Integrative Approach to Laparoscopic Surgery for Colorectal Cancer

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Take-Home Pearls

- A transdisciplinary approach involving the systemic participation of the various medical specialty members in the care of the patients is indispensable for achieving successful surgical treatment.
- Prehabilitation in elderly patients is particularly important to improve the physical fitness and maintain good nutritional and psychosocial condition in elderly patients.
- For those with obstruction due to colorectal cancer, decompression procedures should be considered before performing laparoscopic colorectal surgery.
- Patients who undergo minimally invasive procedures are good candidates for fast-track (FT) perioperative care.
- FT care reduces the incidence of postoperative organ dysfunction and morbidity resulting in a faster recovery after surgery.

8.1 Introduction

Since the first report by Jacobs et al. in 1991 (1991), laparoscopic colorectal surgery has been performed in an increasing number of cases each year not only in Asian countries including Japan but also in other countries worldwide (Fig. 8.1). According to nationwide statistics in Japan, in 2011 over 19,000 cases of laparoscopic colorectal cancer surgery were performed. Among the various laparoscopic surgical

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Fig. 8.1 Laparoscopic colorectal surgery

procedures, laparoscopic colorectal surgery is the second most commonly performed procedure in Japan next to laparoscopic cholecystectomy. In general most laparoscopic colorectal surgeries were performed in cancer patients. The Japan Society of Endoscopic Surgery distributed questionnaires to approximately 500 member hospitals and institutions and collected data regarding the take-up rate of laparoscopic colectomy and laparoscopic rectal resection. The results showed an increase in take-up rate of both laparoscopic colectomy and laparoscopic rectal resection. The take-up rate of laparoscopic colectomy in 2011 was 48 % and that of the rectal resection was 45 % (Fig. 8.2) (Japan Society for Endoscopic Surgery 2012). Reasons for the increasing number of patients treated with laparoscopic colorectal surgery include the minimally invasive nature of the procedure which results in reduced pain, improved cosmesis, earlier recovery, and shorter hospital stay. Another important reason for the increasing adoption of this technique is the fact that the long-term outcomes of colorectal cancer patients are comparable to those observed after open surgery (The Colon Cancer Laparoscopic or Open Resection Study Group 2009; Fleshman et al. 2007). This finding has been documented in several large-scale randomized controlled trials worldwide.

In this chapter the perioperative care of patients who undergo laparoscopic colorectal surgery is presented and discussed focusing on areas of integrative approach. The fundamental perioperative care of the patients who undergo laparoscopic colorectal surgery should be provided not only by surgeons, gastroenterologists,

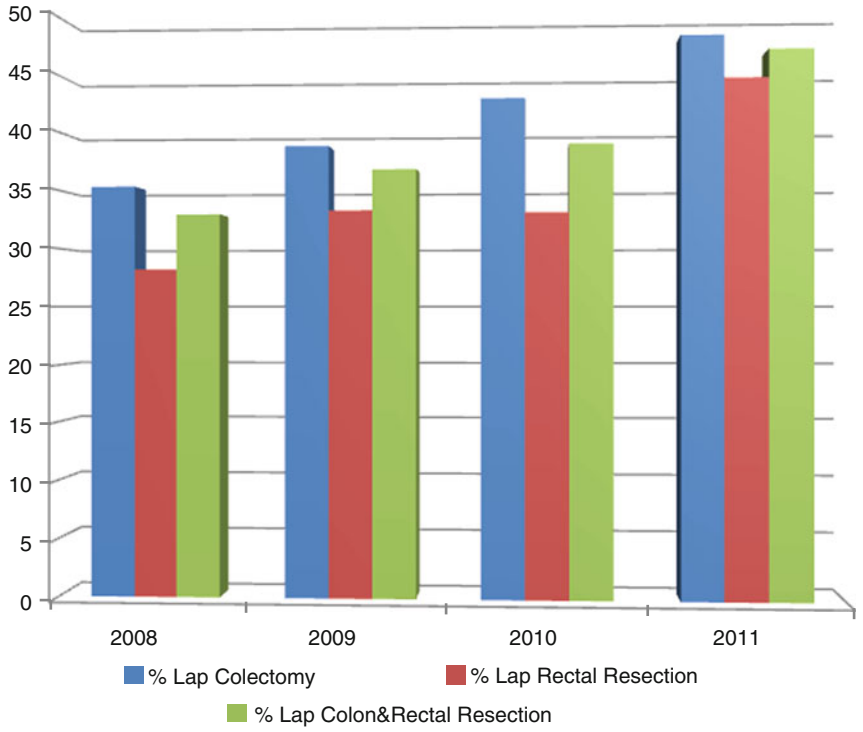

Fig. 8.2 Penetration rate of laparoscopic colon and rectal cancer surgery (Nationwide survey, Japan Society of Endoscopic Surgery (JSES) 2012)

