Hand-Assisted versus Straight-Laparoscopic versus Open Proctosigmoidectomy for Treatment of Sigmoid and Rectal Cancer: A Case-Matched Study of 100 Patients

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ABSTRACT

Objective: The laparoscopic approach is increasingly used for surgical treatment of colorectal cancer. The aim of this study was to assess the efficacy of laparoscopic proctosigmoidectomy for cancer treatment by comparing postoperative outcomes among three groups: hand-assisted laparoscopic resection, conventional straight-laparoscopic resection, and open resection.

Methods: Patients who underwent hand-assisted proctosigmoidectomy because of rectal or sigmoid adenocarcinoma between September 2006 and July 2012 were case-matched to their straight-laparoscopy and open-surgery counterparts. Tumor location, tumor stage, resection type, and year of surgery were the matching criteria. Patients who had an abdominoperineal resection were excluded from the study.

Results: Twenty-five patients underwent hand-assisted laparoscopic resection during the study period and were matched to 25 straight-laparoscopic and 50 open-surgery cases. The patients who underwent hand-assisted resection had higher rates of preoperative cardiac disease and hypertension than did the straight-laparoscopy and open-surgery groups (76% vs 64% vs 26%; $p < 0.0001$ and 72% vs 68% vs 42%; $p = 0.02$, respectively). A history of previous abdominal operations was highest in the straight-laparoscopy group ($p = 0.01$). The mean estimated blood loss was lowest in the straight-laparoscopy group ($p = 0.01$). The straight-laparoscopy group had the shortest median length of postoperative hospital stay ($p = 0.04$). Disease-free survival and overall survival was similar among the groups.

Conclusions: Although both hand-assisted and straight-laparoscopic proctosigmoidectomy appear to be as safe and effective as open surgery in short-term and midterm outcomes, straight-laparoscopic surgery seems to provide faster convalescence compared with open surgery and hand-assisted laparoscopic surgery.

INTRODUCTION

Since the first report of laparoscopic colectomy by Jacobs et al[1] in 1991, laparoscopic surgery has been increasingly used for treatment of colorectal diseases.[2-8] Compared with open surgery, the laparoscopic approach reduces postoperative pain, wound-related complications, and length of stay.[2-5,7,9,10] Mastering laparoscopic techniques, however, requires commitment and can be challenging.[11]

Hand-assisted laparoscopic colectomy was first reported in 1996 as a technique facilitating use of the surgeon's hand in the abdomen during laparoscopic procedures.[12] This technique provides short-term benefits, including faster recovery and reduced wound-related complications compared with open surgery.[2-6] Hand-assisted laparoscopic surgery (HALS) was introduced to facilitate the transition from conventional open surgery to advanced laparoscopic surgery.[13] This type of surgery may ease mastery of laparoscopic techniques with the advantage of tactile sensation.[14] Surgeons can use their hands for retraction and rapid hemostasis by using HALS. The role of HALS in the surgical treatment of colorectal cancer is still under discussion, partly because there is a discrepancy of data available.[11] Therefore, we aimed to compare operative outcomes and oncologic results in patients who underwent open, hand-assisted laparoscopic, or straight-laparoscopic proctosigmoidectomy in this case-matched study.

METHODS

This study consisted of all patients who underwent hand-assisted laparoscopic proctosigmoidectomy with curative intent for rectal and sigmoid adenocarcinoma at our institution between September 2006 and July 2012. Those who had an abdominoperineal resection were excluded from the study. Patients who underwent HALS were case-matched with those who had straight-laparoscopic and open proctosigmoidectomy during the same period on the basis of the following criteria: tumor location (sigmoid colon or rectum), pathologic cancer stage (0, I, II, and III), type of resection (anterior or low-anterior), and year of surgery (± 3 years). Open and straight-laparoscopic counterparts were randomly matched to HALS cases in a 2:1:1 ratio, respectively, with the help of a computer-based program. Demographics, comorbid factors,

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use of neoadjuvant chemoradiotherapy, perioperative outcomes, short-term outcomes (within 30 days after surgery), and oncologic results were compared between the 3 patient groups. The data were retrieved from institutional review board-approved, prospectively maintained cancer and laparoscopy databases.

