

## JSES GUIDELINE

**Gastroenterological Surgery: Large intestine**

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**Clinical Question 1: Is Laparoscopic Surgery Recommended for Colon Cancer?**

Laparoscopic surgery is recommended for colon cancer.  
Strength of recommendation: B

**1-1 For which stages of colon cancer is laparoscopic surgery indicated?**

Laparoscopic surgery is indicated for cecal cancer, ascending colon cancer, sigmoid cancer, and rectosigmoid cancer, regardless of their cStages. For transverse colon cancer and descending colon cancer, careful consideration is required for determining the indications for laparoscopic surgery based on the surgeon's skills and experience.

**■ Explanation**

Many retrospective studies on laparoscopic surgery have shown favorable results in both short-term and long-term outcomes in patients with stages 0 and I cecal cancer, ascending colon cancer, sigmoid cancer, and rectosigmoid cancer (1–3). Large-scale overseas clinical studies on laparoscopic surgery have shown better short-term outcomes than open surgery in patients with stage II and III diseases; these studies also have demonstrated the non-inferiority of laparoscopic procedures in terms of the long-term outcomes (4–6). Furthermore, all meta-analyses have clearly demonstrated that laparoscopic surgery is superior to open surgery in terms of short-term outcomes and comparable in terms of safety and long-term outcomes.

A large-scale Japanese study (JCOG0404: phase III clinical study) for cStage II and III colon cancer has completed enrollment. This study has so far shown better short-term outcomes in the laparoscopic surgery group than in the open group. The long-term outcomes are currently being followed up and will be presented later.

Laparoscopic surgery is recommended for cStages 0–III cecal cancer, ascending colon cancer, sigmoid cancer, and rectosigmoid cancer. For transverse colon and descending colon cancers, careful consideration is required for determining the indications for surgery based on the surgeon's skills and experience, because advanced techniques are required for lymph node dissection, dissection around the middle colic vessels, and splenic flexure mobilization.

It has been reported that laparoscopic surgery for cStage IV disease is safe, has better short-term outcomes than open surgery, and does not significantly differ from open surgery with regard to long-term outcomes. However, these results are all from retrospective studies, and to date, no data has been obtained from prospective studies (7–9). For cStage IV cancer, tumor excision, even as a palliative treatment, is often difficult because the tumor is generally large and has sometimes invaded adjacent organs. Therefore, laparoscopic surgery should be carefully considered only with informed consent, depending on the skills and experience available in each institution.

**1-2 Which complications or previous diseases require careful consideration for determining the suitability of laparoscopic surgery?**

For patients with comorbidities such as chronic respiratory or cardiovascular disease, careful consideration is required for determining the indications for surgery in light of the significance of laparoscopic surgery.

For patients with severe obesity or a history of open surgery, the indications should be determined based on the skills and experience at each institution.

**■ Explanation**

In laparoscopic surgery, the increased intraperitoneal pressure associated with pneumoperitoneum and intraoperative postural changes, such as the Trendelenburg

position and half side-lying position, can affect cardiorespiratory dynamics (10). In patients with comorbidities such as chronic respiratory disease or ischemic heart disease, careful consideration is required for determining the indications for laparoscopic surgery. The ASA classification of physical status (ASA score) is useful for assessing the general condition of patients before surgery (11). A higher ASA score is known to be associated with higher rates of postoperative complications and mortality. However, for high-risk patients, some studies have reported that laparoscopic surgery is more beneficial than open procedures. Among high-risk patients with an ASA score of III or higher, including elderly or obese patients and those with comorbidities, more favorable short-term outcomes with fewer complications have been demonstrated in laparoscopic surgery than in open surgery (11,12). In patients with comorbidities such as respiratory disease or cardiovascular disease, careful consideration is required for determining the indications for surgery in light of the significance of laparoscopic surgery. These considerations should be made after the risk of intraoperative and postoperative complications have been evaluated through coordinated efforts with other departments, including anesthesiology. For patients with obesity or a history of laparotomy, longer operating times, higher conversion rates to open surgery, and higher postoperative complication rates have been reported (13–18). Therefore, in these cases, the indications for laparoscopic surgery should be determined based on the skills and experience of each surgeon.

**1-3 Are long-term and short-term outcomes of laparoscopic surgery comparable to those of open surgery?**

In patients with cecal cancer, ascending colon cancer, sigmoid cancer, and rectosigmoid cancer, laparoscopic surgery has been demonstrated to have better short-term outcomes than open surgery and equivalent long-term outcomes and safety levels, regardless of cStages.

