

Modern Surgery**Prevention of Trocar-Wound Hernia in Laparoscopic Bariatric Operations****Chong-Chi Chiu, MD¹; Wei-Jei Lee, MD, PhD²; Weu Wang, MD²; Po-Li Wei, MD³; Ming-Te Huang, MD³***Department of Surgery, ¹Chi-Mei Hospital – Liou Ying Campus, ²Min Sheng General Hospital, and ³Taipei Medical University Hospital, Taiwan*

Background: Morbid obesity is a risk for fascial wound dehiscence and incisional hernia after abdominal surgery. The development of minimally invasive surgical techniques has led to a dramatic decrease in these complications. However, laparoscopic surgery may still be followed by trocar-wound herniation. Various methods have been advocated for its prevention.

Methods: The records of 752 patients who underwent laparoscopic bariatric operations (610 mini-gastric bypass and 142 gastric banding) as treatment for morbid obesity between October 2001 and June 2005, with regular follow-up, were retrospectively reviewed. In all patients, the fascial layer of trocar wounds was not closed. Instead, a Surgicel® plug was inserted into the muscle layer of trocar wounds of 10- and 12-mm diameter.

Results: 2 male patients in the mini-gastric bypass group developed a trocar wound hernia, for an overall prevalence of 0.33% (2/610). The intervals between surgery and diagnosis were 3 and 5 months respectively. In these 2 patients, the hernia occurred at the 12-mm trocar wound of the left midclavicular line, 2-3 cm below the costal margin, outside the left rectus muscle. These 2 patients have not developed intestinal obstruction as a consequence of the hernia, and have not undergone hernia repair. No patient in the gastric banding group has been found to develop a hernia.

Conclusion: With our technique, the prevalence of trocar-wound hernia after laparoscopic bariatric surgery has been very rare.

Key words: Trocar wound herniation, laparoscopy, bariatric surgery, morbid, obesity, Surgicel®

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Introduction

Incisional hernia is an iatrogenic complication of abdominal surgery that has troubled patients and surgeons over the last two centuries, affecting 5-15% of patients.^{1,2} It is known that the frequency of incisional hernia has decreased greatly with minimal access surgery.² However, laparoscopic technique has resulted in a new operative complication – trocar wound hernia.³ Secure fascial closure has been reported to decrease this complication. However, it is often difficult to directly visualize the fascia through these tiny incisions during the standard hand-sutured closure.⁴ Besides, if there is loss of pneumoperitoneum during port-site closure, the laparoscopic monitoring of suture placement is hindered, and there is a risk of nerve entrapment, abdominal wall vessel injury, and bowel injury, especially in obese patients.^{4,5} We have used a method to prevent trocar-wound hernia without fascial closure.

Materials and Methods**Patients**

The study population comprised 752 patients undergoing laparoscopic bariatric operations as treatment for morbid obesity between October 2001 and June 2005 in En-Chu-Kong Hospital, with regular follow-up. These included patients with mini-gastric bypass (n = 610) and patients with gastric banding (n = 142). In the

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mini-gastric bypass group, there were 146 male and 464 female patients with mean age 32.1 ± 9.3 SD years (range 15-64); the preoperative mean body weight was 99.2 ± 23.4 kg (range 89.0-212.7), and the body mass index (BMI) was 39.4 ± 7.9 kg/m² (range 39.5-77.0). In the gastric banding group, there were 55 male and 87 female patients with mean age 32.2 ± 9.4 years (range 17-56); the preoperative mean body weight was 87.3 ± 21.7 kg (range 91.2-191.6), and the BMI was 39.2 ± 8.1 kg/m² (range 39.8-63.2). Patient records were reviewed retrospectively, and those patients who developed trocar wound herniation were identified.

For all patients, the following additional information was extracted from the patient records: medical history, surgical history, and smoking history. Standard office follow-up for all patients after laparoscopic bariatric operations was within 2 weeks from hospital discharge. Subsequent follow-up was by the surgeons at 3-month intervals in the first year and then annually. Patients who required conversion to an open approach and those who failed to attend for postoperative follow-up were excluded from the analysis. Besides these 752 patients, there were three male patients who received a laparoscopic mini-gastric bypass who were not enrolled in this study due to loss to regular follow-up.

During the operations, all patients received general anesthesia, orotracheal intubation and were put in lithotomy position.