Operative details of HALS and straight-laparoscopic techniques have been described previously.[15] Total mesorectal excision was done for tumors located in the midrectum and low rectum, whereas partial mesorectal excision was performed for tumors in the upper third of the rectum. Use of any incision made after port insertion for anything other than specimen extraction was defined as conversion.[16]

All operations were performed by specialized colorectal surgeons who were beyond their learning curve in laparoscopic techniques, using previously published institutional criteria.[17] Anastomotic leak was defined as the occurrence of a break in the integrity of the anastomosis as documented by the combination of clinical, radiologic, and operative means.[18] Local recurrence was defined as detectable local disease after surgery, developing with or without distant metastasis.[19]

Categorical variables are reported here as frequency (percentage), and quantitative variables are reported as mean ± standard deviation except where otherwise noted. Associations with categorical variables were assessed by χ^2 and Fisher exact tests. Associations with continuous variables were assessed by the Kruskal-Wallis and Wilcoxon rank sum tests. The comparison with respect to recurrence and survival was performed using a log-rank test with the Kaplan-Meier method. A level of $\alpha < 0.05$ was used to establish statistical significance of individual p values.

Table 1. Matching criteria and clinical staging of tumors[a]

Criterion or stage	Hand-assisted laparoscopic surgery (n = 25), no. (%)	Straight-laparoscopic surgery (n = 25), no. (%)	Open surgery (n = 50), no. (%)
Tumor localization			
Sigmoid colon	8 (32)	8 (32)	16 (32)
Rectum	17 (68)	17 (68)	34 (68)
Preoperative clinical stage			
I	11 (44)	11 (44)	24 (48)
II	7 (28)	7 (28)	12 (24)
III	7 (28)	7 (28)	14 (28)
Pathologic stage			
0, I	12 (48)	13 (52)	26 (52)
II	7 (28)	6 (24)	12 (24)
III	6 (24)	6 (24)	12 (24)
Type of resection			
Anterior	7 (28)	7 (28)	14 (28)
Low-anterior	18 (72)	18 (72)	36 (72)
Year of surgery			
2006-2008	2 (8)	2 (8)	10 (20)
2009-2012	23 (92)	23 (92)	40 (80)

[a] p value was not significant.

Table 2. Preoperative characteristics

Characteristic	Hand-assisted laparoscopic surgery (n = 25)	Straight-laparoscopic surgery (n = 25)	Open surgery (n = 50)	p value
Age (years), mean ± SD	67 ± 11	65 ± 13	59 ± 12	0.03
Sex (F/M)	11/14	15/10	18/32	NS
Median ASA score (range)	3 (1-4)	3 (1-4)	3 (1-4)	NS
BMI (kg/m^2), mean ± SD	28 ± 5	28 ± 5	30 ± 16	NS
Previous abdominal operation, no. (%)	4 (16)	14 (56)	18 (36)	0.01
Preoperative chemoradiation therapy, no. (%)	1 (4)	2 (8)	12 (24)	NS[a]
Tumor distance to anal verge (cm), mean ± SD	18 ± 10	14 ± 9	13 ± 11	NS
Comorbid factors, no. (%)				
Diabetes	7 (28)	2 (8)	6 (12)	NS
Hypertension	18 (72)	17 (68)	21 (42)	0.02
Cardiac disease	19 (76)	16 (64)	13 (26)	< 0.0001
Pulmonary disease	2 (8)	2 (8)	5 (10)	NS
Liver disease	0	1 (4)	1 (2)	NS
Renal disease	1 (4)	0 (0)	5 (10)	NS

[a] p = 0.053.
ASA = American Society of Anesthesiologists; BMI = body mass index; F/M = female/male; NS = not significant; SD = standard deviation.

RESULTS

A total of 25 patients who underwent hand-assisted laparoscopic proctosigmoidectomy for treatment of adenocarcinoma were identified. These patients were matched with 25 patients who underwent straight-laparoscopic resection and 50 patients who underwent open resection during the same period at our institution. The parameters of the case matching and clinical staging of cancer in the rectum are shown in Table 1.

There was no difference between the groups in sex, American Society of Anesthesiologists score, or body mass index (Table 2). Patients who underwent HALS were older than those in the straight-resection and

open-resection groups (p = 0.03) and had higher rates of cardiac disease (p < 0.0001) and hypertension (p = 0.02). Distribution of patients with diabetes, pulmonary disease, or liver or renal disorders were comparable among the study groups. History of previous abdominal operations was highest in the straight-laparoscopy group (p = 0.01). The tumor distance to the anal verge was shorter (p = 0.09) and the rate of neoadjuvant chemoradiotherapy was higher (p = 0.053) in the open-surgery group; however, these parameters were not significantly different among the groups.

