Single Incision Laparoscopic Right Colectomy

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Patient Selection

Indications

All the benign and malignant indications for colon resection apply to single incision laparoscopic colectomy (SILC) and multiport laparoscopic colectomy (MPLC) as well as open colon and rectal surgery (Table 2.1). As always, ideal patient candidates for initial cases are those healthy patients who are close to their ideal body weight, who have not been previously operated and who have a benign disease process.

Contraindications

Unstable patients or those with a life-threatening pathology (such as perforation and peritonitis) are not suitable candidates for laparoscopic colectomy.

Several relative contraindications exist for SILC, similar to MPLC. Patient who have had peritonitis or multiple previous surgeries are less likely to be successfully operated by a laparoscopic approach. Patients with complex anatomy due to their disease process, for example Crohn's disease with fistulae and obstruction, may not be amenable to laparoscopic identification of anatomic landmarks. Patients who have bowel obstruction and significant bowel distension are often best served by an open approach because adequate pneumoperitoneum, and therefore visualization, cannot be secured around the distended bowel. There may be literally no space within which to work. Finally, patients with a large palpable mass or phlegm on after induction of general anesthesia will require a commensurate incision for specimen extraction and may be best served by open laparotomy. Unstable patients or those with a life-threatening pathology (such as perforation and peritonitis) are not suitable candidates for laparoscopic colectomy.

Transitioning from MPLC to SILC

Although SILC is closely related to MPLC, some differences are present between the two techniques and thoughtful planning of training and practice is important. First, because the instruments are placed in parallel through one incision, the instruments must be managed in the same, or collinear, planes. This can lead to "boxing," or instrument clashing, externally instead of "sword-fighting" internally. The level of the ports and the instruments must be staggered to help minimize this problem.

Tissue management can be more challenging in SILC. Triangulation of instruments internally is lost with SILC and the motion of the instruments

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W.L. Law and C.P. Delaney (eds.), *Single Incision Laparoscopic and Transanal Colorectal Surgery*,
DOI 10.1007/978-1-4614-8902-3_2, © Springer Science+Business Media New York 2014

Table 2.1 Common conditions treated by laparoscopic colectomy

Indication
Polyps and polyp syndromes
Malignancy
Inflammatory bowel disease
Diverticulitis
Ischemic colitis
Rectal prolapse
Volvulus
Constipation
Colostomy and reversals

must often be back and forth, rather than side to side. Therefore, suspension of the tissue, rather than traction, may be most useful. Management of the tissues requires precise visualization and exposure. More specifically in laparoscopic colon and rectal surgery than other laparoscopic surgeries, the tissues that are manipulated are not all resected. It is important to avoid mechanical or thermal injury to surrounding and adjacent structures. Tissue management includes using a traumatic graspers on bowel to help avoid any injury to bowel that will not be resected.

Aside from choosing an alternative access device to MPLC, there is no special equipment needed. Access devices are available from several major device manufacturers. The same surgical instrumentation used for MPLC can be utilized for SILC.

Skills courses, video observation training and proctoring can all be important components of safe skill acquisition prior to, and in addition to, clinical practice.

Techniques

Operating Room

As with any laparoscopic colectomy, a moveable operating table is essential for positioning the patient for optimal exposure of the target organ. Because Trendelenberg and other steep positions are employed during the case, some surgeons place the patient on a conforming beanbag or use tape across the chest to secure the patient. The patient's arms are tucked bilaterally to allow for ease of surgeon movement around the table. If the patient is too large to safely tuck both arms the left arm should be tucked to facilitate surgeon movement around the table while the right arm remains extended.

Even for right-sided operations, low lithotomy position is ideal for minimally invasive laparoscopic colorectal surgery because it affords free access to all aspects of the abdominal wall. The surgeon or assistant can stand between the patient's legs for upper or lateral abdominal work. For MPLC in lithotomy position, it is most important that the patient's thighs be at or below the plane of the anterior-superior iliac spine to allow for free movement of the laparoscopic instruments in the field. This is less important in SILC since all instruments are placed through the umbilical incision.

Prior to induction of anesthesia, subcutaneous heparin is given and compression boots are placed and activated. An indwelling urinary catheter may be placed at the surgeon's discretion. An orogastric tube is placed for decompression of the stomach, which is particularly helpful for visualization during mobilization of the hepatic flexure. Appropriate perioperative antibiotics are given within 30 min of incision.

