Laparoscopic Repair of Inguinal Hernia Using Two Layers of Mesh with Reinforcement of the Inner Mesh by 2 Sutures

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Purpose : *To determine the effectiveness of the laparoscopic repair of inguinal hernia using two layers of mesh with reinforcement of the inner mesh by 2 sutures.*

Patients and Method : *The hernias included primary, direct, indirect, bilateral inguinal hernias and 5 recurrent inguinal hernias. The present report described laparoscopic repair by the total extraperitoneal mesh placement (TEP) technique using two layers of polypropylene mesh with the inner mesh reinforced by 2 sutures in 20 adult patients with 22 hernias.*

Results : *The operations were successfully performed on all the patients with 1 complication (5.00%) which was treated by surgical procedure. There was no recurrence with a follow-up of 10.27 $\pm$ 5.96 months (range1.10-20.00 months).*

Conclusions : *The report has shown that this operation can be used to treat primary, recurrent, direct, indirect, and bilateral inguinal hernias in adults with no recurrence in a short term follow-up.*

Keyword : *Hernias, Laparoscopic herniorhaphy*

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The increased popularity of minimally invasive methods over the past decade has also included repair of groin hernias which has become an accepted procedure[1]. The present report describes laparoscopic repair by the total extraperitoneal mesh placement (TEP) technique using two layers of polypropylene mesh with the inner mesh reinforced by 2 sutures in 20 patients with a total of 22 hernias.

There are several methods for laparoscopic hernial repair which include; a transabdominal intraperitoneal onlay of mesh (IPOM), a transabdominal preperitoneal mesh technique (TAPP) and a total extraperitoneal approach mesh placement (TEPA)[2]. The desire to decrease the recurrence rate of hernias has prompted an increased use of prosthetic materials in the repair of both recurrent and first-time hernias. Methods include "plugs" of mesh inserted into the internal ring and sheets of mesh to create a tension-free repair. The most widely used technique is that of Lichtenstein, an open mesh repair that allows an early return to normal activities and a low complication and recurrence rate. Laparoscopic hernial repair is based on the preperitoneal approach introduced by Cheatle[3], Henry[4], Nyhus et al[5], Stoppa et al[6], and Read[7]. The principles of the tension free hernioplasty popularized by Lichtenstein are also incorporated into laparoscopic hernial repair. Numerous modifications of the TAPP and TEPA techniques have been introduced. Most of these modifications are minor and relate primarily to the size or configuration of the mesh prosthesis. Other modifications are related to methods of, or even lack of, mesh fixation[8]. An innovative and increasingly popular modification that has been used primarily in recurrent hernias is the double-buttress laparoscopic herniorrhaphy[9]. The double-buttress technique is performed by placing in the groin a 10 cm by 6 cm sheet of polypropylene mesh that has been slit to surround the spermatic cord structures. After securing the initial piece of mesh with staples to the anatomic frame, a large 15 cm by 15 cm sheet of mesh is secured with staples overlying the initial prosthesis. This technique ensures adequate closure of the internal ring and complete coverage of the entire floor[10]. The use of laparoscopic techniques for the repair of inguinal hernias has the benefits of excellent visualization,

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minimal pain, rapid return to work and normal activities, small incisions that provide improved cosmetic appearance and decreased wound infection complications, and potential cost savings secondary to decreased work loss[11]. The objective of this study was to determine the effectiveness of the laparoscopic repair of inguinal hernia using two layers of mesh with reinforcement of the inner mesh by 2 sutures.

Patients and Method

This prospective study was designed to determine the effectiveness of the procedure. It was carried out in the Surgical Division of Thammasat University Hospital from November 1, 2002 to June 30, 2004.

During this 19 month period, the author operated on 20 consecutive adult patients with a total of 22 hernias. Peri-operative data was collected prospectively. Each patient was treated by one surgeon and was periodically assessed postoperatively for at least one month.

Inclusion criteria for the present study included adults who had reducible inguinal hernias.

Exclusion criteria included any irreducible hernias and patients with medical contraindications for surgery. Patients with scars from previous lower abdominal surgery so much that it interfered with the operation. Small children gain little benefit from laparoscopic hernial repairs as the open groin incision is small and the analgesic requirements are minimal. Therefore, the authors usually treat patients under the age of 16 years by open herniotomy. Patients with medical conditions had to be treated before enrolling them into the study. Patients with recurrent inguinal hernias were postponed for at least 6 weeks before enrollment.

