Robotic Left Colectomy with Natural Orifice IntraCorporeal Anastomosis with Extraction: The NICE Procedure

7

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Introduction

Minimally invasive colorectal surgery continues to evolve with new technologies enabling platforms. In particular, advances in robotic surgery have led to renewed interest in natural orifice-assisted surgery with intracorporeal anastomosis (ICA) and transrectal extraction of specimen [1].

This chapter presents a stepwise approach to robotic left-sided resection with transrectal extraction of the specimen as well as a complete ICA. This approach can be successfully completed for numerous types of disease presentations including diverticulitis, colitis, rectal prolapse, and neoplasm. This approach is performed with no incision other than those required for the ports.

Background

Over 20 years ago, laparoscopic left-sided colonic resection with transanal specimen delivery and intracorporeal colorectal anastomosis was first reported by Franklin ME. Since that time, several authors have reported meaningful benefits including earlier return of bowel function, decreased postoperative pain and opioid use, and decreased length of hospital stay [2, 3]. Additionally, decreased postoperative complications and better cosmetic results without compromising oncologic outcomes have been reported [4, 5]. Early adopters of robotic technology were also reported on colectomy with ICA with transrectal extraction in 2009 and again in 2013 with similar benefits [6].

Despite these merits, the technical challenges of laparoscopic and first-generation robotic approaches have limited widespread adaptation and routine use. However, recent advances in robotic technologies and techniques have resulted in a surge of renewed interest [7].

This chapter presents a stepwise approach to the completion of a left-sided colorectal resection with ICA with retrieval of the specimen via the rectum. We refer to this approach as the NICE procedure, Natural orifice IntraCorporeal anastomosis with Extraction.

For the purposes of this chapter, left-sided colectomy refers to disease involving the left colon, sigmoid, and upper rectum. The stepwise approach is presented for benign disease including diverticulitis, rectal prolapse, and colitis. We will not address the entirety of the various types of procedures as these are addressed throughout the book. Rather, we will describe the specific steps unique to natural orifice-assisted ICA and rectal extraction. We will also describe the procedure with the da Vinci Xi platform although the procedure can be accomplished with the Si model.

Room Setup and Positioning

The setup for this procedure is identical to the setup for left-sided colectomies. The patient is placed in a modified lithotomy position using adjustable stirrups and tilted into Trendelenburg position with the left side elevated. The robotic is docked on the patient's left side. The assistant is positioned on the patient's right side (Fig. 7.1).

Port Placement

A total of five ports are used for the NICE procedure: a 5 mm RUQ port for the assistant, an 8 mm port in the RLQ, an 8 mm port hidden in the umbilicus, an 8 mm port in the left quadrant, and another 8 mm port in the left upper quadrant (Fig. 7.2).

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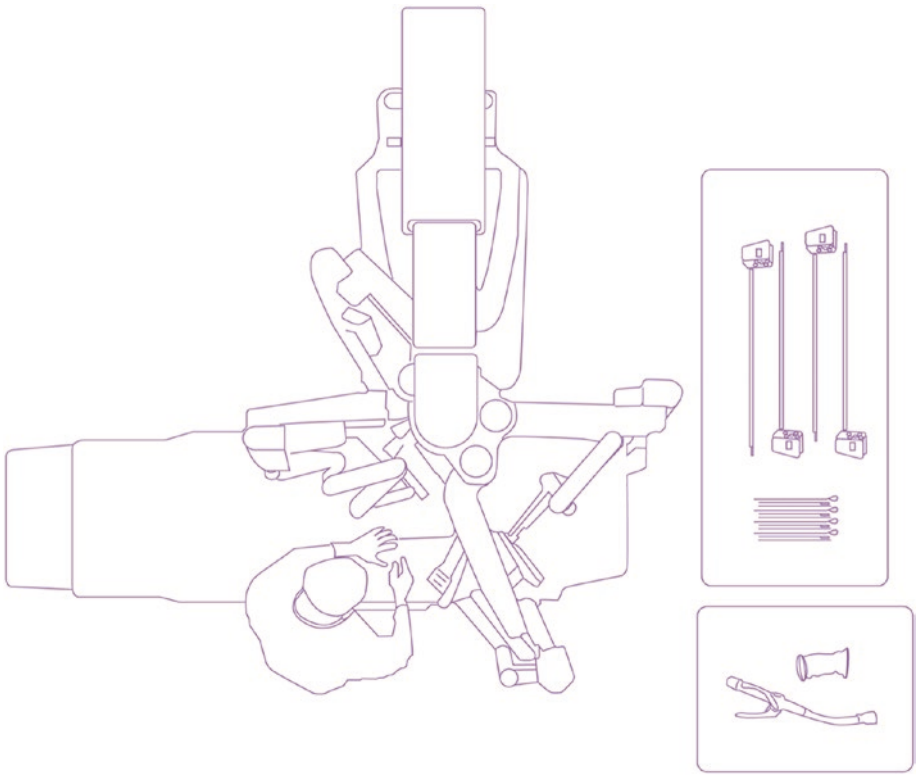

Fig. 7.1 OR room setup with the robot docked on the patient's left side, the assistant positioned on the patient's right side and the back table

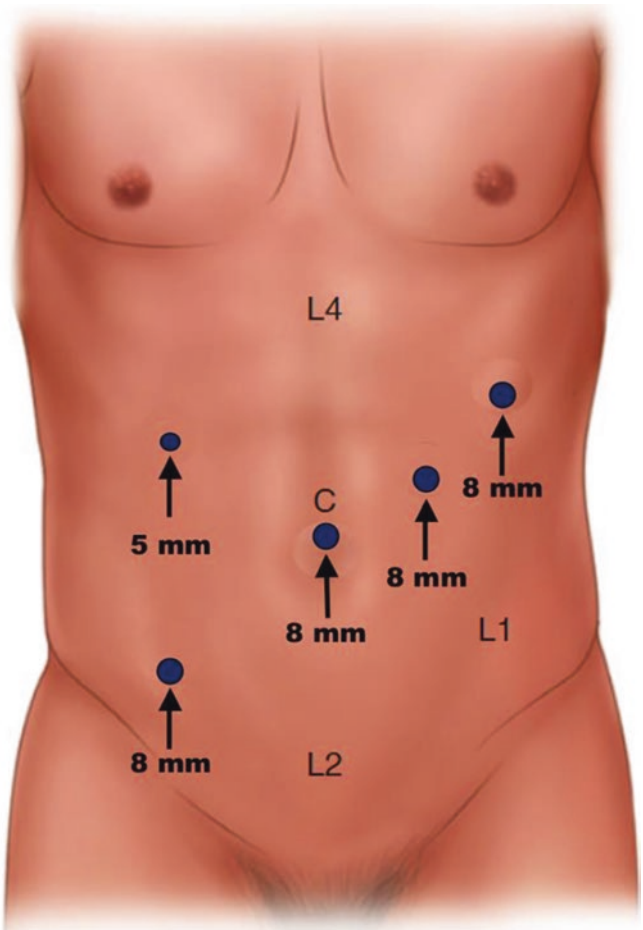

Fig. 7.2 Port placement for NICE procedure. RUQ 5 mm assistant port and four 8 mm robotic ports – one in the RLQ, one hidden in the umbilicus, and two on the left side

We initiate the procedure via direct optical entry using a 5 mm Optiview trocar placed in the right upper quadrant. This port is initially used to visualize placement of the robotic 8 mm ports and thereafter used as the assist port.

