Research Article

Laparoscopic management of rectal carcinoma

Mitra A S[1], Memane S S[2*], Chandak U[3], Ghuge D B[4]

[1]Associate Professor, [2]PG Student, [3,4]Assistant Professor, Department of Surgery, Government Medical College and Hospital Nagpur, Maharashtra, INDIA.

Email: drmemanesantosh@gmail.com

Abstract

Background: Surgical resection is the mainstay of treatment of rectal cancer with curative intent. Laparoscopic surgery for rectal cancer is much more challenging than that for colon cancer because of the confined space within the pelvis. Further, because of the tumour's location in the pelvis, maintenance of resection margins is of greater concern. **Aims and Objectives**: To assess the feasibility of a laparoscopic resection for rectal carcinoma with emphasis on perioperative and short-term oncological outcomes. **Materials and Methods:** It was a hospital based nonrandomised prospective study. From July 2011 to November 2013, 37 patients underwent laparoscopic surgery for the rectal cancer. **Results:** Total 37 patients were operated for rectal carcinoma, 26 laparoscopic anterior resection and 11 laparoscopic abdominoperineal resection. There were 05 cases of conversion to open surgery and 02 procedures were abandoned. The average operative time was 237.5 minutes. The average hospital stay was 9.7 days. The most common postoperative complication was wound infection in 04 patients. The postoperative mortality was seen in 2 patients. The average number of lymph nodes harvested from specimen was 11. There was only one case of positive distal resection margin. The most common Astler Collar stage and tumour grade was stage B and grade 2. **Conclusion**: The laparoscopic surgery was safe and feasible for treatment of rectal cancer and associated with shorter hospital stay, less morbidity and reduced blood loss.

Keywords: Laparoscopy, carcinoma.

[*]**Address for Correspondence:**
Dr. Memane S S, PG Student, Department of Surgery, Government Medical College and Hospital Nagpur, Maharashtra, INDIA.
Email: drmemanesantosh@gmail.com

Received Date: 08/10/2014 Accepted Date: 18/10/2014

Access this article online

Quick Response Code:

Website: www.statperson.com

DOI: 22 October 2014

INTRODUCTION

Laparoscopic surgery has witnessed an explosive development in the last two decades, after the acceptance of laparoscopic cholecystectomy as the gold standard by the surgical fraternity.[1] Every organ in the abdomen was invaded by the laparoscopic surgeons; and numerous reports on techniques of various laparoscopic procedures were reported. This was also reflected in colorectal surgery with description of various laparoscopic procedures for benign and malignant disease. Laparoscopic assisted left hemicolectomy was the first laparoscopic colorectal procedure that was published in 1991 which was followed by the first laparoscopic procedure for a colonic malignancy by Jacobs and colleagues.[2-4] However, the laparoscopic technique was not adopted by surgeons worldwide because of concerns about the adequacy of intra-abdominal exploration and the initial reports of high incidence of port-site metastasis Initially used for procedures such as simple mobilization and colostomy to remove benign lesion, laparoscopic techniques subsequently were applied to the full spectrum of colorectal procedures, with varying degrees of success. But the pace of the development in laparoscopic rectal surgery did not match with that of other laparoscopic surgeries like laparoscopic cholecystectomy and fundoplication. Laparoscopic surgery requires high degree of special resolution, dexterity and technical skill. Laparoscopic rectal surgery has not been accepted as quickly as laparoscopic cholecystectomy. This is because steep learning curve, concerns of oncological outcomes, lack of randomized trials and initial reports on port site recurrence after curative resection. Laparoscopic colorectal surgery offers benefits like shorter hospital stay, lesser pain, shorter post operative ileus, better preserved pulmonary function, decreased abdominal wound infection, reduced incidence of post operative adhesions and decreased morbidity. Several systematic reviews have confirmed the advantages of minimally invasive colorectal surgery versus open surgery.[3,4] This study is an attempt to define role of laparoscopy as a feasible modality of treatment towards surgical management of rectal diseases.

How to site this article: Mitra A S, Memane S S, Chandak U, Ghuge D B. Laparoscopic management of rectal carcinoma. *International Journal of Recent Trends in Science and Technology* October 2014; 12(3): 539-544 http://www.statperson.com (accessed 22 October 2014)

MATERIALS AND METHODS-

Between July 2011 to Nov. 2013, 37 patients underwent laparoscopic surgery for rectal carcinoma. Informed consent was obtained from all patients who underwent laparoscopic surgical treatment. The clinical parameters, operative parameters, and short term outcomes details were collected from prospective database. Descriptive variables were age and gender, whereas outcome variables comprised type of resection, number of lymph nodes resected, margins need of ostomy, complications, operative time and hospital stay.

