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Original Article

Hand-Assisted Laparoscopic Restorative Proctocolectomy for Ulcerative Colitis: The Optimization of Instrumentation Toward Standardization

KIYOKAZU NAKAJIMA[1,2], RIICHIRO NEZU[2], TOSHINORI ITO[1], and TOSHIROU NISHIDA[1]

[1] Department of Surgery, Osaka University Graduate School of Medicine, 2-2 Yamadaoka, Suita, Osaka 565-0871, Japan
[2] Department of Surgery, Osaka Rosai Hospital, Osaka, Japan

Abstract

Purpose. Hand-assisted laparoscopic surgery (HALS) is increasingly used for complex and extensive colorectal diseases, such as a restorative proctocolectomy (RP) for ulcerative colitis (UC). However, the optimal instrumentation for this procedure has yet to be determined. This study reviewed the optimization of the instrumentation employed for HALS-RP and evaluated their impact in standardizing HALS-RP for UC.

Methods. Sixty-six cases with HALS-RP for UC were reviewed. Cases were divided into subgroups according to (1) hand-access devices and (2) vascular control devices, and their intraoperative/postoperative outcomes were compared.

Results. All groups had comparable backgrounds. (1) The hand-access devices employed were first LapDisc ($n = 14$), then HandPort ($n = 25$), and recently GelPort ($n = 27$). The surgical time was shortest in GelPort group in comparison to the other two groups. (2) Laparosonic coagulating shears (LCS) with clips were used for vascular control in the first 29 patients, and the bipolar vessel sealing system (LigaSure) was employed in the 37 subsequent patients. The surgical time was shorter and blood loss was less in the LigaSure group. No differences were seen in postoperative outcomes, including the complication rate and length of hospital stay.

Conclusion. The new instrumentation contributed to improved outcome of HALS-RP. HALS-RP can become a more comfortable and standardized procedure for UC with the adoption of evolving technologies.

Key words Hand-assisted laparoscopic surgery · Restorative proctocolectomy · Ulcerative colitis · Colorectal disease

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Introduction

Hand-assisted laparoscopic surgery (HALS) is increasingly used for complex and extensive colorectal diseases such as ulcerative colitis (UC).[1–5] Hand-assisted laparoscopic surgery significantly reduces the surgical time required for a restorative proctocolectomy (RP) for UC in comparison to laparoscopic-assisted surgery, while retaining the acceptable morbidity rates and recovery benefits of minimally invasive surgery.[3,4] However, the instrumentation for HALS-RP has yet to be optimized, and two major concerns remain among surgeons: which hand-access device is suitable for four-quadrant abdominal surgery requiring multiple hand exchanges without a gas leak, and which vascular control device should be recommended for the safe and quick division of friable colonic mesentery?

The authors have performed HALS-RP since 1998 and have continuously improved the surgical techniques with positive adoption of new instrumentation. This article reviews the optimization of the instrumentation for HALS-RP, and discusses their impact on surgical/early postoperative outcomes.

Patients and Methods

Patients

The study was conducted retrospectively using a prospectively compiled surgical database, which included 66 UC patients scheduled for HALS-RP between July 1998 and February 2006. All operations were performed by the same surgical team. The study protocol was approved by the institutional ethics committee and signed informed consent was provided by all patients prior to each procedure. The cases were divided into subgroups according to (1) hand-access devices and (2) vascular control devices, and their demographic and

surgical/early postoperative data were analyzed for comparison, i.e., age at surgery, gender, body mass index (BMI), type of colitis, indication for surgery, medical comorbidity, operative time, HALS time (pneumoperitoneum time), blood loss, intraoperative and postoperative complications, and length of hospital stay. Postoperative complications were defined as any adverse events requiring therapeutic intervention during postoperative hospital stay period. A software program (StatView v5.0, SAS Institute, Cary, NC, USA) was used to compare differences among subgroups. Those comparisons were performed on an "intention-to-treat" basis, using Student's *t*-test or Fisher's exact test where appropriate. A P value of less than 0.05 was considered to be statistically significant. The median values and ranges are reported unless otherwise indicated.

Technique

The patient was placed in the modified lithotomy position with the lower extremities in Levitator stirrups, under general anesthesia. A 7.5–8-cm Pfannenstiel minilaparotomy was made and a hand-access device was assembled. Two cannulas were placed under a standard carbon dioxide pneumoperitoneum, one in the supraumbilical region for optics and the other in the left mid abdomen for instruments (Fig. 1). The "lateral-to-medial" bowel mobilization and division of the colonic mesentery are performed intracorporeally with HALS technique. The remainder of the procedure, i.e., pelvic dissection, distal rectal stapling, ileal-pouch construction, and double-stapled ileoanal anastomosis, was then accomplished under direct vision through the opened hand-access device. The creation of a diverting ileostomy was performed at the discretion of the surgeon on a case-by-case basis.

