Single Incision Right Colectomy

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Introduction

Minimally invasive surgery (MIS) has revolutionized the traditional approach to colectomy. By minimizing trauma to the abdominal wall and the field of resection, MIS colectomy has been associated with less postoperative pain, shorter return of bowel function, and reduction in hospital length of stay [1, 2]. Single-incision laparoscopy (SIL) is a derivative of traditional multiport laparoscopy, combining trocar and specimen extraction sites with the intention of reducing pain and scarring.

SIL or single-port access (SPA) surgery falls under the umbrella of natural orifice transluminal endoscopic surgery (NOTES). As implied by the name, NOTES utilizes orifices such as the stomach, vagina, anus, and umbilicus for primary instrument access and extraction of specimens. The umbilicus is considered a natural orifice from an embryologic standpoint. The first reported SIL procedures include appendectomy and cholecystectomy in the late 1990s [3, 4].

The original enthusiasm around SIL centered on the goal of minimizing the size and multiplicity of abdominal incisions for both postoperative pain and recovery, in addition to enhancing cosmesis. As feasibility and safety were demonstrated, SIL was applied to more complex procedures, such as gastric banding, colectomy, nephrectomy, hysterectomy, and hernia repair [5–9].

In 2008, separate reports by Bucher et al. [7] and Remzi et al. [10] described the first single-incision laparoscopic surgery (SILS) for right colectomy utilizing an umbilical port site. In both reports, laparoscopic mobilization of the right colon was followed by creation of an extracorporeal ileocolic anastomosis. These successful initial forays into SILS encouraged others to apply this approach within the realm of colorectal surgery with case reports of segmental colectomy, total abdominal colectomy, and total proctocolectomy with ileoanal pouch creation [11–13].

Patient Selection and Preoperative Planning

Patients undergoing SILS right colectomy should undergo appropriate preoperative evaluation for major abdominal surgery. This should include thorough cardiopulmonary assessment to determine a patient's fitness for both general anesthesia and abdominal insufflation. In the setting of malignancy, patients should also have imaging performed for staging with careful attention to the resectability of the tumor.

The onus is on the surgeon to determine whether or not SILS is feasible and appropriate for

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each patient, taking into consideration the surgeon's laparoscopic experience and the complexity of the patient's condition. Early in the SILS learning curve, it is generally advisable that the surgeon select patients with lower body mass index (BMI), minor or no prior abdominal surgery, and less complicated pathology. As experience is gained, more technically challenging disease can be approached (i.e., higher BMI, larger tumor, inflammatory mass, extensive adhesive disease) according to the surgeon's comfort level.

Preoperative Care and Patient Positioning

After induction of general anesthesia and endotracheal intubation, the patient should be placed in the supine position with the left arm tucked at the side. It is important to adequately secure the patient to the bed with generous padding and straps, as the patient may require rotation into the left side down/right side up position. Urinary bladder catheterization should be performed for urine output monitoring. Lower extremity sequential compression devices should be engaged at the time of anesthesia induction. In the setting of malignancy, subcutaneous heparin (5000 units) should be administered for additional thromboembolic prophylaxis. Preoperative prophylactic antibiotics should be administered within 30 minutes of incision time. Iodophor- or chlorhexidine-based skin preparation is recommended for reduction of surgical site infection.

Port Placement

Two generally accepted port placement sites have been utilized for SILS: the umbilicus and the suprapubic location. Laparoscopically, our preferred approach is through a 2.5 cm incision at the umbilicus, which allows for a 4 cm fascial incision below (Figure 19.1a, b). Although several commercial single-incision ports are available, we typically use the Gelport™ platform by Applied Medical (Fig. 19.2) as it includes a wound protector for specimen extraction.

