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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Hand-assisted laparoscopic low anterior resection

Initial experience with a new procedure

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Abstract
Background: Laparoscopic low anterior resection for rectal cancer has never gained wide acceptance among general surgeons, mainly due to the technical difficulties encountered during pelvic dissection. It has therefore been stated that these patients should undergo open rather than laparoscopic surgery. Hand-assisted laparoscopic surgery (HALS) is a new technique that has the potential to overcome many of the existing limitations of pure laparoscopy. In the treatment of rectal cancer, HALS could reproduce an operative setting similar to that of the open approach.
Methods: To assess the technical feasibility of hand-assisted laparoscopic low anterior resection for rectal cancer and evaluate potential benefits and drawbacks of this new procedure, a pilot study was conducted at a university hospital on 16 consecutive patients during a 12-month period. Only patients with extraperitoneal rectal cancer were included in this series. Patients' clinical data, operative time, conversion rate, complications, and early outcome measures were prospectively examined.
Results: There were 9 men and 7 women. The average ± SD operation time was 238 ± 38 min. Conversion to open surgery was never required. Ten of 16 patients were off pain medication on the third postoperative day. Eight were able to walk the day after surgery. Three minor postoperative complications were recorded. Mean postoperative stay for patients without complications was 5.6 ± 1.4 days.
Conclusion: From a technical standpoint, the reported hand-assisted procedure makes pelvic dissection during laparoscopic low anterior resection almost equivalent to the laparotomic operation. The incision for hand access that is needed with this technique does not seem to compromise the quick recovery of patients undergoing purely laparoscopic procedures.

Key words: Hand-assisted laparoscopic surgery — Rectal cancer — Surgical technique

The minimally invasive approach has rarely been proposed for rectal cancer surgery. Calls for total mesorectal excision (TME) and low anastomosis close to the pelvic floor challenge the current limitation of laparoscopy and partly account for the reluctancy of surgeons to adopt the new technology in the management of this disease [7]. Lack of tactile feedback during laparoscopic pelvic dissection makes it difficult to recognize the bounds of extraperitoneal tumors and conventional laparoscopic instruments may not allow efficient traction of the rectum, thus compromising exposure of dissection planes. Finally, accurate laparoscopic placement of the stapler to transect the specimen at a safe distance from the tumor is also technically demanding. When performed, this operation takes considerable experience in advanced laparoscopic technique, usually lasts longer than the equivalent open procedure, and might result in inadequate resection margins.

Hand-assisted laparoscopic surgery (HALS) is a new endoscopic technique that allows the surgeon to insert a hand into the abdomen while pneumoperitoneum is maintained, thus retaining the ability to touch, feel, retract, and expose tissues as with an open procedure. Various operations have been proposed with this technique, including living-related donor nephrectomy [13], splenectomy for splenomegaly [9], vertical banded gastroplasty [12], aortic surgery [8], and colorectal procedures [1, 4]. The use of HALS in the treatment of rectal cancer has not yet been reported; nonetheless, in selected instances it might represent an

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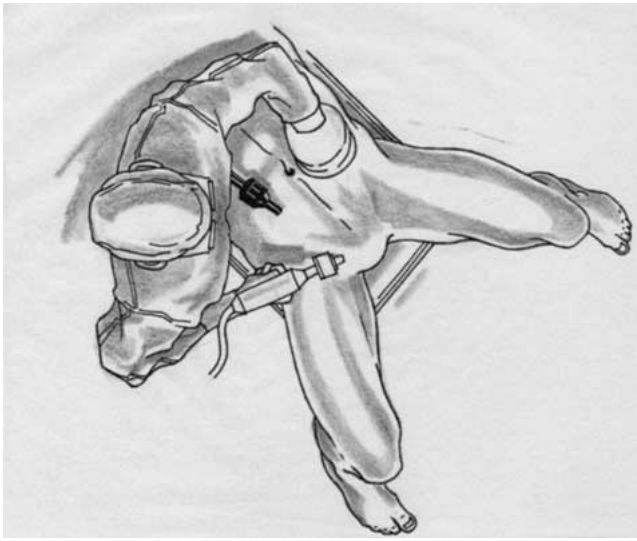

Fig. 1. Port placement for pelvic dissection in hand-assisted laparoscopic anterior resection. The optical port is positioned between the dissecting instrument (*suprapubic port*) and the left hand (*Omniport*).

attractive alternative to conventional open surgery. In fact, during the crucial phase of pelvic dissection, HALS has the potential to reproduce an operative setting that is similar to that of the open approach, retaining many of the dissecting capabilities of laparotomic surgery. At the same time, the reduction in the trauma of access might result in less postoperative pain and quicker recovery, as seen after purely laparoscopic procedures.

