

Trocar Port Hernias After Bariatric Surgery

Usha K. Coblijn¹ · Christel A. L. de Raaff¹ · Bart A. van Wagensveld¹ · Willem F. van Tets¹ · Steve M. M. de Castro¹

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Abstract

Background Laparoscopic bariatric surgery is increasingly being performed worldwide. It is estimated that trocar port hernias occur more often in obese patients due to their obesity and because the ports are not closed routinely. The aim of the present study was to analyze the incidence, risk factors, and management of patients with trocar port hernias after laparoscopic bariatric surgery.

Methods All patients who were operated between 2006 and 2013 were included. During the study period, the trocar ports were not closed routinely. All patients who had any symptomatic abdominal wall hernia during follow-up were included.

Results Overall, 1524 laparoscopic bariatric procedures were performed. There were 1249 female (82 %) and 275 male (18 %) patients. The mean age was 44 years, and median body mass index was 43 kg/m². Patients underwent laparoscopic Roux-en-Y gastric bypass (LRYGB) ($n=859$), laparoscopic adjustable gastric banding (LAGB) ($n=364$), laparoscopic sleeve gastrectomy (LSG) ($n=68$), revisional surgery ($n=226$), and other procedures ($n=7$). Three hundred and one patients (20 %) had one or more postoperative complications and the overall mortality was 0.3 % (four patients). There were 14 patients (0.9 %) with an abdominal wall hernia, of which eight (0.5 %) had a trocar port hernia, three (0.2 %) an incisional hernia from other previous surgery, and three (0.2 %) an umbilical hernia. Gender, age, BMI, smoking, type II

diabetes, procedure type, complications, and weight loss were not associated with the occurrence of abdominal wall hernias.

Conclusions Trocar port hernias after bariatric surgery occur seldom if the trocar port is not routinely closed.

Keywords Obesity · Hernia · Incisional · Trocar · Laparoscopy

Introduction

Bariatric surgery is increasingly being performed worldwide [1]. The advantage of laparoscopy has resulted in general acceptance of this procedure [2]. The most popular procedures include the laparoscopic adjustable gastric band (LAGB), laparoscopic Roux-en-Y gastric bypass (LRYGB) procedure, and laparoscopic sleeve gastrectomy (LSG). Although all procedures have their own advantages and disadvantages, all are associated with significant weight loss.

Complications which can occur include anastomotic leakage, bleeding, pulmonary embolisms on the short term and internal herniation, dumping, marginal ulcers, and trocar port hernias on the long term [3]. While many studies recommend the routine closure of 10-mm trocar ports or greater in laparoscopic surgery in order to prevent the formation of incisional hernias [4, 5], closure of the trocar ports is considerably more difficult in the extremely obese patient. Although some bariatric surgeons routinely close the port if possible, many bariatric surgeons from high-volume centers do not routinely close fascial defects from trocars [6–8].

Morbidly obese patients have considerably more intra-abdominal fat and an increased abdominal wall circumference. It is postulated that these factors contribute not only to an increased risk of incisional hernia formation but also to an increased risk of other abdominal wall hernia formation,

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✉ Steve M. M. de Castro
stevedecastro@gmail.com

¹ Department of Surgery, St. Lucas Andreas Hospital, Jan Tooropstraat 164, 1061 AE Amsterdam, The Netherlands

including umbilical hernias, which often become clinically manifest after weight loss.

The primary aim of the present study was to analyze the incidence of trocar port hernias after bariatric surgery in a population where the trocar ports were not routinely closed. The second aim was to perform a meta-analysis to determine the pooled incidence rate of trocar hernias and to determine if there is a difference in incidence rate between routine closing and not closing the fascia.

Methods

A retrospective analysis was performed in patients who underwent bariatric surgery between 2006 and 2013. Before surgery, all patients underwent standard bariatric screening that consisted of a multidisciplinary evaluation, including an evaluation by a certified dietician, a psychological evaluation, a physical examination, an evaluation of comorbidities, a routine screening at the otolaryngeal department for sleep apnea, and a routine esophagogastroduodenoscopy.

For all procedures, patients were in a beach chair position with the legs split (French position). Position of the surgeon was between patients' legs, whereas the assistant was to the patients' left. Pneumoperitoneum was obtained with a Veress needle inserted at Palmer's point or with insertion of an optical trocar under direct vision. A flexible rectangular liver retractor was positioned.

