Outcome of the laparoscopic total extraperitoneal approach with direct dissection and mesh hernioplasty in the treatment of inguinal hernias

Osama H. Abd-Raboh, Taha A. Ismael, Hamdy A.H. Mohamed, Mostafa M. El-Sheikh

Department of General Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt

Correspondence to Osama H. Abd-Raboh, MD, Department of General Surgery, Faculty of Medicine, Tanta University, Tanta, Egypt; Tel: +20 100 174 4874; e-mail: dr_osama_hassan@med.tanta.edu.eg

Received 14 October 2016
Accepted 15 November 2016

The Egyptian Journal of Surgery
2017, 36:124–130

Aim
The aim of this study was to evaluate the laparoscopic total extraperitoneal (TEP) approach with direct telescopic dissection and mesh hernioplasty for inguinal hernias.
Patients and methods
This study was conducted at the Gastrointestinal, Liver, and Laparoscopic Surgery Unit, General Surgery Department, Tanta University Hospital, over the period from 1 January 2014 to last of June 2015 on 20 patients having inguinal hernias.
Results
This prospective study included 20 adult patients with primary unilateral inguinal hernias, and all of them were males. The age of patients ranged from 22 to 64 years. There were 11 (55%) patients with right inguinal hernias and nine (45%) patients with left inguinal hernias. The mean operative time was 99.30±25.13 min (range: 60–160 min). The mean analgesia time was 3.75±1.62 days (range: 2–7 days). Twenty-four hours postoperatively, mean visual pain score was 2.8±1.15. There was one (5%) case with scrotal edema. Minor surgical emphysema occurred in two (10%) cases. Hospital stay ranged from 1 to 3 days, and the mean value was 1.35± 0.67 days. The mean time until return to work was 14.8±4.26 days (range: 7–21 days). The mean follow-up time was 7.6±2.1 months (range: 6–12 months). There were no reported cases of hernia recurrences.
Conclusion
The laparoscopic TEP repair is an excellent alternative to open preperitoneal repair of inguinal hernias. The operative time was relatively long, but comparable with many studies discussing the TEP technique, which improved over the time of the study, indicating the need for a long learning curve. This technique was proved to be safe, as it was not associated with major morbidity or recurrence. The complication rate was average as compared with other studies, and there was no hernia recurrence during the follow-up period.

Keywords:
laparoscopic hernia repair, telescopic dissection, total extraperitoneal

Egyptian J Surgery 36:124–130

1110-1121

Introduction

Inguinal hernia is the most common type of hernias. More than 70% of all hernias that occur are inguinal [1]. In 1986, Lichtenstein advocated an open on-lay mesh repair applied over the internal oblique fascia. This was in the era of tension-free repairs using meshes [2]. The laparoscopic approach for inguinal hernia repair was first reported by Ger [3], who performed a high ligation of the sac without mesh placement. In 1993, the laparoscopic total extraperitoneal (TEP) approach was reported by McKernan [4]. The TEP approach allows for mesh placement within the preperitoneal space, without entering the abdominal cavity, avoiding incision and closure of the peritoneum that is typically required in the transabdominal preperitoneal approach [5]. The creation of a preperitoneal space is an important first step in TEP hernia repair. Balloon dissection is the most commonly used method to create extraperitoneal space, and it is said to be helpful during the learning curve [6]. Commercially available balloons are expensive and associated with the risks of bleeding, rupture of balloon, rupture of the bladder neck, and need blind dissection without visualizing the important structures [7].

Patients and methods

This study was conducted at the Gastrointestinal, Liver, and Laparoscopic Surgery Unit, General Surgery Department, Tanta University Hospital,

 DOI: 10.4103/1110-1121.204525

over the period from 1 January 2014 to last of June 2015 on 20 patients having inguinal hernia. Our aim was to evaluate the laparoscopic TEP approach with direct telescopic dissection and mesh hernioplasty in the treatment of inguinal hernias. This included evaluation of operative time, hospital stay, postoperative morbidity, and recurrence.

All our patients were adults with unilateral primary inguinal hernias.

Exclusion criteria included the following: recurrent, sliding, and complicated hernias, previous lower abdominal incision or preperitoneal operations, and patients with severe comorbidities (American Society of Anesthesiologists class >III).

All patients were subjected to full history taking and full clinical and laboratory examinations. Informed written consent was obtained from all participants after explaining the benefits, possible risks, and about recording of the procedure.

