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Laparoscopic Restorative Proctocolectomy Technical Notes and Postoperative Results

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Laparoscopic colon surgery has become a proved method for the resection of both benign and malignant disease. With the advance of technological innovations and surgical experience, more complex laparoscopic procedures including restorative proctocolectomy have become increasingly used in the treatment of ulcerative colitis with safe and feasible results. When these operations are realized in a stepwise fashion, the complexity of the procedure becomes simplified. The technical aspects of laparoscopic restorative proctocolectomy in patients with ulcerative colitis are reviewed in this article. A J-pouch with a stapled anastomosis has been the preferred technique because it is quicker and safer. In all patients diverting loop ileostomy is regularly created at the time of ileal pouch-anal anastomosis. In this review the postoperative results are also revised. Postoperative fasting time, postoperative hospital stay, and overall complication rate are in favor of laparoscopic technique when compared to open approach. However, clinical value of laparoscopic surgery for ulcerative colitis needs further evaluation with more well-designed randomized controlled trials along with long-term follow-up.

Key words: laparoscopic surgery, ulcerative colitis, restorative proctocolectomy, ileal pouch-anal anastomosis.

INTRODUCTION

The management of ulcerative colitis (UC) has been significantly changed during the last 30 years by the introduction of new medical and surgical treatment modalities. Restorative proctocolectomy (RP) with ileal pouch-anal anastomosis (IPAA), which was first described in 1978 by Parks and Nicholls[1], constitutes a major paradigm shift on the surgical treatment of UC. This technique is now the procedure of choice for UC patients requiring surgical treatment in elective or semi-elective settings.

The advent of laparoscopic RP/IPAA presents another important progress in this field with favorable short and long-term outcomes. In 1992, Peters[2] first presented laparoscopic total proctocolectomy with IPAA as a new surgical technique for UC. Neverthless because of the complex nature of this chronic disease and because of the changes such as chronic dystrophia, shortened thickening of mesenterium and bowel wall fragility, surgeons were not enthusiastic for laparoscopic approach in the early 1990's. When the surgeons were not sufficiently experienced on laparoscopic colon surgery and the facilitative instruments such as energy devices and special laparoscopic staplers were not on the market, another drawback of surgeons was the difficulty of laparoscopic RP/IPAA. For that reason the technique was not widespreadly used and stayed limited to some centers. However after sufficient experience was gained on laparoscopic colon resections, and the different laparoscopic instruments were introduced, institutions have started to publish series of comparative studies on open and laparoscopic RP/IPAA.

Straight, hand-asssisted and single incision laparoscopic modifications are different preferred techniques for RP/IPAA. The pouch design (J, S or W) depends on the surgeon preference and on the reach problems of terminal ileum, but J pouch is the generally preferred type, because of the construction easiness. The procedures may be performed in a single stage (omission of diverting ileostomy), in two stages (closure of diverting ileostomy 2-3 months after RP) or three stages (total colectomy first, IPAA second, closure of diverting ileostomy) according to the general status of the patients[3,4]. Here we report the details of commonly used technique of strait laparoscopic RP/IPAA in our department and the review of the literature for postoperative results.

PREOPERATIVE PREPARATION, PATIENT POSITIONING AND TROCAR PLACEMENT

The alternative diverting ileostomy sites are marked preoperatively by an ostomy-care nurses. Mechanical bowel preparation is administered the day before the operation. Deep vein thrombosis prophylaxis with low molecule weight heparin is started 12 hours before the operation. Mechanical prophylaxis is provided with pneumatic alternating compression. Antibiotic prophylaxis with second generation cephalosporin and metronidazole is given 30-60 minutes before the incision. In corticosteroid dependent patients stress dose of corticosteroids are administered right before the start of the procedure. An epidural catheter is inserted as adjunct to general anesthesia in order to maximize postoperative pain control. The stomach is decompressed with an orogastric tube. A Foley catheter is placed to decompress the bladder and to follow urinary output during the operation and in the postoperative period.