Inclusion Crieteria and Selection of Patients

All the procedures were performed by trained consultant surgeons assisted by residents. These surgeons had sufficient experience in open colorectal surgeries and had undergone training in laparoscopic colorectal surgery. All patients apart from routine evaluation underwent colonoscopic or per rectal biopsy and contrast enhanced multi slice CT scan to stage the lesion preoperatively. Patients with previous previous colonic resection, multiple previous surgeries, severe comorbid conditions, coagulopathy, and metastatic disease were excluded. All the patients fit for general anaesthesia were offered laparoscopic approach during the study period.

Surgical Technique

Patients were given preoperative bowel preparation with polyethylene glycol a day prior to surgery and allowed liquid diet on the preoperative day. All procedures were done under general anaesthesia. Patients were placed in a Lloyd Davies position and adequate shoulder support was ensured to prevent the patient from slipping off the operating table in a steep Trendelenberg position. Patient's arms were kept on the sides. An 10 mm trocar insertion through umbilicus or supraumbilical site was used in all cases and was inserted either by open or closed technique. Pneumoperitoneum was created by open access through umbilicus in all cases and intrabadominal pressure was maintained at 12–14 mmHg. Subsequent port placements included two 5 mm ports in right and left anterior axillary line, with an additional 10 mm port in the right iliac fossa. For low rectal lesions an optional suprapubic port was added. A 30^0 telescope was used in all cases. The procedure started with mobilisation of the mesorectal pedicle and ligation of inferior mesenteric artery and lymphadenectomy at the level of origin of the artery. Dissection was facilitated by use of ultrasonic shears (Harmonic Scalplel, Ethicon Endo-Surgery, EN seal). Following this, retroperitoneal mobilisation of left colon up to splenic flexure was performed. Lateral peritoneal reflection was divided and splenic flexure fully mobilised. Finally, mesorectal peritoneal reflection was divided bilaterally and mesorectal mobilisation performed. Mesorectum was divided at an appropriate level according to the level of the tumour to get a tumour free mesorectum/total mesorectal excision and an adequate distal margin. Rectum was then transected with endoscopic staplers and a 5–7 cm minilaparotomy was performed to bring out the mobilized and divided tumour-bearing segment. The specimen, including the lympho-vascular pedicle was resected and the anvil of the circular stapler introduced in to the proximal colon and secured using 2.0 polypropylene purse-string sutures. Proximal colon with anvil was returned back to the abdominal cavity and the mini-laparotomy was closed. End-to-end colorectal anastomosis was performed under laparoscopic vision using the circular stapler introduced per rectally by the assistant or by hand sewn method through Pffanensteil incision. A pelvic drain was placed under laparoscopic guidance beyond the anastomosis and in patients undergoing Lap.APR pelvic dissection was done in standard fashion and suction drain was placed subcutaneously at pelvic wound site. In all patients undergoing Lap.APR end colostomy was performed. The need for a diverting colostomy was left to the discretion of the operating surgeon.

Outcome Analysis

Outcome was measured on the basis of intraoperative parameters like operative duration, blood loss during surgery, blood transfusion requirement, conversion to open surgery and abandonement of procedure due to various factors which makes tumour unresectable. Also perioperative parameters like NG tube removal, starting of oral liquids and semisolid diet postoperatively and average hospital stay to determine the benefit of laparoscopy to patients. Postoperative complications like intestinal obstruction, anastomotic leak wound infection, pulmonary and cardiac complications and DVT were observed so that preventive measures could be taken to prevent these. Pathological characteristics like number of retrieved, resection margin involvement, pathological type, tumour stage and tumour grade to assess oncological benefits offered by laparoscopic surgery. Continuous outcomes were summarized in the form of mean and standard deviation and categorical outcomes were summarized by frequency and percentages.