Each patient was informed about the technique, including the advantages and disadvantages of the procedure and the potential complications. Preoperative and postoperative physical examinations were performed.

General anesthesia was used. No antibiotic was administered preoperatively. The patient was placed in a 15-30 degree Trendelenburg inclination and slightly tilted to the opposite side of the hernia in order to retract the loops of colon and bowel from the hernial site. The arms were tucked. Urinary and orogastric catheters were placed for decompression. Three trocars were used. The camera was placed via a 10 mm midline sheath at the umbilicus. A 5 mm trocar was placed on the midline between the umbilicus and pubic symphysis just below the end of the 10 mm midline sheath. A 11 mm trocar was placed between the 10 mm midline-sheath and 5 mm trocar. Care was taken to avoid the epigastric vessels.

A 2 cm subumbilicus skin incision was made. A deep incision was made down to the anterior rectus sheath. The rectus sheath was opened 1 cm lateral from the midline. The underlying rectus abdominis muscle was identified. The rectus muscle was rectracted to expose the posterior rectus sheath. Curved artery forceps were inserted into the plane behind the rectus muscle and anterior to the posterior rectus sheath. This plane can be easily developed a short distance below the umbilicus towards the symphysis pubis on the side of the hernia by gentle to-and-fro, side-to-side and up-and-down movements of the index finger tip. Once enough space has been developed, a blunt-nose trocar and 10 mm cannula can be inserted into the plane. The trocar was removed and the 0 degree telescope was inserted to view the developed plane. This is the preperitoneal layer. CO_2 insufflation was commenced at this point to help further develop the preperitoneal plane and the pressure was kept between 8-14 mmHg. The posterior rectus sheath was absent at this point behind the rectus abdominis muscle. The muscle, therefore, lay directly upon the peritoneum. The initial skin incision may need to be closed around the cannula to prevent CO_2 loss. There were no vessels crossing this layer and therefore visibility should be good. The first landmark identified was the back of the pubic bone which shines brightly through the loose areolar tissue as the plane is developed.

The second port insertion was in the midline, approximately halfway between the symphysis pubis and the umbilicus. A 5 mm port was inserted under direct vision into the extraperitoneal space. Blunt-nosed grasping forceps were inserted and used to develop the extraperitoneal plane from the midline out laterally on the side of the hernia.This plane was developed easily. At the lateral edge of the rectus muscle, the transversalis fascia often adheres to the peritoneum and sharp dissection may be necessary to divide this attachment. As dissection continued, the second landmark-inferior epigastric vessels running over the 'roof' of the space being dissected was noted. The lateral dissection was continued to a point above the anterior superior iliac spine level with the umbilicus. At this point the third port was inserted.

The third port was an 11 mm port on the same side as the hernia. The position of the third port was between the first and second ports. It was inserted under direct vision. A blunt-nosed grasper was inserted

through this port and was used for the dissection of the groin. If the dissection had been too vigorous or sharp-jaw graspers were used to hold the peritoneum, a hole might be made in the peritoneum.

The groin dissection was carried out by tracing the inferior epigastric vessels towards the deep inguinal ring. The upper border of an indirect hernial sac was readily recognized as lying lateral to the inferior epigastric vessels while a direct sac lies medially to the inferior epigastric vessels.

The indirect sac was separated from the underlying testicular vessels. The dissection is continued around the sac to encircle the neck. As the dissection continued medially, the vas deferens could be seen, usually in close proximity to the sac. On the lateral side, the testicular vessels were encountered. Under the neck of the sac, care is required. The external iliac vessels lay between the vas deferens and the testicular vessels at this point. Once the neck had been encircled, and the vas deferens and vessels separated, watch for the vas deferens as it hooks around the first part of the inferior epigastric artery. If the indirect hernial sac is more extensive and inguino-scrotal, it should not be separated very far distally, but transected about 1 cm from the internal inguinal ring. Before the hernial sac is transected it should be clipped distally and proximally. The direct sac can usually be completely freed from the transversalis fascia without dividing the neck. The peritoneum was then dissected free of the structures of the posterior abdominal wall and dissection was continued medially through loose areolar and fatty tissue until the back of the pubic symphysis was seen. This can be traced caudally until it runs into Cooper's ligament which shines brightly and has been referred to as a lighthouse defining where the mesh should be placed medially. The pubic branch of the inferior epigastric runs across the bones at the junction of the pubis and Cooper's ligament and care should be taken not to damage this. The inguinal ligament runs laterally at this point and all these structures should be identified. The dissection was continued medially until the mid-point of the symphysis pubis was exposed and laterally far enough to accommodate the mesh. Cooper's ligament should be cleared of its overlying preperitoneal fat for complete identification. The dissection was now carried medially below the already exposed back of the pubic bone to identify Cooper's ligament. Laterally, the dissection was continued further along the musculoaponeurotic arch of the transversus abdominis for the mesh. The dissection needs to continue far enough to allow the mesh to lie flat on the posterior abdominal wall. Usually the internal spermatic fascia is mistaken for the peritoneal sac. It should be incised to expose the sac. If the identification is still difficult, the neck of the sac can be incised on its superior aspect and the cut edge followed around the neck to allow its complete division. A small incision in the neck of the sac will allow inspection of the contents of the sac before transection. The dissection was complete once the sac had been reduced and the peritoneum had been elevated such that Cooper's ligament, the pubic tubercle, and iliopubic tract were clearly defined.

