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TECHNICAL INNOVATION

Single-Access Laparoscopic Adjustable Gastric Band Removal: Technique and Initial Experience

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Abstract
Background Single-access laparoscopy (SAL) has gained significant interest in recent years. Potential benefits, beyond cosmetic outcomes, could be reduction of abdominal trauma, decreased risk of incisional hernia and diminished postoperative pain. Technique and initial experience in patients submitted to laparoscopic adjustable gastric band removal (LAGBR) through SAL is reported here.
Methods Between December 2009 and March 2012, 14 patients (9 females, 5 males) underwent LAGBR through SAL. Indications for operation were band intolerance (11), pouch dilatation (2) and insufficient weight loss (1). The mean age was 40.3±9.1 years (range 26–57), and the mean interval time between LAGB placement and removal was 94.7±41.9 months (range 37–157). The mean weight and the mean body mass index at the time of LAGBR were 89.3 ±17.6 kg (range 65–119) and 30.6±4.5 kg/m^2 (range 25.3–36.7), respectively. Technically, the previous port site scar was used as the single-access site to the abdominal cavity. An 11-mm reusable trocar was adopted for a 10-mm regular scope, besides curved reusable instruments.
Results No patients required conversion to open surgery and none necessitated additional trocars. The mean laparoscopic time was 24.6±7.9 min (range 13–37), and the mean final scar length was 3.6±0.3 cm (range 3–4). Two patients experienced early postoperative complications. The mean hospital stay was 1.3±1.1 days (range 1–5). The mean follow-up time was of 18±9.8 months (range 3–30), and there were no late complications.
Conclusions LAGBR can be safely performed through SAL. Thanks to this technique, the laparoscopic working triangulation is established as well as the ergonomic positions of the surgeon. Due the use of only reusable material, the cost of this SAL remains similar to multiport laparoscopy.

Keywords Single incision · Single port · Single site · Single access · Laparoscopy · Band removal

Introduction

Open bariatric surgery can be performed with relatively low morbidity and mortality rates, but wound-related postoperative complications remain a significant problem. Wound infection occurs in as many as 25 % of morbidly obese patients treated, and incisional hernia develops in as many as 16.7 % of patients [1, 2]. With the advent of laparoscopy, these complications have been reduced. Other advantages to laparoscopy include less postoperative pain, a shorter length of hospitalisation and faster recovery [3].

Single-incision, single-port, single-site or single-access laparoscopy (SAL) was first described in 1992 [4]. After more than 20 years, thanks to the advent of Natural Orifice Transluminal Endoscopic Surgery (NOTES), and a desire for improved cosmetic outcomes, SAL has gained significant interest. Since 2008, the first SAL bariatric procedures have been described like LAGB [5], sleeve gastrectomy (SG) [6], Roux-en-Y gastric bypass [7] and biliopancreatic diversion [8]. Along with improved cosmetic results, SAL may decrease abdominal trauma (trocar fascial–peritoneal puncture, bleeding,

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hematoma formation, visceral injury, local nerve irritation), postoperative pain and incidence of incisional hernia.

The main technical difficulties during SAL are the lack of triangulation inside the abdomen, the clashing of the instrument tips and crossing of the surgeon's hands externally. Furthermore, one of the essential laparoscopic rules, to keep the surgeon's two effectors at a right angle with the optical system at the bisector of this angle [9], is frequently lost. The use of curved instruments allows for classic laparoscopic triangulation inside and outside the abdomen (Fig. 1a–c).

Patients and Methods

Between December 2009 and March 2012, 14 patients (9 females, 5 males) underwent laparoscopic adjustable gastric band removal (LAGBR) using SAL. Indications for operation were band intolerance (11), pouch dilatation (2) and insufficient weight loss (1). The mean age was 40.3±9.1 years (range 26–57), and the mean interval time between LAGB placement and removal was 94.7±41.9 months (range 37–157). At the time of LAGBR, the mean weight was 89.3±17.6 kg (range 65–119), and the mean body mass index was 30.6±4.5 kg/m^2 (range 25.3–36.7).

