

A prospective cost and outcome comparison of inguinal hernia repairs

Laparoscopic transabdominal preperitoneal versus open tension-free preperitoneal

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Received: 17 March 1995/Accepted: 21 April 1995

Abstract. We previously showed that patients undergoing transabdominal preperitoneal laparoscopic inguinal herniorrhaphy (TAPP) returned to activity twice as fast as open herniorrhaphy without mesh but that TAPP was twice as expensive. However, it was not clear if the immediate postoperative benefits offered by TAPP resulted from smaller incisions and less tissue dissection or from the requisite tension-free placement of mesh. We have therefore completed a prospective outcome and cost analysis comparing TAPP ($n = 59$) to open preperitoneal mesh herniorrhaphy (PPO) ($n = 40$) to determine the differences between the two different surgical techniques. When comparing unilateral repairs, there was no difference in hernia type. PPO patients were older ($P < 0.05$) and their operations were shorter ($P < 0.01$). Comparison of outcome parameters of pill days, out-of-house activity, and initial day to full activity revealed no difference. Cost analysis showed that total costs, disposable equipment costs, and operating room time costs were significantly less for PPO ($P < 0.01$). There were two major complications (3%) and twelve minor complications (20%) in the TAPP group while PPO exhibited no major and five minor complications (12%). Follow-up data revealed one recurrence in the TAPP group. There were no recurrences in the PPO group at only 7 months average follow-up. We conclude that since both procedures had similar outcomes in the immediate postoperative period, the increased cost of TAPP and increased potential for both major and minor complications make it difficult to justify its routine use.

Key words: Cost comparison — Inguinal hernia — Laparoscopic transabdominal — Open tension-free preperitoneal

The increased use of prosthetic mesh during inguinal hernia repairs has been slowly gaining popularity since Lichtenstein began using it routinely in 1984 [5]. General use has not been widespread because surgeons have been satisfied with the simple outpatient inguinal hernia repair *without* mesh. Emphasis had not been placed on improving the postoperative discomfort phase of this procedure until 1990 when surgeons focused on the decreased postoperative discomfort seen after laparoscopic inguinal hernia repairs [3]. This attractive, minimally invasive technique is associated with less discomfort in the postoperative period, presumably because trocar punctures replaced both incision and groin dissection. However, by necessity, mesh is required in the laparoscopic repair to cover the hernia defect. It is not known how much of the decreased discomfort could be attributed to the tension-free repair allowed by the mesh.

We have previously compared the results after our open inguinal hernia repairs *without* mesh to our results after the laparoscopic transabdominal preperitoneal (TAPP) technique [1]. This study found that patients returned to out-of-house or full activity twice as fast with TAPP but that TAPP was twice as expensive. We now feel this comparison of postoperative discomfort between the tension-free TAPP vs the open repair without mesh was unfair.

An outcome-and-cost study was needed to compare preperitoneal tension-free repairs using the open and laparoscopic techniques. Our open preperitoneal tension-free repair was a modification of the open transfloor preperitoneal mesh technique described by Horton and Florence [2]. However, we stapled rather than sewed the mesh to Cooper's and Poupart's ligaments. After this procedure, the mesh rested in the same medial position as TAPP. We also have been prospectively collecting cost data for all equipment and services utilized in over 60 common surgical procedures, beginning with laparoscopic cholecystectomy [6]. The comparison of costs rather than charges cannot be overemphasized in today's cost-conscious man-

Table 1. Average age, hernia types, operating times

	Unilateral PPO	Unilateral TAPP	Bilateral TAPP
Number of patients (sides)	40	59	39 (78)
Age (years)	56 ± 19*	46 ± 15	54 ± 14
Hernia types			
Indirect	62%	53%	35%
Direct	16%	25%	45%
Pantaloon	22%	17%	20%
Femoral	0	5%	0
Associated with femoral	8%	10%	12%
Recurrent	10%	19%	12%
OR time (minutes)	70 ± 16*	104 ± 38	146 ± 42

^a Data is ± standard deviation

* Statistically significant difference ($P < 0.01$) unilateral PPO vs unilateral TAPP

aged-care world. Costs are what the health system spends while charges represent just the anticipated "sticker price." Our study, therefore, is a prospectively gathered outcome-and-cost analysis to determine the difference or similarities between these two different surgical techniques.