anesthesiologists, and nurses in the wards and the theaters but also by rehabilitation trainers, dietitians, cardiologists, pulmonary physicians, and nephrologists depending on the condition of the patients. A transdisciplinary approach involving the systemic and active participation of the various specialty members in the perioperative care of the patients is truly indispensable for achieving successful surgical treatment and also obtaining a good quality of life for the patients after surgery.

8.2 Potential Advantages of Laparoscopic Colorectal Surgery

8.2.1 The Less Invasive Nature

First, the small surgical wound created in laparoscopic colorectal surgery results in less tissue damage than that observed in open surgery. The reduced tissue damage results in lower cytokine and immune responses, which leads to a faster recovery after surgery. In laparoscopic surgery CO_2 is used to insufflate the abdominal cavity. By using CO_2 insufflation, surgeons can prevent the direct exposure of intraperitoneal

organs to the air. Exposure of the intraperitoneal organs to air may suppress immune response which is detrimental to the patient's postoperative recovery, and performing pneumoperitoneum using $C0_2$ may prevent such changes (Hanly et al. 2003). In most previous studies, the amount of blood loss was significantly less in patients undergoing laparoscopic colectomy than in those treated with open surgery. This is due to the ability to precisely observe the intraperitoneal organs and tissue using the laparoscope and meticulous operative maneuvers. Reducing the amount of blood loss is beneficial for improving the patient's recovery from the surgical intervention. Open colectomy involves the manual manipulation of the intestines by the surgeons which induces a significant inflammatory response, possibly leading to paralytic ileus and postoperative adhesions of the intestine (Schwarz et al. 2004). Because the amount of bowel manipulation in laparoscopic surgery is much less than that observed in open surgery, the invasiveness of laparoscopic surgery is considered to be minimized.

8.2.2 Immune, Cytokine, and Hormone Response Following Laparoscopic Colectomy

Surgical intervention is generally considered to result in the suppression of cell-mediated immunity, an increased level of cytokines, and an enhanced inflammatory response. It has been reported that in patients undergoing laparoscopic colectomy, the postoperative rise in levels of IL-6, IL-8, IL-10, and CRP is less than observed in open colectomy (Wichmann et al. 2005). This finding is considered to be due to the reduced invasiveness of laparoscopic surgery comparing to open surgery.

In our previous study comparing laparoscopic vs. open surgery with respect to the cytokine response and inflammatory changes, the rise in the IL-6 levels was significantly lower in the lap colectomy than in the open colectomy group. Similar data have been reported in a number of previous papers. As for the hormonal response, the rise in the ADH and ACTH levels did not differ between the laparoscopic group and the open surgery group (Fig. 8.3) (Ozawa et al. 2000).

8.3 Areas of Integrative Approach

8.3.1 Evaluation of Surgical Risks

The evaluation of surgical risks in patients undergoing laparoscopic colectomy is usually performed in a similar manner to that of open surgery. There is a tendency toward longer operation time in cases of laparoscopic colorectal surgery. Performing pneumoperitoneum using CO_2 may cause hypercapnia and decrease the cardiac output. Therefore, in patients with severe cardiovascular and pulmonary dysfunction, the indication for laparoscopic colorectal surgery should be carefully evaluated.