■ Explanation

Short-term and long-term outcomes have been reported from large-scale phase III clinical studies conducted in the USA and Europe that compared laparoscopic surgery and open surgery in colon cancer patients (4–6). These studies showed laparoscopic surgery had more favorable short-term outcomes than open surgery and equivalent long-term outcomes for colon cancer. The results obtained from subsequent meta-analyses also supported the outcomes of these clinical studies, showing the superiority of laparoscopic surgery over open surgery for short-term outcomes, including less intraoperative blood loss, earlier resumption of oral intake, and a

shorter hospital stay, although the laparoscopic surgery operating time was significantly longer. In addition, the safety of laparoscopic surgery was demonstrated, with a postoperative complication rate comparable to that of open surgery and a lower incidence of postoperative small bowel obstruction. However, in major large-scale clinical studies, there has been a high rate of conversion to open surgery (29% in the CLASICC (4) trial and 17% in the COLOR (5) trial; 21% in the COST (6) trial) and a higher incidence of postoperative complications leading to longer postoperative hospital stays in patients who underwent conversion to open surgery than in those who did not. As such, it is recommended that laparoscopic surgery be performed in medical institutions that employ up-to-date techniques and by well-experienced surgical teams. A large-scale Japanese clinical study JCOG0404, a randomized controlled trial (RCT) comparing laparoscopic and open surgery for stage II/III colorectal cancer, also demonstrated better short-term outcomes in laparoscopic surgery. The long-term outcomes were measured through 2014, but have yet to be released.

**1-4 Is laparoscopic surgery suitable for elderly patients?**

Elderly patients who have undergone laparoscopic surgery have had better short-term outcomes than those who have undergone open surgery and comparable safety and long-term outcomes. However, careful consideration is required for determining the indications for surgery in light of presence or absence of elderly-specific comorbidities.

■ Explanation

Many studies have reported the benefits of laparoscopic surgery in elderly patients (19,20). According to these reports, although the operating time was longer than that in open surgery, a significant reduction in intraoperative blood loss and the rate of blood transfusion were noted in laparoscopic surgery. Additionally, laparoscopic surgery offered equivalent or significantly lower intraoperative and postoperative complication rates compared with open surgery. In a large-scale retrospective study of elderly Japanese patients who underwent laparoscopic colectomy, although the operating time was longer than in open surgery, laparoscopic surgery offered reduced in blood loss and significantly more favorable outcomes, including shorter postoperative hospital stay and fewer postoperative complications. There was no significant difference in long-term outcomes, such as the 3-year recurrence-free survival rate and 3-year overall survival rate, between the procedures (21). However, given the presence of preoperative multiple organ dysfunction, including respiratory and circulatory disorders and

reduced reserve capacity, and a high incidence of postoperative complications, such as mental disorders in elderly patients, careful perioperative management is essential even for laparoscopic surgery.

In summary, the reduced invasiveness of laparoscopic surgery is suitable for treatment of colorectal cancer in elderly patients. However, the indications for surgery should be determined based on the appropriate examination of comorbidities of individual patients.

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## Clinical Question 2: Is Laparoscopic Surgery Recommended for Rectal Cancer?

Laparoscopic surgery may be considered. However, oncological safety has yet to be established in comparison with open surgery.

Strength of recommendation: C1

### 2-1 For which stage is laparoscopic surgery indicated?

Technical safety has been confirmed for cStage 0 and I rectal cancer. The indications for surgery should be determined based on the surgeon's skills and experience upon appropriate informed consent.

### ■ Explanation

Several clinical studies comparing laparoscopic surgery and open surgery have been conducted in the USA, Europe, and Asia to verify the safety of laparoscopic surgery. However, many of them were relatively small-scale clinical studies, and only a few were multicenter studies with a large number of patients. In addition, these overseas studies were differently from therapeutic strategies in Japan, which consequently resulted in a higher incidence of complications in both open and laparoscopic surgery than is seen in Japan (1–11). Accordingly, it was considered necessary to launch clinical studies in Japan to confirm the safety of laparoscopic surgery. Therefore, a prospective study was conducted in Japan in patients with clinical stage 0 and I rectal cancer to demonstrate the technical safety of laparoscopic surgery (12).

Standard therapy for advanced rectal cancer overseas is preoperative chemoradiotherapy, which may increase the difficulty of laparoscopic surgery. Lateral lymph node dissection, the standard therapy in Japan, also poses high technical difficulty when performed laparoscopically. Because of the small number of existing clinical studies, neither effectiveness nor safety of laparoscopic surgery for advanced rectal cancer has been established (13,14).

There, during the initial period of introduction, laparoscopic surgery is recommended for patients with cStage 0 and I rectal cancer—patients in whom the surgery-related risk is low. This procedure must also be performed by a surgical team with sufficient skill and experience in laparoscopic surgery for colon cancer. For patients with clinical stage II or higher rectal cancer, the surgery should be performed at the patient's request after sufficient informed consent has been provided (as part of an adequately designed clinical study or under an equivalent system).

