had occurred in 1 patient in the TAPP group after 9 months of primary surgery. In the TEP group, recurrence also occurred in 1 patient after 4 months of primary surgery. These patients had undergone open Lichtenstein repair of the recurrent hernias.

A single case of post repair moderate hydrocele occurred in one patient in the TEP group, he was diagnosed after 1 year 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 in either group after a 1 year of follow up period.

Table (5): Long term complications.

Variable (days)	TAPP	TEP
• Pain at 6 months	3	2
• Pain at 1 year	0	0
• Recurrence	1	1
• Hydrocele	0	1
• Port-site hernia	0	0
• Umbilical fistula	1	0
• Internal hernia	0	0
• Intestinal obstruction	0	0
• Orchitis	0	0
• Testicular atrophy	0	0

Table (6): Site of chronic pain.

	TAPP	TEP
Site		
• Groin	1	1
• Testis	1	1
• Groin and testis	1	0

Discussion:

The National Institute for Clinical Excellence (NICE) issued in September 2004 their guidelines which included that laparoscopic surgery either TAPP or TEP is recommended as one of the treatment options for the repair of inguinal hernia.[6]

There are few trials that directly compare laparoscopic TAPP with laparoscopic TEP so that the choice of approach to the laparoscopic repair of inguinal hernia is still controversial. We conducted this study to directly compare both techniques in terms of operative and postoperative outcomes, learning curve, long term results and complications. A recently published Cochrane review compared the clinical effectiveness and relative efficiency of TAPP and TEP.[8]

The Cochrane search identified only one prospective randomized trial[9] that reported statistical difference between TAPP and TEP. According to this trial, no difference between TAPP and TEP in terms of length of operations, hematomas, time to return to usual activities and hernia recurrence was noted. Our results are consistent with this study in many points; we did not record any significant difference between both techniques as regard to postoperative pain, period of hospital stay, postoperative complications and recovery period. However, in our trial laparoscopic TEP had slightly longer operative time than TAPP. This is clearly attributed to the technique itself which seems to be more complex. Many authors agree with this opinion because the relatively small working space can be confusing until considerable experience is gained.[10] Learning curve plays an important role in this point. This is proved by the fact that difference in operative time between both procedures had significantly decreased in the last 10 operations.

Recurrence is the most important parameter in the evaluation of inguinal hernia repair. A large multi-center study[11] comparing recurrences following TAPP and TEP repairs concluded, after a mean follow- up period of 13 months, the recurrence rates to be 0.7% and 0.4% respectively; another concluded that there was no significant difference.[12] In our study, we did not find a difference between both groups. The cause of recurrence in our trial 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 two operations complicated by recurrence were performed in the first twenty patients in our study.

The data about complications from many studies of TAPP and TEP suggest that an increased number of visceral injury,[13,14] and port-site hernia[13-16] are associated with TAPP rather than TEP. There appear to be more conversions with TEP.[13,14,17] Vascular injuries[14,17,18] and deep/mesh infections[14,15,17] were very rare and there were no obvious difference between the groups.

In our study, no cases of major vessel injury or port-site hernia were recorded in either group. Whilst, a single case of bowel injury has been recorded in TAPP group and has been successfully managed. The rate of conversion in TEP group was slightly higher than in TAPP group.

According to many authors, TAPP procedure is preferred over TEP. The TAPP operation gives better view of the inguinal anatomy, the procedure also has a shorter learning curve when compared to TEP;[13] it is easier to learn and master.[19] TEP has been criticized of being technically difficult. The operating space is limited, and experience is required to become familiar with the anatomy from this perspective. In addition, care must be taken to avoid penetration of the peritoneum, as this will result in the creation of a pneumoperitoneum that will compromise the size of the extraperitoneal spaces.[20] TAPP procedure allows the assessment of opposite side as well, particularly regarding incidental defects.[21,22] On the contrary, one of the disadvantages of TEP procedure compared with TAPP approach is that unless the contralateral side is dissected, small asymptomatic contralateral hernias will be missed.[23] Another advantage of TAPP procedure is that other intraabdominal surgeries like cholecystectomy can be combined with it.[24] In TEP procedure this is not applicable. Furthermore, TAPP does not suffer the same risks of preperitoneal bleeding and oozing as can be seen in the TEP procedure.[21] One of the disadvantages of TEP operation is the high conversion rate compared with the TAPP approach.[13,14,17] These conversions usually occur as a result of tearing the peritoneum.[23]