There are several assessment tools commonly used to evaluate surgical risks. Some of these tools require specific assessment and interventions using an

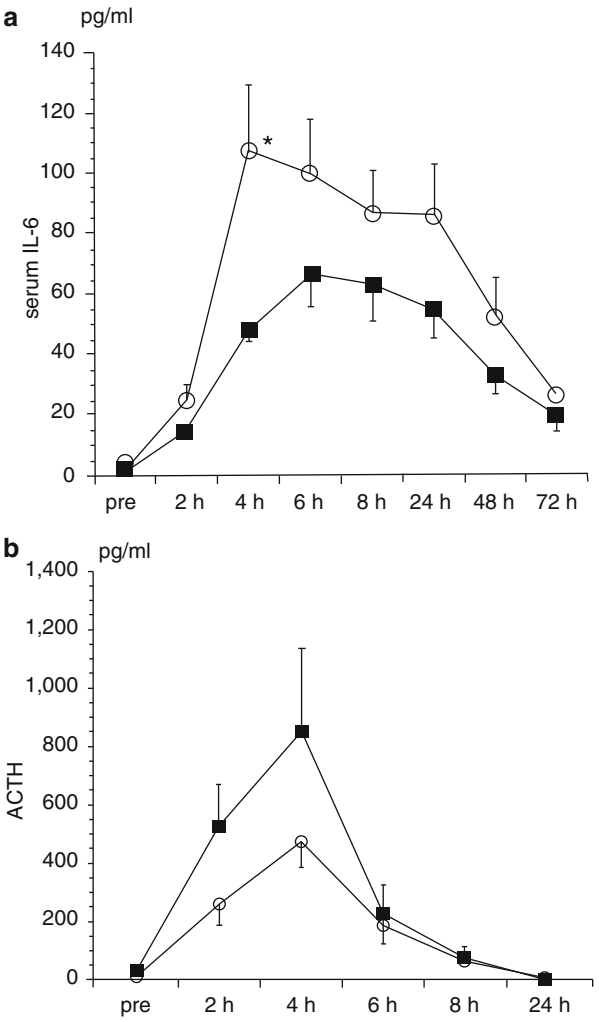

Fig. 8.3 The postoperative changes of serum IL-6 (**a**) and ACTH. * $P<0.05$ (**b**) (Ozawa et al. 2000)

integrative and team-based approach. Various factors including symptoms, comorbidities, and laboratory data have been identified to be important surgical risk factors. The patient's age itself may not be a risk factor; however, comorbidities and frailty associated with old age are considered to be risk factors in surgical patients. The followings are representative operative risk assessment tools.

8.3.1.1 American Society of Anesthesiologists (ASA) Scores

This is the most widely used scoring system (Bowles et al. 2008). This scoring system classifies patients into five categories and determines the surgical risk based on a simple assessment of the patients' condition; therefore, it is easy to use. The mortality rates for and ASA status of I, II, III, and IV have been reported to be 0.08, 1.8,

7.8, and 9.8 %, respectively. In general, conducting preoperative assessments of patients with a Class II or III status is important. Although widely used, this scoring system is a crude method of assessment and offers little opportunities of developing specific preoperative interventions for higher-risk patients.

8.3.1.2 Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM, CR-POSSUM)

The efficacy of the POSSUM score in predicting the postoperative outcome has been proven. This scoring system is widely used due to its relative simplicity and proven efficacy. There are 12 preoperative and six intraoperative variables including age, respiratory and cardiac comorbidities, ECG, blood pressure, BUN, Hb, WBC, grade of operative intervention, amount of blood loss, and the presence of malignant tumors and intraperitoneal bacterial contamination (Copeland et al. 1991). In the scoring system, the postoperative morbidity and mortality rates are automatically calculated. The CR-POSSUM was subsequently developed using multivariate models of colorectal surgery based on the same principles (Tekkis et al. 2004).

8.3.1.3 Charlson Weighted Comorbidity Index

This index is more commonly used by geriatricians. It gives each comorbidity a different weight according to the long-term outcome of patients with that particular comorbidity, which is helpful for quantifying comorbidities in elderly patients (Charlson et al. 1987). Our recent study of colorectal surgery patients showed that the risk of postoperative comorbidities was almost four times higher if the weighted comorbidity index score is 5 or greater (Tan et al. 2009).

8.3.1.4 Frailty

"Frailty" is a new concept for assessing the surgical risks of elderly patients. It is interesting to note that some elderly patients without comorbidities may exhibit higher frailty index. The presence of frailty is determined based on the activity level, grip strength, and walking speed and others as suggested by Fried et al. (2001).