RESULTS

Total 37 cases underwent laparoscopic surgery for rectal diseases, Of these 37 cases of rectal carcinoma, 22 LAR and 08 LAPR were completed successfully laparoscopically, in 5 patients procedures were converted to open and 2 procedures were abandoned. The mean age of presentation was 50.33 years and sex ratio was found to be 1.3:1. In regard to the topography of the neoplastic lesions, maximum number of tumours were located in middle part of the rectum followed by upper part of the rectum. Out of these 37 patients in 17 patients surgery

was completed laparoscopically and in 13 patients it was done laparoscopically assisted procedure. This was for hand sewn anastomosis in 13 patients, the rest of the anastomosis were completed by staplers laparoscopically. In five patients procedure were converted to open surgery due to adhesions to surrounding structures, difficult distal dissection due to bulky tumours and bleeding from presacral space which was difficult to control. In two patients procedures were abandoned due to presence of multiple peritoneal nodules (however CT abdomen and pelvis was suggestive of resectable disease) and accidental urinary bladder injury due to dense adhesions to bladder while dissection which was managed by closure of bladder in two layers and abdominal drain was kept in pelvic cavity. The operative time was evaluated according to the duration of anaesthesia. With range from 90 to 280 minutes, the mean duration of surgery was 237.5±38.59 minutes. The mean blood loss was 150±31.4 ml (90-200 ml). The blood transfusion was given to 4 patients (13.33%).

Intraoperative Parameters

Table 1: Showing intraoperative parameters

Parameter	Duration
Operative duration (minutes)[1]	237.5±38.59
Blood loss(ml)[1]	150.5±31.41
Intraoperative hemorrhage(patients)	03(10%)
Blood transfusion (Patients)	4 (13.33%)
Conversion (out of 37 cases of rectal carcinoma)	05 (13.51%)
Abandoned procedures (out of 37 cases of rectal carcinoma)	02 (5.40%)

Values are mean ± standard deviation

The average duration of hospital stay was 9.43±0.77 days. The mean duration of nasogastric tube removal, starting oral liquids and semisolid diet was as shown in table below.

Perioperative Parameter

Table 2: Showing Perioperative Parameters

Parameter	Duration
NG tube removal	2.86±0.62 days
Oral liquids(days)	4.1±0.66 days
Semisolid diet(days)	6.5±0.68 days
Hospital stay(days)	9.43±0.77 days

The mean duration of postoperative drain removal, analgesia, and antibiotics given was 5.1±0.48 days, 2.53±0.50 and 6.6±0.77 days respectively.

Postoperative Parameters

Table 3: Showing posoperative parameters

Parameter	Duration
Drain removal	5.1±0.48 days
Analgesia	2.53±0.50 days
Antibiotics	6.6±0.77 days

Values are mean ± standard deviation

The postoperative complication was found in 09 patients (30%).Of that most common complication was wound infection (perineal) in 05 (16.66%) cases. The second most common was hemorrhage in 02 (6.66%) cases and anastomotic leak was seen in 02 patients (6.66%) and both were managed conservatively.

Postoperative Complications

Table 4: Showing Postoperative Complications (n=37)

Complication	No of cases	Percentage
Intestinal obstruction	0	0
Anastomotic leak	02	6.66
Intraabdominal abcess	0	0
Secondary Hemorrhage	02	6.66
Wound infection	05	16.66
Pulmonary complication	0	0
Cardiac events	0	0
Deep vein thrombosis	0	0
Mortality (out of 37 cases of rectal carcinoma)	02	5.40

All patients had adenocarcinoma on histopathology except one who had signet ring cell carcinoma. The distal margin was positive for malignant infiltration by tumour cells in only one patient. The mean number of lymph nodes retrieved from surgical specimen was 11.06±1.61. Majority of tumours were of Astler Collar stage B (40%) and stage A (23.33%).Grade 2 tumours (60%) were frequent in studied cases.

Pathological Characteristics

Table 5: Showing Pathological Characteristics

Characteristic	No of cases
Lymph nodes (number)	11.06±1.61
Distal margin involvement	01
Pathological type	
Adenocarcinoma	36 (96.66%)
Signet ring cell ca.	01 (3.33%)
Tumour stage	
Astler Collar A	07 (23.33%)
Astler Collar B	12 (40%)
Astler Collar C1	06 (20%)
Astler Collar C2	05 (16.66%)
Tumour grade	
Grade 1	05 (16.66%)
Grade 2	18 (60%)
Grade 3	07 (23.33%)