Operative Steps

Operative steps	Degree of technical difficulty (scale 1–10)
1. Lateral dissection with release of lateral peritoneal attachments	2
2. Identification and isolation of the proximal level of resection	4
3. Division of the mesentery	3
4. Identification and isolation of the distal level of resection	4
5. Division of the proximal margin	2
6. Division of the distal margin	2
7. Transrectal insertion of the alexis retractor	3
8. Transrectal extraction of the specimen	6
9. Transrectal delivery of the anvil into the abdomen	4
10. Securing the anvil to proximal bowel	5
11. Closing the distal bowel around circular stapler	5
12. Formation and oversewing of end-to-end anastomosis	4

Some of the salient features of the NICE procedure for benign disease include dissection close to the bowel wall through the mesentery above the superior rectal artery. Unlike dissection planes for malignant disease, avoidance of

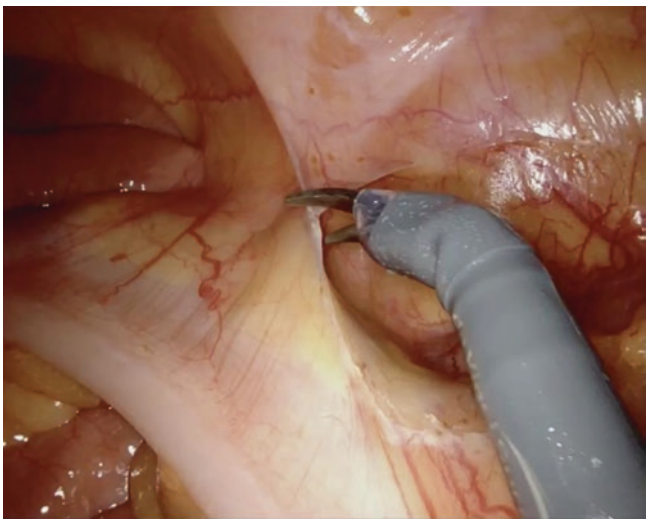

Fig. 7.3 Initial steps with release of lateral peritoneal attachments utilizing monopolar robotic scissors

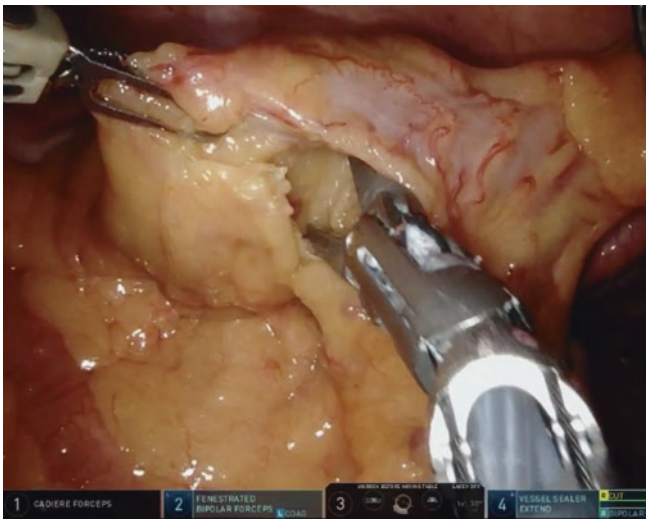

Fig. 7.4 Creation of window through mesentery at proximal level of resection

dissection into the avascular retroperitoneal plane is preferred with dissection close to the bowel wall. This serves to diminish the size of the specimen by leaving behind some of the mesentery important during the rectal extraction process to limit rectal trauma that may result if the specimen is too bulky in nature. It also keeps the dissection planes well above the location of the presacral and hypogastric nerves thereby avoiding inadvertent injury. As a further advantage, the superior rectal artery is preserved which may play in role in the vascularization of the anastomosis. Lastly, the distal margin of the bowel is closed around the spike of the circular stapler using a purse-string suture instead of a linear stapler. Therefore, the circular stapler does not cross linear staple lines. For benign disease, splenic flexure takedown is not routinely performed unless required for a tension-free anastomosis.

Lateral Dissection with Release of Lateral Peritoneal Attachments (Video 7.1)

The left and sigmoid colon is released from the lateral peritoneal attachments. Dissection is initiated in a lateral to medial fashion with release of the white line of Toldt along the left colon to the level of the splenic flexure. The intersigmoid fold is then released exposing the left gonadal vein and left ureter. The dissection can be achieved with the use of the monopolar robotic scissors or the vessel sealer (Fig. 7.3).

The goal of this step is to mobilize the left and sigmoid colon from the lateral attachments to allow access to the mesenteric dissection along the axis of the bowel. Once a window is developed through the mesentery in step 2, division of the mesentery can proceed without concern of injury to the ureter or others critical structures of the pelvis.

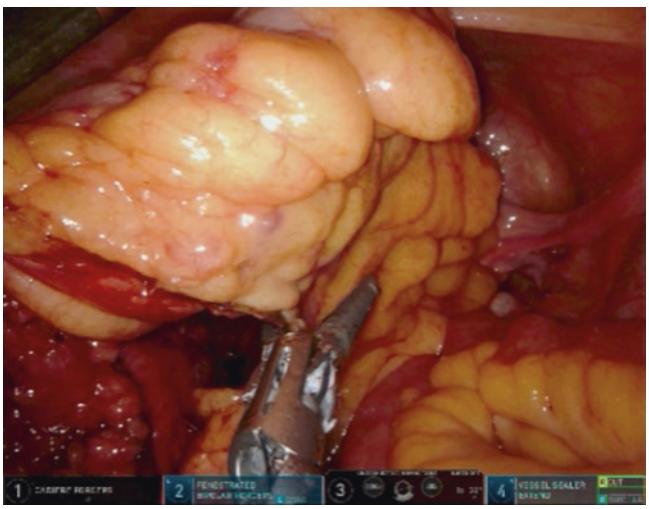

Fig. 7.5 Division of mesentery utilizing vessel seal device from the level of the proximal resection margin to the level of the distal resection margin

Identification and Isolation of the Proximal Level of Resection (Video 7.2)

The proximal level of resection is identified. The mesentery is dissected from the bowel wall, and a window is made through the mesentery (Fig. 7.4). This step is best accomplished with the vessel sealer which provides hemostasis while avoiding thermal injury to the bowel wall.

