

# Evaluating the Efficacy of Open Versus Laparoscopic Abdominoperianal Resection in Management of Patients with Low Rectal Cancer

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**Background:** Abdominoperineal resection (APR) along with permanent colostomy is the standard method of low rectal cancer operation and resection. The laparoscopic APR provides better visualization of pelvic structures compared to the open approach. Disadvantages of the laparoscopic approach have been reported as longer operation duration and requirement of expensive equipment. Although this issue has been investigated extensively worldwide, data is limited from Iran.

**Objectives:** The aim of this study was to compare short-term outcome of Laparoscopic Abdominoperineal Resection (APR) with open APR in patients with low rectal cancer in Shiraz, southern Iran.

**Patients and Methods:** This was a non-randomized controlled trial study performed in Shahid Faghihi Hospital affiliated to Shiraz University of Medical Sciences from 2007 to 2012. We included all patients with rectal cancer who underwent laparoscopic or open APR with permanent colostomy. Both groups were evaluated regarding oncology results. Volume of intraoperative bleeding, short-term complications, operation to diet interval and duration of hospitalization were recorded and further compared between the laparoscopy and open APR groups.

**Results:** Overall, 24 patients were included in this study of whom 11 underwent laparoscopy and 13 underwent open APR. The two study groups were comparable regarding age ( $P = 0.747$ ), gender ( $P = 0.605$ ), tumor stage ( $P = 0.116$ ), tumor histopathology grade ( $P = 0.421$ ) and distance from the anal verge ( $P = 0.711$ ). The duration of operation was comparable between the groups ( $P = 0.336$ ). Those who underwent laparoscopy had significantly lower intraoperative bleeding ( $485.5 \pm 139.8$  vs.  $658.3 \pm 183.2$ ;  $P = 0.024$ ), shorter operation-diet interval ( $2.27 \pm 0.46$  vs.  $3.15 \pm 0.37$ ;  $P < 0.001$ ) and shorter duration of hospitalization compared to the open APR group ( $4.09 \pm 0.53$  vs.  $4.76 \pm 0.59$ ;  $P = 0.008$ ).

**Conclusions:** Laparoscopic APR is associated with minimal perioperative bleeding, shorter operation-diet interval and shorter durations of hospitalization compared to open approach in patients with low rectal cancer who had not received neoadjuvant chemo radiotherapy. Oncologic results in this operation were comparable to open procedure because the mesorectal, anus and sphincter complex excision are performed in the same method. Therefore, laparoscopy could be the method of choice for APR.

**Keywords:** Rectal Cancer; Colorectal Surgery; Laparoscopic Surgery

## 1. Background

Rectal cancer is one of the most common malignancies of the gastrointestinal (GI) tract, involving the lower rectum and surrounding tissues. The importance of rectal cancer is its extension to the anal sphincter, leading to fecal incontinence after operation and resection. The annual incidence of rectal cancer in the United States is estimated to be 40340 (1). The rectum is distal 15-18cm of the large intestine connected to the anal canal (2). Cancers of intraperitoneal part of the rectum are similar to colon cancer regarding presentation, management, prognosis and recurrence pattern (3). Contrary, cancers of the extra peritoneal parts of the rectum are located within the

bony cage of the pelvis. Management and clinical presentation is different from intraperitoneal rectal cancers (4). There are several goals in the management of rectal cancer including local control of cancer, increasing long-term survival of patient, preservation of the bladder, sexual function, and the most important one, function of the anal sphincter. Therefore, some investigations are needed before the operation (5). Maintaining the quality of life of patients is an important issue, which should be kept in mind in management of rectal carcinoma (4). According to different reports in Iran, the most common type of cancer of lower part of rectum is adenocarcinoma (6).

Abdominoperineal resection (APR) along with permanent colostomy is the standard method of low rectal cancer operation and resection. APR is performed for patients with low rectal cancer with invasion to sphincter complex or with poor sphincter function. It was first introduced by W. Ernest Miles in 1908 (7). Since the original publication, only minor modifications in the surgical technique were introduced (3, 8).