Position and anesthesia

Patients rested in the supine position on the operating table. After general anesthesia administration, a routine scrubbing with betadine 7.5% of the entire abdominal wall up to the nipple line, penis, scrotum, and the upper halves of both thighs was carried out. The surgeon stood on the side opposite to the hernia, the assistant stood beside the surgeon toward the head of the patient, and the monitor was placed at the patient's leg at the same side of the hernia. After insertion of the first trocar and telescope, the table was set up with a 15° Trendelenburg tilt (Fig. 1).

Technique

A transverse, subumbilical, 1.5 cm incision was made slightly to the side of the hernia. The anterior rectus sheath was incised transversely between two stay sutures of Vicryl 0. The rectus muscle was retracted laterally, and a small tunnel at midline was made in the direction of the pubis, between the rectus muscle and the preperitoneal fat, first by finger dissection and then by insertion of the first trocar (10 mm trocar).

After insertion of the first trocar between the rectus muscle anteriorly and the posterior rectus sheath posteriorly, we started insufflation with CO_2 at a pressure of 14 mmHg.

As the posterior rectus sheath ends at the line of Douglas (arcuate line), the telescope (0°, 10 mm) passed on top of the posterior rectus sheath will automatically fall into the extraperitoneal space. CO_2 gas insufflation facilitates separation of the preperitoneal loose areolar tissue, which is mostly avascular.

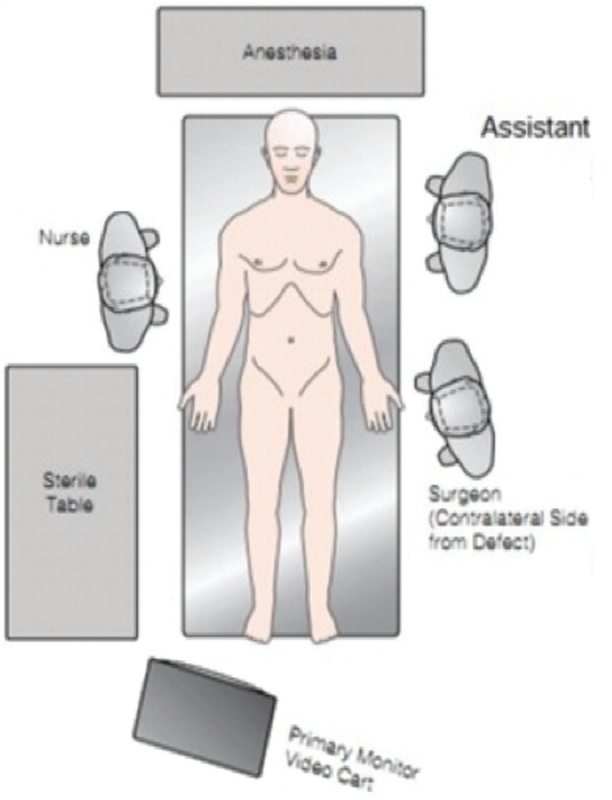
The telescope itself was used for dissection of the midline tunnel down to the symphysis pubis.

After enough space was created by the telescope, the two 5 mm operating ports were inserted under visualization at the midline – the first two fingers' breadth superior to the symphysis pubis and the other midway between the other two ports (5 cm at least above the suprapubic port) (Fig. 2).

After insertion of all trocars (30°, 10 mm.), the telescope was inserted to facilitate further instrumental dissection of the preperitoneal space.

Two blunt graspers or one grasper with a Maryland grasper were used for further dissection of loose areolar tissue, first at the midline until complete visualization of the posterior surface of the pubic bone and space of Retzius. Identification of inferior epigastric vessels is an important landmark that appears in the ceiling of the field (Fig. 3).