The patient is positioned in a modified lithotomy position and the chest is strapped to the operating table before prepping and draping in anticipation of frequent positional changes during the operation. Both arms are padded, protected and tucked along the body. Because the operation is conducted in different positions during different stages of the surgery (steep Trendelenburg, reverse Trendelenburg, left and right side tilting) additional shoulder and upper arm supports are placed on both sides to prevent patient slipping. The legs are placed in Allen stirrups, slightly bent and abducted (Figure 1a). The operator, camera assistant and scrub nurse changes their positions frequently depending of the dissection area. For that reason two or more monitors are suitable in the operation theater. Also ergonomic positioning of the equipment tower, energy devices, electrocauteries, suction systems are very important for easy circulation of the team into the room during different stages of the procedure.

The Veress needle is usually inserted 1-2 cm above the umblicus on the midline and pneumoperitoneum is created at 12-13 mm Hg. If the patient has previous abdominal operations or special features, we change the Veress needle insertion site or we prefer open technique for direct trocar placement. We generally use 5 trocars, but depending on the patient anatomy if additional trocars are needed, we do not hesitate to use them. In standart cases 10 mm camera port is inserted at the Veress needle site and the 30 degree telescope is introduced into the abdominal cavity for general exploration. Dense adhesions or unexpected situations (anatomical variations, bowel distension obscuring operation field view, perforation, peritonitis, etc) wich are unsuitable for laparoscopic surgery are assessed, and if necessary earlier conversion to open surgery is initiated. The other trocars are placed under direct visualization (Figure 1b).

We prefer to do a clockwise dissection and resection, starting from the right colon, following with transverse and descending colon and finally finishing with the transsection of the rectum close to levator muscles.

FIGURE 1a.

A. THE POSITION OF THE PATIENT ON THE OPERATION TABLE

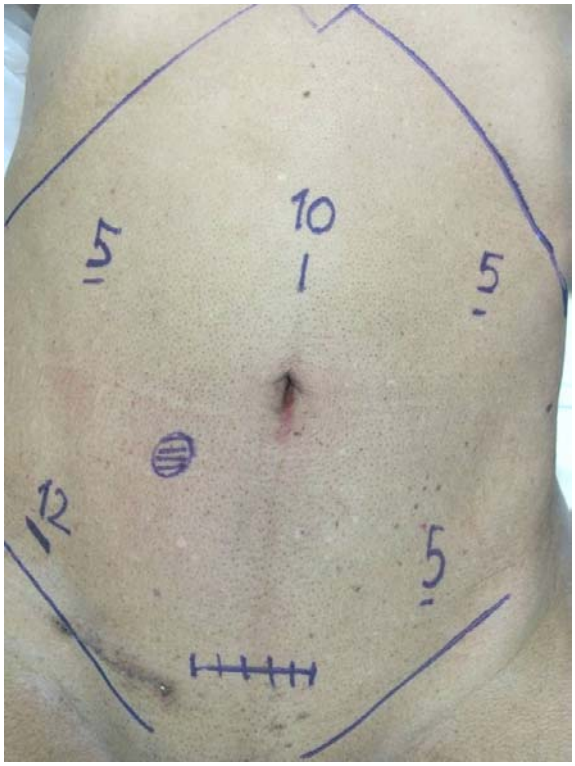

FIGURE 1b

PORT SITES, STOMA SITE AND SMALL PFANNENSTIEL INCISION FOR SPECIMEN EXTRACTION

The major steps of the operation are dissection and ligation of vascular pedicles at their origin, medial to lateral dissection of the colon, full mobilization of the small bowel mesentery, resection of the rectum according to the rules of total mesorectal excision, exteriorization of the specimen through a small Pfannenstiel incision, extraabdominal creation of ileal pouch and intraabdominal pouch-anal anastomosis.

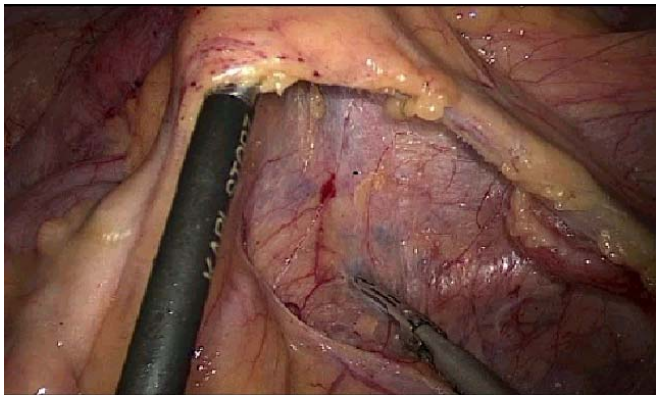

FIGURE 2A.

