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TECHNICAL NOTE

Single incision laparoscopic total abdominal colectomy with ileorectal anastomosis for synchronous colon cancer

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Abstract Single incision laparoscopy is currently performed mostly for basic laparoscopic procedures involving single abdominal quadrants. The aim of this case report is to show that single incision laparoscopic techniques can be utilized for complex abdominal laparoscopic procedures with a large target organ and a working space involving all quadrants of the abdominal cavity. A single incision laparoscopic total abdominal colectomy with an ileorectal anastomosis and intraoperative CO_2 colonoscopy was performed for a patient with synchronous adenocarcinoma of the cecum and the sigmoid colon. The patient was discharged home on postoperative day 4 and had no immediate postoperative complications. Single incision laparoscopy is feasible for complex colorectal procedures. Some of the techniques used may be adapted further to achieve colonic resection via a natural orifice in the future.

Keywords Single incision · Single port · Laparoscopy · Colectomy · Colon cancer · Natural orifice surgery

Introduction

Single incision laparoscopic surgery has been introduced for partial colectomy [1]. In comparison to the more commonly performed single incision laparoscopic cholecystectomy or appendectomy the need to mobilize, retract and remove a larger specimen increases the technical difficulty for single incision laparoscopic colectomy [2]. The question arises whether current instrumentation for single incision laparoscopic surgery and operative techniques can be applied to surgery involving all quadrants of the abdomen including manipulation of the entire colon and mobilization of the transverse colon.

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Materials and methods

We report a case of a 64-year-old male with a past medical history of type 2 diabetes mellitus, hypertension and hypercholesterolemia, who underwent colonoscopy for anemia. He was found to have a large tumor filling the entire cecum and a 3-cm sessile polyp in the sigmoid colon. Biopsy revealed well-differentiated adenocarcinoma of the cecum and synchronous cancer in the sigmoid colon.

Surgical steps

Step 1: patient preparation

The patient was placed in the lithotomy position on a bean bag with both arms tucked to his sides to facilitate retraction of the colon, omentum and small bowel loops by gravity through bed positioning.

Step: 2: access to the abdominal cavity

A 3-cm longitudinal incision was made at the midpoint between the umbilicus and the symphysis pubis. This entry point was chosen for adequate visualization of all

quadrants of the abdomen during the procedure. A GelPoint device (Applied Medical, Rancho Santa Margarita, CA) was inserted. Two 5-mm and a 12-mm trocars were then placed through the GelPoint device in a triangular formation. The following instruments were used throughout the case: a 5-mm flexible tip Olympus EndoEYE laparoscope (Olympus, Center Valley, PA), a Ligasure Atlas energy sealing device (Covidien, Boulder, CO) and a RealHand flexible laparoscopic bowel grasper (Novare Surgical, Cupertino, CA). No other additional sutures/instruments inserted through separate incisions were used.

Step 3: intraoperative colonoscopy

Once access was achieved, colonoscopy with CO_2 insufflation was performed to determine the distal resection margin. The scar at the previous polypectomy site was located in the sigmoid colon.

Step 4: mobilization of the cecum, ascending colon and ligation of ileocolic pedicle and small bowel mesentery

The cecum and ascending colon were mobilized laterally along the white line of Toldt in a caudal-to-cephalad direction and with medial retraction of the colon. The ileocolic pedicle was then isolated medially and high ligation of vessels performed using the bipolar vessel sealing device. The mesenteric division was then continued medially on the small bowel mesentery to reach a point of the ileum which was 10-cm proximal to the ileocecal valve.

Step 5: hepatic flexure mobilization, division of the omentum, and ligation of the transverse colon mesentery

The colon was then retracted medially and inferiorly for the lateral mobilization of the hepatic flexure. This dissection plane was continued without change in exposure entering the lesser sac and followed by dividing the greater omentum attached to the transverse colon. With continuous medial and inferior traction on the colon the mesentery was traced back to the previously divided edge. The mesentery was then divided via this cephalad approach achieving a high ligation of the right and middle colic vessels.

Step 6: splenic flexure mobilization

The two previous dissection planes of the omental and mesenteric division were continued towards the splenic flexure. With inferior and left lateral traction of the colon or superior traction on the greater curvature of the stomach, adequate exposure was achieved to mobilize the entire splenic flexure up to the mid-descending colon.