Currently APR could be performed by both laparoscopic and open approaches. The laparoscopic APR provides better visualization of pelvic structures compared to the open approach. Nonetheless, the laparoscopic APR requires appropriate equipment and a skilled surgeon. Short- and long-term outcomes of laparoscopic APR have been evaluated extensively (9-15). It has been demonstrated that laparoscopic APR is associated with better and faster bowel function recovery, less blood loss, shorter hospitalization and better rectal cancer prognosis and outcome (13-15). Several meta-analyses compared the laparoscopic and open APR regarding short- and long-term outcomes (16-19). They demonstrated that laparoscopic APR is associated with earlier postoperative recovery (20, 21) and less postoperative morbidity (22). However, they reported a comparable oncologic outcome (16, 20). Disadvantages of the laparoscopic approach have been reported as longer operation duration and requirement of expensive equipment (14). Although this issue has been investigated extensively worldwide, data is limited from Iran.

## 2. Objectives

This study was performed to compare short-term outcome of laparoscopic APR with open APR in patients with low rectal cancer in Shiraz, southern Iran.

## 3. Patients and Methods

### 3.1. Study Population

This was a retrospective descriptive analytic study performed in Shahid Faghihi hospital, a tertiary healthcare center affiliated with Shiraz University of Medical Sciences, during five years from 2007 to 2012. We included all patients with low rectal cancer and laparoscopic or open APR with permanent colostomy. The study protocol was approved by the institutional review board (IRB) of Shiraz University of Medical Sciences and the Ethics Committee before beginning the study. The procedure was explained by colorectal surgeon for all patients and they read and signed consent forms.

Rectal cancer was diagnosed by direct visualization and histopathological confirmation. We included only those patients between 20 and 70 years who underwent laparoscopic or open APR with permanent colostomy and did not receive neoadjuvant chemo radiotherapy during the study. All patients had biopsy-proven adenocarcinoma and the tumor was located within five cm of the anal verge as measured before the operation by colonoscopy

or sigmoidoscopy in all patients. Low rectal cancer is defined as malignancy located distal part of the rectum (5 cm) above the dentate line of anal canal. Total colonoscopy, CT-scan and end rectal ultrasonography were performed before the operation. Those who underwent neoadjuvant chemo radiotherapy were excluded from the current study.

Those patients with synchronous tumors, distant metastasis, other anorectal tumors (like squamous cell, small carcinoma and malignant melanoma), emergency operations, local recurrent tumors, low anterior resection (LAR), incomplete resections and locally advanced tumors were excluded from the study. Those who had received neoadjuvant chemo radiotherapy and those with a history of previous pelvic radiation were excluded from the study. History of previous pelvic surgery and skin diseases interfering with wound healing such as pemphigus vulgaris were also considered as exclusion criteria. The final number of patients eligible for the study was 24. Those with less than 2 years of follow-up were excluded from the study.

### 3.2. Study Protocol

Twenty-four patients with low rectal cancer who underwent APR with permanent colostomy in Shahid Faghihi hospital between 2007 and 2012 were included in the study.

The patients underwent laparoscopic or open APR with permanent colostomy in Shahid Faghihi hospital. The operation was performed by skilled colorectal surgeons. The choice of laparoscopy or open operation was made based on patients' opinion and colorectal surgeon recommendation. The protocol of operation was the same for all patients. The TNM stage of tumor was recorded. The excised tumor and the surrounding tissues were sent for histopathological study in the pathology department and laboratory of Shahid Faghihi hospital. Tumor size, distance to anal verge, lymph node involvement and tumor differentiation were recorded in the pathology report.

All patients were followed up for two years postoperatively. We contacted patients via phone number and visited them for a follow-up and determining the outcome. Intraoperative and postoperative characteristics including operation duration, volume of operative bleeding, short-term complications, operation to diet resumption interval and duration of hospitalization were recorded and further compared between laparoscopy and open APR groups.