DISCUSSION

Colorectal cancer is a common malignancy, which usually occurs in the elderly age group. Many of the patients have significant medical co-morbidities, which affect the operative outcomes. Laparoscopic resection revolutionized the treatment of colorectal malignancy in

recent years. With the introduction of laparoscopic resection, favorable operative outcomes in terms of less pain, less analgesic requirement, quick recovery of the gastrointestinal tract, and a shorter hospital stay were demonstrated in most randomized controlled trials.[5-8]. Laparoscopic surgery for colorectal diseases has gained popularity over the last decade. It is being increasingly applied for the treatment of colorectal carcinoma as well. Recent published literature including multicentre trials have demonstrated comparable short and long term results with that of open surgery. There are no published reports of large series of laparoscopic surgery for colorectal cancer from India. This is probably because of the initial technical difficulties in advanced laparoscopic skills in bowel mobilisation and resection given the fact that laparoscopic surgery is still evolving in India. This procedure has a definitive learning curve [9,10] and it is said that it takes 30 number of surgeries to plateau the curve. We feel that a good experience in open colorectal surgeries is a prerequisite to master laparoscopic colorectal surgery. In this study we found that most common tumour location was found to be middle part of the rectum which is consistent with as observed in many studies.[11-13] In this study we found that mean operative duration was 278±76.3 minutes and mean blood loss was 164.42±174 ml. This was comparable with the many studies. We feel that operating time is getting shorter as we gain more experience.[14-16] Unplanned intraoperative conversions from laparoscopic to open surgery are measures of feasibility of the procedure. Conversion rate in this study was 13.51%.The conversion rate was motivated by the adhesions, difficult distal dissection and bleeding from presacral space which was difficult to control. The significant advantage was noticed in patient's short term recovery in terms of early recovery of gut function and ability to tolerate oral liquids earlier. This could be probably due to less tissue trauma in laparoscopic surgery and also to the shorter hospital stay.[17] Dissection through small incisions, precise dissection aided by magnification, lack of manual handling of viscera and forceful retraction in laparoscopy helps in early recovery of gut function.[8,18] Laparoscopic surgery for rectal carcinoma is minimally invasive with a rapid recovery and short length of hospital stay compared with laparotomic approach. Compared with the mortality rate (2%-3%) by the conservative surgery, the mortality rate remains about 1% and the main causes of death were systemic complications.[19] As for postoperative complications, a serial clinical trials including a COST study have demonstrated no significant difference between these two kinds of techniques, which indicated that both methods are safe and feasible.[8] The Randomized Controlled Trial-CLASICC, which includes 484 cases of laparoscopic colorectal surgery and 253 cases of conservative ones, has listed the commonly encountered types of complications and their incidence rates[2]: intraoperative complications (14%) were severe hemorrhage (7%), cardiopulmonary dysfunction (4%), vascular/bladder injury (2%), and bowel injury (1%); short-term (within 30 d after operation) postoperative complications of LAP group were incision infection (13%), pulmonary infection (10%), anastomotic leakage (10%), deep vein thrombosis (0.4%) for LAP group (total 40%); and the most common long-term complications were bowel obstruction and persistent incision infection. Our results revealed that the most common complication to be wound infection (perineal) (16.66%) which was more than in color trial (2013).[12] and comparable with MRC CLASICC TRIAL2005 (13%)[8].While it was absent in MRC CLASICC Trial 2010.[20] With the extensive use of LAR, the prevention or management of surgical complications, especially some common types, has gained more attentions. Anastomotic leakage and hemorrhage are considered to be the two major complications which will directly influence the postoperative recovery of the patients.[21] First of all, a leakage should be discovered promptly, and a fasting should be ordered with an intimate observation of the patient's regional signs and physical status. If the overall status is stable, an abdominal or pelvic lavage through a drainage tube is recommended so as to speed up the regional healing progress. For the patients who present with an ineffective response to preservative treatment or a severe systemic symptom, an interventional therapy or operation should be performed without hesitation, reconstruction of the anastomosis or an ileostomy is both a favorable choice. A defunctioning stoma has always been regarded as a useful method in both preventing and controlling of leakage in conventional colorectal surgery, which could even significantly decrease the occurrence of peritonitis or sepsis. However there was no need of defunctioning stoma in tis study. We found that postoperative placement of silicon drainage tubes near anastomosis or presacral space could not only minimize the possibility of local adhesion and sinus tract caused by rubber tube, but also serve as a monitoring "instrument" for surgical trauma healing by detecting the color and characteristics of fluid. We observed anastomotic leakage in 2 patients (6.66%) and both the patients were managed conservatively. In this study, all the diagnosed secondary hemorrhage cases (6.66%) were recovered by alternative conservative therapies so that patients could rescue from extra distress brought by another operation. In our study we observed mortality rate of 5.40% in 2 patients one was due to the pulmonary complications and other one due to cardiac complications. It was comparable with the study