Methods

From January 1992 through September 1994, a single surgeon (L.W.T.) repaired 177 hernias in 139 consecutive patients who were enrolled into a prospective, nonrandomized hernia registry. Ninety-eight patients underwent laparoscopic transabdominal preperitoneal mesh herniorrhaphy (TAPP), while 41 patients underwent open, transfloor, preperitoneal, tension-free mesh herniorrhaphy (PPO). All laparoscopic repairs were performed transabdominally by stapling (Ethicon), without tension, a 6 × 12-cm Marlex (Bard) mesh sheet in the preperitoneal space, deep to the epigastric vessels, over the *entire* myopectineal orifice (defined as the space between the pubic tubercle, Cooper's ligament, transverse abdominis arch, and the anterior superior iliac spine). The peritoneum was then reapproximated with the hernia stapler in every case.

PPO repairs were performed with a standard groin incision and then transfloor access to the preperitoneal space superficial to the epigastric vessels. A 6 × 10 cm sheet of mesh was stapled over the medial and inferior myopectineal orifice with the Ethicon hernia stapler and then sutured superiorly under the tendon of the transversus abdominis muscle. This technique closely duplicates the laparoscopic repair. An internal ring was created with a slit through the lateral mesh around the spermatic cord.

Every patient was seen postoperatively at 7–10 days and the hernia registry was updated. The number of days the patient consumed oral narcotics was recorded. Close questioning determined when the patient first left the house. Initial "full activity" was defined as the postoperative day on which the patient drove a car, as this signifies a major attempt at "reentry" into North American society. We avoided using data such as number of days off work or the duration of postoperative pain because these have been shown to be highly influenced by motivation [4]. Complications were recorded and followed either in the hospital or with repeated clinic visits until they were resolved. In order to assess recurrence, all patients received a mailed, follow-up survey. Nonrespondents received another mailed survey plus a telephone call. Costs were defined as the expenses to the hospital for services and equipment in the operating room. These were prospectively recorded for each patient and for each item through a data-gathering system to evaluate costs and are in 1994 dollars. Charges or reimbursements were not gathered. Statistical testing involved an unpaired Student's *t*-test with Bonferroni correction for repeated testing; a priori, $P \leq 0.05$ was considered significant.

Results

Of the 139 consecutive patients, 98 patients underwent TAPP (137 hernia sides) while 41 patients underwent PPO (42 hernia sides). Of TAPP repairs, 59 were unilateral (59 hernia sides), while 39 were bilateral (78 hernia sides). Table 1 lists the average age, hernia types, and operating times.

When unilateral TAPP and unilateral PPO are compared directly, unilateral PPO patients were older ($P < 0.01$) and there was no significant difference in hernia type ($P > 0.05$). Operating times for unilateral PPO were significantly shorter when compared to unilateral TAPP ($P < 0.01$).

Table 2 lists the patient responses at the postoperative office visit plus the results of cost tabulation in 1994 dollars. There was no difference in analgesic use or return to out-of-house or initial full activity. Total costs, disposable equipment costs, and cost based on room time were significantly greater for unilateral TAPP when compared to unilateral PPO.

Complications, recurrence, and follow-up data are listed in Table 3. Complications were divided into two categories: major (required operative intervention) or minor (required either hospitalization on the day of surgery or more than one clinic visit). The major complication following bilateral TAPP was a small-bowel incarceration through the right medial peritoneal closure requiring 7 days hospitalization and laparoscopic reduction. The ten minor complications included urinary retention (four), nausea and vomiting (four), subcutaneous emphysema (one), and testicular pain (one). In all, minor complications resulted in a total of 16 hospital days for these 10 patients.

Two major complications were associated with unilateral TAPP. They were incarcerated small bowel in a lateral 12-mm trocar requiring laparoscopic reduction and 4-day hospital stay, and a Veress needle puncture of the vena cava that was associated with no blood loss. The procedure was completed laparoscopically. A postoperative ultrasound was normal and the patient was observed overnight. Twelve minor complications included urinary retention (four), testicular pain (one), nausea and vomiting (two), subcutaneous emphysema (one), pain (one), spinal headache (one), and conversion (one). In all, 10 hospital days were required for these minor complications in 12 patients.