#### 2-2 Are the short-term outcomes of laparoscopic surgery superior to those of open surgery?

Although the operating time is reported to be longer with laparoscopic surgery, this procedure is superior because of its less invasiveness and greater consistency.

### ■ Explanation

An early RCT conducted in the UK reported a higher incidence of complications in patients who required conversion to open surgery and increased incidences of positive resection margins and in patients undergoing laparoscopic anterior resection compared to open anterior resection, although this difference was not significant (2). However, recent studies have shown that laparoscopic surgery is associated with less blood loss than open surgery despite its longer operation times. Some studies

have reported no difference in the incidences of intraoperative and postoperative complications and mortality between open and laparoscopic procedures, whereas others have reported fewer complications with laparoscopic surgery. With regard to postoperative recovery, laparoscopic surgery offered fewer days to first flatus as an indicator of intestinal peristalsis, fewer days to resumption of solid diet, and a shorter postoperative hospital stay than open surgery. Furthermore, the small incisions made in laparoscopic surgery have been reported to offer advantages, such as cosmetic benefits, decreased pain, and reduction in analgesic doses. No difference was shown between the procedures regarding voiding function, sexual function, or quality of life after surgery, but laparoscopic surgery was reported to be more cost-effective. Either no difference or an increased number of lymph nodes retrieved has been reported in laparoscopic surgery as compared with open surgery (1–11,15–17).

A clinical study was conducted on patients with clinical stages 0 and I rectal cancer in Japan. An analysis of 490 patients from 43 sites revealed that conversion to open surgery occurred in 8 patients (1.6%) and anal preservation was possible in 477 patients (97%). Twenty-four intraoperative complications and 160 postoperative complications developed, with no deaths occurring due to complications. Reoperation was performed in 19 patients (4%). The median time to resumption of fluid intake, resumption of oral diet, and discharge from hospital were 1, 3, and 12 days, respectively (12).

#### 2-3 Are the long-term outcomes of laparoscopic surgery comparable to those of open surgery?

To date, there have been no studies reporting the inferiority of laparoscopic surgery with respect to long-term outcomes. Further evaluation through high-quality clinical studies is necessary.

### ■ Explanation

To date, no RCT or meta-analyses have demonstrated any difference between laparoscopic surgery and open surgery in terms of long-term prognosis, local recurrence rate, or distant metastasis rate. With regard to long-term complications, it has been reported that laparoscopic surgery is associated with a lower incidence of small bowel obstruction related to adhesion, but no differences in the incidences of other complications or reoperation between the procedures has been noted. However, because of the small number of study sites and enrolled patients, these results alone are insufficient to evaluate the oncological safety of laparoscopic surgery for rectal cancer (1–11,15–18). Further investigation of the long-term outcomes in multicenter RCT overseas and in Japan

involving a larger number of patients is essential to reach a conclusion on the merits of laparoscopic surgery relative to open surgery.

**2-4 Have any intraoperative or postoperative complications that require attention been reported?**

No complication peculiar to laparoscopic surgery has been reported in recent years.

■ Explanation

Complications peculiar to laparoscopic surgery initially included brachial nerve paralysis likely caused by patient positioning during surgery or patient immobilization on a table, but these occurrences have been decreased by increased attention to patient positioning and immobilization (12).

Some studies have reported no difference in the incidences of intraoperative and postoperative complications or mortality between laparoscopic surgery and open surgery, whereas others have shown laparoscopic surgery has fewer complications. Therefore, laparoscopic surgery has not been shown to be inferior to open surgery, except for its extended surgical time. It was also reported that the incidence of anastomotic insufficiency, which had been an initial concern, was equivalent to that of open surgery.

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### Clinical Question 3: Is Laparoscopic Surgery Recommended for Appendicitis?

Laparoscopic surgery is recommended for acute appendicitis.

Strength of recommendation: B

#### 3-1 Are the short-term outcomes of laparoscopic surgery superior to those of open surgery?

Laparoscopic surgery is superior in terms of reductions in postoperative wound infection and wound pain, shorter length of hospital stay, and earlier social rehabilitation.

#### ■ Explanation

Many of the meta-analyses comparing laparoscopic surgery and open surgery showed a lower incidence of postoperative wound infection after laparoscopic surgery (3% in laparoscopic surgery vs 7% in open surgery) (1–11). Although some studies reported no significant difference in postoperative pain between laparoscopic and open procedures (6), many showed decreased postoperative pain after laparoscopic surgery (3,4,9,10,12). Many studies also reported that the length of hospital stay was shorter (by approximately 1 day) and that the return to daily activities was approximately 4–7 days earlier after laparoscopic surgery than after open surgery (1,3–5,8–10,12–15). The time to resumption of food intake was demonstrated to be approximately 0.34 days earlier after laparoscopic surgery than after open surgery (9,12). Some reports indicated that laparoscopic surgery is associated with a lower incidence of postoperative ileus (8), but others reported no significant difference between the techniques (9).