Division of the Mesentery (Video 7.3)

The mesentery is divided using the vessel sealer from the level of the proximal resection margin to the level of the distal resection margin. Care is taken to remain above the superior rectal artery (Fig. 7.5). In cases in which the

mesentery is severely thickened, inflamed, or involved with a phlegmon, this step may be difficult and cumbersome. In these cases, it may be best to enter into the retroperitoneal plane deep to the superior rectal artery toward the distal level of resection.

Identification and Isolation the Distal Level of Resection (Video 7.4)

The distal level of the resection margin is identified, and the mesentery along the surface of the bowel is cleared at this level.

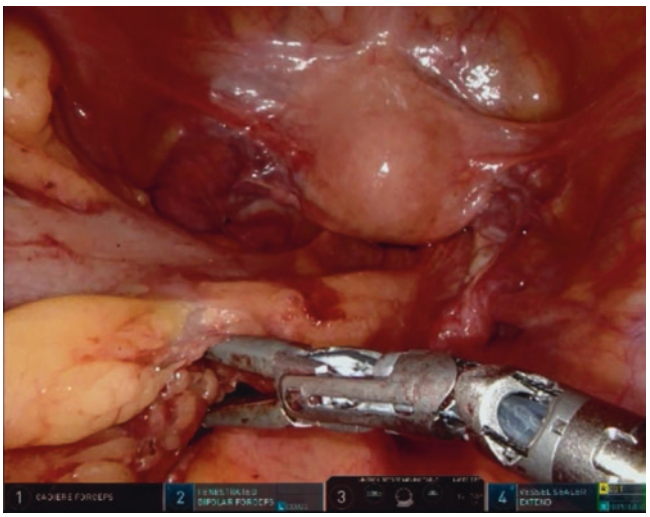

Fig. 7.6 Division of mesentery at distal level of resection utilizing vessel seal device

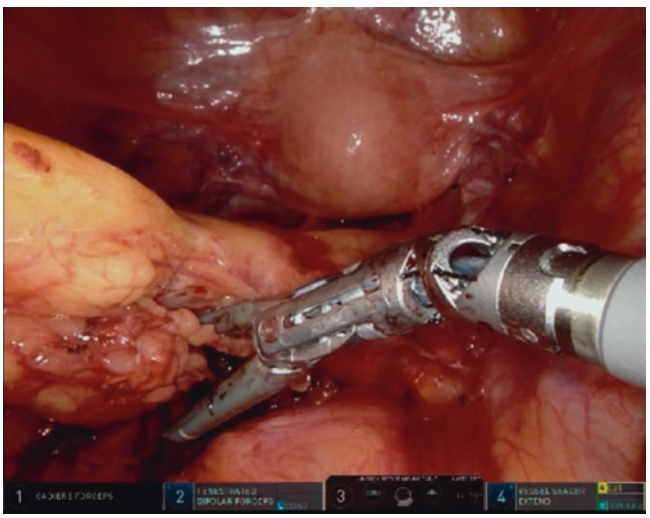

Fig. 7.7 Division of mesentery at distal level of resection utilizing vessel seal device

The vessel sealer is preferred to avoid thermal injury to the bowel wall (Figs. 7.6 and 7.7). It is often preferable to score and release the peritoneum laterally along the mid- and distal rectum as well as the anterior peritoneal reflection. This allows the rectum to be released and straightened which will serve as an anatomical advantage during many of the ensuing steps.

Division of the Proximal Margin (Video 7.5)

The bowel is divided at the proximal margin which has been cleared of the mesentery (Figs. 7.8, 7.9, and 7.10). The ves-

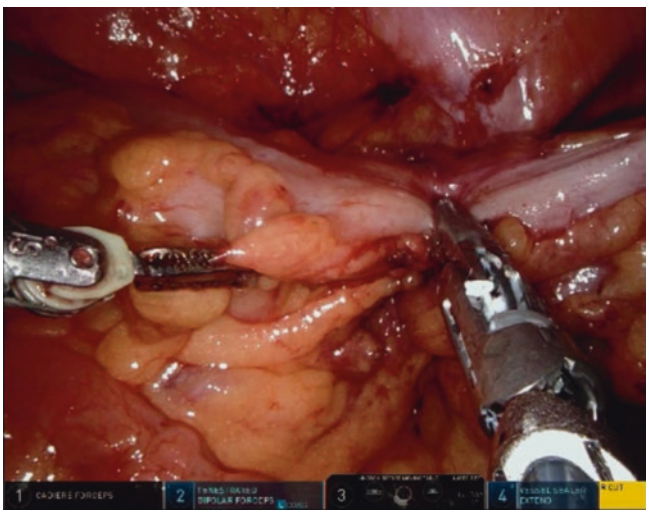

Fig. 7.8 Division of bowel at the proximal margin which has been cleared of the mesentery

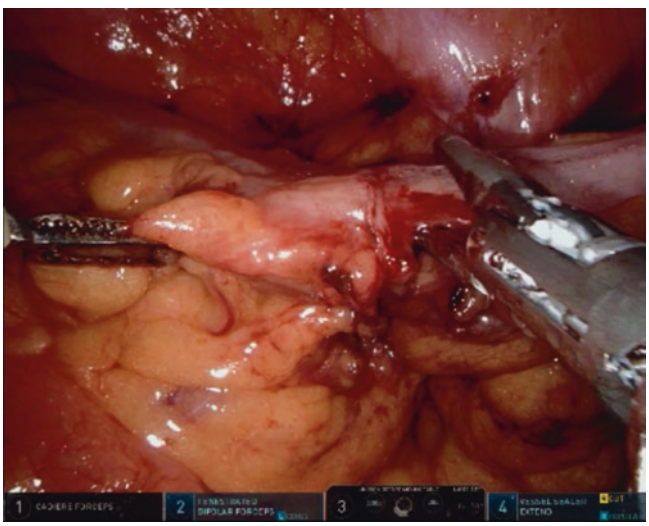

Fig. 7.9 Division of bowel at the proximal margin which has been cleared of the mesentery

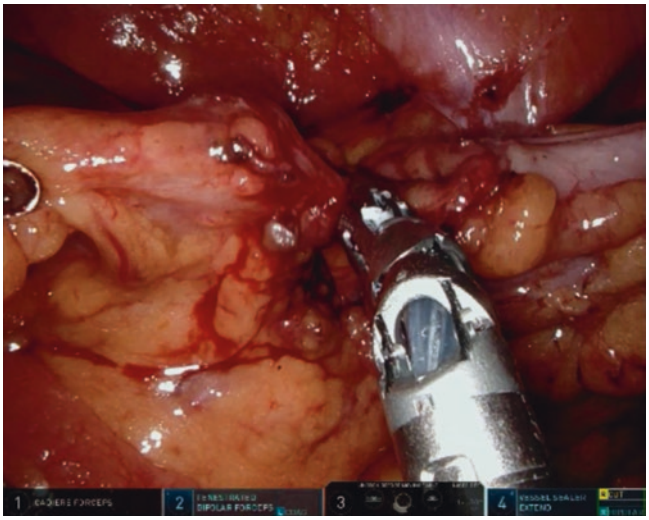

Fig. 7.10 Division of bowel at the proximal margin which has been cleared of the mesentery

