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Preperitoneal Suction Technique to Secure the Proper Mesh Position During Laparoscopic Herniorrhaphy

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Purpose: Dislocation of the mesh is 1 cause of recurrence after laparoscopic inguinal hernia repair (LIHR). Here, we propose a new procedure, the "preperitoneal cavity suction technique," to confirm mesh position during LIHR under a transabdominal preperitoneal approach (TAPP).

Patients and Methods: We developed the "preperitoneal cavity suction technique" during LIHR by TAPP, visualizing the mesh through the closed peritoneum by vacuuming up the carbon dioxide and effusion at the preperitoneal cavity using a suction tube inserted through the tunnel from a laterally placed trocar into the preperitoneal space. We applied this technique in adults with inguinal hernias who were scheduled to undergo elective surgery in our hospital between April 2013 and March 2015.

Results: In total, 84 lesions were treated in 74 consecutive LIHRs by TAPP. The "preperitoneal cavity suction technique" was applied to 83 lesions. We confirmed appropriate positioning of the mesh for 82 of the 83 lesions (98.8%), with dislocation of the mesh detected in 1 case. In that case, we reopened the peritoneal flap and repositioned the mesh correctly during the operation. No patients complained of pain or a sense of discomfort, and no hematoma was identified around the dissected area or anterior superior iliac spine on the affected side. Mean duration of hospitalization was 2.5 days. No cases of hernia recurrence were observed during follow-up (range, 7 to 31 mo; median, 15 mo).

Conclusions: The "preperitoneal suction technique" seems useful to detect mesh dislocation and has potential to reduce TAPP-related complications.

Key Words: inguinal hernia, laparoscopic inguinal hernia repair, transabdominal preperitoneal approach, preperitoneal cavity suction technique

(*Surg Laparosc Endosc Percutan Tech* 2016;26:e167–e170)

Recently, laparoscopic inguinal hernia repair has been widely accepted as a treatment option for inguinal hernia.[1–3] laparoscopic inguinal hernia repair carries a reduced risk of chronic pain and numbness relative to open inguinal hernia repair, but increased risks of recurrence and perioperative complications.[1–6] In Japan, the incidence of recurrence after a transabdominal preperitoneal approach (TAPP) is reportedly 4% (235/6203 cases) according to surveillance by the Japanese Society for Endoscopic Surgery.[7]

Smoking has been reported as 1 significant patient-related risk factor for recurrence after inguinal hernia surgery.[8] Surgeon experience and age have also been identified as important factors associated with recurrence.[9,10] The predominant factor in successful preperitoneal hernia repair is adequate dissection with complete exposure and coverage of all potential groin hernia sites, because hematoma mesh lifting and dislocation of the mesh are the most common causes of recurrence.[9,11]

In this study, we propose a new procedure, the "preperitoneal cavity suction technique," to prevent mesh dislocation. This method provides visualization of mesh position during operation without requiring additional instruments. If the mesh dislocation identified during operation, we replaced the mesh adequate position by reopening the peritoneal flap intraoperatively.

PATIENTS AND METHODS

Study Overview

This study was conducted in adults with inguinal hernias who were scheduled to undergo elective surgery in the Department of Surgery at Aizu Medical Center Hospital between April 2013 and March 2015. Exclusion criteria included urgent surgery (eg, for incarcerated hernia), serious comorbidities, or preoperative diagnosis of a giant inguinal hernia. The nature of the study and surgery was explained to eligible patients. Patients who provided written-informed consent to participate in the study underwent laparoscopic herniorrhaphy by TAPP with the "preperitoneal cavity suction technique." All study protocols were approved by the ethics committee at Fukushima Medical University.