A LAGB was performed with one 15-mm, one 12-mm, and two 5-mm trocars for the camera and instruments. After dissecting the gastrophrenic ligament at the lesser curvature, a retrogastric tunnel was created. Then, the Swedish adjustable gastric band (SAGB) was passed behind the stomach and closed. The fundus was stitched anteriorly with seroserosal stitches in order to prevent the SAGB from slipping. After connecting with the tube, the injection port was placed subcutaneously onto the fascia of the upper part of the left abdominal rectus sheet.

The LRYGB was performed through three 12-mm and two 5-mm ports. A 45-mm Endo-GIA Universal® stapler (Johnson and Johnson, Somerville, NY, USA) was used to create the pouch. The pouch was created by starting in the lesser curvature using one horizontal and two to three vertical staple firings resulting in a pouch size of around 30 ml. The Roux limb was positioned in an antecolic, antegastric fashion. A posterior anastomosis was created with the endo stapler. The anterior side of the gastrojejunostomy (GJ) was closed using uninterrupted VICRYL 2.0 (Ethicon Inc., a Johnson and Johnson Company, Somerville, NY, USA) or a V-loc™ wound closure device (Covidien, Dublin, Ireland). Subsequently, an estimated 120–150-cm small bowel was bypassed after which the side to side entero-enterostomy was made with the linear stapler. The anterior side was closed

with absorbable suture material in a similar manner to the GJ. Finally, the connecting omega limb was divided with the stapler, completing the Roux-Y-limb.

In case of a revisional procedure, the procedure began with the removal of the gastric band followed by a direct revision into LRYGB. The port-a-cath was removed before the skin was closed.

For the LSG, a similar trocar setup was used as in the LRYGB. The LSG was performed by first dissecting the omentum from the greater curvature with a harmonic scalpel. This is performed from approximately 4 cm from the pylorus to the angle of His. The stomach is subsequently divided with the 60-mm linear Endo-GIA Universal® stapler (Johnson and Johnson, Somerville, NY, USA) using a 34-French bougie as guide. The stomach remnant was removed via one of the trocars. This trocar opening was preferably closed if possible.

Patient variables, including general characteristics, comorbidities, medication use, substance abuse, and procedure, were collected. For follow-up evaluation, all patients were seen at 1, 3, 6, and 12 months postoperatively. After 1 year, follow-up was continued annually. Postoperative short- and long-term complications were scored. The severity of the complication was classified according to the Clavien-Dindo Classification System [9].

A systematic review of the existing literature was performed for the second part of this study to calculate the pooled incidence rate of trocar hernias and to determine if there is a difference in incidence rate between routine closing and not closing the fascia defect.

All data were analyzed using IBM SPSS 20 for Windows. The independent Students *t* and Mann-Whitney *U* tests were used to determine any statistical significance for the continuous variables and the chi-square/Fisher's exact test for the dichotomous variables. A two-sided *P* value of less than 0.05 was considered significant.

Results

A total of 1524 patients were operated between 2006 and 2013. General patient characteristics are shown in Table 1. There were 1249 female patients. The mean age was 44 years, and patients had a median BMI of 43 kg/m². Procedures included a LRYGB (*n*=859), LAGB (*n*=364), revisional surgery from previous bariatric surgery (*n*=226), LSG (*n*=68), and miscellaneous procedures (*n*=7). Short- and long-term complications were seen in 301 patients (19.7 %), and four patients (0.3 %) died due to complications after surgery.

Overall, 16 patients had an abdominal wall hernia (1.1 %). Of these, eight patients (0.52 %) had a trocar port hernia. Three patients had an incisional hernia from previous surgery

Table 1 Patient characteristics

	<i>n</i> =1524
Gender (female/male)	1249 (82 %)/275 (18 %)
Mean age ($\pm$ SD)	44 ($\pm$ 10.7)
Median BMI kg/m ² (range)	43 (30–78)
Procedure	
LRYGB	859 (56.4 %)
LAGB	364 (23.9 %)
Revisional surgery	226 (14.8 %)
Sleeve gastrectomy	68 (4.5 %)
Miscellaneous	7 (0.5 %)
Postoperative complication	301 (19.8 %)
Mortality	4 (0.3 %)
Patients with abdominal wall hernia	16 (1.1 %)
Patients with a trocar port hernia	8 (0.52 %)

(one after appendectomy and two after Pfannenstiel). Five patients had a symptomatic umbilical hernia. The types of hernias and the distribution are shown in Table 2.