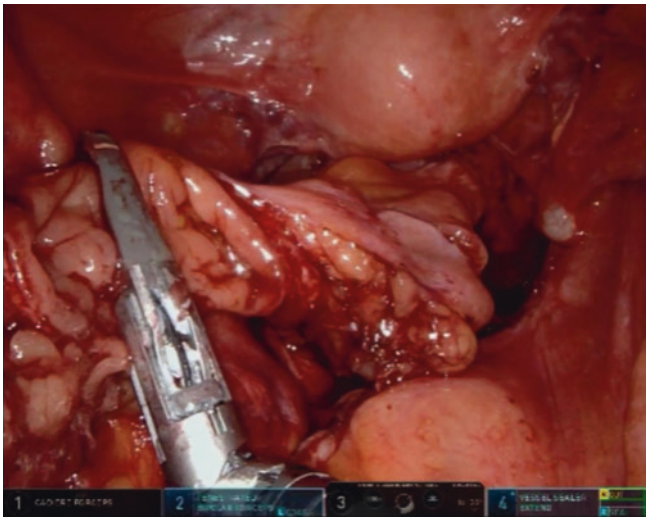

Fig. 7.11 Division of bowel at the distal margin which has been cleared of the mesentery

sel sealer is used to cut the bowel without the use of energy. This device provides consistent division. As an alternative, the robotic scissors can be used; however, this typically results in tendency for uneven edges.

Division of the Distal Margin (Video 7.6)

The bowel is divided at the distal margin which has been cleared of the mesentery (Figs. 7.11 and 7.12). When the proximal and distal bowel is divided, the assistant should be prepared to aspirate any residual intraluminal content to prevent inadvertent fecal soiling.

Transrectal Insertion of the Alexis Retractor (Video 7.7)

The Alexis retractor is placed through the rectum in preparation for extraction of the specimen. We utilize the small Alexis retractor for this purpose. The white rim is compressed with a large Kocher clap and gently introduced through the anus in a retrograde fashion. It is then delivered across the edge of the distal margin (Figs. 7.13, 7.14, 7.15, and 7.16). Placing a retractor through the rectum prior to specimen extraction is optional; however it is typically recommended to help reduce tearing and trauma to the rectal wall during the extraction process. As an alternative, an endobag can be delivered through the rectum; however, this tends to be more cumbersome and traumatic.

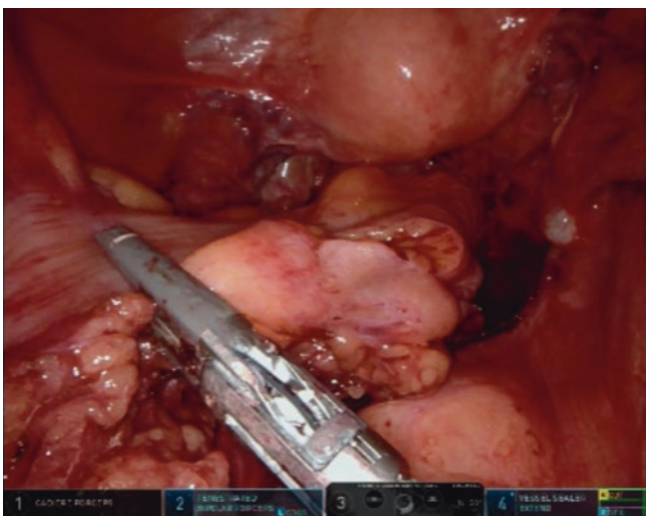

Fig. 7.12 Division of bowel at the distal margin which has been cleared of the mesentery

Transrectal Extraction of the Specimen (Video 7.8)

A bowel clamp is introduced through the anus in a retrograde fashion through the open cuff of the distal bowel. The clamp is opened, and the specimen is delivered into the jaws of the clamp. The clamp is closed about the specimen and extracts the specimen through the retractor and lumen of the rectum to complete the transrectal extraction process. The rim of Alexis retractor is then inverted, and the retrac-

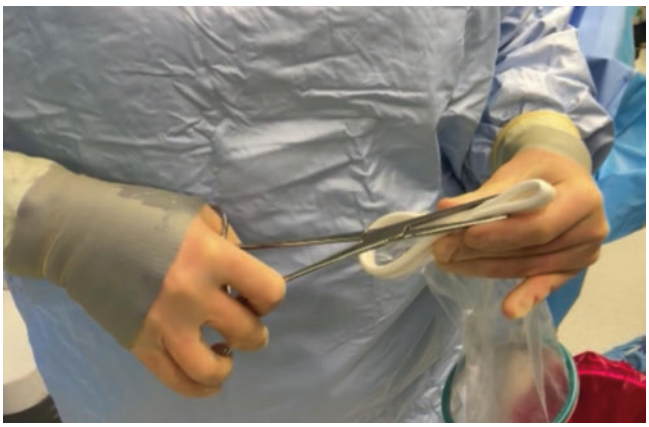

Fig. 7.13 Compression of the small Alexis retractor's white rim with a large Kocher clamp

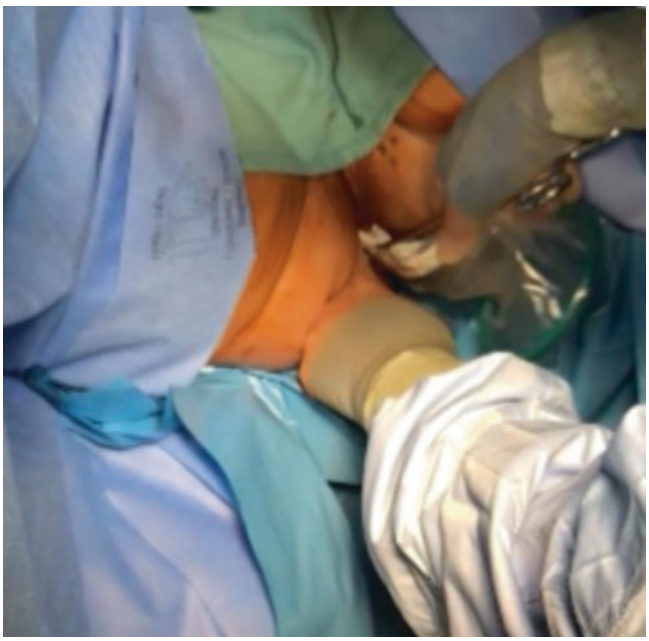

Fig. 7.14 Introduction of Alexis retractor through the anus in a retrograde fashion