Trocar Insertion and Wound Closure

The techniques of laparoscopic mini-gastric bypass and gastric banding that we followed have been detailed previously.⁶ First, pneumoperitoneum was established via a Veress needle with intraabdominal pressure up to 15 mmHg. The initial trocar was advanced with a continuous motion, applying steady pressure and feeling the spread of fascia, muscle, peritoneum and then into the peritoneal cavity (transperitoneal technique). Other ports were placed under visualization on the video monitor with the same technique. Five ports were used. Different brands of disposable trocars (non-bladed and bladed) were employed randomly, with port positioning, as follows:

- 1) The laparoscope was placed above the umbilicus, about 20 cm below the xiphoid process. The initial supraumbilical port was 10-mm for gastric

bypass and 15-mm for gastric banding.

- 2) The surgeon's right and left-handed ports were placed in the right and left midclavicular lines, 2-3 cm below the costal margins. Two 12-mm ports were used for gastric bypass and two 5-mm ports for gastric banding.
- 3) The liver retractor was placed in the infra-xiphoid area via one 5-mm port.
- 4) An assistant port (10-mm) was placed at the level of the umbilicus in the left anterior axillary line.

At the conclusion of the operation, the ports were removed under direct vision from the supraumbilical port, to make sure there was no bleeding or entrapment of intraperitoneal tissue. First, we folded a piece of Surgicel[®] mesh (Johnson & Johnson, Arlington, TX) as a plug and inserted it into the abdominal cavity via the port (Figure 1). Second, we withdrew the port through the muscle layer slowly to prevent gas gushing out (Figure 2). Third, we retracted the Surgicel[®] plug out and left it inside the muscle layer (Figure 3). Finally, the port was removed. The final location of the Surgicel[®] plug is shown in Figure 4. All trocar wounds ≥ 10 -mm were managed with the same procedure. The subcutaneous layer was closed with interrupted 2-0 Dexon sutures, and the skin was closed with interrupted 3-0 Nylon sutures. No fascial closure of these port-sites was performed.

Desufflation of the peritoneal cavity was completed via the supraumbilical port before it was removed. Thus, it was expected that the bowel or omentum



Figure 1. A Surgicel[®] mesh plug being inserted into the abdominal cavity via a port.

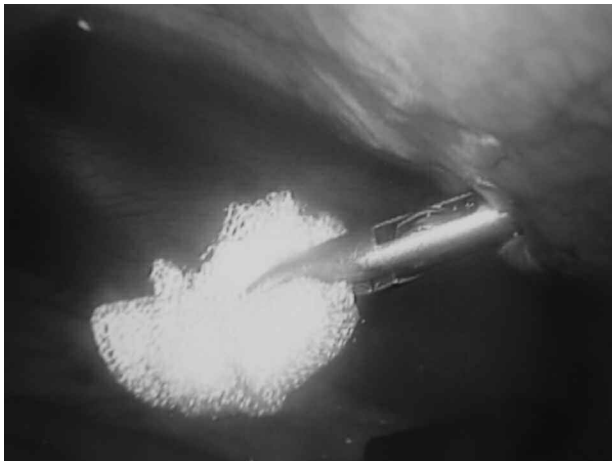


Figure 2. Retraction of the port out of the muscle layer under supervision of the laparoscope.

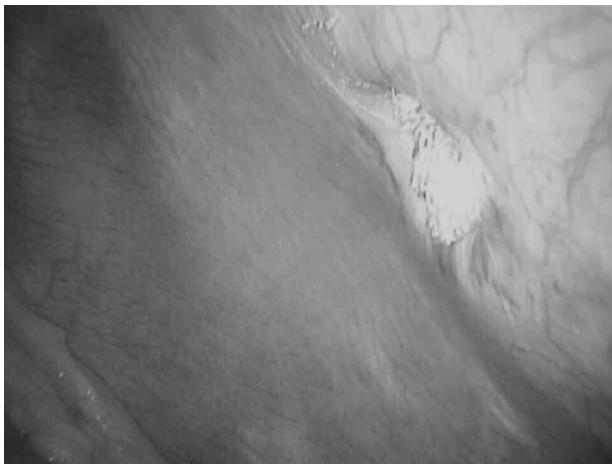


Figure 3. Retraction of the Surgicel® plug, which is being left inside the muscle layer of abdominal wall.

would not be sucked into the wound with the CO₂ jet following port removal. For cases undergoing mini-gastric bypass, we inserted the Surgicel® plug. For cases undergoing gastric banding, we sutured a piece of mesh behind the access-port of the gastric banding system for fixation to the rectus muscle; thus, we just embedded the access-port complex inside a

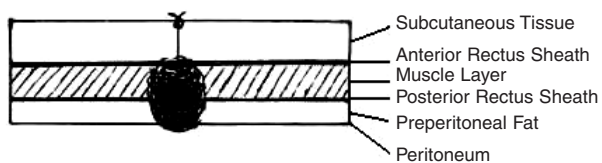


Figure 4. Location of the Surgicel® plug inside the abdominal wall.