Results

Hand-Access Devices

The patients were divided into three subgroups according to the hand-access device employed. The LapDisc (Hakko, Tokyo, Japan) was initially used in the initial 14 patients. The HandPort (Smith & Nephew, Andover, MA, USA) was selected in the next 25 patients, then GelPort (Applied Medical, Rancho Santa Margarita, CA, USA) in the final 27 patients. These three subgroups were well matched in terms of age, gender, BMI, type of colitis, indication for surgery, and morbidity period (Table 1). The past surgical history and medical comorbidity including steroid dependency were also comparable among the three groups.

The surgical and early postoperative outcomes are presented in Table 2. There was one conversion in the early series due to poor surgical exposure. The operat-

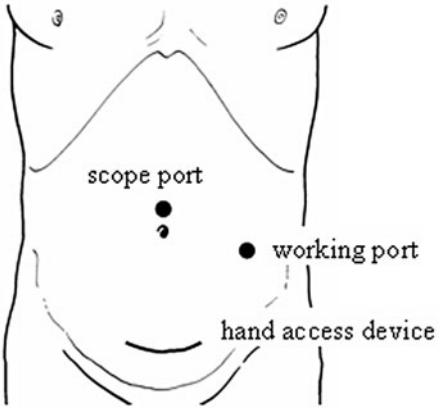

Fig. 1. Placement of the hand-access device and cannulas for hand-assisted laparoscopic restorative proctocolectomy

Table 1. Patients' background data

	LapDisc $n = 14$	HandPort $n = 25$	GelPort $n = 27$
Age at surgery, years	30 (13–67)	35 (18–73)	39 (16–71)
Male/female	7/7	14/11	14/13
BMI, kg/m^2	19.5	18.9	18.7
Left/total colitis	5/9	3/22	4/23
Indication			
Intractable	13	20	20
PSL complications	1	2	2
Dysplasia/cancer	0	2	3
Bleeding	0	0	2
Fulminant	0	1	0
Morbidity period, months	44 (11–187)	89 (2–336)	84 (1–408)
Total PSL, g	11.3	9.4	9.7

Data are median (range)
BMI, body mass index; PSL, prednisolone

Table 2. Impact of hand-access device on operative/early postoperative outcomes

	LapDisc $n = 14$	HandPort $n = 25$	GelPort $n = 27$
Operative outcome			
Conversions	1	0	0
Operation time, min	355 (225–475)	285 (235–480)*	250 (177–390)**
HALS time, min	117 (52–248)	100 (45–350)	75 (40–190)**
EBL, ml	389 (50–2045)	245 (70–815)*	185 (0–900)*
Complications	1 (bowel injury)	0	0
Transfusions	5	5	5
Early postoperative outcome			
Complications, crude	7	12	11
Leakage	0	2	1
Bleeding	0	4	1
SBO	3	2	1
Wound infection	4	4	4
Hospital stay, days	24 (18–84)	30 (17–165)	33 (19–54)

HALS, hand-assisted laparoscopic surgery; EBL, estimated blood loss; SBO, small bowel obstruction
* $P < 0.05$ vs LapDisc; ** $P < 0.05$ vs. LapDisc and HandPort

ing time was significantly shorter in the GelPort group (median 250; range 177–390 min) than in the LapDisc (355; 225–475) and HandPort (285; 235–480) groups. The HALS time, i.e., intracorporeal time under pneumoperitoneum, was the shortest in the GelPort group in comparison to the LapDisc and HandPort groups. Blood loss was less in the HandPort (245; 70–815 ml) and GelPort groups (185; 0–900) in comparison to the LapDisc group (389; 50–2045). The incidence of intraoperative/postoperative complication was similar in the three groups. The postoperative hospital stay was comparable, with a median stay of 24 (range 18–84) days in LapDisc, 30 (17–165) in the HandPort, and 33 (19–54) in the GelPort groups, respectively.

Vascular Control Devices

The patients were divided into two subgroups according to the vascular control devices used at the time of mesenteric division during HALS-RP. Laparosonic coagulating shears (Harmonic Scalpel, Ethicon Endo-Surgery, Cincinnati, OH, USA) with clips were used in the first 29 patients (LCS group). The colonic mesentery was divided with electrosurgical vessel sealing instruments (LigaSure Atlas, Valleylab, Boulder, CO, USA) without clips in the remaining 37 patients (LigaSure group). The patients' background data were again comparable between these two groups (data not shown).