### 3.3. Statistical analysis

The statistical software package SPSS for Windows, version 16.0 (SPSS, Chicago, IL, USA) was used for data analysis. As we included all patients eligible for the study, no sample size calculation was required. Quantitative data were compared between the two study groups using the independent t-test, while chi-square test was used to compare qualitative data. To compare parametric data without normal distribution between the two study

groups, Mann-Whitney test was used. Data were reported as mean  $\pm$  SD or proportions as appropriate. P value less than 0.05 was considered statistically significant.

#### 4. Results

Twenty-four patients with rectal cancer who underwent laparoscopic or open APR with permanent colostomy in our center between 2007 and 2012 were included in this study. There were 17 (70.8%) men and 7 (29.2%) women. The mean age of patients was  $56.3 \pm 11.3$  years ranging from 37 to 70 years. Overall, 13 (54.2%) patients underwent open APR, while 11 (45.8%) underwent laparoscopy. The mean volume of operation bleeding was  $579.7 \pm 183.6$  mL ranging from 250 to 900 mL. The mean duration of operation was  $235.8 \pm 43.2$  ranged from 150 to 360 minutes. The mean operation to diet interval was  $2.75 \pm 0.61$  ranging from 2 to 4 days. The duration of hospitalization was  $4.45 \pm 0.65$  ranging from 3 to 6 days.

The age of patients in the two study groups was comparable ( $P = 0.747$ ). In the same way, gender was matched between the two study groups ( $P = 0.605$ ). The stage of tumor was not significantly different between the two study groups ( $P = 0.116$ ) as well as the grade of tumor ( $P = 0.421$ ). The tumor distance from the anal verge was  $2.90 \pm 0.83$  cm in the laparoscopy group and  $3.38 \pm 0.76$

cm in the open group ( $P = 0.160$ ). The tumor size was also matched between the two study groups and was  $2.50 \pm 0.71$  cm in the laparoscopy group and  $2.81 \pm 1.11$  in the control group ( $P = 0.437$ ). There was no significant difference between the two study groups regarding lymph node involvement (45.5% vs. 46.2%;  $P = 0.962$ ), number of involved lymph nodes ( $1.55 \pm 2.73$  vs.  $1.15 \pm 1.51$ ;  $P = 0.662$ ) and the percentage of lymph node involvement ( $16.28 \pm 30.4$  vs.  $14.31 \pm 19.5$ ;  $P = 0.865$ ). The duration of operation was comparable between the two groups ( $252 \pm 45.6$  vs.  $259 \pm 40.8$ ;  $P = 0.336$ ). The amount of perioperative bleeding was significantly less in those who underwent laparoscopy compared to those in the open APR group ( $485.5 \pm 139.8$  vs.  $658.3 \pm 183.2$ ;  $P = 0.356$ ). In the same way, the interval between the operation and resumption and toleration of diet was significantly lower in the laparoscopy group ( $2.27 \pm 0.46$  vs.  $3.15 \pm 0.37$ ;  $P < 0.001$ ). Those undergoing laparoscopic APR had shorter hospital stay compared to the open APR group ( $4.09 \pm 0.53$  vs.  $4.76 \pm 0.59$ ;  $P = 0.008$ ). Short-term postoperative complications were comparable between the groups ( $P = 0.711$ ). Table 1 compares baseline and tumor characteristics as well as short-term outcome of patients between the two study groups. Some patients had more than one complication; each complication was evaluated separately.

**Table 1.** Comparing Baseline Characteristics and Short-term Outcome of Patients With Rectal Cancer Undergoing Laparoscopic or Open APR