Many studies reported that laparoscopic surgery has a longer surgical time of 10–17 min compared with open surgery (1,3–5,9,10,12,14,15). However, the surgical time for laparoscopic surgery has been shortened in recent years. In a comparison of laparoscopic and open surgery before and after 2000, the difference in operative times was reduced from 15 min before 2000 to 5 min after 2000 (8). Therefore, the role of the learning curve should be considered, as it can affect the evaluation of the surgical time.

Although some studies reported no significant difference in the incidence of postoperative intra-abdominal abscess (3,4), many meta-analyses revealed an approximately three-fold higher incidence after laparoscopic surgery (6–10,13). The conversion rate to open surgery was reported to be approximately 10%, mainly because of perforated appendicitis or abscess-forming appendicitis (9). No port site- or pneumoperitoneum-related complications specific to laparoscopic surgery have been reported.

#### 3-2 Is laparoscopic surgery safe for perforated appendicitis or abscess-forming appendicitis?

There is no robust evidence that supports the safety of laparoscopic surgery in perforated appendicitis or abscess-forming appendicitis.

#### ■ Explanation

A meta-analysis of pediatric patients with perforated appendicitis or abscess-forming appendicitis revealed that laparoscopic surgery was associated with reduced wound infection, shorter hospital stays, and a lower incidence of postoperative ileus (16). However, surgical time was reported to be significantly longer with laparoscopic surgery than with open surgery (16,17). In addition, it was reported that there is a high conversion rate to open surgery and frequent incidence of intra-abdominal abscess (16). Therefore, selection of surgical procedure and the potential for postoperative intra-abdominal abscess should be carefully considered when performing laparoscopic surgery for perforated appendicitis or abscess-forming appendicitis.

No meta-analyses, including RCT comparing laparoscopic and open surgery in adult patients with perforated or abscess-forming appendicitis, were identified by a literature search. Meta-analyses of prospective and retrospective studies reported less frequent wound infection in laparoscopic surgery and a comparable incidence of intra-abdominal abscess between the procedures (18). No significant difference was observed in surgical time, length of hospital stay, or occurrence of postoperative intra-abdominal abscess in a prospective study (19). The conversion rate from laparoscopic surgery to open surgery was reported to be as high as 36% (19). According to a subgroup analysis on perforated and abscess-forming appendicitis from an RCT comparing laparoscopic and open surgery, there were no significant differences in the incidences of wound infection or intra-abdominal abscess between the procedures (20). In the future, large-scale RCT with less potential for bias are required for adult patients with perforated appendicitis or abscess-forming appendicitis.

#### 3-3 Is laparoscopic surgery safe for appendicitis in pediatric, pregnant, and obese patients?

Laparoscopic surgery can be safely performed in pediatric, pregnant, and obese patients. However, some studies reported a high miscarriage rate in pregnant patients who underwent laparoscopic surgery.

### ■ Explanation

Regarding laparoscopic surgery in pediatric patients, some studies reported no significant difference in surgical time between laparoscopic and open surgery (21), but others showed that laparoscopic surgery had a significantly longer surgical time (8). The length of hospital stay was shown to be significantly shorter after laparoscopic surgery. A meta-analysis consisting of only RCT showed a significantly lower incidence of wound infection in the laparoscopic surgery group (1.4% in laparoscopy vs 4.7% in open surgery) (8,21). In addition, the incidence of postoperative ileus after laparoscopic surgery was significantly lower than after open surgery (2.9% vs 3.4%) (21). By contrast, the incidence of postoperative intra-abdominal abscess was reported to be significantly higher in laparoscopic surgery (21). However, an analysis of RCT conducted after 2000 showed no significant difference in the incidence of intra-abdominal abscess between the procedures (21).

An RCT in obese patients with a BMI  $\geq 25$  showed that laparoscopic surgery required a longer surgical but did not offer a decrease in postoperative pain or shorter hospital stay (22). A prospective study in obese patients with a BMI  $\geq 30$  showed that laparoscopic surgery offered a shorter hospital stay, but no significant difference in postoperative pain, wound infection, or occurrence of intra-abdominal abscess relative to open surgery (23). The meta-analyses including those data indicated that laparoscopic surgery shortened hospital stay (24,25), significantly decreased occurrence of wound infection, and significantly extended surgical time (24).

The rate of miscarriage in pregnant women following laparoscopic surgery was reported to be 6%, which was higher than after open appendectomy, and to occur particularly frequent in those with perforated or abscess-forming appendicitis (26). Some reported a lower preterm birth rate after laparoscopic surgery (26), but other reports revealed no significant difference between the procedures (27).