RETROPERITONEAL MEDIAL TO LATERAL DISSECTION UNDER THE RIGHT COLON MESENTERY. ILEOCOLIC VESSELS ARE HOLDED WITH THE LEFT INSTRUMENT

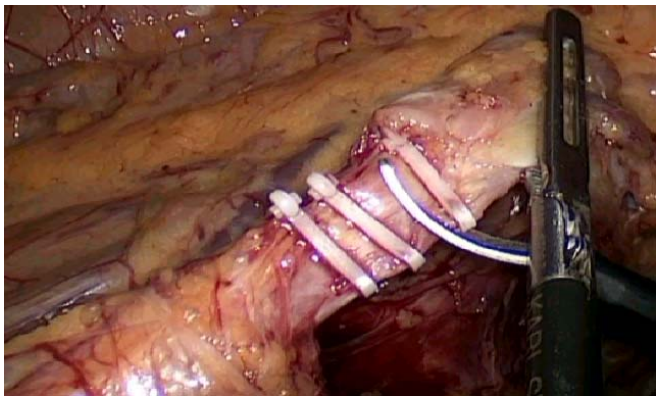

FIGURE 2b.

THE CONTROL OF INFERIOR MESENTERIC ARTERY

ASCENDING COLON AND PROXIMAL TRANSVERSE COLON

The patient is in slight Trendelenburg and left tilted position. The operator is situated at the left side of the patient, the camera assistant is at right side of the operator and the nurse is between the legs of the patient. The caecum is grasped and pulled down and right to visualize the ileocolic pedicle. The peritoneum is incised under and parallel to the pedicle for the creation of a small space behind the right mesentery, high intraabdominal CO_2 pression help to create this retroperitoneal space. The second and third part of the duodenum are pushed posteriorly with careful blunt dissection, with the aim of secure vascular ligation (Figure 2a).

In some institutions, the level of vascular control depends on the mucosal changes, benign or malignant in nature. But in our practice, for all of our patients we prefer to dissect the artery and vein separately at their origin and ligate them with nonabsorbable polymeric clips (Hem-o-lock®) before they are taken down. After the control of ileocolic vascular pedicle, retromesenteric medial to lateral blunt and sharp dissection is carried out to reach lateral abdominal wall under the terminal ileum, caecum and right colon. It is important to stay in good dissection plane to avoid injury of underlying retroperitoneal organs such as second and third part of the duodenum, head of the pancreas, right ureter, right kidney and it's vascular pedicles.

The next step is the dissection under the mesentery of proximal transverse colon. The slight reverse Trendelenburg position may help the small intestine move away from the area. During this dissection the duodenal arcade and the head of the pancreas are pushed posteriorly. Care must be taken to avoid the injury of regional veins, because their anatomy shows variations and bleeding from them may obscure the dissection area and bleeding control difficulties may force the team for conversion to open surgery. The dissection is pursued cranially until the transperitoneal visualization of the liver and the gallbladder. The mesentery of the transverse colon is incised horizontally at that level to see the liver directly.

The dissection is turned on to the control of vascular pedicles. The anatomy of right colonic artery is not constant, but it must be searched and ligated if it is found. When the transverse colon is hold with two graspers, right and left branches of middle colic artery are easily demonstrated in their courses. They are dissected, ligated with plastic clips and cut in between. If necessary, in some cases the short trunk of middle colic artery is found near the pancreatic body and taken down after clipping.

After complete vascular control of the right colon, it is now time for the mobilization of the terminal ileum and of the right colon from lateral to medial. For this purpose, the operation team changes their positions. The operator goes between the legs of the patient, camera assistant passes to the right side and scrub nurse to the left side. The operator holds the caecum with graspers and take-down the lateral attachements of the terminal ileum, caecum and ascending colon in caudal to cranial direction. Lateral dissection is carried out to liberate the hepatic flexure. We generally preserve the greater omentum. The separation of the greater omentum and proximal transverse colon is done in that stage to free the right colon completely. After the completion of the right colon liberation, the mesentery of the terminal ileum is taken down with energy devices (Ligasure®, Harmonic Ultracision®) and the ileum is cut with endostaplers 5 cm above the ileocolic junction. Then attention must be turned to the dissection of the mesentery of the terminal ileum, wich is imperative for preventing reach problems. During this dissection the mesentery of the terminal ileum must be liberated completely from it's medial and posterior attachments, up to the duodenum and to the origin of superior mesenteric vascular pedicle. This manoeuver will help to achieve the maximum length of the small bowel mesentery to reach easily the rectal stump deeply in the pelvis.