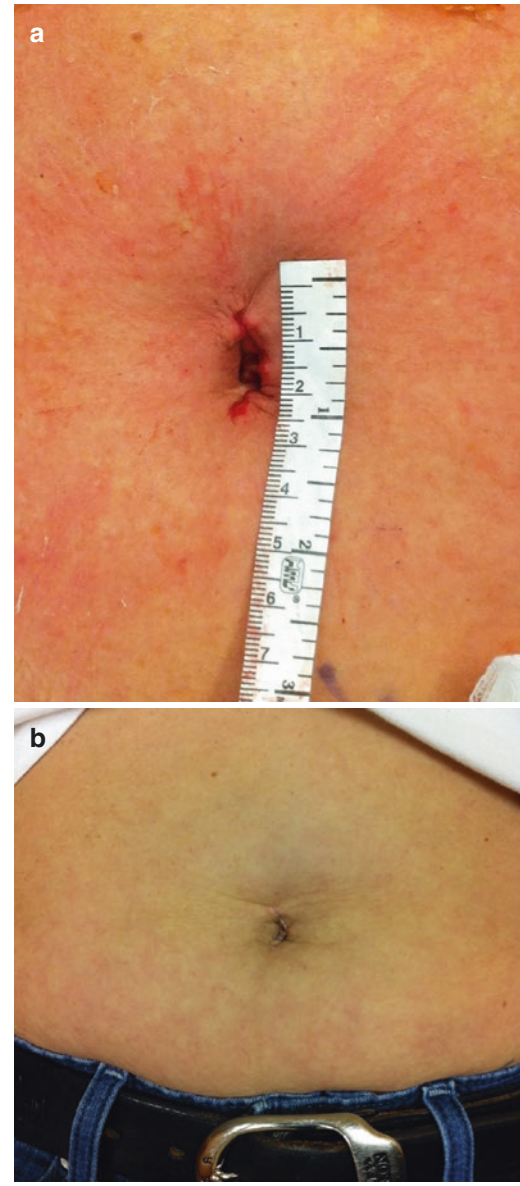

Fig. 19.1 (**a**) Measurement of the single-site incision with a ruler. Incision with ruler. (**b**) The postoperative appearance of the single-site incision

Alternatively, we have also used a wound retractor with an attached surgical glove as a single-incision port (Fig. 19.3). Insufflation can be initiated either through a port placed through the platform or through an insufflation valve on the platform. Insufflation pressure is based on distensibility of the abdominal wall but typically set at 10–15 mmHg.

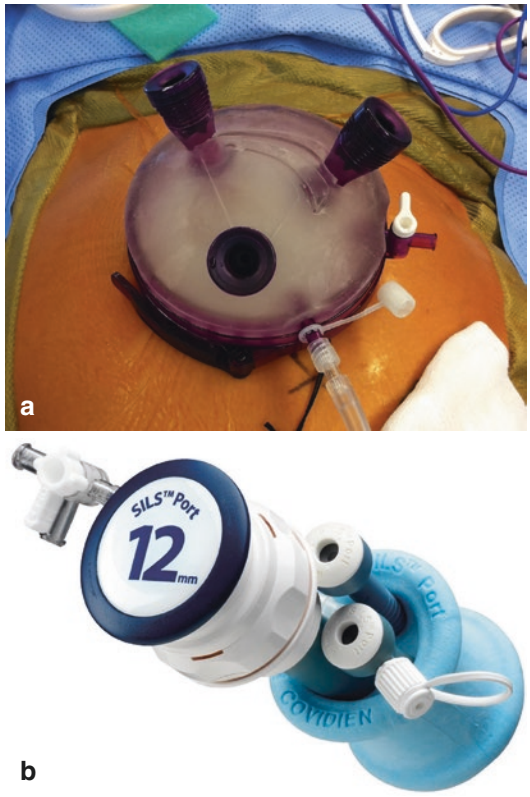

Fig. 19.2 Image of a commercially available single-site port

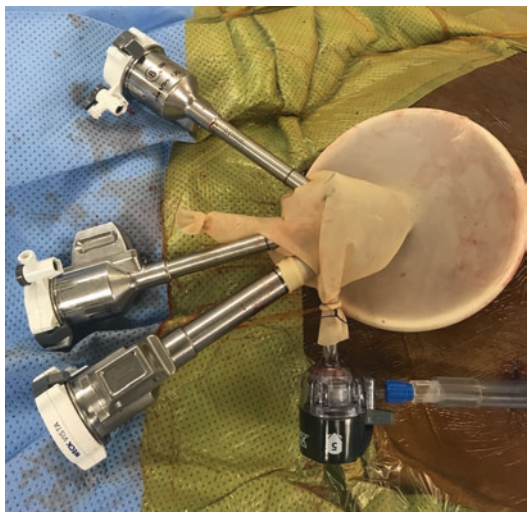

Fig. 19.3 Intraoperative image of a glove modified to serve as a single-site port

Trocars, Camera, and Instrumentation

Given spatial constraints, three ports are placed through the SILS platform: one 5/12-mm trocar for the camera and two 5-mm ports for instrumentation. It can be difficult to find room for an assistant port; however, this depends on the size of the platform and the configuration of trocar placement. Some authors report using an assistant port outside the SILS platform in a technique described as a "single-incision plus one" approach. Unlike with standard multiport laparoscopy, triangulation of the tissues can be difficult with SILS because of limited space and range of motion. Adequate exposure and traction/counter-traction can be achieved with smaller and less dramatic movements. Despite these considerations, external collisions can occur. A 30 ° bariatric length laparoscope with a right-angle light cord is recommended to allow the assistant to avoid excessive external collisions. Alternatively, a flexible tip 5 mm laparoscope can also be utilized. A grasper and energy device (monopolar or bipolar) can be used through the two working trocars.