To assess the technical feasibility of hand-assisted laparoscopic low anterior resection for rectal cancer and define the surgical technique, a prospective nonrandomized pilot study was conducted at a university hospital. In this article, the proposed surgical technique is described and the early results in the first 16 patients are analyzed to estimate potential benefits and drawbacks of this new procedure.

Methods

Patient selection

Between May 1, 2000, and April 30, 2001, all patients referred to this institutution for surgical treatment of rectal cancer were evaluated as potential candidates for HALS. Previous extensive abdominal surgery or evidence of tumor infiltration of adjacent organs at preoperative computed tomography were considered contraindication to the laparoscopic approach. Rectal cancer suitable for laparoscopic anterior resection was defined as a biopsy-proven adenocarcinoma with the lowest edge located between 3 and 12 cm from the anal verge. All measurements were obtained using a rigid scope. In all cases the tumor was assessed to be (or have originated) below the peritoneal reflection at the time of laparoscopic exploration (extraperitoneal rectal tumor). Tumors of the rectosigmoid junction and very low lesions for which a sphincter-ablating procedure was considered the appropriate treatment were not included in this series. Informed written consent was obtained from all patients following discussion of risks and potential benefits with the operating surgeon.

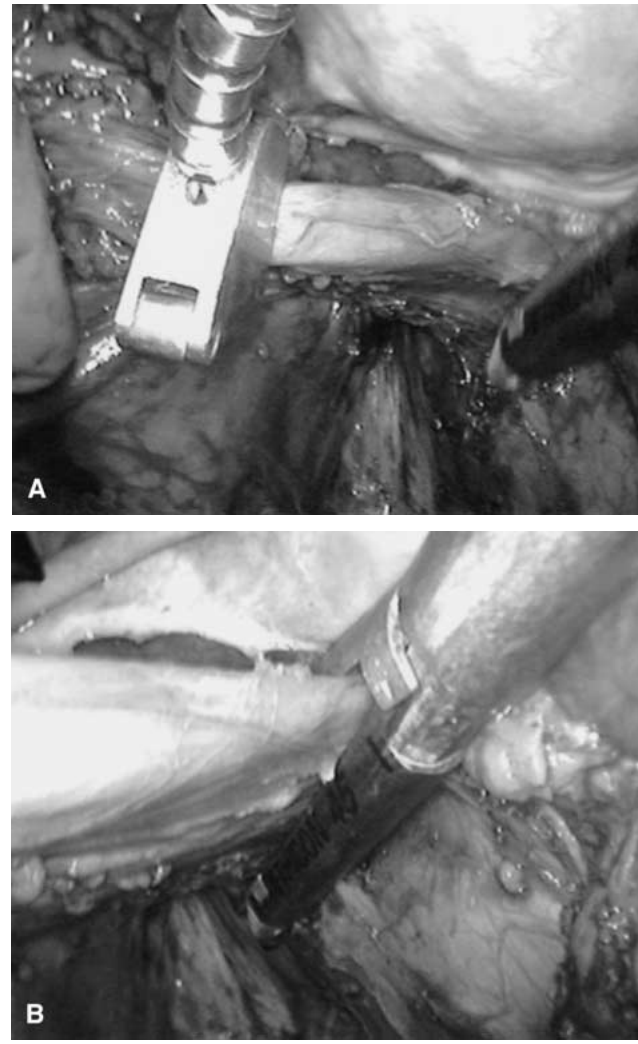

Fig. 2. The distal rectum is cross-clamped below the tumor by a flexible clamp introduced with the surgeon's left hand through the Omniport and washed transanally with a cytocidal solution (**A**); afterwards, the linear stapler is applied at the level of the pelvic floor (**B**).

Surgical technique

At our institution, the standard surgical technique for the curative treatment of extraperitoneal rectal cancer, regardless of its location within the rectum, includes proximal division of the inferior mesenteric vessels, total mesorectal excision, and low anastomosis.