Technique

The patient was placed in a supine position with the arms alongside the body and the legs abducted. The surgeon stood between the patient's legs with the camera assistant to the patient's left. The subcutaneous port was identified and the previous port site scar was incised sufficiently to expose and remove the port. The peritoneal cavity was entered using the "open laparoscopy technique" with a fascia opening of 1 cm. Purse-string sutures using one polydiaxone (PDS) and one polyglactine (Vicryl) were placed in the superficial and deep muscular fascia, respectively. A reusable 11-mm trocar was used for a 10-mm, 30° angled, rigid and regular length scope. Curved reusable instruments (Karl Storz—Endoskope, Tuttlingen, Germany) were inserted into the abdomen through the same incision without trocars by following the curves on the shaft and forming a 45° angle with the abdominal wall plane. The curved grasping forceps I (Fig. 2a) was advanced through a different fascial window outside of the purse-string suture (10 o'clock position), which was created using the wire of a 5-mm trocar. Other instruments, including a curved coagulating hook (Fig. 2b), curved scissors (Fig. 2c) and a curved suction device, were introduced alongside the 11-mm trocar and inside the purse-string sutures (3 o'clock position) (Fig. 3). The sutures were adjusted to maintain a tight seal around the 5-mm tools and the 11-mm trocar. The sutures were loosened only to permit instrument exchange or to evacuate the smoke generated from the dissection. The band was identified by following the tubing and was dissected off of the left lobe of the liver. Internal triangulation was established (Fig. 4a), which allowed the surgeon to work in ergonomic positions similar to multiport laparoscopy (Fig. 4b). After sufficiently detaching the band from the stomach, the band was cut, pulled away from the gastric surface and removed from the abdomen through the single-access site. The instruments were removed under direct vision and the purse-string sutures were tied. Supplementary absorbable sutures were placed to reinforce the access site and to close the separate opening for the grasper. The final scar length varied depending on the diameter of the previous subcutaneous port.

Results

No patient required conversion to open surgery or additional trocars. The mean total operative time (between skin incision and closure of the fascia) was 55.9±21.6 min (range 34–120), and the mean laparoscopic time (between beginning of pneumoperitoneum and removal of the instruments and trocars) was 24.6±7.9 min (range 13–37). The mean blood loss was 6.1±

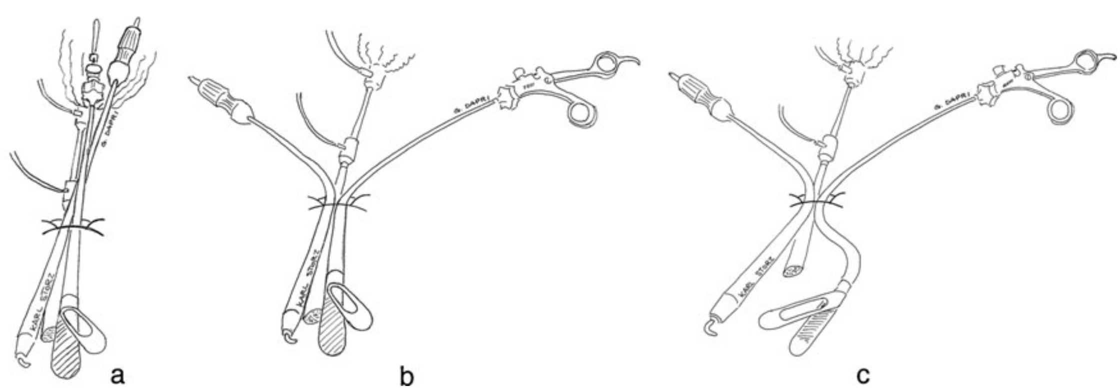

Fig. 1 a–**c** The straight classic laparoscopic instruments (**a**) are curved outside the access (**b**) and inside the abdomen (**c**) to permit the establishment of the conventional laparoscopic triangulation