There were no major complications associated with PPO and 5 minor (12%) complications which included postoperative arrhythmias (2), urinary retention (1), hematoma (1), and seroma (1). These required 3 hospital days.

The average follow-up and percent response to our survey are listed in Table 3. One patient had an indirect hernia recurrence 5 months postoperatively following unilateral TAPP for primary direct hernia. One patient indicated on follow-up survey and subsequent telephone call that he had a recurrent hernia following bilateral TAPP which he had not previously reported. To date, he has not been examined by a physician to confirm. Thus, both unilateral TAPP (1.7%) and bilat-

Table 2. Outcome and costs

	Unilateral PPO	Unilateral TAPP	Bilateral TAPP
Pill days	3.8 ± 2.8	3.7 ± 3.6	3.5 ± 3.0
Out-of-house activity (days)	2.6 ± 1.9	2.6 ± 1.8	2.7 ± 1.8
Initial full activity (days)	6 ± 5.9	6 ± 4.5	7.3 ± 4.8
Costs			
All (\$)	1343 ± 165*	2176 ± 366	2723 ± 455
Disp. equip. (\$)	329*	978	1265
Room time costs (\$)	535*	750	933
Other (\$)	379	348	525

* = $P < 0.01$, unilateral PPO vs unilateral TAPP

Table 3. Complications and follow-up

	Unilateral PPO	Unilateral TAPP	Bilateral TAPP
Complications			
Major	0	3%	3%
Minor	12%	20%	26%
Follow-up (months)	7 ± 5	22 ± 8	19 ± 4
Response to survey	73%	63%	95%
Recurrence	0	2%	3%

eral TAPP (2.6%) have a reported recurrence. There has been no recurrence noted in PPO patients.

Discussion

The economics of laparoscopic inguinal hernia repair are extremely complex. The increased expense of TAPP has either been ignored or justified on the grounds of earlier return to productive work. We have shown previously that charges for unilateral TAPP were twice those of conventional open repair and that individuals returned to out-of-house activity and to full activity twice as quickly after TAPP vs an open inguinal hernial repair without mesh [1]. The current study was completed to provide a fair comparison of a tension-free laparoscopic technique to a tension-free open inguinal hernia repair. The prosthetic mesh was placed in the preperitoneal space during both techniques.

Although no difference was seen between groups in hernia types, the unilateral PPO patients were older. In our experience elderly patients seem to have less postoperative discomfort. This clinical phenomenon might favor the older unilateral PPO group in their return to out-of-house activities and decrease their number of pill days even though no differences were noted in those variables when compared to the younger unilateral TAPP group.

When just the unilateral TAPP cases were compared to the unilateral PPO patients, the initial return to out-of-house activity, initial return to full activity, and the number of oral analgesic pill days were similar. This finding indicates that a tension-free repair results in decreased groin discomfort postoperatively and may be more important to consider than the comparison of a groin incision vs trocar punctures.

Since both procedures had similar outcomes in the immediate postoperative period, the increased costs for TAPP (\$2,176 versus \$1,343) cannot justify its routine use. Reasons for the increased cost included the use of disposable equipment and longer operating-room times. It should be remembered that the stapler was utilized in both laparoscopic and open repairs and that the difference in the cost of disposable equipment was due to other disposable laparoscopic instruments and trocars. Omission of the stapler in the open repair would have widened this difference. The increased operating-room time was also reflected in a significantly higher cost based on services acquired while undergoing the operation.

TAPP is a technically more complicated procedure and it requires general anesthesia. The major complications after TAPP were due to placement of laparoscopic equipment and were therefore not seen after the open repair. A higher minor complication rate with TAPP was also noticed, some of which may have been due to the general anesthesia (nausea and vomiting) or the laparoscopic procedure (testicular pain, subcutaneous emphysema, and need for conversion).

A decision to pursue any laparoscopic hernia repair cannot be based on recurrence at this time. The learning curve has taught us principles about the laparoscopic repair to prevent recurrence. We believe that if the entire myopectineal orifice is covered with a suitably sized patch of prosthetic mesh, then recurrence would be essentially eliminated on a long-term basis. Therefore, recurrences, as in this study, are due to technical errors and occur soon after the repair. A final judgment on hernia recurrence cannot be made from this study as we lack long-term follow-up.

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