DISTAL TRANSVERS COLON AND SPLENIC FLEXURE

The table is tilted to the right side, small intestine loops are moved to the right part of the abdomen to visualize the mesentery of the distal transvers colon and the mesentery

of the descending colon. In this stage of the procedure the liberation of the greater omentum from the distal transvers colon is achieved with the help of energy devices. The splenic flexure and the few proximal centimeters of the descending colon are liberated from the spleen and from their lateral attachments. The mesentery of distal transverse colon is mobilized from the upper surface of the pancreas.

DESCENDING COLON AND RECTUM

The operator move to the right side of the patient, close to the abdomen, camera assistant stands on his left hand side, close to the thorax and scrub nurse stays between the legs of the patient. Steep Trendelenburg position and maximal right side tilting may help to clear small intestine loops from the dissection area. We prefer medial to lateral dissection.

The dissection of the left colon starts with the visualization of inferior mesenteric pedicle. For that purpose, the camera assistant holds the sigmoid colon with graspers to left. The peritoneum is incised on the right side, starting from the level of promontorium, passing under the inferior mesenteric pedicle and the origin of the pedicle. The incision is allonged until the inferior border of the pancreas. The pneumoperitoneum helps to create a small retroperitoneal space through which a blunt and sharp dissection is carried out under the mesentery of the left colon. During this dissection care must be taken to stay in a good plane in front of the Gerota fascia and to prevent injury to the left ureter and hypogastric nerve bundles. Inferior mesenteric artery is dissected, clipped at its origin and taken down (Figure 2b). Inferior mesenteric vein is controlled on its course, close to the inferior border of the pancreas. Retroperitoneal medial to lateral dissection is followed until the lateral border of the abdominal wall.

The next stage of the procedure is the mobilization of the rectum. The dissection is carried out according to the rules of nerve-sparing total mesorectal excision (TME) described by Heald in 1982[5]. The most important principle of this technique is to carry the dissection in between the parietal and visceral pelvic fascia, through the holy plane. If the rules of TME are followed strictly and, if the hypogastric nerves are preserved successfully, we believe that this technique is easier than intra-mesorectal excision with the same functional results.

The mobilization starts from the posterior aspect of the rectum, followed by the right and left side and accomplished by the anterior aspect. If the patient has no advanced rectal cancer, Denonvillier's fascia is preserved.

When the levetor muscles are reached, and the rectum is completely mobilized, the rectum is pulled cranially and a finger is introduced through the anal canal to assess the level of transsection (Figure 3a). An articulating laparoscopic linear stapler is introduced from the right lower quadrant port, the rectum is closed and divided 1 to 2 cm above the dentate line, with an assistant applying external perineal pressure (Figure 3b).

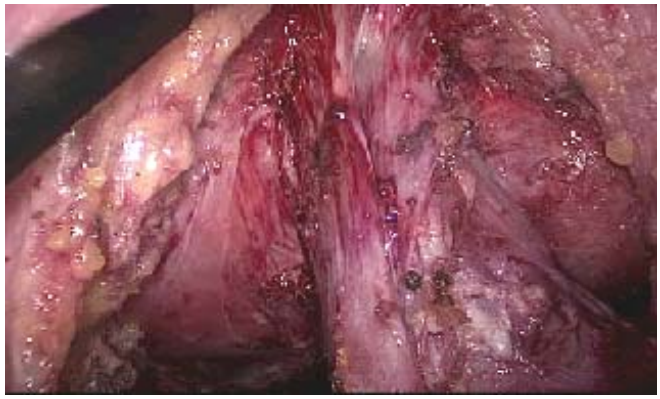

FIGURE 3.a
COMPLETE MOBILIZATION OF THE RECTUM UNTIL THE LEVATOR MUSCLES

FIGURE 3b
CLOSURE AND CUT OF THE RECTO-ANAL JUNCTION WITH AN ARTICULATING LAPAROSCOPIC STAPLER

The distal rectum must be prepared carefully so that no more than two cartridges are required for transsection in order not to increase anastomotic leakage. In female patients care must be taken to not capture the posterior vaginal wall into the stapler line to prevent pouch-vaginal fistulas.