One of the eight patients developed a trocar port hernia 3 days after surgery and underwent emergency repair. A loop of small intestine was strangulated in a 12-mm trocar port. Reduction was performed under laparoscopic guidance. The intestine was vital, and the trocar port was closed. The patient had an uneventful recovery.

A multitude of risk factors were tested for the entire group of patients with abdominal wall hernias and for only those patients with trocar port hernias as shown in Table 3. There were no statistically significant risk factors identified in any of the groups.

Overall, 229 patients (15 %) were lost to follow-up in the present study. The mean follow-up time was 39.5 months ($\pm$ 21.8).

In the literature, we found 36 studies which specifically describe trocar port hernias. Overall, 13,940 patients underwent a bariatric procedure and 131 developed a trocar port hernia. This results in a pooled incidence estimate of 0.94 % (95 % CI). The incidence ranged from 0.14 to 8 % in literature. A forest plot of the incidence rates of trocar port hernias is shown in Fig. 1.

Table 2 Type of abdominal wall hernia

	All patients <i>n</i> =1524	All patients with hernias <i>n</i> =16
Incisional hernia		
Trocar port	8 (0.5 %)	8 (50 %)
Previous laparotomy	3 (0.2 %)	3 (19 %)
Umbilical	5 (0.3 %)	5 (31 %)

Of the 131 patients with trocar port hernias reported in literature, 34 patients (26 %) developed complications, 14 patients (11 %) had no complication, and 83 patients (63 %) had an unknown outcome. Of the 34 patients with complications, 2 were not operated and 32 were repaired surgically in an elective setting. All 14 patients with complicated hernias underwent emergency surgical repair. One patient required small bowel resection and one colonic repair. One patient (0.8 %) died of multi-organ failure resulting from bowel strangulation. Time to development of trocar port hernias was recorded in nine studies. All three studies, reporting complicated hernias (100 %), found that herniation occurred within 30 days of the initial procedure, while five out of six studies reporting uncomplicated hernias (87 %) found that herniation occurred at least 30 days after the procedure.

Discussion

The incidence of trocar port hernias found in literature is 0.5–2 % for the general (non-obese) population and thus comparable to the incidence found in the present study [4]. However, the incidence of trocar port hernias found in the present study and pooled from the literature is probably an underestimation of the true incidence (Table 4). Many studies in the literature lost patients to follow-up. Studies reported a lost to follow-up rate of up to 20 to 30 %. The present study also lost 15 % of the patient in the long-term follow-up.

Closure of the fascia at the trocar port can be very difficult and time consuming in the morbidly obese. Many techniques, varying from direct closure with retractors to laparoscopic-assisted closure with suture retrievers, have been described to facilitate closure [10]. In the latter technique, a suture is introduced in the abdominal cavity. This suture is picked up at the other side by the suture retriever. A hemostat can also be used instead of a suture retriever. Finally, devices have been developed to facilitate closure of the fascia.

Trocar port hernias can become clinically manifest early or late after surgery. Trocar port hernias that occur early after surgery generally present with intestinal or omental strangulation. This was seen not only in the literature but also in one of the patients in the present study [7]. Prompt recognition is important to prevent bowel ischemia. Treatment predominantly consists of reduction under general anesthesia. In these cases, laparoscopic bowel inspection is advised. In contrast, the late hernias seldom present with strangulation. The late hernias generally become manifest after considerable weight loss and present with abdominal pain and bulging at the trocar site. Generally, the hernia sac content is reducible.

Table 3 Risk factors associated with abdominal wall hernias and trocar port hernias