by Prakash *et al* (2010).[11] Perhaps the most important aspect of surgery for malignant disease is the ability to remove the disease radically without compromising on oncologic principles. This was followed in the current study as well. Moreover, the long term results of multicentre randomised trials like COST, CLASSIC and COLOR have demonstrated equal disease free and overall survival for colorectal cancer treated by laparoscopy compared to open surgery [7,22,23]. These observations imply that laparoscopic approach for resection of colorectal is oncologically safe in treating this disease. In India, laparoscopic surgery for colonic carcinoma is still evolving and we are yet to see long term results of this treatment modality, which is likely to be comparable to open surgery. We presume that it shall not be different considering that an equally radical resection could be achieved laparoscopically in terms of lymph node harvesting, completeness of resection etc. as observed in this study. A larger number of patients and long term follow up data from Indian patients are required to substantiate this fact. In our study all the tumours were of adenocarcinoma except one which was signet ring cell carcinoma involving the middle part of the rectum. Perhaps the most important aspect of the surgery is the ability to remove the disease radically without compromising the oncological principles. In this study the mean number of lymph nodes retrieved from specimen was 11.06±1.61. It was 14.4±2.02, 13 and 15 in studies by Prakash *et al*(2010)[11], Martijn *et al* (2013)[12] and Aslak *et al* (2012)[16] respectively. In a study by Braga *et al* (2007)[24] the number of lymph nodes retrieved was 12.7±7.3 which is comparable with the present study. According to Astler Collar staging(Modified Dukes stage), in this study tumours were more frequently of Astler Collar stage B (40%) and Dukes stage A(23.33%). It is comparable with study conducted by Jayne *et al* (MRC CLASSIC 2007)[23] in which 34.6% were of Astler Collar stage B and 29.5% were of Astler Collar stage C1. In this study tumors were of Grade 2 in 60% and Grade 3 in 23.33% of patients. In study conducted by Law *et al*[25], 84.29% tumors were of Grade 2 and 10.27% of tumours of Grade 3. In S. Omidvari *et al* (2013)[26] study 78.43% tumours were of Grade 1 and only 18.30% were of Grade 2.

CONCLUSION

Laparoscopic rectal surgery is feasible in both benign and malignant rectal disease. This study shows that with increasing experience, laparoscopic rectal surgery can be performed safely with minimal coversion rates and morbidity. Although there was less blood loss, early removal of nasogastric feeding tube and short hospital stay with improving experience, the overall short term outcomes are comparable even when advanced and complex procedures are taken up by an experienced team Following the initial learning curve, more complex laparoscopic rectal procedures can be safely taken up without compromising short term outcome. With increasing experience, further benefits of laparoscopic surgery in form of shorter postoperative hospital stay, decreased blood loss and postoperative morbidity may be availed by the patients. Institutional stress on appropriate training programs in laparoscopic colorectal surgery will increase the uptake of this technique and shorten the learning curve. The impact of conversion to open surgery during rectal cancer resection should not be taken lightly, however, and careful patient selection is paramount. In this study in selected patients treated by skilled surgeons, laparoscopic resection of rectal cancer provided oncological radicality, using the histopathology report as the proxy. The longterm follow up to assess local recurrence and survival is necessary to ascertain the safety of laparoscopic resection in patients with rectal cancer and other rectal diseases. Laparoscopy is a safe and effective strategy in the treatment of rectal cancer. Credentialing and training surgeons of the future is important to be able to reproduce the results of the large multicenter trials.