Step 7: lateral sigmoid colon mobilization, identification of the left ureter, division of the inferior mesenteric artery (IMA)/inferior mesenteric vein (IMV) pedicle and distal transection of the colon

The sigmoid colon was then mobilized laterally along the white line of Toldt with medial traction of the colon. This dissection plane was connected with the previously mobilized descending colon. The left ureter was identified from the pelvic brim to its proximal portion. With continuous medial traction of the sigmoid colon, a window was created at the distal resection margin from the lateral side and the distal sigmoid colon divided using a 450-mm EndoGIA stapler (Ethicon Endo-Surgery, Cincinnati Ohio). The remaining colonic mesentery including the IMA and IMV pedicle was ligated starting at the divided end of the colon from a lateral approach using continuous medial and cephalad traction of the distally transected sigmoid colon.

Step 8: specimen extraction

The colon was extracted starting from the distal end through the base of the GelPoint device. The device also served as a wound protector. The small bowel was divided extracorporeally 10 cm proximal to the cecum.

Step 9: surgical anastomosis

An end-to-end anastomosis using a circular stapler (29-mm Proximate ILS circular stapler, Ethicon Endo-Surgery, Cincinnati, OH) was performed by extracorporeal anvil placement and connection to the transanally introduced stapler after reestablishment of pneumoperitoneum.

The estimated blood loss for the procedure was minimal.

Results

The patient was advanced to a liquid diet on the first postoperative day, and a low residue diet was started on the third postoperative day. The patient was discharged home on postoperative day 4. He had no intraoperative or postoperative complications. The pathological examination of the specimen revealed a $5 \times 4 \times 3$ cm adenocarcinoma of the cecum with 17 negative lymph nodes (T3N0M0) and villous adenoma with no residual adenocarcinoma in the sigmoid colon.

Discussion

We describe a single incision laparoscopic total abdominal colectomy with an ileorectal anastomosis as an oncologic

resection for synchronous adenocarcinoma of the colon. Currently, laparoscopic techniques for total colectomy typically involve either an extraction site or a hand port site and the use of up to five additional trocars [3]. This typically translates to a primary incision size of 7–8 cm and five additional 0.5–1 cm incisions. The current single incision laparoscopic technique allows for a single 2–4 cm incision which is needed for transabdominal specimen extraction.

There is a steep learning curve associated with laparoscopic total colectomy due to the need to mobilize the entire transverse colon and mesentery [4, 5]. The surgical technique described in the current case is reproducible. It is an adaptation of the technique used extensively by the authors for hand-assisted or conventional laparoscopic total colectomy, and addresses transverse colon mobilization and mesenteric transection with a top down and cephalad approach. This step significantly facilitated the single incision laparoscopic approach. It appeared to be difficult to retract and tent up the transverse colon to visualize and dissect the middle colic artery from an inferior approach because only one grasper was available for retraction and the second port was used for the working instrument and vessel ligation. Therefore, retraction of the already divided ascending colon towards the left lower quadrant permitted visualization of the mesenteric root from above the transverse colon and continuous division towards the splenic flexure. This technique allowed for complete splenic flexure mobilization which was not accomplished in two previously reported single incision laparoscopic sigmoid resections [6]. Furthermore, the procedure was accomplished without the need of additional stab incisions for placement of sutures or smaller instruments as previously described. All retraction could be adequately achieved using a single instrument through the GelPoint device and patient positioning. The advantage of the GelPoint device as compared to other single port access devices is that a variable incision size from 2–4 cm can be used depending on the size of the extracted colon. It allows the use of a single straight fascial incision with a potentially decreased risk of hernia formation as compared to separate fascial incisions described previously. Rotation of the outer ring of the device around the inner ring allowed for a 360° adjustment of the trocar configuration as needed. Traditional laparoscopic colectomy is described following different approaches in a step by step fashion using a strict "lateral to medial" or "medial to lateral" approach, which is used favorably to achieve high ligation of vessels. An important technical aspect of this technique using single incision laparoscopy is to combine elements of both approaches. It is technically very challenging to safely isolate and encircle the mesenteric pedicles with identification of the ureter specifically on the left side given the inline view and parallel instrument positioning of single incision laparoscopy. Therefore, prior lateral mobilization and identification of the ureter help with subsequent isolation and high vessel ligation from a medial approach. The placement of the single incision laparoscopic access device in the lower abdomen allowed adequate exposure to all quadrants of the abdomen. A Pfannenstiel incision or an incision through a right lower quadrant ileostomy site could be an alternative access site. The viewing point and the subsequently utilized dissection techniques from this angle provide good access to the entire abdomen as compared to a 360° rotation which is needed from a periumbilical access. This viewing angle from the lower abdomen may be more similar to a possible transvaginal or transrectal viewpoint in colectomy performed with natural orifice transluminal endoscopic surgery (NOTES) (Figs. 1, 2, 3, 4, 5).