The assessment of comorbidity index and frailty do not fall within the usual competence of a standard surgical team. Individuals trained in the assessment of geriatric patients may be more appropriate. Nonetheless, they may well offer more sensitive measures of increased perioperative vulnerability. It is becoming clearer that these assessments may become indispensible in the assessment of the elderly surgical patient. Integrating individuals well versed in geriatric assessment into the surgical team may well be advantageous.

8.3.2 Decompression of the Colon Proximal to the Tumor Causing Stenosis

Stenosis or obstruction due to colorectal cancer should be dealt with somewhat differently than using open surgery. This is because the ability to expose the operating

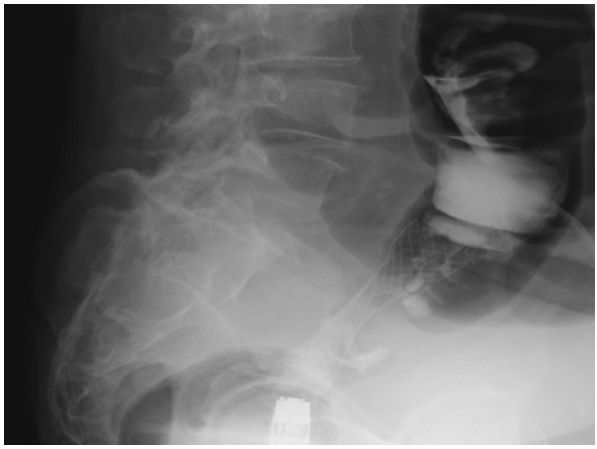

Fig. 8.4 Stenting in a case of rectosigmoid carcinoma

field during laparoscopic procedures is difficult in the presence of distension of the large or small bowel or both. Therefore, in cases of laparoscopic colorectal surgery, stenosis or obstruction should be managed to resolve distension in the bowel proximal to the tumor. When there is stenosis without symptoms of bowel obstruction, the patient is advised to stop taking solid food and to consume only liquids. This allows the feces accumulated in the bowel proximal to the tumor to be eventually passed through the stenotic segment. It usually takes approximately a week for the accumulated feces to pass through the stenosis.

On the other hand, when there is obstruction due to a tumor, decompression of the distended bowel proximal to the tumor should be attempted before resection. The most effective way to decompress the bowel is to either construct a stoma or place a self-expandable colonic stent via a colonoscopic procedure. Stenting is effective for achieving decompression and is useful as a bridge to surgical resection. The procedure requires a high level of technique and is usually performed by a well-trained colonoscopist to avoid complications during stent insertion (Fig. 8.4) (Sarkar et al. 2013). Therefore, collaboration between surgeons and endoscopists is essential. There are certain limitations associated with this procedure. When the tumor is situated around the acute bend of the colon, inserting the stent is technically difficult. In addition, if the obstruction is severe and it is not possible to pass a guidewire through the tumor, it is technically impossible to place a stent. As for the site of the tumor, the patients with mid to lower rectal tumors are usually not indicated for stenting. This is because the distal portion of the stent may project into the lower rectum causing difficulty performing rectal resection. Although not always unsuccessful, performing stent insertion of the transverse or the right colon can be difficult due to the instability in colonoscopic manipulation. Although there are technical problems and the long-term outcomes of colon cancer patients who undergo stenting as a bridge to surgery are still controversial (Sabbagh et al. 2013), colonic stenting is an effective modality for decompressing the obstructed colon before laparoscopic surgery.