After the induction of general anesthesia the patient is placed in the Trendelemburg position with a tilt of the operating table toward the right side, where surgeon and camera person stand. A 12-mmHg CO_2 pneumoperitoneum is established via a Veress needle and three 10-mm trocars are inserted. The first is placed in the epigastrium along the midline and the other two are placed in the right and left iliac fossa, respectively. An additional 12-mm trocar is inserted in the right suprapubic area for the dissecting instruments and the stapling device. After identification of the left ureter through a transmesosigmoid window, the inferior mesenteric vessels are proximally divided between hemoclips followed by complete mobilization of the left colon and the splenic flexure. The previous steps are always performed to obtain a sufficient length of proximal bowel that obviates tension on the anastomosis and fills the dead space that is left in the pelvis after TME. After desufflation of the pneumoperitoneum, the hand-access device (Omniport Hand-Access Device, Advanced Surgical Concepts, Bray, Ireland) is placed through an 8-cm incision created by widening the entry site of the left iliac fossa trocar, which is removed. The inner ring present in the device is inserted into the abdominal cavity and flattered

Table 1. Patients data and cancer staging

Patient No.	Age (years)	Sex (F, M)	BMI (K/m2)	Distance of tumor from the anus (cm)	TNM	Duke's stage
1	58	F	22.6	4	T1N1M0	C1
2	66	M	24	4	T1N0M0	B1
3	90	M	20.3	4	T3N2M0	C2
4	71	F	26.5	7	T3N2M1	D
5	91	F	21	9	T3N1M0	C2
6	61	M	27.2	8	T3N1M0	C2
7	62	M	24.4	5	T3N1M1	D
8	50	M	22.6	4	T1N0M0	B1
9	52	M	28.1	3	T2N1M0	C1
10	71	M	23.3	8	T2N1M1	D
11	64	F	20.6	10	T1N0M0	B1
12	45	F	24.3	10	T1N0M0	B1
13	52	F	22	6	T2N0M0	B1
14	53	M	21	7	T2N0M0	B1
15	57	M	24.7	8	T2N0M0	B1
16	50	F	25.6	6	T3N0M0	B2
Average	**62**	**7 F, 9 M**	**23.6**	**6.4**		

BMI, body mass index; F, female; M, male; TME, total mesorectal excision

against the parietal peritoneum. The inflatable helycoidal chamber of the Omniport is then insufflated and, with the surgeon's left hand in the abdomen, the pneumoperitoneum is reestablished. The pelvic dissection is conducted with the 30° optics advanced through the right iliac fossa trocar, the harmonic scalpel in the suprapubic port, and the surgeon's left hand retracting, palpating, and exposing, in accordance with the endoscopic principle of instrument triangulation [5] (Fig. 1).

The presacral space is entered at the level of the promontory keeping the dissection in the avascular plane, attempting to preserve the hypogastric nerves. The rectum is fully mobilized and then elevated with the mesorectum completely excised en block with the specimen. This includes the whole posterior and distal mesorectum with its typical encapsulated, lipoma-like appearance. Anteriorly, the plane of Denonvillier's fascia is entered with a combination of sharp and finger dissection. The lateral ligaments are then exposed by manual traction of the rectum to the opposite site and divided with the harmonic scalpel. Before firing the articulated stapling device at the level of the pelvic floor, the distal rectum is cross-clamped below the tumor and washed transanally with a cytocidal solution (Fig. 2). The rectum and sigmoid colon are then drawn out through the hand-access device. The specimen is removed extracorporeally and the proximal anvil is positioned. End-to-end anastomosis is performed with the transanal circular stapler and a draining tube is left in the pelvis after irrigating the surgical field and trocar sites with povidone iodine solution. A loop ileostomy for proximal diversion is usually constructed in the left iliac fossa using the access incision for the hand-access device to deliver the distal ileum to the skin. This is closed within 8 weeks of the operation when there is no evidence of anastomotic leak on contrast enema.

Postoperative management and outcome measures

Analgesia is partly achieved by local infiltration of the port sites and hand-access site with local anesthetic at the end of the procedure. After surgery, continuous intravenous infusion of Ketorolac is also administered for 48 h. From the third postoperative day, intramuscular doses of Ketorolac are given only on patient's request. Patients were required to rate the extent of the worst pain experienced within the last 24 h using a 10-point visual analog pain scale (VAS). Postoperative VAS scores and pain medication requirement were monitored on a daily basis. The urinary catheter was removed the morning after surgery. A semiliquid diet was initiated on the first postoperative day and advanced to a regular diet as tolerated. Early ambulation was encouraged beginning on the day after surgery. Patients' data, duration of the procedure, conversions and reason for them, occurrence of complications, and length of hospital stay were prospectively recorded.