Surgery

Cefazolin sodium hydrate (1.0 g) was administered intravenously just before surgery, as prophylactic antibiotic therapy after induction of general anesthesia. At an umbilical site, a 12-mm trocar was placed through a small umbilical incision using the Hasson technique and pneumoperitoneum was induced.[12] Next, two 5-mm trocars were positioned bilaterally on the umbilical line in the iliac fossa. An incision was made in the peritoneal wall, starting at the level of the superior margin of the internal inguinal ring and at the level of the epigastric vessels. The incision was extended medially up to the residue of the umbilical artery and then laterally, 3 to 4 cm past the inguinal ring; total

Received for publication March 1, 2016; accepted September 29, 2016.
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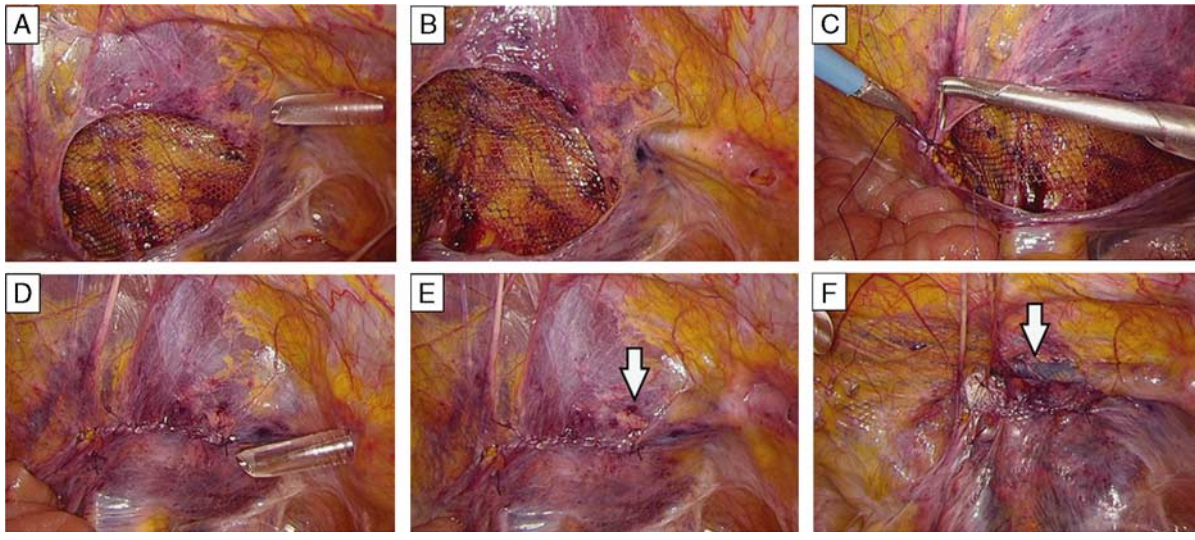

FIGURE 1. Intraoperative visualization of the mesh using the "preperitoneal cavity suction technique." Before closure of the peritoneal flap (A), the laterally placed 5-mm trocar was once withdrawn from the peritoneal cavity to the preperitoneal space, and dissected until the outer edge of the mesh (B). The laterally placed 5-mm trocar was reinserted to the peritoneal cavity, and the peritoneal flap was then closed with 3-0 absorbable sutures (C). After closure of the peritoneal flap (D), the laterally placed 5-mm trocar was removed and a suction tube inserted to the preperitoneal space using the same route, to remove carbon dioxide and effusion from the preperitoneal cavity (E; arrow indicates suction tube). The peritoneal flap adhered tightly to the mesh using this maneuver, which visualized the mesh through the peritoneum (F).

incision length was 7 to 8 cm. In the presence of direct hernia, the hernial sac was directly isolated and reduced. In the case of an indirect or femoral hernia, the preperitoneal parapubic adipose tissue was carefully dissected medially to expose the horizontal pubic ramus and Cooper's ligament. Accurate dissection of the preperitoneal retrovesical tissue facilitated positioning of the mesh. The internal inguinal ring was explored, and the hernial sac was isolated and reduced. Once the spermatic cord was freed from the peritoneal wall, a ULTRAPRO Partially Absorbable Lightweight Mesh (Johnson & Johnson) or 3D Max Light mesh (BARD, Warwick, RI) was placed in the preperitoneal space such that it was in medial contact with the paravesical area, covered Cooper's ligament, rested on the inguinal region, and extended laterally over the epigastric vessels. The mesh was fixed with an Endopath Multifeed Stapler with a 5-mm shaft and helical titanium staples (Protack; Covidien, Mansfield, MA) to the Cooper's ligament inferiorly, the pubic tubercle medially. Another fixation staples were placed, but avoiding tack or staple placement below the iliopubic tract to prevent injury of nerve and vessels.