Operative outcomes, conversion to open surgery in the laparoscopy groups, diverting stoma creation, and intraoperative complications were similar among the study groups (Table 3). Adhesions (n = 3) and unclear anatomy (n = 1) were the causes of conversion. The straight-laparoscopic resection group had the lowest estimated blood loss (p = 0.01). Mean specimen length was largest in the HALS group (29 cm [HALS] vs 23 cm [straight laparoscopy] vs 27 cm [open surgery]; p = 0.01). Although length of hospital stay was shortest in the straight-laparoscopic group (p = 0.04), the time to bowel movement, reoperation, readmission, and requirement of blood transfusion rates were comparable among the groups. Oncologic outcomes, including harvested lymph nodes; distance to resection margin; recurrence; and postoperative complications, such as deep venous thrombosis, urinary retention, urinary tract infection, anastomotic leak, ileus, wound infection, intraabdominal abscess, sepsis, and stomal complications, were similar regardless of operative technique (Table 4). No patients died within the 30-day postoperative period. All diverting stomas were reversed during follow-up. Disease-free and overall survival were similar in midterm follow-up among the groups (Figure 1). Follow-up times were comparable for the HALS, straight-laparoscopy, and open groups after surgery (23 ± 18 months vs 32 ± 16 months vs 29 ± 22 months, respectively; p = 0.08).

DISCUSSION

Our results showed that the two minimally invasive techniques for treatment of sigmoid and rectal cancer, HALS and straight-laparoscopic surgery, could provide similar outcomes compared with open surgery. Despite the fact that patients who underwent open surgery were younger, postoperative morbidity after straight laparoscopic surgery and HALS was acceptable and comparable with open surgery. There was no evidence in our study to suggest that HALS was superior to straight-laparoscopic surgery. Whereas intraoperative blood loss and postoperative hospital stay were similar after HALS and straight-laparoscopic colorectal surgery in a systematic review, straight-laparoscopic surgery reduced estimated blood loss and shortened hospital

Table 3. Intraoperative parameters and complications

Parameter	Hand-assisted laparoscopic surgery (n = 25)	Straight-laparoscopic surgery (n = 25)	Open surgery (n = 50)	p value
Operative time (minutes), mean ± SD	186 ± 58	173 ± 44	170 ± 98	NS
Conversion, no. (%)	2 (8)	2 (8)	—	NS
Estimated blood loss (mL), mean ± SD	233 ± 144	137 ± 84	411 ± 552	0.01
Diverting stoma, no. (%)	6 (24)	3 (12)	7 (14)	NS
Intraoperative complications, no. (%)				
Intraoperative bleeding	0 (0)	0 (0)	1 (2)	NS
Intraoperative vascular injury	1 (4)	0 (0)	0 (0)	NS

NS = not significant; SD = standard deviation.

Table 4. Postoperative and oncologic outcomes

Outcome	Hand-assisted laparoscopic surgery (n = 25)	Straight-laparoscopic surgery (n = 25)	Open surgery (n = 50)	p value
Median hospital stay (range, days)	6 (2-21)	4 (2-13)	6 (4-23)	0.04
Time to bowel movements (days), mean ± SD	4 ± 2	3 ± 2	4 ± 1	NS
Reoperation, no. (%)	3 (12)	0 (0)	5 (10)	NS
Readmission, no. (%)	2 (8)	2 (8)	6 (12)	NS
Transfusion, no. (%)	1 (4)	0 (0)	5 (10)	NS
Postoperative complications, no. (%)				
Deep venous thrombosis	0 (0)	1 (4)	2 (4)	NS
Urinary retention	4 (16)	1 (4)	2 (4)	NS
Urinary tract infection	0 (0)	0 (0)	2 (4)	NS
Anastomotic leak	0 (0)	0 (0)	4 (8)	NS
Ileus	4 (16)	2 (8)	4 (8)	NS
Wound infection	4 (16)	1 (4)	4 (8)	NS
Intraabdominal abscess	1 (4)	0 (0)	5 (10)	NS
Sepsis	1 (4)	0 (0)	0 (0)	NS
Stoma complications	1 (4)	0 (0)	2 (4.0)	NS
Oncologic outcomes				
Harvested lymph nodes, mean ± SD	35 ± 18	24 ± 11	29 ± 17	NS
Distance to resection margin (cm), mean ± SD	4 ± 3	4 ± 3	4 ± 3	NS
Recurrence, no. (%)[a]	2 (8)	0 (0)	8 (16)	NS

[a] One patient in the hand-assisted laparoscopic surgery group and one patient in the open-surgery group had a local recurrence; the others had distant recurrences.
NS = not significant; SD = standard deviation.

stay after proctosigmoidectomy in our series.[6,20] Because the total length of abdominal incision is technically smaller in straight-laparoscopic surgery, some surgeons accept that it is less invasive than HALS.[21,22] Cardinal outcomes showing quality of surgery, including conversion, harvested lymph node numbers, and resection margins, were comparable and acceptable for both types of laparoscopic proctosigmoidectomy techniques in our study. On the other hand, patients in the HALS group were older and had higher rates of heart problems and hypertension. Laparoscopic surgery can be completed safely with hand assistance in patients with comorbid conditions and complex diseases.[23] However, these comorbidities could be the factors prolonging hospital stay after hand-assisted proctosigmoidectomy in our patients. Because HALS improves postoperative recovery and reduces morbidity compared with open surgery,[6] HALS may be preferred as a minimally invasive treatment alternative for the patients who are not appropriate for straight-laparoscopic surgery. In recent studies, it has been shown that the laparoscopic colorectal surgery can be performed with similar costs compared with open surgery.[24] Hospital costs for HALS and standard laparoscopic surgery were also comparable.[25-27]