Figure 1

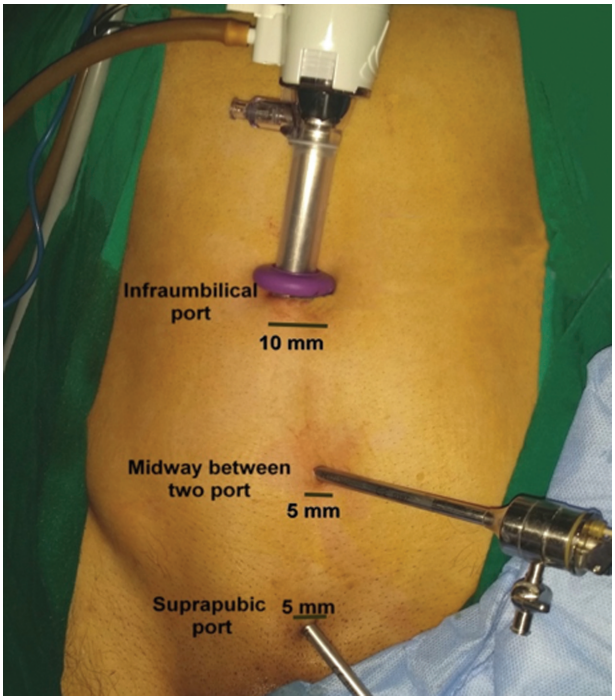


Position of surgical team.

External downward traction on the ipsilateral testis facilitates identification of cord structures lateral and below the inferior epigastric vessels through the internal ring associated with the indirect (oblique) peritoneal sac (Fig. 4).

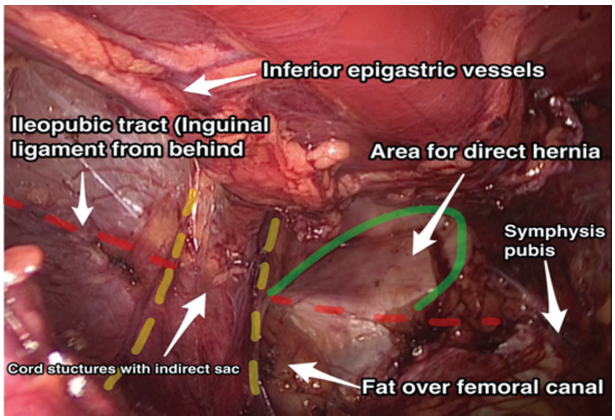
The hernial sac was identified and reduced. The sac was freed from the cord structures by traction and counter traction by the other hand. Parietalization of cord structures by peeling off the peritoneum was performed, continuing the dissection cranially from the internal ring till the crossing of the vas deferens with external iliac vessels and freeing all bands extending from the peritoneum to the parietal wall (Fig. 5).

Figure 2



Trocars positioning.

Figure 3



Laparoscopic view of groin area.

A direct hernia sac is usually dissected easily and reduced with midline dissection, whereas the fascial defect appears medial to inferior epigastric vessels and cord structures.

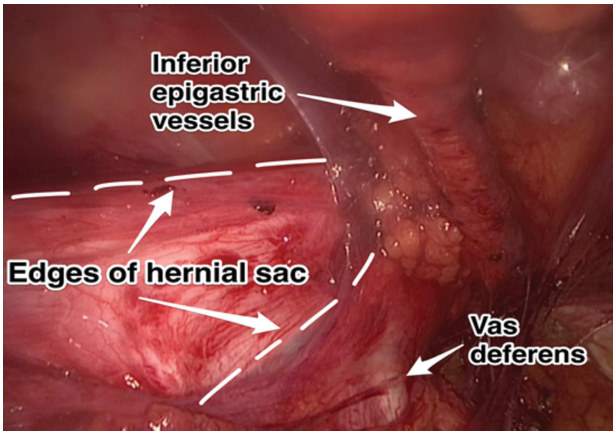
Blunt dissection of the lateral space between inferior epigastric vessels superiorly and cord structures inferiorly is carried out until reaching the anterior superior iliac spine laterally and visualization of the psoas muscle inferiorly (Fig. 6).

Mesh insertion

A 12×15 cm, fashioned, polypropylene mesh was rolled lateral to medial and was introduced through the 10 mm infraumbilical port and unfolded medial to lateral (Figs 7–9).

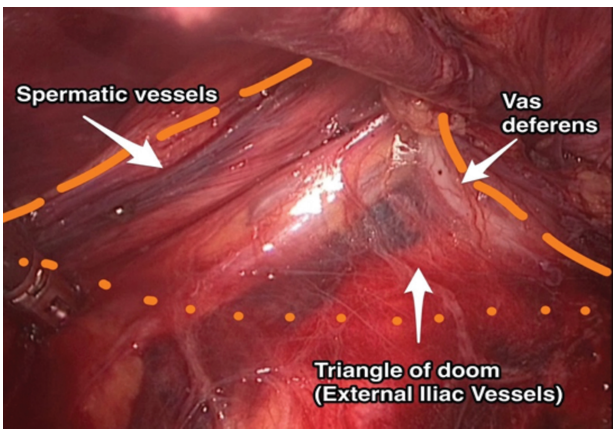
The mesh should lie unfolded in the preperitoneal space with the cord structures parietalized. The lower edge must extend well below the level of the inguinal ligament (Fig. 10). The lateral part of the

Figure 4



Laparoscopic view of groin area.