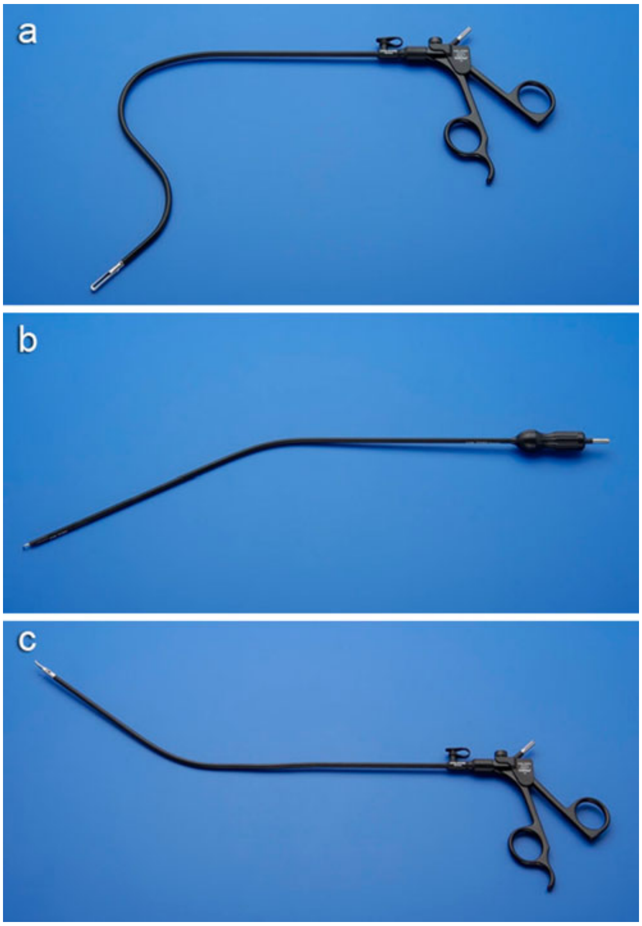

Fig. 2 **a**–**c** DAPRI curved reusable instruments: grasping forceps I (**a**), coagulating hook (**b**), scissors (**c**) (source: Karl Storz—Endoskope, Tuttlingen, Germany)

5.8 mL (range 0–20), and the mean final scar length was 3.6± 0.3 cm (range 3–4). Two patients developed early postoperative complications (one pleural effusion, one subcutaneous abscess). The mean hospital stay was 1.3±1.1 days (range 1–5). At a mean follow-up of 18±9.8 months (range 3–30), no late complications were observed. Nine patients gained a mean

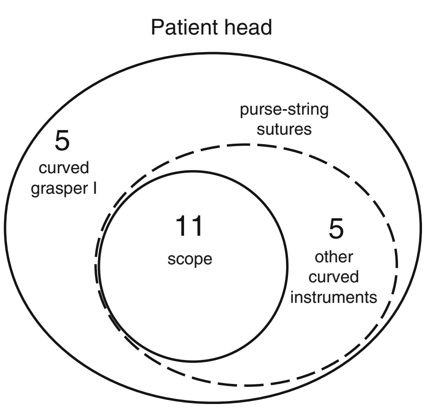

Fig. 3 Single-access site: placement of purse-string sutures, 11-mm reusable trocar and curved reusable instruments

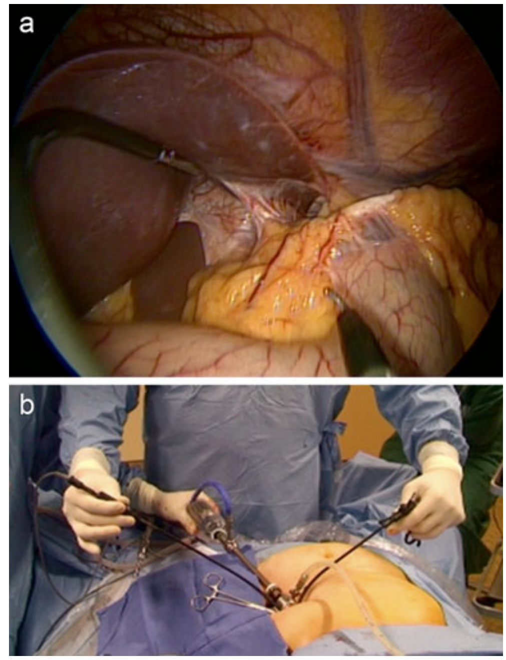

Fig. 4 **a**,**b** Intracorporeal working triangulation (**a**) and external surgeon's ergonomy (**b**)

weight of 14.5±11.7 kg (range 2–39), one patient remained with a stable weight, one patient continued to lose weight and the remaining three patients refused follow-up.

Discussion

SAL has mainly been described through the original umbilical scar, which is considered an embryologic orifice and keeps good cosmesis [10]. For patients who have had previous LAGB, the improved cosmetic outcomes with SAL are less of an issue because these patients already present with three to ten cutaneous scars. Other potential advantages, such as reduced abdominal trauma (trocar fascial–peritoneal puncture, bleeding, hematoma formation, visceral injury, local nerve irritation), less postoperative pain and lower risk of incisional hernia, are significant because these patients will likely undergo another bariatric procedure. Increasing the number of trocars can contribute to the development of incisional hernias [11].

The scar covering the subcutaneous port can be used as the single-access site for the procedure. As subcutaneous ports have different diameters, the final scar length will depend on the size of the port. Every patient treated in our series had their subcutaneous port located in the left upper quadrant. Nevertheless, this procedure can also be applied for patients who have their port placed more medially. For patients with ports above the xiphoid process or in other abdominal areas, the access site for SAL will be chosen among the previous scars, preferably in the left-sided upper quadrant.