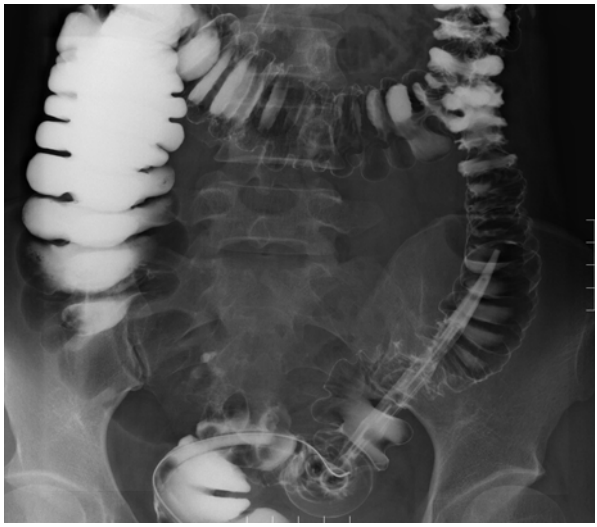

Fig. 8.5 Transanal decompression tube

When stent insertion is technically difficult, a transanal decompression tube can be used to treat obstructing tumors in the left side or in the rectum, although the effectiveness of decompression is not always sufficient and the time required for a decompression will be longer (Fig. 8.5). The usage of transanal decompression tube before laparoscopic colectomy was reported by Shingu et al. (2013). The insertion of the decompression tube is performed during a colonoscopic procedure and by a well-trained colonoscopist.

All the above described techniques may carry a significant risk of tumor perforation and failed decompression mandating more emergent surgical intervention, and thus constant communication between the endoscopist and the surgeon needs to be established.

8.3.3 Laparoscopic Colorectal Cancer Surgery in the Elderly

As the age of patients with colorectal cancer is becoming higher, the perioperative care of elderly patients is a particularly important issue (Tan and Tan 2013). In Japan the Ministry of Health defines "elderly" as an age of 65 or higher. Elderly individuals are further divided into two groups. Patients between 65 and 74 years of age are defined as "young old," and those 75 or over are defined as "old old." Therefore, in Japan an age of 75 or older is an appropriate definition of "elderly." In the UK, a colorectal cancer collaborative group reported that patients between 65 and 70 years of age should not be considered old from physiological and functional point of view. Due to the less invasive nature of laparoscopic colorectal cancer surgery, elderly patients are considered to be good candidates for laparoscopic colectomy. Previous studies have evaluated octogenarians who underwent laparoscopic colectomy. The authors reported that although the operative time of laparoscopic

surgery is longer, the length of hospital stay is significantly shorter and the rate of postoperative complications tends to be lower than that observe in open colectomy (Tan et al. 2009; Issa et al. 2011). However, there is a higher incidence of comorbidities in elderly patients; therefore, the transdisciplinary perioperative care of elderly patients who undergo laparoscopic colectomy is of significant importance. The potential systemic effects of prolonged laparoscopy may potentially lead to medical complications including complications in the cardiovascular and respiratory system, and these require interventions from physicians best delivered through a transdisciplinary approach.

8.3.4 Prehabilitation in Elderly Patients

Strengthening of the functional capacity before surgery can be achieved with the process of "prehabilitation." Such preoperative care is particularly required when operating on elderly patients (Carli and Zavorsky 2005). A poor level of preoperative fitness is associated with an increased rate of morbidity and delayed recovery after surgery. Prehabilitation aims to improve the patient's physical fitness and obtain a good nutritional and psychosocial condition (Tan 2013). Although laparoscopic colectomy is considered to be less invasive than open surgery, the use of "prehabilitation" should be considered in order to minimize surgical complications and to achieve a good quality of life after surgery particularly in elderly patients. There are two reports on the use of prehabilitation before colorectal surgery. Li et al. reported the results of their trial of "trimodal prehabilitation program" in laparoscopic colectomy patients. In their study exercise, anxiety reduction and nutritional therapy were adopted as methods of prehabilitation, and the outcomes were compared with those observed in the control patients treated without prehabilitation. The results showed that exercise was significantly effective in improving the preoperative 6MWT (6 min walking test) values (Li et al. 2013). Although only a few randomized trials have evaluated the effects of prehabilitation in patients undergoing colorectal surgery, it is expected that such treatment will reduce the number of postoperative complications, shorten the length of hospital stay, reduce disability, and improve the quality of life. Carli et al. compared simple walking and breathing with biking and strengthening exercises and found no differences in postoperative walking capacity between the two groups (Polle et al. 2007). The implementation of prehabilitation demands integration of nursing and physiotherapy support into the preoperative care of patients. To obtain best results, care delivery has to be holistic. Sharing of goals and reviews of achievement of targets between the providers delivering prehabilitation and the surgeons is indispensible.