Figure 5



Triangle of doom.

patch should fold over and extend beyond the iliac vessels. A 14-F suction drain was used in all cases to prevent hematoma and to drain any remaining gas in the scrotum and preperitoneal space to help mesh incorporation in the preperitoneal space. The drain was inserted through a lower 5 mm suprapubic port. The gas was released under direct vision, ensuring that the inferior border of the mesh will not roll up; the mesh was not fixed in all cases in this study.

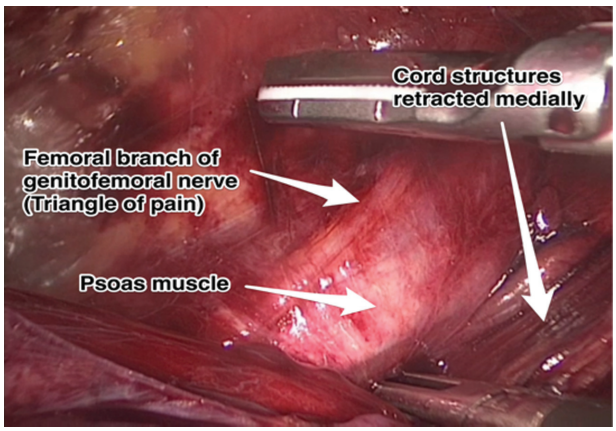
Follow-up

All patients were followed-up for at least 6 months postoperatively; follow-up was carried out a on weekly basis during the first month and monthly thereafter for any complications – for example, chronic pain or recurrence.

Results

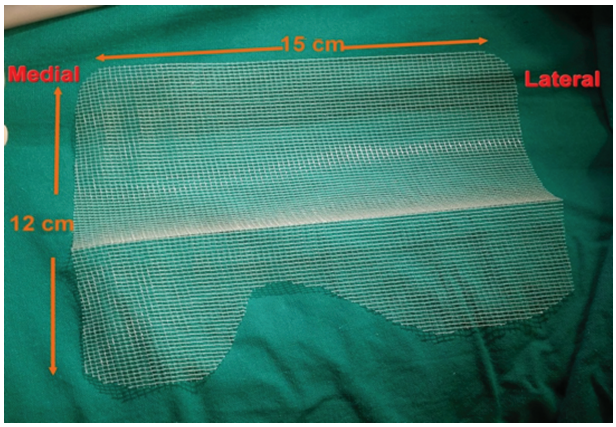
This prospective study included 20 adult patients with primary unilateral inguinal hernias, and all of them were males. The age of our patients ranged from 22 to 64 years, with a mean age of 39.60±11.46 years. Eight (40%) patients were nonsmokers, seven (35%) were

Figure 6



Lateral dissection and psoas muscle.

Figure 7

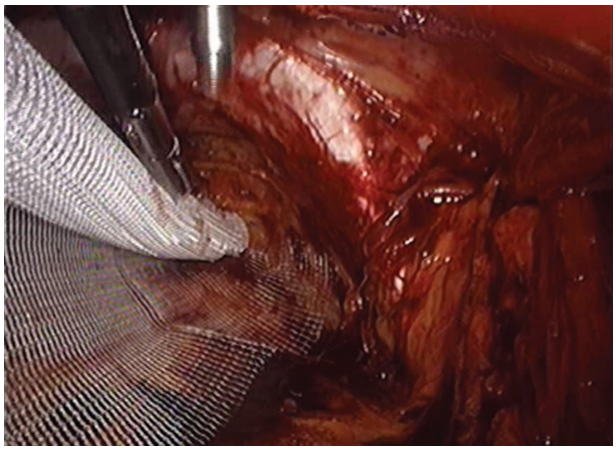


Fashioned polypropylene mesh.