	Laparoscopy (n = 11)	Open (n = 13)	P value
<b>Age, y</b>	$55.4 \pm 9.6$	$57.1 \pm 12.8$	0.747
<b>Gender</b>			0.605
Men	17 (70.8%)		
Women	7 (29.2%)		
<b>Stage</b>			0.116
I	3 (27.3%)	0 (0.0%)	
II	4 (36.4%)	8 (61.5%)	
III	4 (36.4%)	5 (38.5%)	
<b>Pathology</b>			0.421
Well differentiated	4 (36.4%)	3 (23.1%)	
Moderately differentiated	3 (27.3%)	7 (53.8%)	
Poorly differentiated	4 (36.4%)	3 (23.1%)	
<b>Complications</b>			0.711
No complication	4 (36.4%)	3 (23.1%)	
Urinary retention	0 (0.0%)	1 (7.7%)	
Atelectasis	2 (18.2%)	1 (7.7%)	
Perineal wound infection	3 (27.3%)	4 (30.8%)	
Abdominal wound infection	2 (18.2%)	4 (30.8%)	
<b>Lymph node involvement</b>	5 (45.5%)	6 (46.2%)	0.962
<b>Number of involved lymph node</b>	$1.55 \pm 2.73$	$1.15 \pm 1.51$	0.662
<b>Distance to anal verge, cm</b>	$2.90 \pm 0.83$	$3.38 \pm 0.76$	0.160
<b>Size of tumor, cm</b>	$2.50 \pm 0.71$	$2.81 \pm 1.11$	0.437
<b>Operation duration, Min<sup>a</sup></b>	$252 \pm 45.6$	$259 \pm 40.8$	0.356
<b>Operational bleeding, mL</b>	$485.5 \pm 139.8$	$658.3 \pm 183.2$	0.024
<b>Interval to start diet, d</b>	$2.27 \pm 0.46$	$3.15 \pm 0.37$	<0.001
<b>Hospital stay, d</b>	$4.09 \pm 0.53$	$4.76 \pm 0.59$	0.008

<sup>a</sup> Operation duration: incision time till the time of dressing.

## 5. Discussion

In the current study, we compared short-term outcomes and operative characteristics of laparoscopic and open APR in 24 patients with low rectal cancer who had not received chemo radiotherapy. We found that laparoscopic APR was associated with less intraoperative bleeding, shorter interval between operation and diet resumption and shorter hospital stay. Our results were not consistent with previous studies indicating that laparoscopic APR is associated with earlier postoperative recovery (20, 21) and less postoperative morbidity (22). Oncologic outcome was reported to be comparable with open APR (16).

The role and utilization of minimally invasive surgery in the management of anorectal diseases, especially cancers, is increasing internationally in the current era. However, controversy still exists on long-term outcomes of patients operated by minimally invasive methods. Experts are still concerned regarding local and port site recurrence, adequacy of mesorectal excision and long-term survival with laparoscopic excision of rectal adenocarcinoma. Several studies compared long-term outcomes of patients with low rectal cancer between laparoscopic and open procedures. Almost all these studies demonstrated that long-term oncologic outcome of laparoscopic approach is comparable with open APR (10-16, 20-22). The problem for addressing this issue is relative rarity of the procedure. Although the prevalence of rectal cancer is relatively high (1), surgeons mostly tend to preserve the sphincter through LAR operation. APR is used not only for advanced low rectal tumors, but also for refractory inflammatory bowel disease, familial malignancy syndromes, congenital predisposition to colorectal cancer and chemo radiation resistant anal squamous cell carcinoma.

Recently Simorov et al. (14) performed a large, multicenter, retrospective, observational study, to determine perioperative outcomes of laparoscopic and open APR in patients with low rectal tumors. They included 667 patients who had undergone laparoscopic APR and 2443 who had undergone open APR. When lower risk patient groups with minor or moderate severity of illness were compared, laparoscopic APR showed lower morbidity, reduced length of stay, reduced cost and reduced incidence of intensive care unit admission. Comparative analysis showed no significant difference in mortality rate or 30-day readmission. When higher risk patients were compared, significantly reduced expenses and incidence of intensive care unit requirement in the laparoscopic group were reported. This study clearly demonstrated that laparoscopic APR is associated with better perioperative outcomes compared to open APR. In another similar study, Inada et al. (17) compared short-term outcome of laparoscopic APR for rectal cancer, by comparing it with a case-controlled series of open APR. In this study, 14 patients undergoing laparoscopic APR and 14 patients undergoing open APR were compared for short-term out-

comes. They found that operation duration was longer in laparoscopic APR, while the amount of intraoperative bleeding was lower in the laparoscopic APR group. Patients undergoing laparoscopic APR had shorter hospital stay and smaller changes in WBC count and serum CRP level after operations. Perioperative morbidity and readmission rates were comparable between the groups. These results are similar to ours, which showed shorter hospital stay and lower blood loss in laparoscopic group compared to open APR (17).