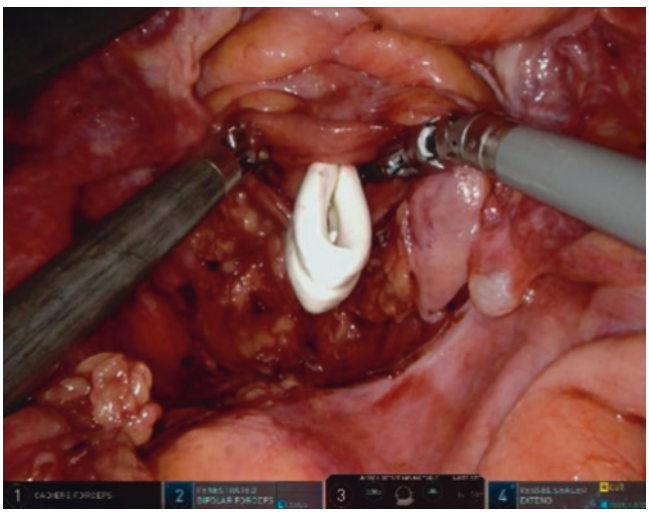

Fig. 7.15 Delivery of retractor across the edge of the distal margin

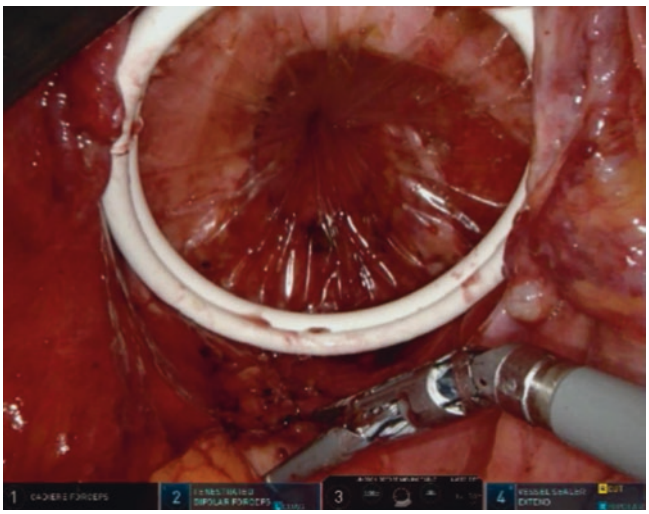

Fig. 7.16 Full expansion of retractor through the rectum

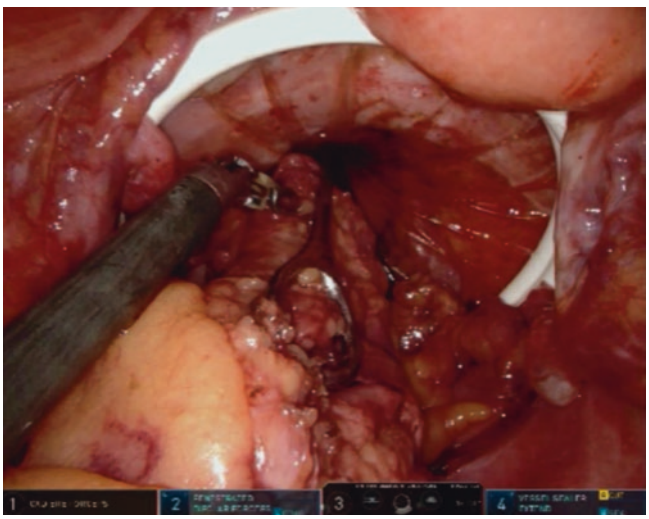

Fig. 7.17 A bowel clamp is introduced in a retrograde fashion through the anus beyond the open cuff of the distal bowel in order to grasp the specimen

tor is removed (Figs. 7.17, 7.18, 7.19, and 7.20). This step can be the most challenging and injury-prone step of the procedure. Measures to avoid trauma and facilitate delivery are addressed below.

Transrectal Delivery of the Anvil into Abdomen (Video 7.9)

The circular stapling device is inserted through the anus with the anvil attached and advanced through the open distal bowel lumen. The anvil is then detached and delivered into the abdominal cavity. Alternatively, the anvil can be detached from the stapler prior to insertion and delivered with a clamp

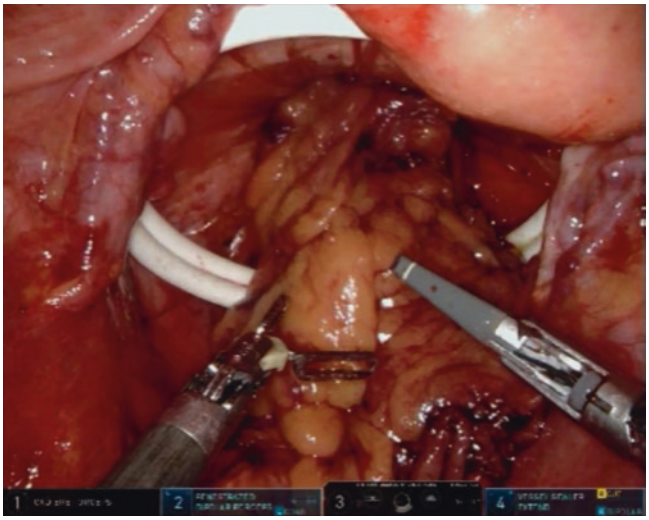

Fig. 7.18 The clamp is closed about the specimen, and extraction through the retractor and lumen of the rectum is accomplished

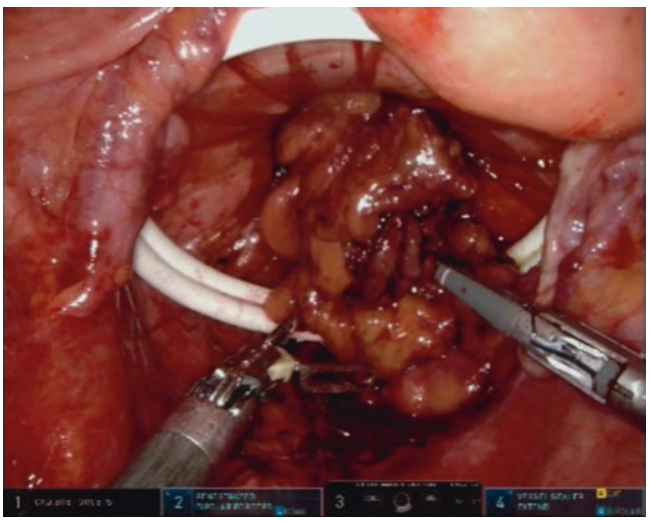

Fig. 7.19 The clamp is closed about the specimen, and extraction through the retractor and lumen of the rectum is accomplished

through the rectum (Figs. 7.21, 7.22, and 7.23). Introducing the stapler through the rectum with the anvil attached facilitates ease of passage. This serves a distant benefit in cases in which the flat edge of the stapler head results is tearing or difficulty passing through the rectum.