#### 3-4 Is laparoscopy safe for interval appendectomy?

Laparoscopic interval appendectomy can be performed safely.

### ■ Explanation

No meta-analyses, including RCT on laparoscopic interval surgery, were identified by a literature search. An RCT comparing interval and immediate laparoscopic procedures showed no significant differences in the length of hospital stay and the recurrence rate of intra-

abdominal abscess (28), but the surgical time and the period to resumption of oral diet were significantly shorter in the interval surgery group (28).

In contrast, an RCT comparing laparoscopic interval surgery and open interval surgery showed significantly reduced postoperative pain, a shorter length of hospitalization, and an earlier recovery to daily life after laparoscopic surgery (29). No significant difference was noted in the incidence of postoperative complications, but the length of postoperative intestinal paresis was reported to be significantly shorter in the laparoscopic group than in the open group (29). However, the surgical time was significantly longer in the laparoscopic group than in the open group (29).

#### 3-5 Is single-port laparoscopic surgery less invasive than three-port laparoscopic surgery for appendicitis?

There is no robust evidence supporting the less invasiveness of single-port laparoscopic surgery.

### ■ Explanation

To date, no meta-analyses, including RCT, on single-port laparoscopic surgery have been identified. An RCT comparing single-incision laparoscopic surgery and three-port laparoscopic surgery revealed no significant differences in the period to resumption of food intake, length of hospital stay, or incidence of wound infection (30,31). However, surgical time was significantly longer in the single-incision laparoscopic group (30,31). In an RCT comparing single-port laparoscopic surgery and three-port laparoscopic surgery in obese patients and normal-weight patients, significantly longer surgical times and hospital stays were reported in obese patients treated with single-port laparoscopic surgery than in normal patients treated with the same approach (32). An RCT comparing single-port laparoscopic surgery and three-port laparoscopic surgery in pediatric patients yielded no significant differences in the length of hospital stay or incidences of wound infection and intra-abdominal abscess, but it did show a significantly extended surgical time in patients undergoing single-port laparoscopic surgery (33). A three-arm RCT compared single-port laparoscopic surgery, three-port laparoscopic surgery, and open surgery; this study reported a significantly longer surgical time (average, 7 min) in single-port laparoscopic surgery than in open surgery and a shorter hospital stay in the laparoscopic group than in the open group, but no significant difference was found in the postoperative course between the techniques (34). Further investigation using meta-analyses including RCT is expected.

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#### Clinical Question 4: Is Laparoscopic Surgery Recommended for Colonic Diverticulosis?

Laparoscopic surgery is recommended for colonic diverticulosis.

Strength of recommendation: B

##### 4-1 Are the short-term outcomes of laparoscopic surgery superior to those of open surgery?

Favorable short-term outcomes are likely to be achieved when laparoscopic surgery is selected based on the skills and experience of the institution and its surgical team.

#### ■ Explanation

Although many studies have reported extended surgical times with laparoscopic surgery compared to open procedures for diverticulitis (1–6), some have reported equivalent surgical times for both procedures (7,8). In addition, it has often been reported that laparoscopic surgery is associated with reduced postoperative pain and earlier resumption of food intake compared with open surgery (2,5–7,9,10); this in turn shortens postoperative hospital stay and enables earlier social rehabilitation (2,4,5,7,11,12). Other reports have suggested that laparoscopic surgery may contribute to reducing medical costs (6,8,11). Although some studies have reported no difference in the incidence of postoperative complications between the procedures, many studies have reported reduced postoperative complications after laparoscopic surgery (3–6,9,11). In particular, the incidence of wound

infection and ileus has been reported to be decreased with laparoscopic surgery (2–4,11).

Only one study has demonstrated the benefits of laparoscopic surgery for right-sided diverticulitis. No difference was observed between laparoscopic and open procedures regarding the effectiveness and safety of surgery and the recurrence rate of diverticulitis (13). Therefore, further studies with high-quality evidence are needed in Japan.

Based on the existing studies, laparoscopic surgery is likely to yield superior short-term outcomes than open surgery, but one prospective randomized trial reported no difference between the procedures (1).

##### 4-2 Is laparoscopic surgery indicated in patients with specific conditions such as abscess or fistula?

Laparoscopic surgery is indicated for such conditions if performed by a surgeon with sufficient experience.

#### ■ Explanation

Some studies have reported that laparoscopic surgery is associated with a higher incidence of wound infection and ileus in colonic diverticulitis patients with preoperative complications such as abscess or fistula than in those without complications (14), but others have shown no difference (15,16). In either case, this surgical procedure should be performed only by surgeons with sufficient experience (15–17). When compared by number of operations performed, surgeons with greater experience have been shown to have a lower incidence of postoperative complications, despite the fact that they frequently operate on complicated cases (16). It has been reported that surgical time is longer in laparoscopic surgery for complicated colonic diverticulitis than in open surgery, but the length of postoperative hospitalization is shortened (15,17).