With unilateral hernias, a 7.62 x 10.16 cm polypropylene mesh is placed over the orifice of the hernia and fixed with helical titanium tacks to the symphysis pubis and inferior pubic ramus. The medial, superior and lateral margins of the mesh were then fixed to the abdominal wall muscle using tacks with care being taken to avoid the inferior epigastric vessels and to avoid placing tacks inferior to the iliopubic tract on the lateral margin of the mesh. Usually 6-8 tacks are used. Suturing should be done to reinforce the mesh to the abdominal wall in the right and left upper quarters each one stitch with 3/0 silk.

The second mesh will cover the defects of any or all of direct, indirect and femoral hernias. The mesh must cover all potential hernia defects with at least a 2 cm margin. A mesh size of 10.16 x 12.70 cm should be appropriate for most cases. The mesh can be passed in through the port 'flat'. A curved grasper was passed through a 5 mm reducer and used to grasp the mesh in the middle of one side which will be placed further through the 11 mm port and put the reducer in place. The mesh was placed into the right position. No tacks were placed in the lower and outer quadrant. Tacks were placed in the upper corners of the mesh and through the mesh medially into Cooper's ligament. There is no need to use large numbers of tacks, as about 6-8 tacks are enough. The medial and inferior corners of the mesh overlap the bone and lie in the pelvis. The medial edge of the mesh would reach the midline in a direct hernial repair.There are dangers when placing tacks in the following areas: 1) triangle of doom between the vas deferens and the spermatic vessels as the external iliac vessels lie in this area 2) the inferior epigastric artery can be damaged by a tack in the centre of the upper border of the mesh 3) tacks placed laterally below the inguinal ligament may cause crippling neurological injuries to the cutaneous nerves running to the thigh 4) if all the hernial orifices are not covered with a satisfactory margin there will be a danger of

recurrence. The mesh must reach far enough laterally to cover the internal ring with a 2 cm lateral margin. Once in place it should lie quite flat in the inguinal gully without any curling of the margin. A recurrence can occur under a curled-up mesh margin. Avoiding the use of tacks decreases cost and may decrease the incidence of some of the complications such as nerve and vessel injury.

A 10.16 x 12.70 cm polypropylene mesh which overlay the initial prosthesis was secured to the symphysis pubis and inferior pubic ramus with tacks. The medial, superior and lateral margins of the mesh were then fixed to the abdominal wall muscle using tacks.

The blood was removed by suction after the meshes had been secured. The 10 and 11 mm trocar sites were then closed with 0 Maxon. The skin was closed with 3/0 silk sutures.

With bilateral hernial repair, the third port is between the first and second port in the midline. After repairing one side, then proceed to the other side.

Analgesic given post-operatively, if any, was left to the discretion of the attending staff. The patients were encouraged to mobilize, drink and eat when they felt able and were discharged when they felt comfortable. All patients were seen in the outpatient department one week after the operation. Follow up was periodical and detailed records of progress and any complications were made. Patients who could not come in for appointments were followed-up by phone call. Descriptive statistics: range mean $\pm$ SD were applied to report the results.

Results

Data on the patients and their hernias are given in Table1.