8.3.5 Anesthesia

Although anesthesia is performed in a similar manner as that used in open surgery, there should be specific considerations of anesthesia techniques to facilitate

laparoscopic colorectal surgery. During the induction of anesthesia, ventilation of the patients is performed by pressing the anesthesia bag. During this procedure, oxygen gas is pushed into the stomach, and it can eventually reach the small intestine. This may cause distension of the small bowel, resulting in serious difficulties in exposing the operative field during laparoscopic colorectal surgery. The role of the anesthesiologists is important in preventing such situations. If a nasogastric tube is placed before anesthesia is induced, the oxygen gas insufflated into the stomach will automatically be evacuated through the nasogastric tube, resulting in a minimal distension of the stomach and small intestine. Alternatively, the surgeons may ask the anesthetists to perform "crash induction" in which the patient is intubated immediately following muscle relaxation without ventilation using the anesthesia bag.

As previously stated, performing pneumoperitoneum using CO_2 may cause hypercapnia during the surgical procedure. Therefore, depending on the patient's condition during anesthesia, the frequency of ventilation should be increased if there is a risk of hypercapnia.

It is important that the anesthetist understands the difficulties of laparoscopic colorectal surgery and takes steps to facilitate easier laparoscopy, and thus the anesthetist needs to be constantly engaged into the laparoscopic surgical team.

8.3.6 Enhanced Recovery After Surgery (ERAS)

The use of fast-track perioperative care was initially reported in the mid-1990s. The fast-track perioperative care programs consist of multidisciplinary approaches, including the participation of dieticians, nurses, surgeons, and anesthesiologists. Its aim is to reduce the surgical stress response and incidence of organ dysfunction and morbidities, thereby promoting a faster recovery after surgery (Vlug et al. 2011). Due to the less invasive nature of laparoscopic procedures including laparoscopic colorectal surgery, patients treated with such procedures are good candidates of the fast-track perioperative care. The Enhanced Recovery After Surgery (ERAS) system was created during the development of fast-track perioperative care by Kehlet and Wilmore (2002). Fast-track perioperative care consists of the following items: preoperative counseling of the patients, no usage of mechanical bowel preparation, no usage of sedatives, administration of liquid containing carbohydrate solution until 2 h before surgery in place of preoperative fasting, the use of epidural anesthesia during and after surgery in place of opioid pain control, restrictions on the perioperative administration of intravenous fluid, restriction on the routine use of drains and nasogastric tubes, and the early removal of Foley catheter (Wind et al. 2006a).

There are a number of reports on the use of fast-track perioperative care in patients undergoing laparoscopic colorectal surgery. The LAFA (laparoscopic fast track) randomized controlled trial reported in 2011 is the highest level study to prospectively compare four groups, i.e., Lap (Laparoscopic)/FT (Fast Track), Open/FT, Lap/Standard, and Open/Standard (Wind et al. 2006a; Vlug et al. 2011). A total of 472 patients from nine Dutch hospitals were randomized among the four groups. This trial is special because the four groups were blinded as much as possible. The

abdomen was covered with a large dressing to hide the type of surgical procedure to blind the surgeons, patients, and nurses. The fast-track patients were treated in a ward specialized in fast-track perioperative care. The criteria for discharge were predetermined in the protocol. As a result, the combination of laparoscopic surgery with fast-track care resulted in a significantly faster recovery after surgery than that observed in the other three combinations, resulting in the shortest length of hospitalization. Therefore, it is considered that both laparoscopic surgery and the fast-track care contributed to achieving a faster recovery after surgery. Similar results were found in the meta-analysis reported by Li et al. (2012). Regarding the incidence of postoperative morbidities in LAFA trial, there were no differences among the four groups. However, in one meta-analysis and one systematic review of colorectal surgery, reduced incidence of morbidity and mortality was observed in the patients treated with fast-track care than in those treated with standard care (Gouvas et al. 2009; Wind et al. 2006b). Discussions on a team-based integrative approach to enhanced recovery have been presented in a previous chapter.

Conclusions

Laparoscopic colorectal surgery is technically well established and is beneficial for the patients due to the reduced invasiveness compared to that observed in open surgery. Patients who undergo minimally invasive procedures are good candidates for fast-track (FT) perioperative care, and FT care reduces the incidence of postoperative organ dysfunction and morbidity resulting in a faster recovery after surgery. The use of transdisciplinary perioperative care involving the systemic and holistic participation of various specialty members is indispensable for achieving successful surgical treatment and obtaining good quality of life for the patients after laparoscopic colorectal surgery.

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