The patient is prepped and draped with the entire abdominal wall exposed in order to always be prepared for the possibility of conversion to a multiport or an open procedure.

The video monitor should be positioned ipsilateral to the target organ, that is, in the right lower quadrant, at a height that allows for neutral positioning of the surgeon's neck. The surgeon stands opposite the target organ, on the left side of the patient. The assistant may stand next to the surgeon in the cephalad position. The operating table height should be lowered so that when the abdomen is insufflated the surgeon can operate with his or her shoulders level. Sometimes standing on a platform will add ergonomic advantage when the patient's abdomen is large or protuberant. A consistent operating room team of nurses and technicians familiar with laparoscopic colectomy will facilitate flow and ease of the operation.

Access Devices, Optics and Instrumentation

Access Devices

There is an array of principles for port placement for MPLC, but there is standardized umbilical access device placement for SILC. Most surgeons use a vendor designed platform with openings for trocars. An insufflation port is part of the device. Three, sometimes four, trocars are placed through the device. The level or height of both the ports and the instruments must be staggered at the level of the device to help minimize instrument clashing externally, or boxing.

Most instruments and devices can be used through 5 mm ports. The sole limitation on port size selection currently is that endoscopic staplers must be placed through a 10/12 port. A 5 mm trocar can always be up-sized later in the case if needed. Trocars should be oriented toward the operative target for the surgeon's ergonomic benefit.

Optics

Optimal visualization is key to a safe and expeditious surgery. Special considerations for SILC optics include the need to stagger the position of the instruments externally at the access port site. A 30° down scope will facilitate visualization. When using a straight scope, a bariatric length is recommended in order to keep the camera apparatus away from the instruments at the umbilicus, again to reduce clashing. Alternatively, flexible tip scopes that can deflect within the field to change the angle of view can be used. Video monitors should be placed at a height to facilitate neutral positioning of the neck and shoulders as the surgeon operates. The monitors must be mobile so that they can be moved to accommodate changing operative fields.

Energy Devices

In order to perform intra-corporeal soft tissue mobilization and vascular division we utilize instruments such as thermal sealing devices that seal tissue by melting it. All thermal sealing devices have some lateral spread of heat for a few mm that occurs with activation of the instrument. It is important to have the device applied only to the tissue that is to be sealed or divided. It is also important to be able to visually verify a clear zone around the device. The advantage to use of the thermal sealing device in SILC is that it can also be used as a grasper and a retractor.

There is some evidence that thermal sealing of vessels is associated with fewer mishaps than stapling vascular structures [1]. However, all devices can fail and it is important to have a backup plan for management of bleeding vessels. An endoscopic looped suture can be very useful to stop bleeding from a pedicle that has failed another technique.

Monopolar cautery can be used in association with scissors or other instrumentation. It is crucial to avoid any electrical injury to surrounding tissues from arcing along instrumentation. Any unsheathed portion of an instrument is live with electrical current and can cause injury to surrounding structures. Intuitively, it seems more likely to occur in the setting of collinear instrument management. Because of this particular risk of arcing of current and remote thermal injury to tissues, many surgeons simply do not use monopolar energy in single incision laparoscopic surgeries.

Staplers and Wound Protection

Division of the colon requires endoscopic staplers, which come in different lengths and may have the ability to articulate. For right colectomy, many surgeons will simply divide the bowel extracorporeally. A wound protection device for the abdominal wall site of extraction is used to minimize bacterial contamination and tumor implantation. If the platform for single incision laparoscopic surgery does not include a sleeve for the abdominal, a separate sleeve can be placed.

Appendectomy, Extended Appendectomy or Partial Cecectomy

The patient is prepared in the manner described above after induction of anesthesia. The umbilicus is everted and a vertical incision is made through the umbilicus for a distance of 2.5–3 cm. The fascia is opened and the selected access

device is placed under direct visualization. Trocars are staggered in height, if appropriate, and arranged as a triangle with the apex pointing away from the right gutter. Therefore two working ports will lead and the camera port will be lateral and behind the instruments. Pneumoperitoneum is established. The camera is placed through the lateral, or left side, trocar. A 10/12 mm trocar will be required for division of the appendix or cecum. It is often easier to work with 5 mm trocars throughout the dissection and then exchange for a 10/12 mm trocar when preparing to staple.