After rectal transsection, lateral attachements of descending and sigmoid colon are takedown, and the co-lon and rectum are totally liberated. At that stage we catch the transsected rectum with one grasper and the cut end of terminal ileum with one other. The orientation of ileal mesentery must be kept carefully in order not to compromise pouch creation.

SPECIMEN EXTRACTION, POUCH CREATION, IPAA, DIVERTING ILEOSTOMY

For specimen extraction we prefer 4-5 cm Pfannenstiel incision. We use small plastic wound protector. First of all we extract the colon and rectum specimen and sent to the pathology, then take out the cut end of terminal ileum. If we have some doubt about the orientation of the small bowel mesentery, we do not hesitate to restore the pneumoperitoneum for laparoscopic control of the axis. If everything is normal, we construct a 15 cm J pouch, using

FIGURE 4a
INTRODUCTION OF THE PIN OF CIRCULAR STAPLER CLOSE TO THE RECTAL STUMP STAPLER LINE

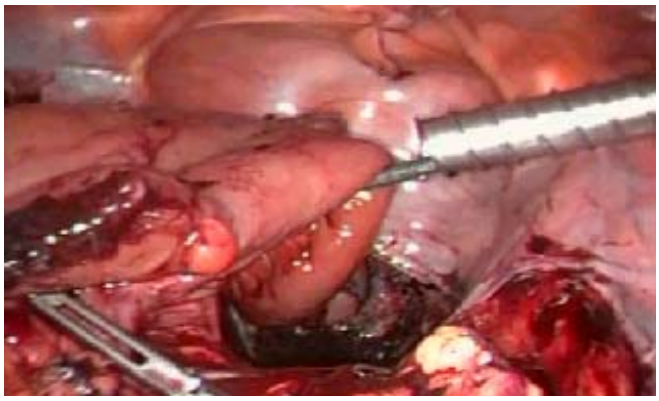

FIGURE 4b
CONTROL OF THE POUCH-ANAL ANASTOMOSIS FOR APPROPRIATE ORIENTATION AND LAXITY OF THE ILEUM MESENTERY

two cartridges of 100 mm linear staplers. The anvil of circular stapler is introduced into the pouch through the distal lateral opening on the ileum and secured with 2-0 polypropilene purse string suture. The pouch is left in the abdomen, correctly positioned into the pelvis with stapler line on the anterior surface of the pouch. The wound protector is constricted, wound edges are temporarily approximated with towel clamps and pneumoperitoneum is then reestablished. The circular stapler is introduced into the anal canal, the pin is passed through the anorectal ring under direct vision and joined with the anvil of the pouch (Figure 4a). In female patients particular care should be taken to pass the pin posterior to stapler line. Two organ are approximated with special attention to appropriate orientation and laxity of the ileum mesentery (Figure 4b). Once again in female patients, posterior vaginal wall must be kept out of the stapler line under direct vision and with the control of a finger introduced into the vagina. After firing of the staple, the instrument is taken out, doughnuts are controlled for their integrity, air-leak test is performed. A closed suction drain is positioned into the pelvic cavity and exteriorized through the left lower port site.

An intestinal loop proximal to the pouch is chosen for diverting ileostomy and taken out at the preoperatively marked stoma site. A last laparoscopic control must be done for the correct orientation of ileal loop before finalization of the stoma. After ending the pneumoperitoneum, diverting ileostomy is created according to Brooke technique. The Pfannenstiel incision is closed, also the port sites.

The patients are followed with their stomies minimally for 2 months. After this waiting period the pouch is controlled with endoscopy and pouchography with water-soluble contrast medium to rule out leakages. If the configuration of the pouch is normal, and the general health status of the patient is ready for a second operation then the ileostomy closure is realized.