There were 20 patients with 22 hernias.The hernias were classified as: 5 right indirect inguinal hernias, 2 left indirect inguinal hernias, 3 right direct inguinal hernias, 3 left direct inguinal hernias, 2 recurrent right indirect inguinal hernias, 2 left recurrent indirect inguinal hernias, 1 recurrent direct hernia, 1 bilateral indirect inguinal hernia, and 1 bilateral direct inguinal hernia. All the patients were male. The mean age $\pm$ SD of the patients was 53.00 $\pm$ 13.43 years (range 31.00-84.00 years). The mean duration $\pm$ SD of the hernias before surgery was 24.30 $\pm$ 37.01 months (1.00-120.00 months).

Laparoscopic repair by the total extraperitoneal mesh placement (TEP) technique using two layers of polypropylene meshes with the inner mesh reinforced by 2 sutures was used in all 20. Two patients also underwent TUR for BPH under the same anaesthetic. The mean operative time $\pm$ SD for unilateral hernias was 127.67 $\pm$ 36.43 minutes (range 75-195 minutes). The operative times for bilateral hernias were 165 and 180 minutes. Two patients did not require any analgesia while in hospital, 4 patients required oral analgesia, 9 patients required one opiate injection and 5 patients required two or more opiate injections. The mean post-operative stay $\pm$ SD in hospital was 3.60 $\pm$ 1.79 days (range 1-8 days). The mean time $\pm$ SD patients took to resume normal activities was 3.60 $\pm$ 1.64 days (range 2-10 days).

Four patients developed complications after the surgery.These were 1 seroma, 1 scrotal bruising, and 2 neuralgia. The seroma was aspirated and healed. The scrotal bruising was treated symptomatically and healed. The 2 patients with neuralgia both recovered spontaneously within 2 weeks. There were no recurrent hernias. All patients were able to return to normal activities. The operations were successfully performed

Table 1. Data on patients and hernias

Number of hernias	22
Type of hernia	
Unilateral	18
Bilateral	2
Primary	15
Recurrent	5
Indirect	12
Direct	8
Previous open hernial repair on contralateral side	2
Number of patients	20
Male: female	20:0
Mean age $\pm$ SD (years) (range)	53.00 $\pm$ 13.43 (31.00-84.00)
Mean follow-up $\pm$ SD (months) (range)	10.27 $\pm$ 5.96 (1.10-20.00)
Mean duration of hernia before surgery $\pm$ SD (months) (range)	24.30 $\pm$ 37.01 (1.00-120.00)
Mean operative time $\pm$ SD (minutes) (range)	132.15 $\pm$ 37.20 (75.00-195.00)
Mean operative time of unilateral hernia $\pm$ SD (minutes) (range)	127.67 $\pm$ 36.43 (75.00-195.00)
Operative time of bilateral hernas in 2 patients (minutes)	165 and 180
Mean post-operative stay in hospital $\pm$ SD (days) (range)	3.60 $\pm$ 1.79 (1.00-8.00)
Analgesia required in hospital	
None	4
Oral analgesia	2
One opiate injection	9
Two or more opiate injections	5
Mean time taken to resume normal activities $\pm$ SD (days) (range)	3.60 $\pm$ 1.64 (2.00-10.00)

on all 20 patients with a 20.00% complication rate. Three of the 4 complicated cases were either healed by symptomatic treatment or recovered spontaneously. Only 1 case was treated by surgical intervention which corresponded to a 5% rate. There were no recurrent hernias in the mean follow-up time ± SD of 10.27 ± 5.96 months (range 1.10-20.00 months).

Discussion

Open hernial repair has undergone a significant evolution during the 1990s changing from a predominantly sutured repair to a tension-free repair with mesh. Due to its effectiveness it has almost completely replaced sutured repair. For the meta-analysis, reported in 2002[12-14],the conclusions were: (1) faster return to normal activities following lapraoscopic repair, (2) reduced persistent pain following lapraoscopic repair, and (3) a lower recurrence rate for laparoscopic mesh repair versus open nonmesh repair but was the same for laparoscopic repair versus open-mesh repair. However, two issues were not addressed. The laparoscopic repair of bilateral hernias and recurrent hernias are two situations in which the laparoscopic approach may be advantageous. A review of 23 noncomparative trials of laparoscopic hernioplasty from 1992 to 1995, all of which included ≥ 100 patients, showed recurrence rates ranging from 0 to 4.5%[15]. Nearly all of the recurrences were a consequence of technical problems. If inexperience (steep learning curve) and incomplete dissection are excluded from these technical problems, most of the remaining problems were a result of the mesh such as mesh size (too small, inadequate overlap of defect, migration), configuration (slit or keyhole), mesh fixation (mesh poorly fixed laterally, mesh poorly fixed medially, clips pulled through, mesh never stapled, mesh displacement). As the techniques have evolved and improved, recurrence rates have fallen[11].