Securing the Anvil to Proximal Bowel (Video 7.10)

A purse-string suture is placed around the edge of the proximal bowel lumen using a 3–0 V-lock suture. The anvil is then placed into the bowel lumen and secured in place by

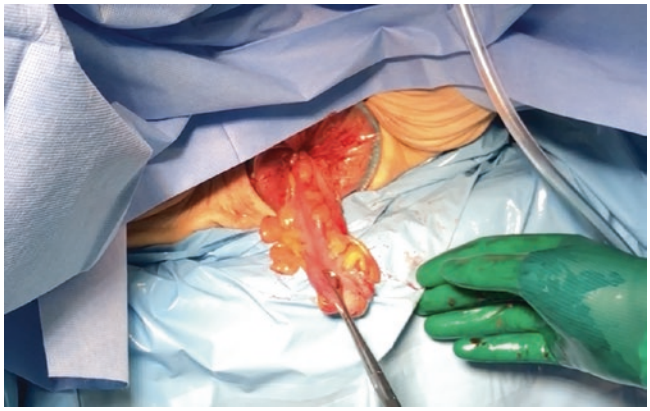

Fig. 7.20 The specimen is extracted through the rectum

Fig. 7.21 The circular stapling device is inserted through the anus with the anvil attached and advanced through the open distal bowel lumen

tightening the suture. Typically, additional suturing is required to ensure the tissue is adequately drawn into the anvil (Figs. 7.24, 7.25, and 7.26). An Endoloop can be used to reinforce the closure once the purse-string is place. In some cases, the Endoloop alone may suffice to secure the anvil.

Closing the Distal Bowel Around Circular Stapler (Video 7.11)

A second purse string is placed around the edge of the distal bowel lumen. The spike of the circular stapler is advanced, and the purse string is tightened drawing the tissue around the spike. Additional sutures may be required to ensure complete closure of the tissue about the spike of the stapler (Figs. 7.27 and 7.28).

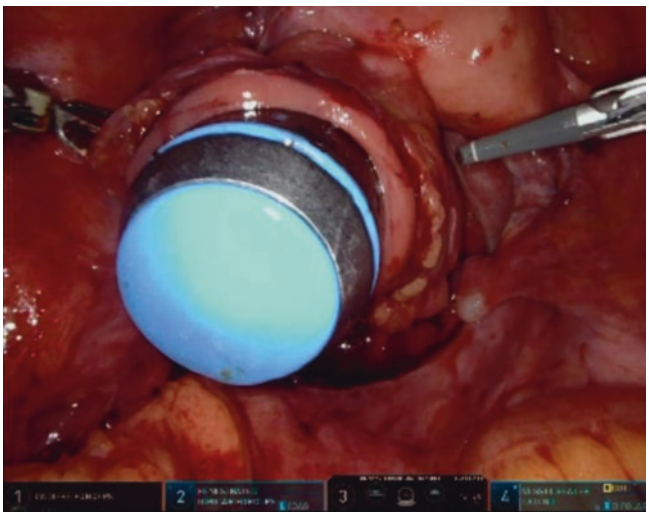

Fig. 7.22 The anvil is detached from the head of the circular stapler and delivered into the abdominal cavity

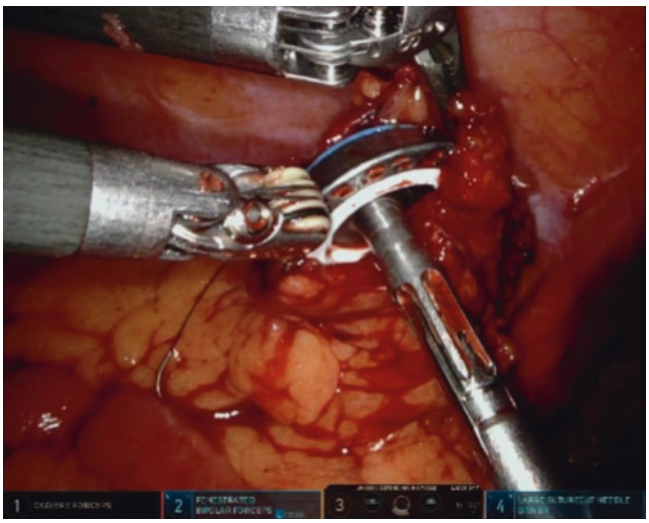

Fig. 7.25 The anvil is placed into the bowel lumen

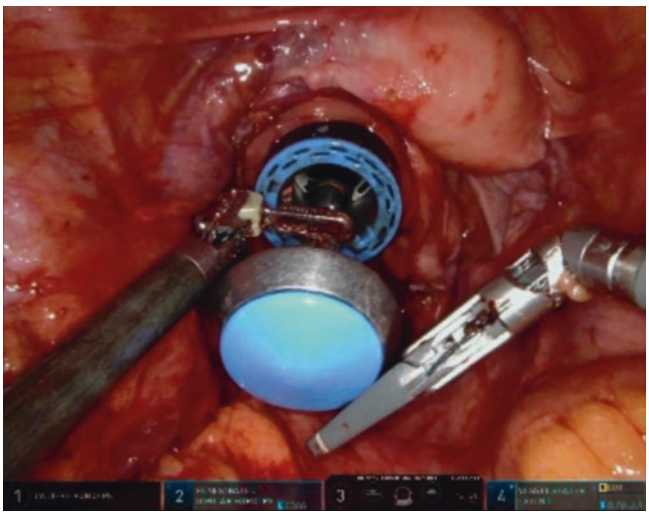

Fig. 7.23 The anvil is detached from the head of the circular stapler and delivered into the abdominal cavity