POSTOPERATIVE RESULTS

Since Peters[2] performed proctocolectomy with ileal pouch in two patients, there were many uncontrolled and controlled studies and meta-analysis assessing the safety and efficacy of laparoscopic surgery for UC.

In that purpose Tan and Tjandra[6] have published the first meta-analysis in 2006. They reviewed 10 studies published between 1992 and 2001comparing laparoscopic with open surgery for UC. There were 387 patients in the pooled data. In some of the studies there was no conversion from laparoscopic to open surgery, in the others the convertion rate was not documented. The time taken for surgery was significantly longer in the laparoscopy group, with a weighted mean difference of 62.92 min (p= 0.19). On the average the time taken for laparoscopic RP/IPAA was 44.9% longer. In the same meta-analysis the reoperation rate was analyzed and 6.7% of laparoscopic patients underwent a repeat operation, compared to 1.6% in the open group (p= 0.25).

The gastrointestinal recovery was also reviewed. Laparoscopic patients were able to tolerate oral intake significantly earlier, with a difference of 1.39 days (p=0.002). The patient who underwent laparoscopic surgery were able to tolerate oral intake 78% earlier. On the average, after laparoscopic surgery, patients had recovery of bowel function 92.5% earlier compared to open group.

Another parameter assessed in this meta-analysis is the lenght of hospital stay which was significantly shorter in laparoscopy group, with a mean difference of 2.64 days (p=0.003). On the average, patients who had undergone laparoscopic surgery, were discharded 20.1% earlier than the patients who had open procedure.

The complication rates were similar: 35% in the laparoscopic group, compared to 26.5% in the open group (p=0.30). The overall mortality rates for laparoscopic and open RP/IPAA were not adequately evaluated because of the lack of sufficient information!

In their meta-analysis, Tan and Tjandra[6] conluded that laparoscopic surgery for UC is both safe and feasible, when performed by an experienced surgeon.

In 2009 a Cochrane review was published on open versus laparoscopic ileal pouch anal anastomosis for UC and familial adenomatous polyposis to compare the beneficial

and harmful effects of the techniques[7]. The 11 trials included 607 patients, of whom 253 (41%) in the laparoscopic and 354 (59%) in the open IPAA group. A total of 516 (85%) patients suffered from UC and 89 (14,7%) from FAP. The reviewers attract the attention to the low level of evidence of retrospective studies and to the increased risk of bias.

As a results of this analysis, no significant differences were found in the primary outcome measures: mortality and morbidity. Also readmission and reoperation rates were not statistically different. The laparoscopic RP/IPAA is associated with significantly operative time. Short term benefits of the laparoscopic approach regarding convalescence were not confirmed reliably. The follow-up periods of most studies were inappropriate to draw any conclusion on the long-term outcomes.

The authors of this Cochrane review conclude that laparoscopic IPAA is a safe procedure, that could be performed successfully in experienced centers on laparoscopy and restorative pouch surgery. The laparoscopic approach seems to be asscociated with some short-term advantages regarding post-operative recovery, but these advantages seem to be limited and their clinical significance is arguable. This review has shown that for cosmesis there are some data favouring the laparoscopic technique. At the end, the cost may not become a decisive item in the decision between open and laparoscopic RP/IPAA. The authors encourage the researchers and high volume centers to conduct randomized controlled trials to compare short and long-term outcomes, complications, cosmesis, quality of life and costs for obtaining reliable results with high level of evidence[7].

Another meta-analysis to assess the role of laparoscopic surgery for UC is published in 2010 by Wu et al[8]. Sixteen controlled trials including 923 patients were enrolled in this review. A pooled analysis combining the effects of 12 trials showed that total complication rate of laparoscopic surgery in UC was 39.3%, markedly lower than open surgery group (50.7%, $p<0.01$). Four patients died in all 16 trials, with each half in laparoscopic surgery and open surgery in UC. The causes of death were not associated with surgery itself.