Therefore, a solution for the problems of mesh size and mesh fixation has been proposed in the present report, namely the laparoscopic repair of inguinal hernias using two layers of mesh with reinforcement of the inner mesh by 2 sutures. The first layer of mesh, which is smaller, is placed over the hernial orifice and is reinforced with 2 sutures using silk 30 with one suture in the right and left upper quarters after the mesh has been fixed with tacks. No sutures are required in the lower quarters of the mesh since it has been fixed to stronger structures. The second layer of mesh is larger to cover all potential hernia defects. These techniques are performed to prevent hernial recurrence. There were no recurrences in this report with the mean follow-up ± SD of 10.27 ± 5.96 months. This report only provides short-term results; however, Stoppa showed that all of his recurrences using the open preperitoneal technique occurred within the first year and were thought to be due to technical difficulty[11]. Although two patients developed neuralgia in the present series (10.00%), they were not permanent and recovered spontaneously. Neuralgia may result from surgical handling of the sensory nerves as these nerves run between the muscle layers of the abdominal wall. The risk of neuralgia was reduced by using helical titanium tacks instead of staples to anchor the mesh as the latter may trap nerves. Injuries to the femoral nerve were prevented by avoiding placement of staples posterior to the iliopubic tract or more than 1.5 cm lateral to the internal ring. One patient developed a seroma because the distal end of the hernial sac was not closed. A patient with chronic renal failure and ascites who had bilateral hernias was operated on after the above mentioned case. Both sides of the distal sacs were closed and there was no resulting seroma.

The mean operative time ± SD for unilateral hernias was 127.67 ± 36.43 minutes and the operative times for bilateral hernia were 165 and 180 minutes. The mean post-operative length of stay ± SD in hospital was 3.60 ± 1.79 days. Discharge from hospital was determined by the doctor and by the willingness of the patients to go home. Only 2 of the 20 patients did not require analgesia. The other patients needed analgesia since no local anesthetic such as bupivocane was infiltrated into the trocar sites[16]. The mean time ± SD taken to resume normal activities not including work was 3.60 ± 1.64 days.

Conclusion

There was no recurrent hernia in the mean follow-up time ± SD of 10.27 ± 5.96 months. There were 4 complications which were treated symptomatically or recovered spontaneously. One complication could have been prevented. Therefore, this procedure may be used to treat primary, recurrent, direct, indirect, and bilateral inguinal hernias in adults with no recurrence in the short term follow-up.

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การผ่าตัดไส้เลื่อนขาหนีบด้วยกล้อง laparoscope โดยการใช้ mesh 2 ชั้น ร่วมกับการเสริมความแข็งแรงของการยึด mesh ด้วยการเย็บเสริม mesh ชั้นแรก 2 เข็ม

วีรวัฒน์ เหลืองชนะ

เพื่อศึกษาผลของการผ่าตัดไส้เลื่อนขาหนีบด้วยกล้อง laparoscope โดยการใช้ mesh 2 ชั้น ร่วมกับการเสริมความแข็งแรงของการยึด mesh ด้วยการเย็บเสริม mesh ชั้นแรก 2 เข็ม ได้ทำการผ่าตัดไส้เลื่อนขาหนีบชนิด primary, direct, indirect, bilateral inguinal hernias และ recurrent inguinal hernias 5 ราย การผ่าตัดไส้เลื่อนขาหนีบด้วยกล้อง laparoscope โดยเทคนิค total extraperitoneal mesh replacement (TEP) ใช้ polypropylene mesh 2 ชั้น ร่วมกับการเสริมความแข็งแรงของการยึด mesh ชั้นใน 2 เข็ม ในผู้ป่วย 20 รายโดยเป็นไส้เลื่อน 22 ข้าง สามารถทำการผ่าตัดได้สำเร็จในผู้ป่วยทุกรายโดยมีภาวะแทรกซ้อนที่ต้องรักษาโดยการผ่าตัด 1 ราย (5%) ไม่มีการเป็นซ้ำจากการตรวจติดตาม 10.27 $\pm$ 5.96 (1.10-20.00) เดือน การผ่าตัดโดยวิธีนี้สามารถใช้รักษา primary, recurrent, direct, indirect และ bilateral inguinal hernias ในผู้ใหญ่ได้โดยไม่มีการกลับเป็นซ้ำจากการตรวจติดตามระยะสั้น