Other authors consider TEP repair superior to TAPP repair because of less morbidity as well as lower recurrence rate and complications.[25,26] Closure of the peritoneal incision in TAPP procedure can be problematic. Furthermore, pneumoperitoneum is associated with considerably more postoperative problems than pneumoextraperitoneum.[27]

TEP procedure does not destroy the virginity of the abdominal cavity, and therefore, has lower complications.[28]

In TAPP the abdominal cavity is entered, leading to the possibility of injury to the intraperitoneal contents.[14,25,29] Small bowel obstruction can be a late complication of TAPP, either from intraabdominal formation of adhesions, or from intestines being trapped in a defect left in the peritoneum which was inadequately re-approximated. Internal hernias caused by a defect in the peritoneum, however, have been reported on several occasions with the TAPP repair and in one patient who had a TEP hernioplasty.[11,30,31] An increased number of port-site hernias are associated with TAPP rather than TEP.[13-16]

Surgeons who prefer TEP technique must be also able to do TAPP procedure. In some cases during the TEP approach a big peritoneal tear may happen, and the surgeon can not proceed with TEP. If the surgeon knows how to perform TAPP technique he can easily switch to it; otherwise conversion to open technique is mandatory.[28]

Conclusion:

After studying and interpreting the advantages and disadvantages of both techniques performed in our study we find that the most important advantage of TAPP procedure is that it is easier to learn and master when compared to the more complex TEP procedure. However, TEP procedure has a great advantage; the abdominal cavity is not entered and therefore, much of the feared morbidity related to TAPP is avoided.

In conclusion, TEP technique when mastered is the procedure of choice in laparoscopic repair of inguinal hernia. TAPP could be a good alternative rather than open conversion in case of peritoneal tear occurring during TEP approach aborting the procedure.

Therefore, surgeons performing TEP technique must know well how to do TAPP procedure both efficiently and safely.

References:

1- Ger R: The laparoscopic management of groin hernias. *Contemp Surg* 1991; 39(4): 15-19.

2- Arregui ME, Davis CJ, Yucel O, et al: Laparoscopic mesh repair of inguinal hernia using a preperitoneal approach: A preliminary report. *Surg Laparosc Endosc* 1992; 2: 53-58.

3- Dion YM, Morin J: Laparoscopic inguinal herniorraphy: *Can J Surg* 1992; 35: 209-212.

4- Philips EH, Carroll BJ, Fallas MF: Laparoscopic preperitoneal inguinal hernia repair without preperitoneal incision: Technique and early results. *Surg Endosc* 1993; 7: 159-162.

5- McKernan JB, Laws HL: Laparoscopic repair of inguinal hernias using a totally extraperitoneal prosthetic approach. *Surg Endosc* 1993; 7: 26-28.

6- Snehal F: Laparoscopic versus open repair of inguinal hernia. *World J Laparosc Surg* 2008; 1(1): 41-48.

7- Deepraj S, Manu S, Tehemton E: Laparoscopic surgery for inguinal hernia: Current status and controversies. *J Minim Access Surg* 2006; 2(3): 178-186.

8- Wake BL, McCormack K, Fraser C, et al: Transabdominal pre-peritoneal (TAPP) vs totally extraperitoneal (TEP) laparoscopic techniques for inguinal hernia repair. *The Cochrane database of systematic reviews* 2005; issue 1. Art. No: CD004703.pub2. D01: 10.1002\14651858.CD004703.pub2.

9- Schrenk P, Woisetschlager R, Rieger R, et al: Prospective randomized trial comparing postoperative pain and return to physical activity after transabdominal preperitoneal, total preperitoneal or Shouldice technique for inguinal hernia repair. *Br J Surg* 1996; 83: 1563-1566.

10-Robert J, Jose C, Nam X, et al: Laparoscopic inguinal herniorrhaphy: Results of a multicenter trial. *Ann Surg* 1995; 221(1): 3-13.

11-Tetik C, Arregui ME, Dulucq JL, et al: Complications and recurrences associated with laparoscopic repair of groin hernias. A multi-institutional retrospective analysis. *Surg Endosc* 1994; 8: 1316-1323.