Table 3 shows a comparison of the surgical/early postoperative outcomes between the LCS and LigaSure groups. The duration of surgery was significantly shorter in the LigaSure group (median 255; range 177–390 min) than in the LCS group (340; 225–480). The LigaSure group showed almost 50% less blood loss (185; 0–900 ml) in comparison to the LCS group (365; 140–2045 ml; $P = 0.0025$). Postoperative bleeding from the ileal pouch was seen in three patients in the LCS group, and one in the LigaSure group. Another patient in the LigaSure group developed late intra-abdominal bleeding on postoperative day 1. An emergency laparotomy revealed the presence of bleeding from the superior hemorrhoidal artery, which had been initially sealed with the LigaSure. Serious vascular calcification was thought to be responsible for the incomplete sealing in this instance. The postoperative recovery was otherwise uneventful in both groups, and the hospital stay was compatible between the two groups.

Discussion

Several previous studies have reported the advantages of HALS over laparoscopic surgery for an RP in UC patients.[3,4] Another study group compared the outcomes of HALS versus laparoscopic RP and demonstrated that HALS reduced the surgical time by approximately 1 h in comparison to the laparoscopic approach.[3] This reduction appeared to be due to (1) faster, easier, and more effective organ retraction and subsequent better surgical exposure, (2) more effective countertraction on tissue during the dissection, (3) faster and easier identification of vascular structures with finger palpation, and (4) faster digital dissection of the retroperitoneum.[3–5]

These advantages become evident when the pneumoperitoneum is well maintained at each hand insertion/withdrawal and manipulation during HALS. The hand-access device should be durable and flexible so that a wide range of movement of the surgeon's hand in all

Table 3. Impact of vascular control device on operative/early postoperative outcomes

	LCS $n = 29$	LigaSure $n = 37$
Operative outcome		
Conversions	1	0
Operation time, min	340 (225–480)	255 (177–390)*
HALS time, min	120 (45–350)	75 (40–190)*
EBL, ml	365 (140–2045)	185 (0–900)*
Complications	1 (bowel injury)	0
Transfusions	9	6
Early postoperative outcome		
Complications, crude	16	12
Leakage	1	2
Bleeding	3	2[a]
SBO	4	2
Wound infection	8	4
Hospital stay, days	30 (17–84)	30 (19–165)

* $P < 0.05$ vs. LCS
[a] One case with intra-abdominal bleeding included

four quadrants of the abdomen causes neither gas leakage nor device malfunction, since the intracorporeal manipulation is more extensive in an RP in comparison to other surgical procedures.[6] The device should also be an excellent wound retractor, since the extracorporeal procedures, especially pelvic dissection and ileoanal anastomosis, require good and stabilized exposure through the opened hand-access device. The performance of the surgical energy device is another concern when controlling the vascular structures during HALS-RP. The coagulation should be consistent even on the friable and thickened colonic mesentery due to inflammation.[6] The subsequent division should be quick and precisely in the middle of the coagulated tissue. The heat production should be minimal to avoid any thermal injury to the patient's adjacent organs, as well as to the surgeon's hand.

The LapDisc was not an optimal hand-access device for HALS-RP. The thin membrane between the two valves was not durable, resulting in frequent gas leakage due to accidental rupture. In addition, the iris-valve confined the hand/forearm insertion into a deeper abdominal cavity, making four-quadrant surgery technically difficult. The HandPort allowed a wider range of hand/forearm insertion than the LapDisc; however, it showed frequent "pop-outs," thus resulting in poor wound retraction/protection during the extracorporeal components of HALS-RP. GelPort, on the contrary, showed excellent performance, allowing unlimited exchange and deeper insertion of the hand/forearm into each of the four abdominal quadrants. This allowed more extensive manipulation without gas leaks. The GelPort also worked as an excellent wound retractor/protector during the extracorporeal portion, providing good surgical exposure and contamination-free bowel resection/anastomosis. The complete pelvic dissection down to the pelvic floor muscles was feasible via an "opened" GelPort in all patients in the current series.

The LigaSure was found to be a suitable vascular control device for HALS-RP, since the device provided consistent coagulation and rapid/precise division even on the friable UC mesentery. The heat production at the tip of LigaSure was minimal in comparison to other surgical energy devices such as the LCS, enabling its safer and closer use adjacent to surgeon's fingers during HALS-RP. The authors believe that this feature also partially contributed to the shorter surgical time and reduced blood loss in the LigaSure group.

One major criticism of this retrospective study is that the reduction of surgical time/blood loss reflected the learning curve, not the optimization of the instrumentation. The authors do agree that there was a learning curve effect among the surgeons with regard to the present cases. Nevertheless, the authors believe that factors such as the range of hand insertion, quality of wound retraction/protection, and the level of heat production were not related to the learning curve. The ability to select optimal instrumentation is always the key to becoming skilled and proficient. A randomized trial is necessary to further address this issue.

In conclusion, the combination use of suitable surgical devices (GelPort and LigaSure devices) contributed to the improved outcome of HALS-RP. With the positive adoption of these evolving technologies, HALS-RP is therefore expected to become a more comfortable and standardized procedure for UC.

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