##### 4-3 What surgical procedure should be selected for diverticular perforation?

Laparoscopic lavage and drainage is potentially effective.

#### ■ Explanation

For perforated diverticulitis (Hinchey stage III: generalized peritonitis with purulent ascites), intestinal resection of the affected site and colostomy (Hartmann's procedure) through an open procedure are the conventional approach. However, laparoscopic lavage and drainage without intestinal resection has recently been proven to be highly effective with fewer complications and no increase in mortality rate (18–20). Once the inflamma-

tion has subsided, laparoscopic sigmoidectomy can be performed in many cases (19). This surgical procedure may be a potential alternative to intestinal resection and colostomy for the purpose of decreasing the occurrence of complications and the duration of hospitalization, as well as avoiding colostomy. Large-scale clinical studies are required to strongly recommend the use of this approach in the clinical setting.

#### 4-4 Is laparoscopic surgery suitable for obese or elderly patients?

Laparoscopic surgery can be safely performed in obese or elderly patients when performed by an adequately skilled and experienced surgeon.

#### ■ Explanation

One study comparing a normal-weight group, slightly overweight group, and obese group undergoing laparoscopic surgery for colonic diverticulosis demonstrated no differences in the surgical time, intraoperative complications, or length of hospital stay. Laparoscopic sigmoidectomy for sigmoid diverticulitis is likely to be safely performed even in obese patients (21).

Some studies have reported that although the surgical time and hospital stay are slightly longer in patients aged over 75 years than in younger patients, laparoscopic surgery is associated with fewer postoperative complications and earlier postoperative recovery than open procedures (5,12).

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### Clinical Question 5: Is Laparoscopic Surgery Recommended for Ulcerative Colitis?

Laparoscopic surgery may be performed for ulcerative colitis at institutions with sufficient experience, but the benefits are limited in view of its complexity and difficulty.

Strength of recommendation: C1

#### 5-1 Are the long-term and short-term outcomes of laparoscopic surgery superior to those of open procedure?

One report indicated that laparoscopic surgery offered better cosmetic results than open surgery, but no other studies have shown superiority in short-term or long-term outcomes.

#### ■ Explanation

Laparoscopic surgery is broadly defined to include surgery in which all the procedures, except specimen extraction and ileal pouch formation, are performed laparoscopically, those with rectal dissection and resection through a suprapubic mini-laparotomy, and hand-assisted laparoscopic surgery (HALS) in which a surgeon's hand is inserted into the abdominal cavity to assist surgical field expansion. Hereinafter, these are collectively called "laparoscopic surgery."

There has been only one RCT comparing laparoscopic surgery and open surgery for ulcerative colitis (UC) (1). According to four meta-analyses based on other non-RCT (2–5), laparoscopic surgery required more surgical time than open surgery (2,3,5); it had a significant decrease in blood loss in only one analysis (3), and it had a shorter postoperative time to the first bowel movement and shorter length of hospital stay in three analyses (2–5). The postoperative complication rate was significantly lower in two analyses that included total abdominal colectomy (4,5), although no difference was observed in the mortality rate.

Long-term outcomes revealed no significant differences between the procedures with regard to the number of bowel movements and frequency of incontinence (6–11), but some studies reported less use of pads in patients after undergoing laparoscopic surgery (7,8). Better cosmetic results were reported with laparoscopic

surgery (6,11), but no difference was demonstrated in other QOL indicators (1,6–9,11,12). In addition, it was reported that laparoscopic surgery is associated with reduced occurrence of adhesions (13,14). Because open ileal pouch anal anastomosis results in low fertility associated with periovarian adhesion in female patients, further examination is awaited on whether laparoscopic surgery can contribute to a decrease in small bowel obstruction and maintenance of female fertility.

These studies demonstrated the safety of laparoscopic surgery in UC patients when performed by sufficiently experienced surgeons. Nevertheless, the benefits are limited at this point, considering the procedure's complexity and difficulty. However, given that UC is common in the young, the potential advantages of laparoscopic surgery are still attractive, and further data accumulation from a long-term perspective is expected.

#### 5-2 Have any complications specific to laparoscopic surgery been reported?

No particular complications specific to laparoscopic surgery have been reported.

#### ■ Explanation

Based on meta-analyses (2–5), no increase in complication rates and only a few complications specific to laparoscopic surgery have been reported. However, some studies have indicated a trend toward increased incidence of small bowel obstruction before closure of the ileal stoma among laparoscopic surgery patients (8,15). Other reports have also suggested small bowel obstruction is associated with an ileal stoma (10,16). Possible causes may include inadequate laparoscopic observation during stoma elevation and twisting of the intestine around the stoma due to poor intestinal adhesion. As such, caution is required.