It has been noted that single incision laparoscopic surgery has currently no proven benefit except for good cosmetic results. This may be particularly true if a certain incision size is needed for the extraction of a larger organ like the colon especially with a larger tumor as in the case presented here. Therefore, a current limitation of this

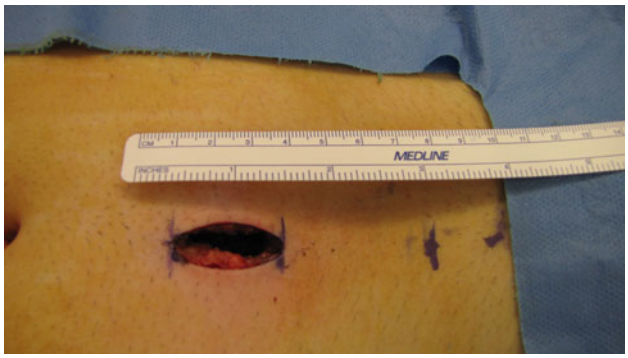

Fig. 1 Incision closeup

Fig. 2 Instrument positioning for right colon and hepatic flexure

Fig. 3 Instrument positioning for transverse colon, splenic flexure and descending colon

Fig. 4 Transverse colon mobilization with retraction of colon (cephalad approach)

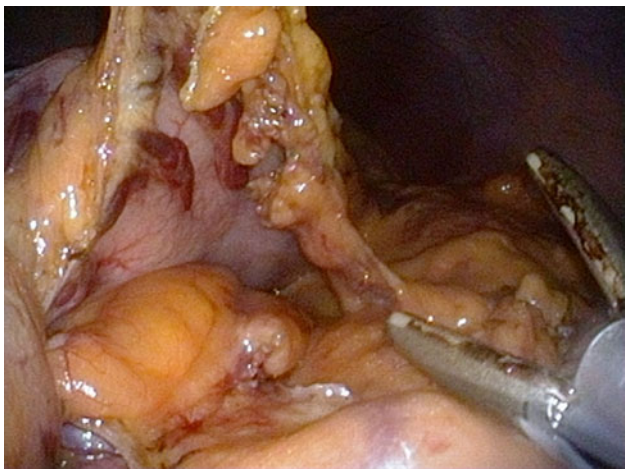

Fig. 5 Transverse colon mobilization with retraction of stomach (cephalad approach)

technique is that the potential benefit of a single incision laparoscopic technique may be lost with a certain specimen size due to obesity and the primary tumor.

The ability and techniques to perform safe and reproducible mobilization and mesenteric division and high ligation of vessels through a very limited access point may be combined with transrectal or vaginal extraction [7–11] and intracorporeal anastomosis [12, 13], eventually shifting to complete access using a natural orifice.

Larger case series and studies are needed to evaluate short- and long-term outcome with this technique. The comparison of total laparoscopic and hand-assisted laparoscopic colectomy has shown that short-term outcome after these procedures are the same. Therefore it may be difficult to show a benefit of single site laparoscopy for colorectal surgery as compared to conventional laparoscopy, too. Nevertheless, it may be necessary to gain experience with single site laparoscopic colectomy and combine new techniques to develop less invasive surgical approaches.

Conclusion

Single incision laparoscopy is feasible for complex laparoscopic colorectal procedures. Further studies are needed to assess the efficacy, learning curve, outcome and cost with this approach. These single incision laparoscopic techniques can potentially be adapted to achieve a natural orifice colectomy.

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