Surgical Technique

Colonic Mobilization

Our preference is for a medial-to-lateral approach once insufflation has been achieved. It can be useful to suspend the ileocecal region using a 0-silk suture by passing a transabdominal Keith needle or by intracorporeally tacking the cecum to the anterior abdominal wall. This maneuver allows the surgeon to elevate the cecum and stretch out the ileocolic pedicle, without committing the grasper to this action. The dissection can then be carried out by carefully separating the right colonic mesentery from the retroperitoneum and, in particular, the duodenum. The lateral attachments and hepatic flexure can then be

mobilized. The gastrocolic ligament should be released allowing entrance into the lesser sac. We use a 5 mm blunt-tipped LigaSure™ vessel sealing device by Covidien to ligate the ileocolic, right colic, and right branch of the middle colic vessels. The mesentery of the terminal ileum and the transverse colon can be taken with the energy device up to the edge of bowel.

Creation of the Anastomosis

Once the right colon has been completely mobilized, a resection of the bowel and creation of the anastomosis are then performed. We favor performing the anastomosis in an extracorporeal fashion, given the limited range of motion of the instruments and the technical challenge of intracorporeal anastomosis. An iso- or antiperistaltic anastomosis can be created. After reduction of the anastomosis back into the abdomen, we close the fascia with a 0-PDS and the skin with 4-0 Vicryl and Dermabond®.

Overall Outcomes

An early study by Papaconstantinou et al. [14] reported improvement in postoperative pain and decreased length of stay with SILS colectomy compared to multiport laparoscopic resection. In this case-matched study, 29 patients who underwent SILS right colectomy were matched to patients who had undergone hand-assisted laparoscopic (HAL) or standard laparoscopic right colectomy. A significant decrease in postoperative pain scores on postoperative day 1 was observed in the SILS group compared to both HAL and standard ($p < 0.05$) groups, despite similar incision length (4.5 cm, SILS vs. 5.1 cm, standard). This suggests that the addition of 5-mm ports may contribute to increased postoperative pain. However, several subsequent papers reported no difference in pain scores when comparing SILS to multiport colectomy [15]. Length of stay was decreased by 1 day in the SILS group (mean, 3 days) compared to both HAL and standard groups (mean, 4 days) ($p < 0.05$), despite similar postoperative care. Operative times and conversion rates were similar in both groups.

Oncologic Outcomes

In addition to safety and feasibility, the maintenance of oncologic principles is critical for the adoption of new surgical techniques for colorectal malignancy. The gold standard is the achievement of negative margins combined with complete mesocolic excision with appropriate lymph node harvest. With single-incision approach, technical challenges such as instrument crowding, difficulty with triangulation, limited counter-traction, and in-line viewing are ubiquitous. Despite the lack of data to support SILS as a standard technique, several publications have demonstrated oncologic equivalency between SILS and standard multiport laparoscopic right colectomy [16–21].

Robotic-Assisted Single-Incision

To overcome some of the technical challenges posed by SILS, robotic technology has been applied to the single-incision approach. The technique involves using robotic trocars, inserted through a single-port platform, that are then docked to the surgical robot. The surgeon then controls the arms at the robotic console. Our preference is to use the da Vinci Xi® platform.

Patient Positioning

Preoperative care is identical to that mentioned above for laparoscopic SILS. We place the patient in the supine position; however, we pad and tuck both arms.

Port and Trocar Placement

We prefer to use a wound retractor with an attached glove for our platform, placed through a 3–4 cm Pfannenstiel incision. After cutting off

the fingertips of the glove, the four 8-mm trocars are inserted and secured with 0-silk ties (Fig. 19.3). Through the fifth fingertip, an assistant port is secured for insufflation. Ideal insufflation pressures range from 10 to 15 mmHg, depending on the laxity of the abdominal wall.

Camera and Instrumentation

We utilize a 30 ° scope that can be rotated upward or downward during the dissection. Monopolar scissors, bipolar fenestrated grasper, and Cadiere forceps are used. Due to the small confines of the working space, it is imperative that the joints of the Xi platform are optimally spaced to allow for passage and mobilization of the instruments.

Surgical Technique

Colonic Mobilization

We begin with an inferior approach to the dissection by elevating the cecum. First, the appendix is mobilized from its lateral attachments. We enter the avascular space, carefully separating the mesocolon from the retroperitoneum. Close attention is paid to identifying and sparing the right ureter, duodenum, and pancreas. We continue this dissection all the way up to the hepatic flexure, eventually visualizing the liver parenchyma and gallbladder. The colon can then be rotated medially, allowing the lateral attachments and gastrocolic ligament to be released. We then address the ileocolic pedicle by performing a high ligation using the EndoWrist® one™ vessel sealer. The right colic and right branch of the middle colic artery are transected and sealed in a similar fashion. Lastly, the mesentery of the terminal ileum and proximal transverse colon are taken with the vessel sealer.