	No hernia (<i>n</i> =1508)	Hernia (<i>n</i> =16)	Trocar hernia (<i>n</i> =8)	<i>P</i> value
Female	1236 (82 %)	13 (81 %)	6 (75 %)	ns
Age ≥45	722 (49 %)	9 (56 %)	6 (75 %)	ns
BMI (kg/m ²)	44	44	46	ns
DM	386 (26 %)	6 (38 %)	3 (38 %)	ns
Smoking	239 (16 %)	2 (13 %)	1 (13 %)	ns
Procedure				
LRYGB	855 (57 %)	4 (25 %)	3 (38 %)	ns
LAGB	358 (24 %)	6 (38 %)	1 (13 %)	ns
Revisional surgery	221 (15 %)	4 (25 %)	3 (38 %)	ns
LSG	67 (4 %)	1 (6 %)	1 (13 %)	ns
Any postoperative complication	301 (20 %)	4 (25 %)	3 (38 %)	ns
Leakage	11 (0.7 %)	0	0	ns
Bleeding	29 (1.9 %)	0	0	ns
Wound infection	6 (0.4 %)	0	0	ns
Mean BMI (at 1 year)	34	33	34	ns
%TWL at 1 year	24	25	27	ns
Mean BMI at 1 year	44	44	46	ns
Mean weight loss (kg)	30	30	36	ns

ns not significant

There are two groups of risk factors associated with incisional hernia development. The first includes conditions associated with impaired wound healing (e.g., age and diabetes [11], smoking [12], wound infections [13]), and the second conditions in which the abdominal pressure is raised (e.g., obesity [14], COPD [15]). In the present study, no risk factor was identified. One explanation could be the relatively low event rate of trocar port hernias which makes detecting a statistical difference more difficult. Another factor influencing these statistics is that the population consists of a relatively homogeneously bariatric population. This homogeneity could influence analysis of risk factors which could otherwise be detected by statistical analyses in a more heterogeneous population.

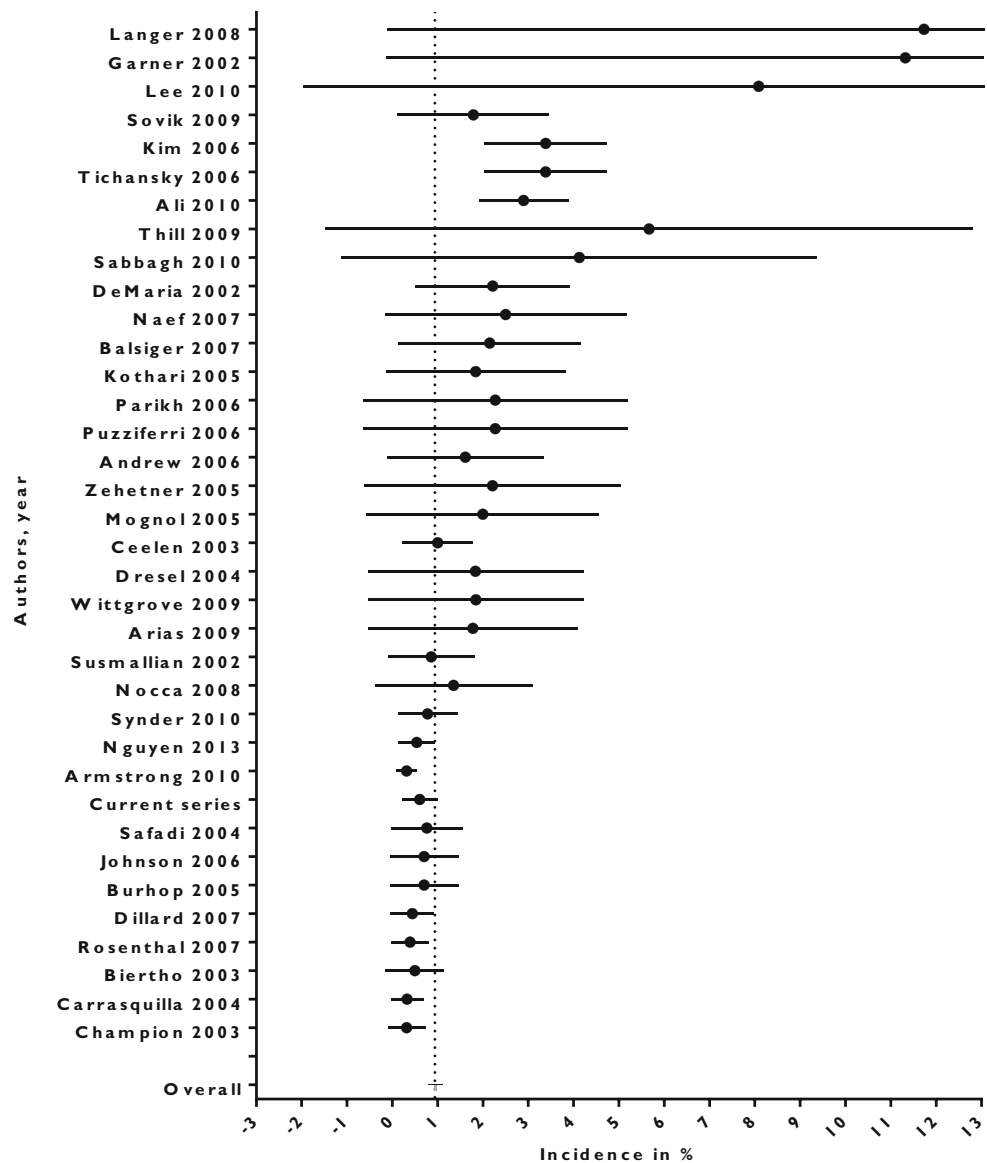
The size threshold above which the risk of herniation increases is not clear. The majority of reported herniation in the literature were found in ports ≥10 mm. In the present study, all incisional hernias occurred in the 12-mm trocar sites. In the retrospective cohort study of Kadar et al., incidences of 0.23 and 3.1 % are found in fascia defects of 10 and 12 mm, respectively [16]. However, the power of this study is not sufficient for an accurate estimation of incidence and risk calculations.