Figure 8

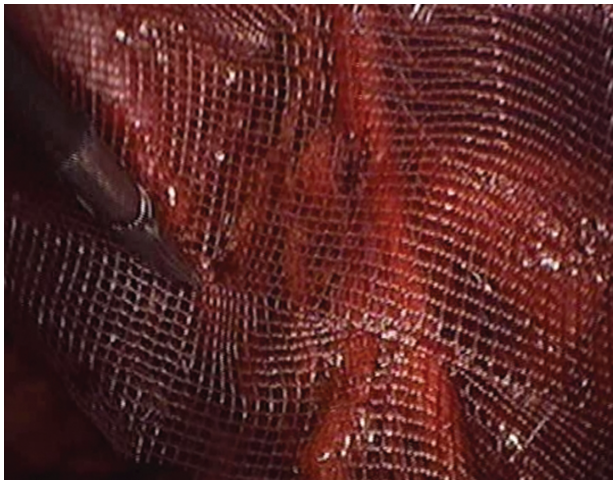
Mesh insertion via 1st trocar.

Figure 9



Unfolding of mesh.

Figure 10



Mesh completely unfolded.

mild smokers, and five (25%) patients were heavy smokers. There were 11 (55%) patients with right inguinal hernias and nine (45%) patients with left inguinal hernias.

Intraoperatively, four (20%) patients were shown to have direct inguinal hernias, whereas 14 (70%) patients had indirect inguinal hernias. In two (10%) patients, combined direct and indirect hernial defects were present. The mean operative time was 99.30 ±25.13 min (range: 60–160 min) (Table 1).

In four (20%) patients, peritoneal tears occurred during dissection of the indirect sac with gas leak into the peritoneal space. Insertion of a Veress needle through the subumbilical incision to the peritoneal space was efficient as a vent in three cases. In the fourth case, we used a 16-F cannula instead of a Veress needle. In all four cases, the operative field was sufficient to complete the operation regularly. All cases of this study underwent surgery through the TEP approach with no conversion to transabdominal preperitoneal or the open approach.

All patients needed two injections of analgesia on the first postoperative day to relieve pain, and needed two to three oral doses per day of analgesics until they were pain free. The mean time for analgesia was 3.75±1.62 days (range: 2–7 days). The mean visual pain score was 2.8±1.15 24 h postoperatively (Table 2).

In our study, there was one (5%) case of scrotal edema. Minor surgical emphysema occurred in two (10%) cases and resolved over the following 2 days postoperatively. One case had minor superficial infection in the subumbilical port incision after 1 week, which resolved after antibiotic therapy with daily dressing.

The drain was removed from all patients after 24 h with 20–50 ml. of serosangenous discharge. Hospital stay ranged from 1 to 3 days, and the mean value was 1.35 ±0.67 days (Table 3). The mean time until return to work was 14.8±4.26 days (range: 7–21 days).

The mean follow-up time was 7.6±2.1 months (range: 6–12 months). There were no reported cases of hernia recurrences during the follow-up in our study.

Discussion

Tension-free prosthetic inguinal hernial repairs are much more favored nowadays in view of the uniformly reported good results and low recurrence rates [8]. Laparoscopic hernioplasty has been proved to be an effective minimally invasive operation with low recurrence rates when performed correctly [9]. TEP is more expensive and technically demanding with a steep learning curve [10], but with less postoperative pain, reduced recovery time, and easier repair of recurrent and bilateral hernias with the highest possible ligation of the sac [11].

Regarding operative time, although some studies have shown very short operative times for TEP (17±6 min) in 3100 hernia repairs over 15 years [12], this is not always the case. Kuhry *et al.* [13] found that 10 out of 15 trials reported a TEP repair to be associated with an increased duration of surgery compared with open repair. A study comparing balloon dissection versus direct telescopic dissection in TEP showed no difference in the mean operative time between two groups (77.5±24.1 vs. 74.2±24.4 min) [7]. In our study, the mean operative mean time was 99.30± 25.13 min (range 60–160 min), which was longer than many other studies. This can be attributed to a longer learning curve for endoscopic hernia repair than open repairs due to the limited working space and different appreciation of the anatomical landmarks [14].

Direct hernias are easily reduced. At times, a long indirect sac cannot be completely reduced from the deep inguinal ring and is divided, with the peritoneal side being ligated with a laparoscopic suture [15]. In this study, three indirect (oblique) hernias with long

Table 1 Operative time

Operative time (min)	*n* (%)
60–80	4 (20)
80–100	8 (40)
100–120	5 (25)
120–140	1 (5)
140–160	2 (10)

Table 2 Visual analog pain scale 24 h postoperatively

	n (%)
2	11 (55)
3	5 (25)
4	2 (10)
5	1 (5)
6	1 (5)

Table 3 Postoperative hospital stay

Hospital stay (days)	*n* (%)
1	15 (75)
2	3 (15)
3	2 (10)

sacs necessitated proximal ligation of the sac with extracorporeal knotting.