Creation of the Anastomosis

Upon complete release of the specimen, the right colon is placed into the left lower quadrant. We prepare for intracorporeal anastomosis by bringing the terminal ileum up to the transverse colon. A 3-0 silk suture, cut to 10 cm, is then passed through a trocar. We determine whether an anti-peristaltic or isoperistaltic anastomosis is performed by assessing the natural position of the bowel. A robotic needle driver is used to align the bowel in a side-to-side fashion.

Enterotomies are created in the aligned small bowel and colon to allow for passage of a stapler with a blue load. Once the stapler has been fired, the anastomosis is evaluated intraluminally for adequate hemostasis. The resulting enterotomy for the common channel is then closed with a 2-0 barbed suture in a running fashion.

The instruments are then removed and insufflation is terminated. After removing the glove with the attached trocars, the specimen can be brought through the wound protector. The fascia is then closed with 0-PDS suture. We irrigate the soft tissue of the wound with sterile saline and then close the skin with a running 4-0 Vicryl suture and Dermabond. Local anesthesia is then injected around the wound.

Outcomes

Spinoglio et al. reported three cases of robotic right colectomy utilizing Single-Site™ instrumentation by Intuitive Surgical, Inc. [22]. The Single-Site™ kit is comprised of a gel faceplate with curved cannulae through which semirigid robotic instruments are inserted. The instruments cross each other at the point of entry into the abdomen and are then reassigned to the surgeon's opposite hand to restore the natural alignment (Fig. 19.4). For each of the three cases, a suprapubic location was selected for platform placement. Mean operating room time was 218 ± 75.9 minutes. Intracorporeal isoperistaltic anastomoses were created in two cases with one extracorporeal anastomosis. All patients were discharged within 5 days of surgery.

Unfortunately, the lack of wristed instruments utilized in the Single-Site™ technology does not allow the surgeon to capitalize on the perceived

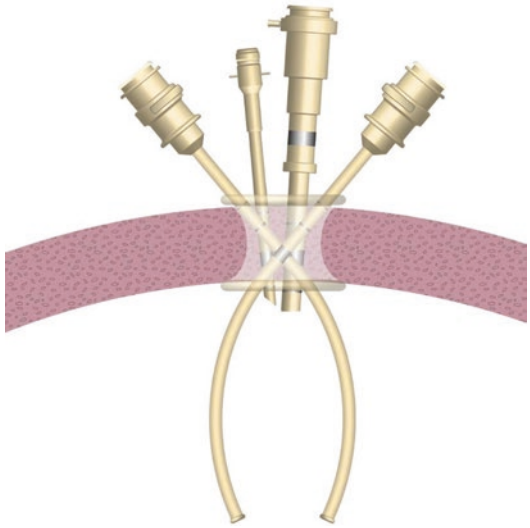

Fig. 19.4 Image of a single-site kit with cannula crossing at the level of the fascia

Fig. 19.5 Intraoperative image of a modified glove platform with robotic trocars

advantages of robotic surgery. Subsequent reports have largely described the use of standard wristed instruments and robotic trocars which have been inserted through a single-incision platform (Fig. 19.5).

The largest experience with single-incision robotic right colectomy to date was reported by Juo et al., describing 31 patients [23]. The da Vinci Si™ robotic system with a Gelpoint™ platform (Applied Medical) was used via an umbilical incision, employing four trocars: one 12-mm camera trocar, two 8-mm robotic trocars, and one 5-mm laparoscopic assistant port. The authors describe a "crossed-arm" technique where the two robotic arms are crossed intracorporeally to minimize instrument collisions and to improve triangulation. This technique requires the reassignment of the robotic arms to the surgeon's opposite hand (e.g., right arm assigned to surgeon's left hand). The median operating room time was 180 minutes, which is slightly longer time compared to SILS in other series [24]. Only one conversion was noted in this initial series. An incisional hernia rate of 10.2% was reported, which falls within a wide range of other reports of hernias following SILS with periumbilical extraction (4.9–12%) [24, 25].

Criticism of single-incision surgery, especially with umbilical port placement, has been centered around a focus on cosmesis at the expense of postoperative hernia formation [26]. Several papers have looked at patient preference for reduced port surgery based on size, location, visibility, and number of incisions, in addition to perceived recovery time [27, 28]. Currently, there are no studies in the literature that directly evaluate patient cosmetic satisfaction after either SILS or SILS robotic colectomy.

Conclusions

Innovation in surgery has been driven by the quest to enhance the surgical experience and improve patient outcomes. Single-incision technology has been applied to colorectal surgery with the intent of expediting recovery, enhancing cosmesis, and providing alternative laparoscopic options. While SILS has been shown to be safe, feasible, and oncologically sound, further investigation into these techniques is necessary to assess overall benefits. In addition, technological advances in platform design, optics, and instrumentation may help realize the potential advantages of the single-incision approach.

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