Operating time in laparoscopic surgery was found to be significantly longer than the open one ($p<0.05$). Bowel function (discharge of gas or bowel movements) recovery time was statistically heterogene among trials probably because of the variation of methods in evaluating bowel function recovery time. However, a trend was found that laparoscopic surgery could probably have quicken recovery process after surgery. Patients undergoing laparoscopic surgery were reported to start earlier to oral intake than open surgery in pooled data with a total of 163 patients ($p<0.01$). In this meta-analysis hospital stay after laparoscopic surgery was found shorter than that of open surgery ($p<0.01$). The re-operation rates between two groups were not statistically significant ($p>0.05$). Peritoneal abscess, anastomotic leakage, abdominal bleeding, incisonal hernia, bowel obstruction were the re-operation causes. The conversion rate was 4.2%.

Wu at al.[8] concluded that laparoscopic surgery for UC was at least safe as open surgery according to less fasting time, shorter hospital stay, and lower overall complication rate.

Specific complications such as peritoneal abscess, anastomotic leakage, and intestinal obstruction did not differ between laparoscopic group and open group. However, clinical value of laparoscopic surgery for UC needed further evaluation with more well-designed and long-term follow-up studies.

In a recent study conducted by Fleming at al.[9], the database of the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) was used to assess the early complications in patients who un-derwent open or laparoscopic IPAA with diverting ileostomy. Six hundred seventy-six cases were included, of which 339 (50.1%) were laparoscopic procedures. After adjustment, a laparoscopic approach was associated with a lower rate of major ($p=0.04$) and minor ($p=0.01$) complications. Laparoscopy was not associated with a significant reduction in length of hospital stay compared with open pouch formation ($p=0.87$).

Adhesion risk after laparoscopic and open ileal pouch-anal anastomosis surgery for ulcerative colitis was studied by Hull et al[10]. The incisional adhesion score was significantly lower after laparoscopic IPAA than followi-ng an open procedure ($p=0.004$). The total abdominal adhesion score was also significantly lower in the laparos-copic group ($p=0.002$). Applying the American Fertility Society score, women undergoing laparoscopic IPAA had a significantly lower mean prognostic classification score than those in the open group ($p=0.023$).

Bartels and colleagues[11] studied the pregnancy rates after open and laparoscopic RP/IPAA.

Of 179 eligible patients, 160(89%) returned the questionnaire. After IPAA, 50(31%) patients attempted to conceive. Of these, 23(46%) had undergone open and 27 (54%) had undergone laparoscopic IPAA. A Kaplan-Meier survival function was plotted for time to first spontaneous pregnancy and showed a higher pregnancy rate after laparoscopic IPAA ($P=0.023$). Similarly, subsequent survival analysis for all patients with UC showed an increased pregnancy rate for the laparoscopic group (log-rank, $P=0.033$). The authors conclude that pregnancy rates are significantly higher after laparoscopic IPAA. This makes the laparoscopic approach the method of choice in young women.

SUMMARY

LAPAROSKOPSKA RESTORATIVNA PROKTOKOLEKTOMIJA - TEHNIČKI DETALJI I POSTOPERATIVNI REZULTATI

Laparoskopska kolorektalna hirurgija je postala dokazan metod za resekcije i benignih i malignih bolesti. Sa inovacijama u tehnologiji i hirurškim iskustvom kompleksnije laparoskopske procedure, koje uključuju restorativnu proktokolektomiju su sve češće korišćene u tretmanu ulceroznog kolitisa sa sigurnom izvodljivošću i po-

voljnim rezultatima. Kada se ove operacije realizuju korak po korak, kompleksnost procedure se smanjuje. Tehnički aspekti laparoskopske restorativne proktokolektomije kod pacijenata sa sa ulceroznim kolitisom su prikazani u ovom radu. J-pouch sa staplerskom anastomozom je preferirana tehnika pošto je brža i bezbednija. Kod svih pacijenata diverziona ileostoma se po pravilu kreira nakom anastomoze ilealnog pouch-a i anusa. U ovom radu su takodje izloženi postopoerativni rezultati. Vreme do postoperativnog početka per os unosa hrane, boravak u bolnici i ukupne komplikacije govore u prilog laparoskopskog pristupa u odnosu na otvoreni pristup. Ipak, klinička evaluacija laparoskoske hirurgije kod ulceroznog kolitisa zahteva dalje praćenje i dobro osmišljene randomizirane kontrolisane studije zajedno sa dugotrajnim praćenjem.

Key words: laparoskopska hirurgija, ulcerativni kolitis, restorativna proktokolectomija, ilealni pouch-analna anastomoza

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