We did not fix the mesh in place in this study. Some investigators advocated not fixing the mesh in place [16]. This idea was bolstered by Stoppa's success with nonfixation of a mesh in an open preperitoneal operation [17]. A recently published meta-analysis of six randomized controlled trials on laparoscopic inguinal hernia repair through the TEP approach concluded that the nomesh fixation was not associated with higher recurrence rate but lower cost was an advantage [18].

Peritoneal tears in TEP are the most common reason for conversion and predispose patients to small bowel adhesions. Loss of preperitoneal space may require switching to another technique. Placing a Veress needle into the abdomen to evacuate the intra-abdominal gas in minute perforations or closure by loop ligation, pretied suture, endoscopic stapling, and endoscopic suturing is mandatory [19]. In our study, peritoneal tears were dealt with insertion of a Veress needle through a subumbilical incision to the peritoneal space, which was efficient as a vent in three cases. In the fourth case, we used a 16-F cannula instead of a Veress needle. In all four cases, the operative field was sufficient to complete the operation regularly, and the peritoneal tears were small with no need for ligation or sutures.

In our study, intensity of pain was recorded 24 h postoperatively. The mean visual pain score was 2.8 ±1.15. This was comparable with other studies recording postoperative pain after 24 h of TEP; 79.7% of patients had a score of 2 [20], 4.8±2.33 [21], and 2.9 ±1.3 [7].

There were complaints of chronic groin pain during follow-up in this study. The incidence of chronic pain after endoscopic hernia repair varies between 1 and 16% [22]. Postoperative pain (acute or chronic) is a potential complication; injury to the nerves during dissection is a common cause of chronic pain. Such injury can be avoided by gentle dissection in the triangle of pain and not fixing the mesh [23].

There were no reported cases of intraoperative serious visceral or vascular complications in this study. This is in agreement with the results of other studies [21]. In our study, 25% of patients developed postoperative minor complications in the form of scrotal edema (5%), surgical emphysema (10%), and superficial wound infection (5%). Seroma and scrotal edema are frequent complications after laparoscopic repair of inguinal hernias, with a reported incidence ranging from 1.9 to 11.7% [24]. A closed, suction drain can be used to reduce the risk of seroma formation without increased the risk of infection [25]. In our study, a 14-F suction drain was used in all cases to prevent hematoma and to drain any remaining gas from the scrotum and preperitoneal space. However, the amounts collected by the drain were small (20–50 ml), and therefore we do not recommend routine use of drains in such cases. Incidence of subcutaneous emphysema is reported to be in the range 2.2–56% [26,27]. Superficial infections are rare after endoscopic techniques. The risk is probably about 1–3% for open surgery and less than 1% after endoscopic surgery [28]. There was one (5%) patient in our study who developed a superficial infection that was treated conservatively. Elective primary abdominal reconstruction with mesh is considered a clean surgery, with infection rates of up to 8% being reported [29]. Another study showed no difference between open and endoscopic approaches regarding wound infection rate (4.5 vs. 3.3%) [30,31].

Dulucq *et al.* [12] studied laparoscopic TEP inguinal hernia repair retrospectively for 15 years on 3100 hernia repair cases and showed that the recurrence rate was 0.46%. The recurrence rate for the first 200 repairs was 2.5%, but it decreased to 0.47% for the subsequent 1254 hernia repairs. Kuhry *et al.* [13] showed that most trials (n=14) reported no differences in recurrence rates after either TEP or open repair. In our study, there were no reported cases of hernia recurrence during follow-up. In our opinion, these excellent results can be confirmed only by studying large number of cases and for longer periods of time.

In this study, hospital stay ranged from 1 to 3 days, and the mean value was 1.35±0.67 days. These results coincided with the results of the others such as Cheah *et al.* [32], who found a mean hospital stay in the laparoscopic TEP group of 1.4 days, [33], who found a mean value of 1.48 days, and [12], who found a mean value of 1.5±0.4 days.

In this study, the mean time until return to work was 14.8±4.26 days (range: 7–21 days). Small incision and reduced postoperative pain after laparoscopic TEP are the causes for early ambulation and return to normal activities [34]. Liem *et al.* [35,36] proved that patients who underwent laparoscopic repairs regained their physical strength faster than those who underwent conventional hernia repairs.