Seshadri et al. (18) compared short-term outcomes and adequacy of laparoscopic and open resection of rectal cancer in those who received neoadjuvant chemo radiotherapy. They included a series of 72 patients who underwent laparoscopic surgery for rectal cancer after neoadjuvant chemo radiotherapy and 72 patients who underwent the open procedure. The two groups were matched regarding age, gender, tumor grade and tumor size. No significant difference was found between the two groups for age, distance of tumor from the anal verge, body mass index or post-treatment pathologic stage of the disease. Patients who underwent laparoscopic operation had less blood loss, longer duration of operation, shorter time to pass first flatus, shorter time to diet resumption and shorter hospital stay. These differences were also observed when subgroup analysis was performed in those undergoing laparoscopic or open APR. They concluded that laparoscopic surgery for rectal cancer, especially laparoscopic APR, after neoadjuvant chemo radiotherapy is safe and associated with earlier recovery of bowel function, a shorter hospital stay, and an oncologically adequate specimen compared with conventional open surgery (18).

Previous reports showed that operative mortality is comparable between laparoscopic and open APR (19, 23, 24). These studies also reported that morbidity was significantly lower in patients who underwent laparoscopic APR compared to open approach (19, 23, 24). Previous studies indicated that shorter hospital stay in laparoscopic group is more significant in low risk patients (19, 23). A recent prospective, randomized trial did not find a significant difference in duration of hospitalization between patients undergoing laparoscopic versus open APR (24). In the present study, we showed that hospital stay was shorter in the laparoscopy group. Previous reports showed that laparoscopy is associated with decreased expenses of care, which could be due to shorter hospital stay (14). This is contrary to another cost analysis study, which indicated that laparoscopic operation is associated with increased costs of care (24).

Minimally invasive colorectal procedures are complex cases that require advanced laparoscopic skills. The learning curve to decrease morbidity and operative time for colorectal procedures has been reported from 30 to 70 surgeries. Decreased length of hospitalization with in-

creased operative experience has been thought to be due to increased comfort and confidence with outcomes over time (25). Many general surgery residents improve their laparoscopic skills with minimally invasive surgery fellowship training. A recent study examined the learning curve of a surgical fellow who performed colorectal procedures under the supervision of an experienced mentor. According to the findings, morbidity was not increased and oncologic equivalence was maintained when the surgical fellow experienced supervision. Operative time was normalized after the surgical fellow performed 35 supervised colorectal cases (26).

There were some limitations in our study. First, this was a retrospective study and thus we could not record all required data such as distant metastases and long-term outcomes. We could only extract data regarding short-term inpatient outcomes, including characteristics of the operation and any following re-admission to the hospital. Therefore, long-term outcomes of patients could not be compared between the two study groups. Long-term studies, preferably prospective ones are recommended to overcome this shortcoming. Second, the number of included patients was limited and comparisons were performed between a limited number of patients. However, we included all patients who met our inclusion criteria. Further prospective studies with larger study populations are recommended to shed light on this issue. The cost of operation is another issue, which remained unaddressed in the current study.

In conclusion, laparoscopic APR was associated with minimal perioperative bleeding, shorter operation-diet interval and shorter duration of hospital stay compared to open approach in patients with low rectal cancer who had not received neoadjuvant chemo radiotherapy. Therefore, laparoscopy could be the method of choice for APR.

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## Authors' Contributions

Leila Ghahramani: Operation, writing final manuscript; Hesameddin Eghlimi: writing and statistical analyzing; Alimohammad Bananzadeh: Operation, data collection and final revision.; Seyed Vahid Hosseini: Data collection and final approval; Alireza Safarpour: statistical analyzing and final editing; Ahmed Mohammed Ali Al Hurry: final editing and follow up; Khairallah Muzhir Gabash: final editing and follow up the patients.

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