Using the superior trocar, grasp and elevate the appendix. Dissect and isolate the base of the appendix using the inferior trocar. The appendiceal mesentery can be divided with a stapler, or a thermal sealing device. After the appendix is isolated, exchange the inferior trocar for a 10/12 mm trocar. Staple the base of the appendix in the usual manner. The appendix is then placed in an endoscopic retrieval bag through the 10/12 port and removed.

The incision is closed at the fascia and the skin after the access device is removed.

Right Colectomy

The patient is prepared in the same manner described above and the access device is placed. The umbilicus is everted and a vertical incision is made through the umbilicus. For colectomy, the fascial incision may need to be slightly larger to accommodate the extraction of the specimen without trauma to the tissues. The fascia is opened for 3–4 cm and the selected access device is placed under direct visualization.

There are three distinct anatomic approaches to right colectomy: medial, lateral and inferior. The inferior approach is used infrequently and is not particularly suited for single incision approach.

With *medial-to-lateral* approach, the first operative goal is division of the ileocolic vascular pedicle and the associated right colon mesentery. This approach is optimal in many patients undergoing SILC because the lateral attachments of the colon to the side wall are another "retractor" that facilitates tissue management. The mesentery is grasped at the colonic end of the vascular pedicle and elevated toward the right side wall. Usually the right hand or most superior port is the best point of access for this retraction. Enough traction is created to give the typical "bowstring" appearance to the vessels that is needed for their safe identification. It is crucial that the duodenum be identified and avoided at the base of the vascular pedicle. Using the left hand through the most inferior port, an adequate window is created around the vessels and they are divided by a thermal sealing device. Thus, a window is created in the mesentery inferior to the duodenum. This plane is then used to continue dissection in the retroperitoneal plane out to the right side wall. The right hand provides traction on the mesentery by suspending it as the grasper pushes out to the right side wall. Dissection can continue lateral and superior to the duodenum in this plane, as well, with hand-over-hand exchange of tissue between the instruments. The mesentery is divided up to the middle colic vessels in this fashion.

The mesentery between the ileum and the ileocolic pedicle is then sequentially divided by suspending the pedicle in one hand and walking the thermal sealing device up the plane to the terminal ileum.

The colon is then mobilized out of the right gutter in the manner described below in the lateral-to-medial approach to right SILC.

The *lateral-to-medial approach* replicates the standard open technique of right colectomy. The cecum is grasped and rolled medially using an instrument in the right hand in the superior trocar. The appendix is freed from any attachments. Care is taken to identify the right ureter at the pelvic brim. Dissection should be above and lateral to the ureter. Using a thermal sealing device, the White line of Toldt is incised and the colon is sequentially mobilized up the right gutter to the hepatic flexure. After the peritoneal attachments are incised, a gentle sweeping maneuver moving the colon to the midline will display the attachments for division. A common mistake is to drift dissection too far laterally and dissect out in the abdominal sidewall, including under or lateral to the kidney.

When the hepatic flexure is reached, the patient is placed in reverse Trendelenberg to allow gravity to aid in exposure. The operating instrument is placed in the superior trocar. The gastrocolic omentum is elevated cephalad taken off the transverse colon. Downward traction is applied to the hepatic flexure and the attachments are then taken down through the superior port. The attachments are divided so that the colon is mobilized to the level of the middle colic vessels. Care is taken to work lateral to and below the duodenum as the colon is rolled down toward the pelvis. Adequacy of mobilization can be assessed by bringing the flexure to the pelvic brim and the cecum to the midline with a grasper.

The specimen can then be exteriorized and the resection and anastomosis completed extracorporally. It is important to place a locking grasper on the lead point for exteriorization, i.e., the appendix or cecum, prior to performing extraction to facilitate specimen retrieval.

A wound protecting sleeve is placed through the incision if it is not already part of the access device. The specimen is exteriorized. If the mesentery was not divided intra-corporally it can be divided at this time. The bowel is dividied with staplers and a side-to-side functional end-to-end anastomosis is created with standard technique, either stapled or hand-sewn. The anastomosis is then returned to the abdominal cavity and the abdomen is re-insufflated. There is no data to support closure of the mesentery and this is not commonly performed in laparoscopic colectomy. Careful inspection for hemostasis and any abnormality is performed before the access device is withdrawn and the fascia is closed.

Prior to closure of the fascia, it is easy to perform a TAPP (transabdominal pre-peritoneal) block of the abdominal wall with local anesthesia. The fascia may also be infiltrated primarily.