Conclusion

The laparoscopic TEP repair is an excellent alternative to open preperitoneal repair for inguinal hernias with the ability of using a large mesh to cover all inguinal potential defects with a much better visualization of anatomical landmarks.

The operative time was relatively long but still comparable with many studies discussing the TEP technique, and showed improvement over the time of the study, indicating the need for a long learning curve. The TEP method proved to be cost-effective, as we tried in this study to reduce the overall cost by using telescopic dissection without balloon and without mesh fixation, without any need to convert to other techniques in all our patients. This technique was proved to be safe, as it was not associated with any major morbidity or recurrence. The complication rate was average compared with other studies, and there was no hernia recurrence during follow-up.

We recommend the use of the TEP technique for uncomplicated inguinal hernia repairs. Future studies with large number of cases and extended periods of follow-up are needed to confirm our results.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Zollinger RM. Classification systems for groin hernias. Surg Clin North Am 2003; 83:1053–1063.

2 Kurzer M, Belsham PA, Kark AE. The Lichtenstein repair for groin hernias. Surg Clin North Am 2003; 83:1099–1117.

3 Ger R, Monroe K, Duvivier R, Mishrick A. Management of indirect inguinal hernias by laparoscopic closure of the neck of the sac. Am J Surg 1990; 159:370–373.

4 Mckernan JB, Laws HL. Laparoscopic repair of inguinal hernia by total extraperitoneal approach. Surg Endosc 1993; 7:26–28.

5 Bruce R. Laparoscopic total extraperitoneal inguinal hernia repair. Oper Tech Gen Sur 2006; 8:34–44.

6 Froeling FM, Deprest JA, Ankum WM, Mendels EL, Meijer DW, Bannenberg J. Controlled balloon dilatation for laparoscopic extraperitoneal bladder neck suspension in patients with previous abdominal surgery. J Laparoendosc Adv Surg Tech A 2000; 10:27–30.

7 Misra C, Kumar S, Bansal V. Total extraperitoneal (TEP) mesh repair of inguinal hernia in the developing world: comparison of low-cost indigenous balloon dissection versus direct telescopic dissection: a prospective randomized controlled study. Surg Endosc 2008; 22:1947–1958.

8 Cuschieri A. Disorders of abdominal wall and peritoneal cavity: hernias. Section 6. In: Cuschieri A, Steele RJC, Rahim Moosa A, editors. Essential surgical practice. 4th ed. London, UK: Arnold; 2002. 8. pp. 167–179.

9 Reddick EJ, Morton CE, Bradham WG, O'Reilly MJ. Kugel herniorrhaphy: an outpatient option to laparoscopic hernia repair. Sixth World Congress of Endoscopic Surgery. Rome, Italy; 3–6 June 1998.

10 Anniballi R, Fitzgibbon JR. Operative strategies in laparoscopic surgery. Berlin, Germany: Soringer; 2005. pp. 57–82.

11 Fitzgibbons RJ, Filipi CJ, Quinn TH. Inguinal hernia [Chapter 36]. In: Brunicardi F, Anderson D, Dunn D, editors . Scwartz's principles of surgery. Vol. 4. 8th ed. McGraw-Hill; 2005. pp. 1353–1394.

12 Dulucq JL, Wintringer P, Mahajna A. Laparoscopic totally extraperitoneal inguinal hernia repair: lessons learned from 3,100 hernia repairs over 15 years. Surg Endosc 2009; 23:482–486.

13 Kuhry E, van Veen RN, Steyerberg EW, Jeekel J. Open or endoscopic total extraperitoneal inguinal hernia repair? A systematic review. Surg Endosc 2007; 21: 161–166.

14 Schouten N, Simmermacher RKJ, Dalen TV, Smakman N, Clevers GJ, Davids PHP, *et al.* Is there an end of the 'learning curve' of endoscopic totally extraperitoneal (TEP) hernia repair? Surg Endosc 2013; 27:789–794.

15 Ferzli G, Shapiro K, Chaudhry G, Patel S. Laparoscopic extraperitoneal approach to acutely incarcerated inguinal hernia . Surg Endosc 2004; 18:228–231.