In the literature, it is recommended to close fascia defects ≥10 mm to prevent herniation [16, 17]. Examination of the same literature, however, shows that there is no good evidence to support this recommendation. In the literature, there are no RCTs, which analyzed the

occurrence of port herniation in relation to closing the fascia in bariatric surgery. Sound medical and scientific retrospective studies, which might show that closing fascia defects in bariatric surgery will reduce the risk of port site herniation, are also very limited. Closing a fascia defect may not necessarily result in a decrease in the incidence of port site herniation but can also cause complications like nerve constriction, superficial vascular injury, and bowel injury. The incidences of these complications are unknown and probably underreported. They are, however, expected to be lower than the incidence of port site herniation.

There was an unexpected inverse association between routine trocar port closure and the incidence of trocar port hernias in the literature. In contrast, there are studies in the non-obese population which have shown that routine closure of the trocar ports results in less hernias. The findings in the bariatric population were surprising. It could be that surgeons who close sites examine for the presence of hernia more assiduously in the follow-up, or the technique of closure may be a factor. The inherent difficulty in placing transfascial stitches precisely with a suture passer can result in incomplete closure of the fascia or increase damage to already traumatized tissue. Also, it is possible that suture closure results in tissue ischemia or cutting/tearing when the wound swells or the patient's intra-abdominal pressure increases during a cough or straining; both mechanisms could result in an even larger fascial defect. Complications such as bowel damage, hematomas, and nerve

Fig. 1 Forest plot of trocar port hernia incidence rate in the literature



constriction due to trocar port closure were not reported in the bariatric literature.

The weaknesses of the present study and systematic review of the literature include the heterogeneity of operative technique and follow-up time variation with no clear notification of examination for hernia formation. For

example, not all authors reported details of the sizes and types of trocars that were utilized. The effect of trocar type, such as bladed, nonbladed, and radially expanding, may play a role in the development of hernias as these devices create varying fascial defects [18]. Also, the location of the trocar-site hernias was not always mentioned, and some authors routinely closed fascial defects in the midline, but left other defects open in the lateral abdomen where there are several layers of musculature [6–8].

In conclusion, trocar port hernias occur seldom after bariatric surgery, even if the fascia defects are not routinely closed. Routine closure can be omitted since the incidence of hernia formation is low, and it can easily be managed should it occur. Severe complications such as bowel strangulation occur even less often, and prevention by routine closure of the fascia is not mandatory.

Table 4 Incidence of trocar port hernias reported in the literature. Analyses of studies reporting routine closure versus no closure of trocar sites (including patients from the current study)

Procedure	Not closed	Closed	<i>P</i> value
RYGB	12/3340 (0.4 %)	14/1333 (1.1 %)	<0.05
LAGB	5/1028 (0.4 %)	6/735 (0.8 %)	0.5415
Overall	17/4368 (0.4 %)	20/2086 (1.0 %)	<0.05

Conflict of Interest The authors declare that they have no competing interests.

Ethical Approval This study was approved by our Institutional Research Committee and is in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Statement of Informed Consent Informed consent from patients was not necessary.

Statement of Human and Animal Rights This does not apply.

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