Before closure of the peritoneal flap, the laterally placed 5-mm trocar was withdrawn from the peritoneal cavity, and dissected to the preperitoneal space until the outer edge of the mesh (Figs. 1A, B). Positioning the mesh in the preperitoneal space, created by dissection between the peritoneum and preperitoneal fat, enables visualization of the mesh over the peritoneum with the suction technique even in patients with relatively extensive and thick preperitoneal fat. The laterally placed 5-mm trocar was reinserted into the peritoneal cavity after completion of preperitoneal dissection, and the peritoneal flap was then closed with 3-0 absorbable sutures (Fig. 1C). After closure of the peritoneal flap, the laterally placed 5-mm trocar was removed and a suction tube was inserted into the preperitoneal space from the same route, to remove carbon dioxide and effusion from the preperitoneal cavity (Figs. 1D, E). The peritoneal flap adhered tightly to the mesh with this maneuver, which allowed visualization of the mesh through the peritoneum (Fig. 1F). Additional sutures were placed on the peritoneal flap when exposure of the mesh was identified. If the mesh dislocated, turning inward or outward, we replaced the mesh by reopening the peritoneal flap intraoperatively.

Postoperative Follow-up and Evaluation

Recurrence was evaluated after 1 week, 1 month, 6 months, and then every 6 months up to 2 years postoperatively. Hernia recurrence was defined as a palpable, reducible lump in the treated groin, with or without symptoms.

RESULTS

We treated 84 lesions in 74 consecutive laparoscopic herniorrhaphies by TAPP between April 2013 and March 2015. The "preperitoneal cavity suction technique" was applied for 83 of the 84 lesions in this series. We could not

TABLE 1. Patient Characteristics and Perioperative Outcomes

Characteristics	n = 74 (84 Lesion)
Age (mean ± SD) (y)	66.5 ± 10.4
Sex	
Male	67
Female	7
Preperitoneal suction technique time (mean ± SD) (s)	90 ± 34
Postoperative complication	
Seroma	2
Postoperative hospital stay (mean ± SD) (d)	2.5 ± 1.1
Recurrence	0

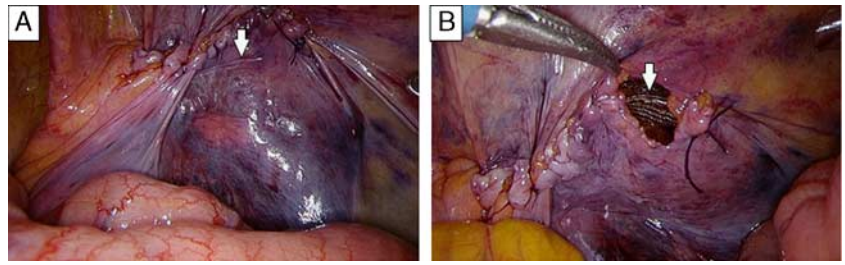

FIGURE 2. Dislocation of the mesh detected using the "preperitoneal cavity suction technique." Because the lateral side of the 3D Max Light mesh rolled up medially (A; arrow indicates rolled-up mesh), we reopened the peritoneal flap and repositioned the mesh in the correct position during the operation (B; arrow indicates rolled-up mesh).