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supraumbilical wound, but no Surgicel® plug was inserted. The procedures for subcutaneous and cutaneous layer closure were the same.

Results

At a mean follow-up time of 29 months (range 2 to 44 months) for these 752 patients, trocar wound herniation was detected in two male patients in the mini-gastric bypass group, for an overall prevalence of 0.33% (2/610). One was age 33 and the other was age 27. None had a history of abdominal surgery, but both were smokers. Diabetes mellitus was present in one of these two patients. BMI was 43.4 kg/m² and 44.1 kg/m². None of them had a wound infection after the operation. The interval between surgery and diagnosis were 3 and 5 months, respectively. Both hernias occurred at the 12-mm trocar wound of the left midclavicular line, 2-3 cm below the costal margin, outside the left rectus muscle. A protruded soft mass was noted at this trocar wound during abdominal muscle exertion. None developed intestinal obstruction or peritonitis, nor received subsequent operative management. In contrast, no patient in the gastric banding group showed a hernia.

The follow-up rate of our database was 752/755 (99.6%). Regarding the three patients lost to follow-up and excluded from this study, two were lost to follow-up 2 years after the operation and the other was lost to follow-up 3 years after the operation; they had no sign of trocar wound herniation from the data recorded.

Discussion

Crist and Gadacz⁷ defined trocar-wound herniation as the development of a hernia at the trocar-cannula insertion-site of laparoscopic surgery. The reported incidence of this specific complication ranges from 0.021% to 5%, with an average of 1% in most series published.^{2-5,8-15} However, the true incidence may be underestimated for a variety of reasons, such as failure to diagnose, delay in diagnosis, patient tolerance of an asymptomatic hernia and loss to follow-up.^{13,16} The wide variety of procedures and surgeons makes it difficult to analyze the true incidence.^{16,17}

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Risk factors related to trocar wound herniation may be divided into *clinical* and *technical (mechanical)* aspects. Clinical factors include male sex, advanced age, poor nutrition, anemia, diabetes, renal failure, treatment with steroids, advanced malignancy, and obesity.^{3,15,18} Technical and mechanical factors include sharp-bladed trocar-tip, larger trocar size, open laparoscopy (Hasson trocar insertion), stretching the port-site during manipulation, the technique of closure, properties of the suture materials used for closure, and location of the incision.^{3,16,18} Some reports suggest that the main pathogenesis is not host factors but rather technical ones, and most assert that a large trocar size, a bladed trocar-tip, and leaving the fascial defect open may lead to trocar wound hernia.³

As techniques and equipment advance, larger trocar openings are required (some instruments require trocar-sites as large as 20 mm).^{4,14} It is claimed that trocar hernias are associated with increased size of trocars.^{3,4,11,19} Montz and co-workers²⁰ found that of 840 hernias in which the trocar size was known, 86% occurred in connection with trocars ≥ 10 mm. Kadar et al²¹ reported an incidence of 0.23% (1 in 429 patients) by the application of 10-mm trocars, rising to 3.1% (5 in 161 patients) when 12-mm trocars were used. In the survey of the American Association of Gynecologic Laparoscopists, of 840 trocar wound hernias, 725 (86.3%) occurred in sites where the diameter was ≥ 10 mm. Only 92 hernias (10.9%) occurred at a site of insertion of ports of 8-10 mm in diameter, with 23 (2.7%) occurring in sites where ports were ≤ 8 mm.^{3,20} It is generally recommended that fascia of 5-mm trocar incisions not be closed, while that of 10- to 12-mm trocar incisions be closed at the end of laparoscopic procedures because of the increased risk of trocar wound hernias.^{4,5,8,10,14,15} To reduce the frequency of trocar hernias, it is recommended to apply small size trocars whenever possible.¹¹ For trocar wounds ≥ 10 mm, we believe that the muscular layer should be managed, and not just the subcutaneous and cutaneous layers be sutured.