#### 5-3 Which medical conditions should cause laparoscopic surgery to be avoided?

Laparoscopic surgery should be avoided in cases necessitating emergency surgery.

#### ■ Explanation

Conditions indicating surgery in UC patients include the following: (i) toxic megacolon, perforation, or massive bleeding; (ii) resistance to medical treatment; and (iii) neoplastic lesion. The conditions in group (i) require emergency surgery and, according to many studies, should be excluded as an indication for laparoscopic surgery.

Some patients with severe UC that is resistant to medical treatment are the target for quasi-emergency surgery; these patients have anemia, are in a poor nutritional state, and/or have become immunosuppressed due to intensive medical management, and their incidence of postoperative complications is high. Surgical manipulation is considered more difficult in these cases due to brittle tissues and an increased tendency for bleeding and perforation. In such cases, a three-stage surgical procedure may be often selected.

According to studies that compared laparoscopic surgery and open surgery for severe UC (all non-RCT) (17–24), quasi-emergency total abdominal colectomy was performed in many cases, and HALS was adopted in about half (17–19,24); however, the definition of UC severity varied among the reports. Most of these studies excluded patients with perforation or toxic megacolon. The conversion rate to open procedure was 0%–7%. Although many studies reported a significantly extended surgical time for laparoscopic surgery (18,19,21,23,24), laparoscopic and open procedures had an equivalent incidence of intraoperative and postoperative complications; also, some studies indicated a significantly decreased incidence of postoperative complications among patients who underwent laparoscopic procedures (17,18,24). Shorter hospital stays were often reported after laparoscopy (18,19,21–24), and some studies demonstrated benefits such as a shortening of the three-stage surgery's entire treatment period (18,22), fewer adhesions during resection of the remaining rectum at the second stage (17), and the feasibility of the laparoscopic approach for restoration of intestinal continuity (20).

Nevertheless, given that quasi-emergency surgery further increases the technical difficulty in severe UC cases when compared with interval surgery, the indications for laparoscopic surgery should be carefully determined based on the surgeon's skills and the patient's condition and provision of informed consent.

#### 5-4 Are the postoperative outcomes of HALS superior to those of laparoscopic surgery?

There is no evidence demonstrating the superiority of HALS. It is essential to select the surgical procedure depending on each site, the surgeon's skills for the approach, and the patient's body shape and medical condition.

#### ■ Explanation

Many studies comparing HALS and other laparoscopic procedures (LAP) indicated that HALS had a shorter surgical time (25–27), but other reports showed the opposite result (28). The amount of blood loss was comparable,

and no differences were observed in the postoperative time to the first bowel movement, the incidence of complications, or the length of hospital stay. The cosmetic result was reported to be better (shorter wound length) with LAP (26,27), but other studies insist on the benefits of HALS given that it is easier to acquire the skills to perform this surgical procedure (26). However, as rectal dissection, which is the most demanding part in total colectomy is sometimes performed using a Pfannenstiel incision even in LAP (25,26), careful consideration should be given to the interpretation of cosmetic results. It is essential to select the surgical procedure depending on each site, the surgeon's proficiency for the approach, and the patient's body shape and medical condition.

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### Clinical Question 6: Is Laparoscopic Surgery Recommended for Crohn's Disease?

Laparoscopic surgery is recommended for Crohn's disease.

Strength of recommendation: B

#### 6-1 For which intestinal complications of Crohn's disease is laparoscopic surgery indicated?

An initial surgery for a non-perforating ileocecal lesion is a good indication for laparoscopic surgery.

#### ■ Explanation

Crohn's disease is classified as either stenosing type associated with fibrosis (non-perforating type) or perforating type causing fistula, abscess, or perforation. Laparoscopic surgery is generally performed as the initial surgery for non-perforating, localized lesions in the ileocecum (1). A laparoscopic procedure may not be well suited for patients with a fistula, abscess, inflammatory mass, or fistula formation in other organs (e.g. ureter, urinary bladder). However, some studies indicated that laparoscopic surgery could be performed once the inflammation subsides with intensive nutrition therapy before surgery (2,3). It was also reported that factors responsible for making this procedure difficult include three or more episodes of relapse and formation of abscess (4), as well as advanced age, mass formation, and

reoperation (5). Patients with such difficulties are not good candidates because of the extended operating time, higher conversion rate, and resultant creation of a stoma in most of the cases (6). Another study reported internal fistulas, use of steroids, large intestinal lesions, and malnutrition as factors causing difficulties (7).