Benefits of HALS over straight-laparoscopic surgery on operating time have been shown in left-sided colectomy, total colectomy, and total proctocolectomy.[28,29] On the basis of our results, hand assistance for laparoscopic rectal dissection may not be a factor in reducing the operating time. The type of prior surgery and surgeon factors may change operating time and the decision making for the operative approach in patients with a history of prior abdominal surgery. We did not have detailed information about the type of prior surgeries, and we did not evaluate surgeon factor in this study. We previously showed that having a prior abdominal operation worsens the postoperative outcomes after laparoscopic colorectal surgery.[30] However, straight-laparoscopic colorectal operations can be performed safely in patients who had prior major laparotomy and may reduce rates of wound infection compared with open surgery.[31] Indeed, in our study, patients who underwent HALS had slightly higher rates of wound infections, although it was not statistically significant. Creation of a diverting stoma, which was similar among our study groups, was not performed depending on definitive criteria. The decision for creating a diverting stoma in our patients was given by the operating surgeons. Straight-laparoscopic, sphincter-saving rectal resection without diverting stoma can be performed selectively.[32]

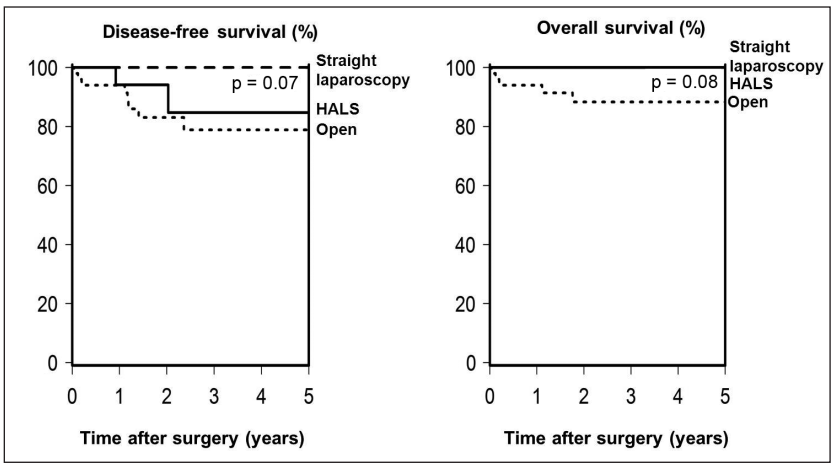

Figure 1. Disease-free and overall survival among surgical treatment groups.
HALS = hand-assisted laparoscopic surgery; open = open surgery.

We noted a trend toward a higher rate of neoadjuvant chemoradiotherapy in the open-surgery group that was not statistically significant. The general approach of our group is to use neoadjuvant chemoradiotherapy in patients with extraperitoneal rectal tumors staged as cT3-T4 or any cN1.[33] Because we evaluated pathologic staging for case-matching, neoadjuvant chemoradiotherapy may downstage disease.[34] The tumor distance to anal verge and the number of harvested lymph nodes did not reveal statistical significance among the groups. In our experience, we do not believe laparoscopic approach is a limitation for lower pelvic dissection. In contrary, better laparoscopic vision allows for a very low rate of stapling. It has been previously reported that variances of pelvic anatomy or tumor size does not adversely affect postoperative outcomes of laparoscopic colorectal surgery.[35] A recent study from our institution showed that laparoscopic surgery is associated with a lower risk of splenic injury during flexure mobilization.[36]

As a retrospective study, our study has limitations because of its nonrandomized nature. Somewhat different follow-up periods between the groups may be considered a drawback of the study. Although the rate of the adjuvant treatment was not evaluated among the groups, all of our cases were discussed at our institutional tumor board, and the National Comprehensive Cancer Network guidelines were followed. We aimed to reduce potential biases by creating a case-matched study and including the patients who were treated in the same period. It is expected that the trial of the American College of Surgeons Oncology Group will provide more information related to oncologic outcomes after laparoscopic rectal resection.[37]

… straight-laparoscopic surgery seems to provide faster convalescence …

CONCLUSION

Although both hand-assisted and straight-laparoscopic proctosigmoidectomy appear to be as safe and effective as open surgery in short-term and mid-term outcomes, straight-laparoscopic surgery seems to provide faster convalescence, possibly because of causing less surgical trauma compared with open surgery and with HALS. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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