Results

During the 12 months of this study, 16 patients met the entry criteria (9 men and 7 women). Patients' general data and tumor stage are given in Table 1. The mean duration ± SD of the procedure was 233 ± 38 min. No conversion to laparotomy was necessary to complete the operations. Ten patients were off pain medication on postoperative day 3, with occasional use of analgesics reported by the remaining 6 patients. The mean VAS score in the latter subgroup on the postoperative day 3 was 2.6. Eight patients were able to walk around the ward on the first postoperative day (Table 2). Three complications occurred: Case Nos. 1 and 14 required postoperative nasogastric decompression due to transient malfunction of the ileostomy, and case No. 4 developed a pelvic collection that was managed conservatively and resolved. Postoperative stay in these cases was 10, 10, and 13 days, respectively. The length of hospital stay for the 13 patients who had an uneventful course was 5.6 ± 1.4 days. No anastomotic leak was seen at contrast enema in these patients.

Discussion

The role of laparoscopy in the treatment of colorectal malignancies has not been defined. The surgical technique for laparoscopic sigmoid resection done in curative intent has been standardized and available results of large clinical series indicate no prognostic difference in comparison with open surgery [2, 11]. Oncological reservations have been expressed following reports of port site metastases [3]. Experimental evidence suggests that surgical trauma with laparoscopic instruments directed to affiorating tumors and CO_2 pneumoperitoneum can promote this phenomenon via implantation of exfoliated cells into the trocar sites [10]. Based on this as-

Table 2. Length of surgery and postoperative outcome measures

Patient No.	Operating room time (min)	Back to regular diet (postop day)	Able to walk (postop day)	Length of hospital stay (days)
1	190	8	1	10
2	220	3	1	5
3	175	4	3	6
4	230	3	1	13
5	180	3	1	5
6	220	7	2	8
7	290	3	1	4
8	210	3	1	4
9	270	3	1	4
10	250	4	1	6
11	220	3	3	7
12	240	6	2	8
13	315	5	2	5
14	225	8	2	10
15	260	6	4	7
16	240	4	2	5
Average	233	4.6	1.7	6.7

sumption, port site recurrences are less likely to develop after laparoscopic resection of extraperitoneal rectal cancer, provided the surgical dissection is conducted in planes at some distance from the tumor. Despite this theoretical advantage, anterior resection for rectal cancer has largely remained a prerogative of open surgery, the primary goal of which is complete removal of regional disease to reduce the chances of local recurrence and improve survival rate. Total mesorectal dissection is important in achieving this target and is recommended as part of the standard treatment for all extraperitoneal rectal adenocarcinomas [6]. Exclusion of rectal surgey from laparoscopic randomized studies was consequently justified due to the impaired surgical access of available endoscopic instruments during pelvic dissection, with reduced dexterity, efficiency, and, in some cases, safety when compared to the open approach. Tactile sensing is also very useful for rectal cancer surgery to detect the limits of the tumor, usually obscured from the laparoscopic view, and accordingly direct surgical dissection.

HALS enables the surgeon to perform an endoscopic procedure with his or her hand inside the patient's abdomen, thus retaining the tactile feedback, control, and ease of manipulation of traditional open surgery. The hand-assisted approach has allowed us to perform the same oncological procedure that we usually perform in open surgery—that is, anterior resection with total mesorectal excision and low coloanal anastomosis. The use of the surgeon's left hand inside the abdomen greatly facilitates pelvic dissection and placement of the endoscopic linear stapler. The ability to palpate the rectum and perirectal tissue further limits the risk to understage the disease, which can occur when the surgeon's assessment depends only on the laparoscopic view. The longer operating times in comparison with those of open surgery seemed to have no influence on postoperative outcome and no conversion was required to satisfactorily complete the procedure. Large female pelvis and small rectal tumors are best for employing this operation. Larger tumors or a narrow pelvis demand much more effort and a larger operative time. Complications in these instances are also more likely to occur. At this stage of development with the new procedure, we believe that the HALS approach should best be considered in the former group of patients. The small incision that is required by the HALS technique did not seem to compromise the postoperative outcome of our patients. Limited bowel manipulation and reduced fluid and heat loss are possibly more important than the total length of the abdominal incision in influencing recovery, although this empirical statement requires experimental evidence.

In conclusion, our early experience suggests that HALS can retain many of the recovery advantages of purely laparoscopic procedures without compromising intraoperative staging and dissecting capabilities. We believe that HALS will potentially improve, in selected patients, the short-term outcome of anterior resection for rectal cancer.

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