12-Fitzgibbons RJ, Camps J, Cornet DA, et al: Laparoscopic inguinal herniorrhaphy. Results of a multicenter trial. *Ann Surg* 1995; 221: 3-13.

13-Cohen RV, Alvarez G, Roll S, et al: Transabdominal or totally extraperitoneal laparoscopic hernia repair? *Surg Laparosc Endosc* 1998; 8: 264-268.

14-Felix EL, Michas CA, Gonzalez MH: Laparoscopic hernioplasty. TAPP vs TEP. *Surg Endosc* 1995; 9: 984-989.

15-Tamme C, Scheidbach H, Hampe C et al: Totally extraperitoneal endoscopic inguinal hernia repair (TEP). *Surg Endosc* 2003; 17: 190-195.

16-Weiser HF, Klinge B: Endoscopic hernia repair-Experiences and characteristic features.*Viszeralchirurgie* 2000; 35: 316-320.

17-Van Hee R, Goverde P, Hendrickx L, et al: Laparoscopic transperitoneal versus extraperitoneal inguinal hernia repair: A prospective clinical trial. *Acta Chir Belg* 1998; 98: 132-135.

18-Lepere M, Benchetrit S, Debaert M, et al: A multicentric comparison of transabdominal versus totally extraperitoneal laparoscopic hernia repair using parietex meshes. *J Soc Laparoendosc Surg* 2000; 4: 147-153.

19-David S: Laparoscopic transabdominal pre-peritoneal (TAPP) repair of groin hernia: One surgeon's experience of a developing technique. *Ann R Coll Surg Engl* 2002; 84: 393-398.

20-Annibali RG, Fitzgibbons RJ, Filipi C, et al: Laparoscopic inguinal hernia repair. In: Endoscopic surgery. Frederic L, Jeffrey L (Editors); Philadelphia: WB Saunders (Publisher); 1994; p. 352-386.

21-Thumbe VJ, Evans DS: To repair or not to repair incidental defects found on laparoscopic repair of groin hernia: Early results of a randomized control trial. *Surg Endosc* 2001; 15: 47-49.

22-Bittner R, Leibl BJ, Jager, et al: TAPP-Stuttgart technique and result of large single center series. *J of Min Access Surg* 2006; 2(3): 158-159.

23-David W, Caron P, Neil S, et al: Five-year follow-up of patients undergoing laparoscopic or open groin hernia repair: A randomized controlled trial. *Ann Surg* 2002; 235(3): 333-337.

24-Kriplani AK, Shyam S, Daipayan G: Laparoscopic transabdominal pre-peritoneal (TAPP) repair of inguinal hernia. Kriplani A, Bhatia P, Prasad A, Govil D,Garg H (Editors); New Delhi: Sagar printer (Publisher); 2007; p. 119-130.

25-The MRC Laparoscopic Groin Hernia Trial Group: Laparoscopic versus open repair of groin hernia: A randomized comparison. *Lancet* 1999; 354: 185-190.

26-Leibl BJ, Jager C, Kraft B, et al: Laparoscopic hernia repair: TAPP or/and TEP? *Arch Surg* 2005; 390: 77-82.

27-Dulucq JL: Laparoscopic treatment of inguinal hernia: The extraperitoneal approach. In: Laparo-Endoscopic Surgery. Iris B (Editor); Oxford: Blackwell Science (Publisher); 1996; p. 257-261.

28-Sabanci U, Ogun I, Candemir G: Laparoscopic inguinal hernia repair results of a military hospital in Turkey. *Balkan Military Medical Review* 2007; 10: 132-135.

29-Ramshaw BJ, Tucker JG, Conner T, et al: A comparison of the approaches to laparoscopic herniorrhaphy. *Surg Endosc* 1996; 10: 29-32.

30-Phillips E, Arregui M, Carrol J, et al: Incidence of complications following laparoscopic hernioplasty. *Surg Endosc* 1995; 9: 16-21.

31-Azur D, Schuricht A, Stoldt S, et al: Small bowel obstruction following endoscopic extraperitoneal-preperitoneal herniorrhaphy. *J Laparoendosc Surg* 1995; 5(4): 263-266.