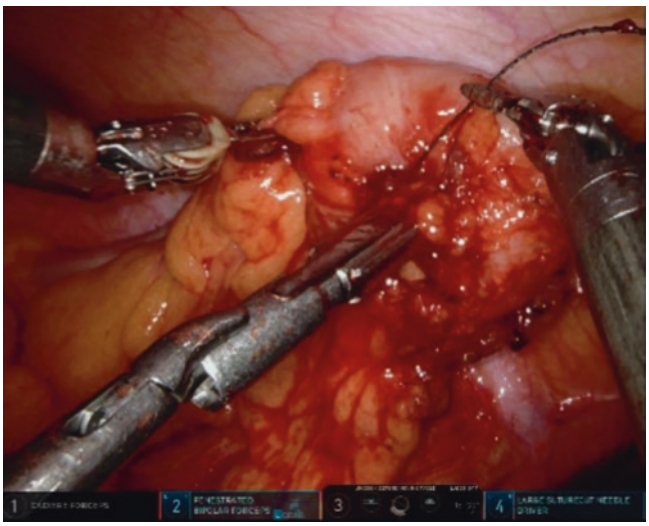

Fig. 7.26 The anvil is secured in place by tightening the suture

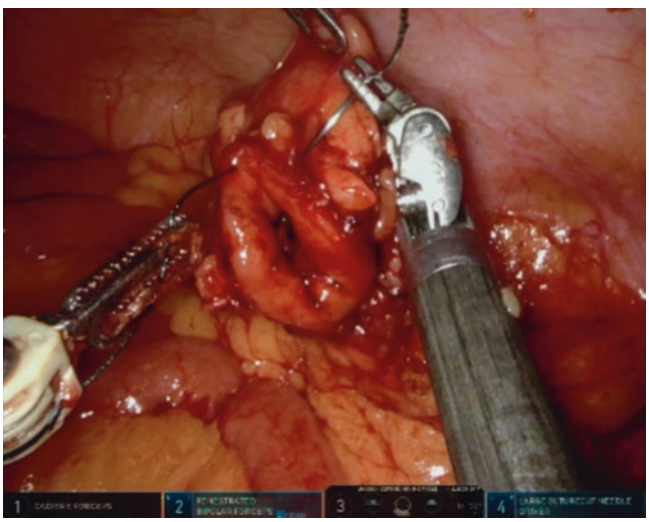

Fig. 7.24 A purse-string suture is placed around the edge of the proximal bowel lumen

Formation and Oversewing of End to End Anastomosis (Video 7.12)

The anvil is seated to the spike of the circular stapler, and an anastomosis is formed by activating the stapling device (Figs. 7.29, 7.30, and 7.31). The anastomosis is evaluated by several measures. Direct luminal visualization is achieved via rigid or flexible proctosigmoidoscopy. External visualization is performed before and during air insufflation testing. The proximal and distal donuts are removed and inspected for completeness and thickness. If any measures indicate, the anastomosis is oversewn preferentially with interrupted 3.0 absorbable suture (Figs. 7.32 and 7.33).

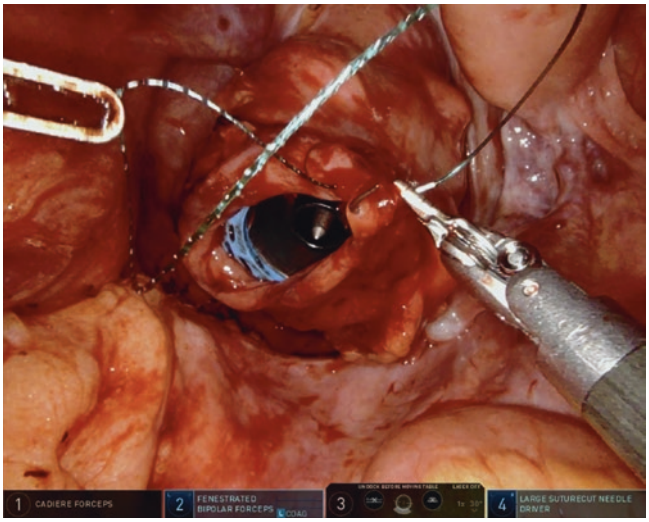

Fig. 7.27 A second purse string is placed around the edge of the distal bowel lumen

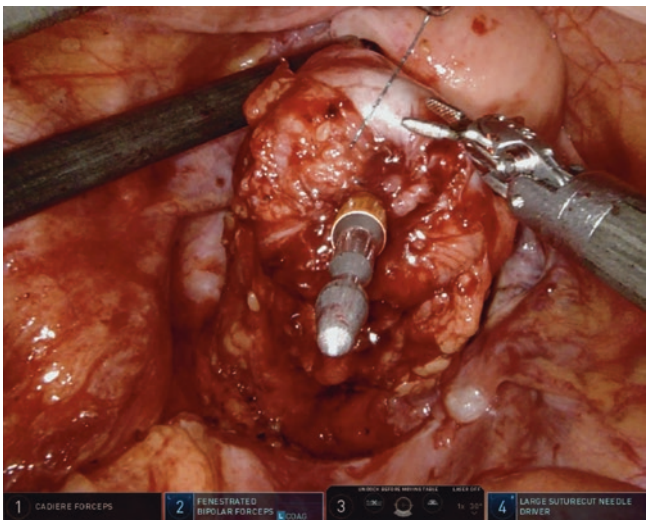

Fig. 7.28 The spike of the circular stapler is advanced, and the purse string is tightened drawing the tissue around the spike