dissect sufficient preperitoneal space for insertion of the suction tube in a patient who showed severe adhesion around the left lateral port site resulting from prior sigmoidectomy. A summary of the characteristics for that patient is shown in Table 1. Hernia was unilateral in 64 patients and bilateral in 10 patients. According to the Japanese Hernia Society Classification, the 84 lesions included 11 lesions with type I-1 (indirect hernia with diameter of the internal inguinal ring < 1.0 cm), 40 lesions with type I-2 (indirect hernia with diameter of the internal inguinal ring ≥ 1.0 cm but < 3.0 cm), 5 lesions with type I-3 (indirect hernia with diameter of the internal inguinal ring ≥ 3.0 cm), 12 lesions with type II-1 (direct hernia with diameter < 3 cm, supravesical hernia), 1 lesion with type II-2 (direct hernia with diameter < 3 cm, posterolateral hernia), 10 lesions with type II-3 (direct hernia with diameter ≥ 3.0 cm), 2 lesion with type III (femoral hernia), and 3 lesions with type IV (combination type).[13] In total, 79 lesions were primary and 5 lesions were recurrent. The time for preperitoneal suction technique was 90.6 ± 34.2 s (mean $\pm$ SD).

We confirmed appropriate positioning of the mesh in 82 of 83 lesions (98.8%), with dislocation of the mesh detected in the remaining case. In this case, as the lateral side of the 3D Max Light mesh had rolled up medially, the same closed peritoneal flap was reopened and the mesh was repositioned accurately during the same operation (Figs. 2A, B). Subsequently, the same peritoneal flap was closed again without difficulty.

In this series, the preperitoneal cavity suction technique was performed in cases of reoperation without any difficulty. In the case of bilateral hernia, suction from 1 side was insufficient to adequately affect the contralateral preperitoneal space, so we needed to perform this technique from both sides.

No patients had no hematoma around the dissected area or anterior superior iliac spine on the affected side. The mean duration of hospitalization was 2.5 days. No cases of hernia recurrence were observed during the follow-up period (range, 7 to 31 mo; median, 15 mo).

DISCUSSION

The incidence of recurrence after laparoscopic herniorrhaphy for inguinal hernia has been reported as 1.6% to 10.4%,[14–16] relatively higher than that observed with open mesh repair, at 0.8% to 2.9%.[14,17–20] A report from the Japanese Society for Endoscopic Surgery found a recurrence rate of 4% (235/6203 cases).[7] Causes of recurrence were described for 47 of those cases, with mesh dislocation as one of the most common (17/47, 37%).[7] The present study applied the preperitoneal cavity suction technique for 83 lesions, and no early recurrences were observed for the 6- to 12-month follow-up period.

One of the benefits of the preperitoneal cavity suction technique is as follows. We can see the mesh through the peritoneum by providing suction in the preperitoneal space without needing any additional surgical instruments, providing visualization of mesh position after the cessation of pneumoperitoneum. In this technique, the suction tube was not blindly inserted into the preperitoneal space but safely under direct observation by using a laparoscope. Further, while aspirating the preperitoneal space in the lateral side of the mesh, care was taken to ensure that the mesh does not slip off. We can thus correct any mispositioning during the operation, if the mesh is dislocated or turned inward or outward. Actually, we applied this technique for all 84 lesions, with correction of the mesh position needed in 1 lesion. Avoidance of placement of tack or staple below the iliopubic tract is important to prevent injury of nerve and vessels during mesh fixation, thus mesh dislocation might occur at this nonfixed lesion.[21] Because the recurrence rate after TAPP depends on the experience of the surgeon, this technique is recommended for surgeons in the early period after completion of their personal learning curves.[9,10]

Another benefit of this technique is the confirmation of tight closure of the peritoneal flap without defect. Bowel obstruction has been reported as a rare but serious complication after TAPP.[22,23] This complication is caused by peritoneal defect after TAPP, and sutured repair of the peritoneum has reduced the incidence of this complication.[22,23] The preperitoneal cavity suction technique visualized not only the position of the mesh, but also tight repair of the peritoneal flap. Additional suture of the peritoneal flap is added if exposure of the mesh is identified, to avoid adhesion or herniation of the intestine.

In conclusion, our preperitoneal suction technique seems useful to detect mesh dislocation and defects of the peritoneal flap and thus has the potential to reduce TAPP-related complications. Because this procedure is easy and requires no additional instruments, we recommend this as a useful technique for TAPP.

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