16 Van Steensel CJ, Weidema WF. Laparoscopic inguinal hernia repair without fixation of the prosthesis. In: Arregui ME, Nagan RF, editors. Inguinal hernia: advances or controversies?. New York, NY, USA: Radcliffe Medical Press; 1994. pp. 435–436.

17 Stoppa R, Henry X, Verhaeghe P. Repair of inguinal hernias without tension and without suture using a large Dacron mesh prosthesis and by preperitoneal approach: a method of reference for selective indication. Ann Chir 1996; 50:808–813.

18 Teng YJ, Pan SM, Liu YL, Yang KH, Zhang YC, Tian JH, Han JX. A meta-analysis of randomized controlled trials of fixation versus nonfixation of mesh in laparoscopic total extraperitoneal inguinal hernia repair. Surg Endosc 2011; 25:2849–2858.

19 Lau H, Patil NG, Yuen WK, Lee F. Management of peritoneal tears during endoscopic total extraperitoneal hernia repair. Surg Endosc 2002; 16:1474–1477.

20 Garg P, Rajagopal M, Varghese V, Ismail M. Laparoscopic total extraperitoneal inguinal hernia repair with nonfixation of the mesh for 1,692 hernias. Surg Endosc 2009; 23:1241–1245.

21 Hamza Y, Gabr E, Hammadi H, Khalil R. Four-arm randomized trial comparing laparoscopic and open hernia. Int J Surg 2010; 8:25–28.

22 Burgmans JPJ, Schouten N, Clevers GJ, Verleisdonk EJMM, Davids PHP, Voorbrood CEH, *et al.* Pain after totally extraperitoneal (TEP) hernia repair might fade out within a year. Hernia 2015; 19:579–585.

23 Stark E, Oestreich K, Wendl K, Rumstadt B, Hagmuller E. Nerve irritation after laparoscopic hernia repair. Surg Endosc 1999; 13:878–881.

24 Lau H, Lee F. Seroma following endoscopic extra-peritoneal inguinal hernioplasty, Surg Endosc 2003; 17:1773–1777.

25 Bittner R, Montgomery MA, Arregui E, Bansal V, Bingener J, Bisgaard T, *et al.* Update of guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endohernia Society). Surg Endosc 2015; 29:289–321.

26 Singh K, Singhal A, Saggar VR, Sharma B, Sarangi R. Subcutaneous carbon dioxide emphysema following endoscopic extraperitoneal hernia repair: possible mechanisms. J Laparoendosc Adv Surg Tech A 2004; 14:317–320.

27 Murdock CM, Wolff AJ, van Geem T. Risk factors for hypercarbia, subcutaneous emphysema, pneumothorax and pneumo-mediastinum during laparoscopy. Obstet Gynecol 2000; 95:704–709.

28 Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J, *et al.* European Hernia Society guidelines on the treatment of inguinal hernia in adult patients in adult patients. Hernia 2009; 13:343–403.

29 Falagas ME, Kasiakou SK. Mesh-related infections after hernia repair surgery. Clin Microbiol Infect 2005; 1:3–8.

30 Finan KR, Vick CC, Kiefe CI, Neumayer L, Hawn MT. Predictors of wound infection in ventral hernia repair. Am J Surg 2005; 190:676–681.

31 Falagas ME, Makris GC. Mesh-related infections after hernia repair [Chapter 13]. In: Schumpelick V, Fitzgibbons RJ, editors . Hernia Repair Sequelae. Springer Medizin; 2010. pp. 97–102.

32 Cheah WK, So JB, Lomanto D. Endoscopic extra-peritoneal inguinal hernia repair. Singapore Med J 2004; 45:267–270.

33 Halm J, Hiesterkamp J, Boelhouer R. Totally extraperitoneal repair of inguinal hernia. Surg Endosc 2005; 19:1373–1376.

34 Colack T, Akca T, Aydin S. Randamized clinical trial comparing laparoscopic totally extraperitoneal approach with open mesh repair of inguinal hernia repair. Surg Laparosc Endosc Percutan Tech 2003; 13:191–195.

35 Liem MS, van Der Graaf Y, Zwart RC, Vroonhoven TJ. A randomized comparison of physical performance following laparoscopic and open inguinal hernia repair. Br J Surg 1997; 84:64–67.

36 Ujiki MB, Gitelis ME, Carbray J, Lapin B, Linn J, Haggerty S, *et al.* Patient-centered outcomes following laparoscopic inguinal hernia repair. Surg Endosc 2015; 29:2512–2519.