The *Inferior approach* to laparoscopic right colectomy is less commonly used, but can be helpful in the setting of a large mass in the cecum that makes clear identification of the ureter more important or when the medial mesenteric anatomy is not clear. However, these are two situations where the single incision laparoscopic approach may be quite limited. Large masses are difficult to control with just one functional retractor. The approach begins by reflecting the cecum and terminal ileaum mesentery cephalad to expose and incise the junction of the visceral and parietal peritoneum. Retraction is accomplished through the inferior trocar with the grasper pushing the tissue "up and away" from the pelvic brim. The superior trocar is used to incise the peritoneum. A gentle sweeping motion will peel the colon and mesentery off the retroperitoneum without injury to the ureter or vasculature. The duodenum is encountered directly at the cephalad end of this dissection. The duodenum is deflected posteriorly and the operative plane continues on top of the duodenum with judicious use of energy to divide attachments. After successful posterior mobilization, the lateral attachments and mesentery are divided as previously described.

Postoperative Care

Routine postoperative fast-track or enhanced recovery pathways are employed after SILC. The patient is treated with multimodality pain medications, including the TAPP and/or local block performed at closure. Nonsteroidal anti-inflammatory medications are administered intravenously from the operating room and subsequently for 72 h. Intravenous and oral acetaminophen are given as appropriate and, finally, patient controlled anesthesia with narcotic is offered.

Feeding is offered ad lib on postoperative day one. Early ambulation and incentive spirometry are encouraged. When patients pass flatus and tolerate a regular diet and oral pain medications they may be discharged home.

Complications

Any operation carries a risk of bleeding and infection. The risks specific to colectomy and laparoscopic surgery apply to single incision laparoscopic right colectomy. Postoperative ileus, obstruction, and anastomotic leak are seen with equal frequency in multiport laparoscopic and single incision laparoscopic right colectomy [2].

Current Experience with Right SILC

The first case reports of single incision laparoscopic right colectomy appeared in 2008 [3].

In the next several years, several case series were published comparing SILC-Right to MPLC-Right surgeries. There were small numbers of patients in these series. However, safety and feasibility of the SILC approach were shown. Most authors found no significant differences in multiple parameters between the two laparoscopic approaches. These parameters include operative time, nodal harvest, morbidity and length of hospital stay [4–7].

A larger multicenter, case-matched series was published in 2012 with 330 patients, 234 of which were right colectomies. There were no significant differences between SILC and MPLC for conversion rate, complications, reoperation rate or readmission to the hospital. In this review, postoperative day one pain scores were significantly lower using the SILC approach [8]. Another larger case-controlled series of 100 patients undergoing SILC and MPLC-Right found that operative time was significantly shorter in the SILC group [2].

The question of whether oncologic outcomes are equivalent arises with any newer surgical technique. Within the papers referenced in the preceding discussion, a portion of the patients in each group were operated for malignancy. Lymph node harvest as a surrogate marker for adequate oncologic resection was equivalent in all case comparisons. A recent study specifically compared oncologic outcomes for SILC-Right versus MPLC-Right in 159 patients. The colectomy groups were similar in clinical characteristics. There was no difference in complications between the groups. Oncologic resection, as assessed by lymph node harvest and proximal and distal margins, was equivalent. Tumor characteristics were equivalent. At 24 months mean follow up, disease-free survival was not significantly different between the SILC and MPLC groups [9].

Two meta-analyses have recently compared the outcomes between SILC and MPLC. The first review of 15 studies and 1,026 patients found variable methodology throughout the studies. There was no difference between the groups in conversion to open laparotomy, morbidity or operative time. After analysis, it was concluded that SILC procedures led to a significantly shorter postoperative length of stay as well as shorter skin incision [10]. A second meta-analysis of essentially the same pool of data came to the same conclusions: hospital length of stay and incision length are shorter with SILC [11].

Laparoscopic surgery has been a significant advance in perioperative patient care for many different surgical approaches, including colectomy. SILC is equivalent to MPLC in outcomes. SILC may be of additional marginal benefit to patients for hospital length of stay, postoperative pain and cosmesis as it relates to incision length. Advanced laparoscopic skills are required to perform SILC. For surgeons with an advanced skill set, the practice and performance of SILC-Right is an excellent way to extend their skills.

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http://www.springer.com/978-1-4614-8901-6

Single Incision Laparoscopic and Transanal Colorectal Surgery

Law, W.L.; Delaney, C.P. (Eds.)
2014, X, 117 p. 67 illus., 26 illus. in color., Hardcover
ISBN: 978-1-4614-8901-6