In the technique described here, no disposable ports specifically designed for SAL were used. Instead, we used an 11-mm trocar and curved instruments. We utilised purse-string sutures in the abdominal fascia to maintain sufficient pneumoperitoneum and to minimise air leak. A purse-string suture allows the surgeon to insert instruments into the abdomen, parallel to the 11-mm trocar, using his or her dominant hand. Furthermore, because the instrument held by the surgeon's nondominant hand (grasper) does not change during the procedure, it is inserted through a separate window outside of the purse-string sutures. A thick and sliding stitch, such as PDS 1 suture, is chosen for closure of the superficial abdominal fascia. Vicryl 1 suture is used for closure of the deep abdominal fascia. The purse-string sutures have to be adjusted to maintain pneumoperitoneum during the procedure and enlarged only to permit the exchange of the instruments for the surgeon's dominant hand or to evacuate the smoke generated by the dissection.

The curved grasping forceps I has two curves. The first curve is at the level of the abdominal incision, which avoids the unintentional contact between the grasper's handle and the camera assistant's hand. The second curve is inside the abdomen and establishes the working triangulation with the other curved tools. The other curved instruments (coagulating hook, scissors, suction device) are similar in shape, but have only one curve. They are designed to avoid the collision between the surgeon's hand and camera assistant's hand outside of the access site. These curved instruments allow the surgeon to work ergonomically during SAL, without clashing of instrument tips or crossing of the surgeon's hands (Fig. 4a, b). All curved instruments must be introduced and removed from the abdominal cavity by following the curves of the instruments and maintaining a 45° angle with respect to the abdominal wall.

Operative field's exposure during SAL remains one of the main drawbacks. When SAL is applied to bariatric surgery, exposure to the hiatal region is problematic. The classic Nathanson liver retractor can be inserted through the single-access site or through a different skin puncture [12]. Other available options include the use of percutaneous diaphragmatic crura sutures [13], percutaneous transhepatic sutures [7], a nonpuncturing penrose drain with endohernia stapler [14], a penrose drain [15], a bulldog clamp with a hook retractor [16], a magnetic-assisted grasper [17] and placement of a subcostal Veress needle [18]. In our technique, we used the distal curve of the grasper for the dissection and for exposure to the hiatal region (Fig. 4a).

SAL has been reported to increase the cost of the procedure [19], mainly because of the use of specific disposable port devices and instruments. We adopted a procedure that can be performed without the use of disposable equipment, which should make the cost of SAL similar to multiport laparoscopy.

No patients in this study required insertion of additional trocars. The need for additional trocars has been reported in SAL with an incidence of 4.5–13 % during LAGB [20–24] and 4–66.6 % during SG [6, 25–28]. We consider insertion of one or more trocars not as a failure of SAL, but rather as a technique of reduced port laparoscopic surgery [29]. Galvani et al. [30] compared single- and dual incision LAGB and had a 0 % of conversion rate in the last 19 patients treated.

We reported a mean difference of 31.3 min between the total and laparoscopic time. This interval time can be explained by the time needed to remove the port, to obtain access to the peritoneal cavity through the "open laparoscopy technique," and to close the access site, taking care of the different fascial opening for the grasper. Our laparoscopic time was not dependent on the learning curve, unlike the literature data [6, 21].

Although no perioperative complications were registered, two patients developed postoperative complications. One patient developed a pleural effusion, was successfully treated by chest physiotherapy and was discharged on postoperative day 5. A second patient developed a subcutaneous infection at the access site. This infection was probably due to a port problem rather than laparoscopic single-access site [31].

At a mean follow-up of 1.5 years, no patients presented with complications related to the laparoscopic procedure. No patient developed an incisional hernia at clinical follow-up. However, longer follow-up is needed to make firm conclusions.

Finally, there are several limitations to this study. First, this is a single surgeon experience. Therefore, the patient population suffers from selection bias. Most patients refused the procedure and preferred another bariatric procedure. Second, the evaluation of the postoperative pain, which is the most significant short-term outcome, is not included in this study. In a comparison between SAL and multiport laparoscopic LAGB, Raman et al. [32] reported a significant difference in analgesic use during the immediate postoperative period after SAL. Patel et al. [22] reported a visual analogue scale score of 2.5 out of 10 (range 0–7) at 24 h following SAL. Similarly, in another comparison between SAL and multiport laparoscopic SG, Saber et al. [33] reported a significantly reduced pain score in the SAL group. Other authors have found significantly less pain after the 1st [25] and the 8th [34] postoperative hours following SAL.

Conclusions

LAGBR can be safely performed through SAL. Thanks to this technique, the laparoscopic working triangulation is established as well as the ergonomic positions of the surgeon. Due the use of only reusable material, the cost of this SAL remains similar to multiport laparoscopy.

Conflict of interest G. Dapri is a consultant for Karl Storz—Endoskope, Tuttlingen, Germany. The other authors have no commercial associations that might pose a conflict of interest in relation to this article.

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