In addition, patients with high disease activity, such as those with a fistula and abscess or those undergoing reoperation, are unlikely to be good candidates. However, some studies reported the feasibility of laparoscopic surgery in patients with fistula formation (2,7), and others supported the advantages of laparoscopy in these patients, although no significant difference was observed between laparoscopic and open surgery (8).

The feasibility of laparoscopic procedures in patients undergoing reoperation has been reported (9,10). One study described a higher incidence of intraoperative injury relative to open surgery, but the surgical outcomes were equal (11). Many studies comparing reoperation to initial surgery showed an equivalent or slightly extended surgical time in reoperation, equivalent blood loss, and no difference in the incidences of complications and conversion (12–15).

It was reported that laparoscopic surgery for a large intestinal lesion could cause more frequent occurrences of intraoperative complications and extended surgical time in patients undergoing subtotal proctocolectomy than in those undergoing ileocecal resection (16). In contrast, recent studies have shown reductions in complications and pain, earlier postoperative recovery (17,18), and favorable surgical outcomes, as well as the safety of the laparoscopic procedure, despite an equivalent or extended surgical time (19–21). HALS is also recommended in terms of its surgical time, safety, and complication rate (22). Some reports have insisted on the superiority of laparoscopic surgery for total colorectal resection (23).

Regarding the indication for use in pediatric patients, it was reported that the length of hospital stay was shortened by laparoscopic surgery in adolescents (24). Additionally, although the occurrence of complications was equivalent between the procedures in patients undergoing subtotal proctocolectomy, a shorter surgical time and an earlier recovery of intestinal function were noted among those who underwent laparoscopy (25). Pediatric patients, including adolescent patient, gain benefits from laparoscopic surgery, such as reduction in pain and a shorter hospital stay (26–28).

**6-2 Are the short-term outcomes of laparoscopic surgery superior to those of open surgery?**

Despite its extended surgical time, short-term outcomes of laparoscopic surgery are superior.

■ **Explanation**

Despite its extended surgical time, many studies reported that laparoscopic surgery is associated with no increase in complications, a reduction in blood loss, a decrease in wound infection, earlier recovery of intestinal function, and shorter length of hospitalization (29–38). Some studies reported no differences between laparoscopic surgery and open surgery (34), but generally, an earlier recovery of the digestive tract function is expected with laparoscopic surgery. According to one large-scale database analysis, laparoscopic surgery could decrease complications, shorten the length of hospital stay, and reduce medical costs (36); another database analysis demonstrated that the laparoscopic approach could contribute to decreasing both mild and severe complications and shortening the length of hospitalization (39).

Surgical stress indexes include interleukin-6, interleukin-10, C-reactive protein, and granulocyte elastase. Although no difference in these indexes was shown between the procedures for Crohn's disease, the laparoscopic approach was reported to result in less of an increase in these indexes for various types of colectomy (40,41). In addition, it was reported that laparoscopic surgery could prevent fluctuations in body temperature and increases in C-reactive protein level and white blood cell count (42), but its effects on interleukin-6, C-reactive protein, and human leukocyte antigen-DR levels were similar to open surgery's effects (43).

Laparoscopic surgery could reduce medical costs compared with open procedures, owing to shortened hospital stays and reduced costs of drugs such as analgesics (44–48).

Although superior cosmetic results were reported with laparoscopic surgery (49–51), no difference was observed in patients' body image between the open and laparoscopic procedures (50,51). Patients' objective satisfaction was also better with laparoscopic surgery (52).

**6-3 Are the long-term outcomes of laparoscopic surgery comparable to those of open surgery?**

Despite fewer incidences of postoperative small bowel obstruction and hernia, long-term outcomes are equivalent.

■ **Explanation**

Crohn's disease is a life-long refractory chronic disease. Long-term outcomes of laparoscopic surgery for Crohn's disease involve issues such as complications due to small bowel obstruction and ventral hernia common to surgical treatment, as well as recurrence of Crohn's disease itself and reoperation after relapse.

It has been reported that laparoscopic surgery is associated with a reduced chance of reoperation in the postoperative long-term clinical course because of fewer incidences of postoperative adhesive small bowel obstruction and incisional hernia (53,54). However, the postoperative recurrence of Crohn's disease and reoperation for recurrence are equivalent to those observed after the open approach; thus, laparoscopic surgery does not improve the long-term prognosis of Crohn's disease (32,51,53–57).

Most studies have revealed no difference in the postoperative QOL between the laparoscopic and open procedures (44,51–54). Patients with Crohn's disease have a lower QOL than the general healthy population, and recurrence of the disease is the only factor responsible for decreasing the QOL (58). Laparoscopic surgery has not produced an improvement in the long-term prognosis of Crohn's disease, but it does decrease the likelihood of reoperations for adhesive small bowel obstruction and ventral hernia.

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