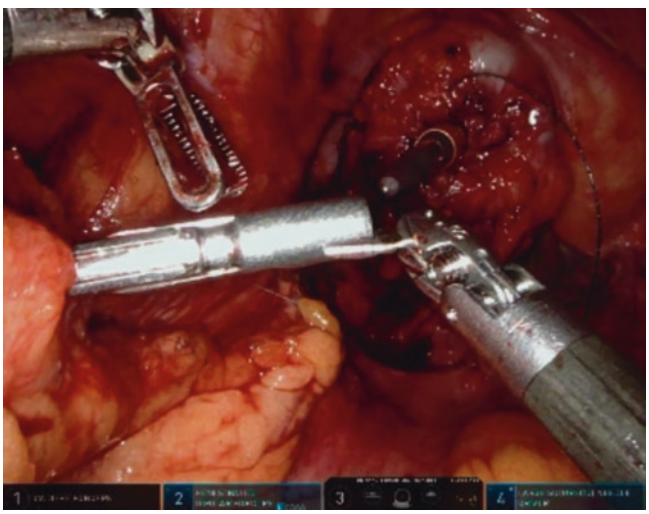

Fig. 7.29 The anvil is seated to the spike of the circular stapler

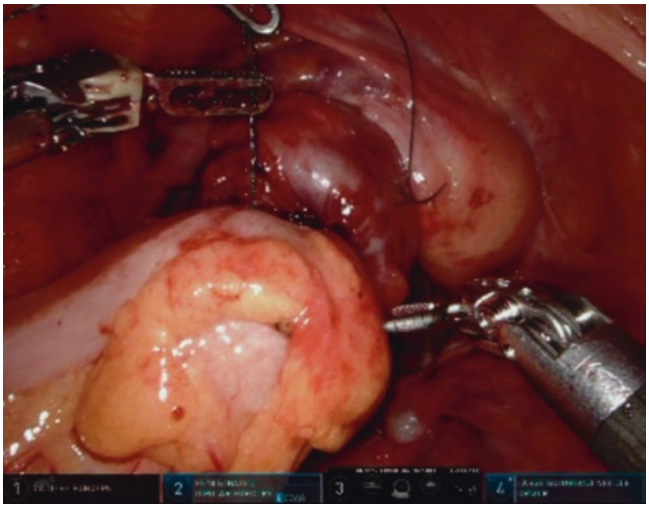

Fig. 7.30 The anastomosis is formed by activating the stapling device

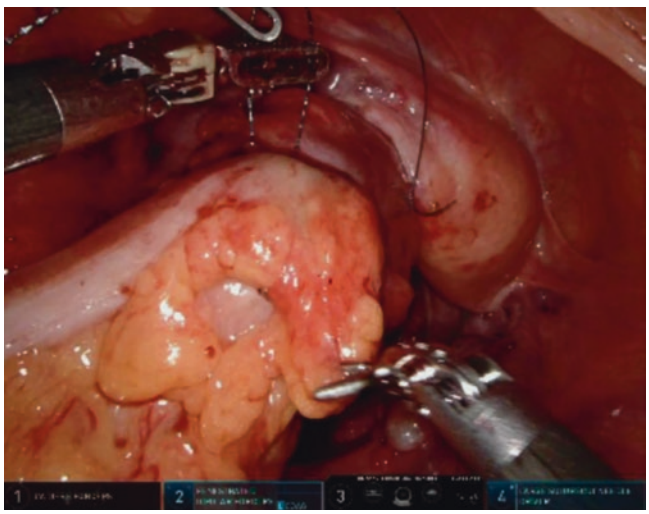

Fig. 7.31 The anastomosis is formed by activating the stapling device

Technical Considerations

Bowel prep: A mechanical bowel preparation is recommended for these cases to help avoid contamination following division of the bowel. When dividing the bowel, prepare for inadvertent contamination by having the beside assistant hold a suction adjacent to the tissue. If soilage occurs, evacuation can typically be accomplished with suction and gentle irrigation alone. If this is not sufficient, insertion of a small surgical sponge through one of the 8 mm ports can help to aspirate and clear the contents. The soiled surgical sponge can then be delivered transrectally along with specimen through the Alexis retractor.

Continuous pressure pneumoperitoneum: To facilitate continuous pneumoperitoneum, we prefer to use the air-seal device although others can be used. Continuous pressure pneumoperitoneum is most important during the transrectal

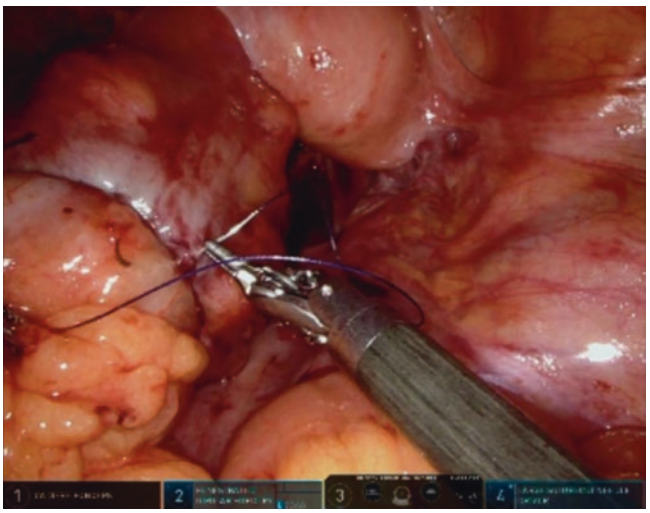

Fig. 7.32 Oversew of the anastomosis with interrupted 3.0 absorbable suture

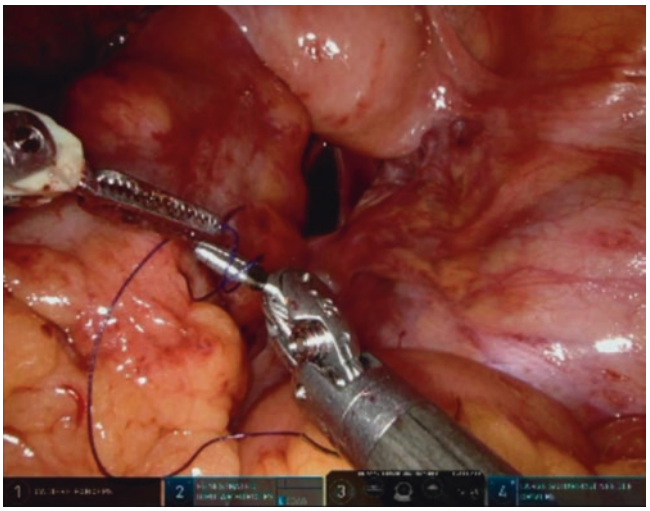

Fig. 7.33 Oversew of the anastomosis with interrupted 3.0 absorbable suture

extraction process where loss of pneumoperitoneum can occur when placing the Alexis and extracting the specimen.

Securing the anvil: Intracorporeal placement of the anvil in preparation for the anastomosis can be one of the more technically challenging and important steps of the procedure. Suboptimal placement can lead to an insecure anastomosis. We prefer placement of a purse-string suture; however, in some scenarios, an Endoloop alone can be used to secure the anvil. In other scenarios, we use a purse-string suture followed by an Endoloop to reinforce the closure. Once the anvil is secured, it may be necessary to trim excess tissue to achieve a smooth surface in preparation for a successful anastomosis. Allow for additional time to successfully complete this step in the early phases of your learning curve.

Closing the rectal cuff: Closing the bowel wall around the spike of the circular stapler can also be technically challenging especially during the early phases of the learning curve for this technique. Using an Endoloop is typically not feasible. In cases in which the distal level of the bowel margin is closer to the mid- or low rectum, the rectal wall tends to be wider, and it may be more feasible to staple across the rectum as opposed to placing a purse-string suture.

Extracting the specimen: There can be several situations in which it is difficult to extract the specimen transrectally. This most commonly occurs in complex diverticular disease with an abscess or phlegmon. In these cases, it becomes evident during the extraction process that the bulky nature of the specimen will not readily pass through the rectum. It is important not to force too much pressure during the extraction process as this can lead to significant injury and tearing of the rectal wall. In such cases, we divide the mesentery along the border of the specimen using the vessel seal device or robotic scissors. This serves to effectively splice the specimen in half and allow retrieval of the bowel and then retrieval of the detached mesentery in a second extraction. This process allows safe extraction while avoiding inadvertent injury. Although this can be a laborious task, we find these patients may benefit the most by avoiding a larger abdominal wall incision required to extract the bulky specimen.

Injury to the bowel during extraction: Trauma during the extraction process may result in tearing of the bowel wall. Most cases involve minor injury along the edge of the bowel lumen that can be primarily repaired. Some tears may not be readily apparent and may occur in the mid or lower rectum if too much force is used to extract a bulky specimen. Unassuming injury may also occur while placing the extracting instrument into the rectum to grasp the specimen. Regardless of the mechanism, the key is to identify the full extent of the injury and repair it. The repair can be a single layer with running or interrupted suture oriented to avoid narrowing of the rectal lumen. It is prudent to perform a thorough evaluation of the anastomosis as well as the integrity of the distal bowel in every case to ensure any injury is identified and attended to. Diverting loop ileostomy is not required or recommended as long as the full extent of the injury is identified and properly repaired.

Summary

The NICE procedure is an advanced robotic technique that facilitates left-sided resection and primary anastomosis without an extraction incision. All of the steps of the anastomosis are performed intracorporeally with enabling robotic technology. The procedure affords the patient many advantages including elimination of pain associated with the extraction incision as well as elimination of surgical site infection risk and hernia risk.

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