When non-bladed systems are used, damage is minimal, because dilation and fiber splitting are the principal mechanism of entry.^{2,5,16} The separated fascia generally re-approximates after port removal, much like a valve.¹⁶ Conversely, the bladed trocar perforates the abdominal wall by cutting fascia, muscle fibers, and peritoneum, and creates a defect, which consti-

tutes a risk for hernia formation.⁵ In an animal experiment, Tarnay et al¹⁶ compared the area of the fascial defect created by insertion of six different laparoscopic trocar-cannula systems – two of blunt conical design (non-bladed), two of pyramidal design (bladed), and two of cutting-dilating design (bladed). The blunt conical trocars created smaller fascial defects than both the pyramidal and the cutting-dilating trocars and reduced the risk of trocar wound herniation.^{2,16} These conclusions were supported by data from Leibl et al² who found a reduction of trocar wound herniations from 2% to 0.2% when a conical-shaped trocar was used in place of a sharp cutting trocar. In many other studies, it has been suggested that with the use of non-bladed trocars, closure of the fascia may not be necessary, except for an umbilical trocar.^{5,16,22,23} From our data, we could not draw any conclusion because we had no record of what type of trocars were used in the cases of hernia.

In the early development of laparoscopic surgery, some authors did not recommend routine closure of the fascial defects, while others suggested that any opening ≥ 10 mm in diameter should be closed.^{4,11,15,16,24} Some surgeons proposed that an attempt should be made to close the fascia at the site of insertion of the umbilical port if it was >10 mm, but not the lateral sites.²⁴ Studies have suggested that when the fascia was left open, the risk of trocar wound hernia formation was proportionate to the diameter of the cannula at both the umbilical or extraumbilical sites.¹⁶ However, Montz and associates²² showed, in a survey of 933 trocar hernias that 17.9% still occurred although fascial closure had been performed.²⁰ How to properly close a fascial defect is contentious. Callery et al²⁵ stated that all large trocar-sites should be closed meticulously, even if the skin incision had to be extended. Some authors even suggested that larger trocar-sites be closed completely with adequate muscle relaxation.³ Elashry et al⁴ recommended that closure be done with a fascial closure device (Carter-Thomason[®] device) under direct vision to ascertain adequate closure of the fascial defect. Eid and Collins¹⁵ also found that the Carter-Thomason CloseSure System XL[™] (Inlet Medical, Eden Prairie, MN, USA) resulted in a superior closure, both in terms of operative time and patient outcomes. Besides, it achieves a full-thickness trocar wound closure, not just the fascial layer.¹⁵ However, some surgeons believe that

use of such devices is time-consuming and costly while still without guarantee of a hernia-proof closure, especially in the obese.⁵

In morbidly obese patients who underwent laparoscopic bariatric surgery, initial studies found a decreased wound complication rate (infection, hernia) compared to historical results from laparotomy.^{8,15,26} Bariatric patients are at a high risk for preperitoneal hernias because of their elevated intra-abdominal pressure and substantially thicker fatty preperitoneum.^{3,15} Besides, this thick fatty preperitoneum is potentially a space for intestinal incarceration, with the peritoneum acting as the strangulating ring, despite adequate fascial closure.^{8,15} Also, it is not easy to securely close the fascial defect in morbidly obese patients.

Our group performs no fascial closure of all trocar-site wounds after port removal. Instead, we fold a small piece of Surgicel[®] mesh as a plug and insert it into the muscle layer of trocar wounds of 10-mm and 12-mm size.

Surgicel[®] mesh, an oxidized regenerated cellulose hemostat, has proven to be a safe and reliable product that offers some advantages over other topical hemostatic agents including ease of use, efficacy on many types of bleeding surfaces, antibacterial action, biocompatibility, and trivial mass effect.²⁷⁻²⁹ In an animal study, when inserted into the muscular layer, the Surgicel[®] served as a barrier preventing intestinal herniation; it did not incite an inflammatory or foreign body reaction, and it retarded the formation of adhesions with the intestine.²⁹ Another study revealed that the average time of trocar wound herniation was within 10 days after operation.^{5,14} Surgicel[®] has been found to clear from the implantation site in 1 week,²⁹ which is likely adequate for separated muscle fibre healing and approximation.

In open abdominal surgery, prophylactic use of mesh as a solution for incisional hernia has gained wide popularity. We are aware of no human study on mesh plug use for prevention of trocar wound hernia. Our initial result of trocar wound herniation in mini-gastric bypass was 0.33% (2/610) and in gastric banding was 0% (0/142). Compared to other studies with Roux-en-Y gastric bypass (0.3%³⁰ to 1.0%³¹) and gastric banding (0.4%³²), our short-term results appears favorable. However, a randomized prospective comparison with other techniques is required to determine long-term benefits.

Laparoscopic surgery offers bariatric patients greater comfort in the postoperative period, short hospital stay and quick return to physical activities.¹ However, postoperative hernia may still be an infrequent complication. Our method of Surgicel[®] plug insertion may have theoretical advantages, and can be applied safely in patients with high risk for trocar-wound hernia.

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