REFEREBCES

1. Reynolds W Jr. The first laparoscopic cholecystectomy. JSLS. 2001; 5 (1): 89– 94.
2. Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy). Surg Laparosc Endosc. 1991; 1(3): 144-50.
3. Kuhry E, Schwenk WF, Gaupset R, Romild U, Bonjer HJ. Long-term results of laparoscopic colorectal cancer resection. Cochrane Database Syst Rev 2008; 2: CD003432.
4. Coratti F, Coratti A, Malatesti R, Testi W, Tani F. Laparoscopic versus open resection for colorectal cancer: meta-analysis of the chief trials. G Chir. 2009; 30 (8-9): 377-84.
5. Lacy AM, Garcia-Valdecasas JC, Delgado S, Castells A, Taura P, Pique JM, Visa J (2002) Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. Lancet 359:2224–2229
6. The Clinical Outcomes of Surgical Therapy Study Group (2004) A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med 350:2050–2059
7. Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Bonjer HJ, Haglind E, Pahlman L, Cuesta MA, Msika S, Morino M, Lacy AM (2005) Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. Lancet Oncol 6:477–484
8. Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, Heath RM, Brown JM (2005) Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC

CLASICC trial): multicentre, randomised controlled trial. Lancet 365:1718–1726
9. Kuhry E, Schwenk W, Gaupset R, Romild U, Bonjer HJ. Longterm results of laparoscopic colorectal cancer resection. Cochrane Database of Systematic Reviews 2008, Issue 2. Art. No.: CD003432. Doi: 10.1002/14651858.
10. Schlachta CM, Mamazza J, Seshadri PA, Cadeddu M, Gregoire R, Poulin EC (2001) Defining a learning curve for laparoscopic resections. Dis Colon Rectum 44:217–222
11. Kurumboor Prakash, D. V. (2010). Lparoscopic colonic resectcion for rectosigmoid colonic tumours: A retrospective analysis and comparision with open resection. Indian J Surg, 318-322.
12. Martijn H G Mvan der Pas, E. H. (2013). Laparoscopic versus open surgery for rectal cancer (COLOR II): short term outcomes of a randomised, phase 3 trial. Lancet oncology, 1-9.
13. Weida Day, P. Y. (2011). Clinical outcome of open and laparoscopic surgery in Dukes B and C rectal cancer: experience from a regional hospital in Hong Kong. Hong Kong Med J, 26-32.
14. Krumboor Prakash, N. P. (july- sept 2013). Does case selection and out come following laproscopic colo-rectal resection change after initial learning curve? Analysis of 235 consecutive elective laproscopic colorectal resection. journal of minimal access surgery, 99-103.
15. Kang SB, Park JW, Jeong SY *et al*, Open versus laparoscopic surgery for mid or low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial):short term outcomes of an open label randomized controlled trial.Lancet Oncol.2010;11:637-45
16. Katrine Kanstrup Aslak, O. b. (2012). The implementation of a standardized approach to laproscopic rectal surgery. journal of the society of laproendoscopic surgeons, 264-270.
17. Braga M, Frasson M, Vignali A *et al* (2005) Laparoscopic vs. open colectomy in cancer patients: long term complications, quality of life, and survival. Dis Colon Rectum 48(12):2217–2223
18. Fleshman J, Sargent DJ, Green E *et al* (2007) Laparoscopic colectomy for cancer is not inferior to open surgery based on 5- year data from the COST study group trial. Ann Surg 246(4):655–662
19. Patankar SK, Larach SW, Ferrara A, Williamson PR, Gallagher JT, DeJesus S, Narayanan S. Prospective comparison of laparoscopic vs. open resections for colorectal adenocarcinoma over a ten-year period. Dis Colon Rectum 2003; 46: 601-611
20. Jayne DG, Thorpe HC, Copeland J, Quirke P, Brown JM, Guillou PJ. Five-year follow-up of the Medical Research Council CLASICC trial of laparoscopically assisted versus open surgery for colorectal cancer. Br J Surg. 2010; 97 (11): 1638-45.
21. Sonoda T, Pandey S, Trencheva K, Lee S, Milsom J. Longterm complications of hand-assisted versus laparoscopic colectomy. J Am Coll Surg 2009; 208: 62-66
22. COST Study Group (2004) A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med 350:2050–2059
23. Jayne DG, Guillou PJ, Thorpe H *et al* (2007) Randomized trial of laparoscopic-assisted resection of colorectal carcinoma: 3-year results of the UK MRC CLASICC trial group. J Clin Oncol 25:3061–3068
24. Braga M, Frasson M, Vignali A, *et al* Laparoscopic resection in rectal cancer patients: outcome and cost benefit analysis, Dis Colon Rectum 2007;50:464-471
25. Wai Lun Law, J. T. (2012). Survival following laparoscopic versus open resection for colorectal cancer. Int J Colorectal diseases, 1077-1085.
26. Shapour Omidvari, S. H. (2013). Comparision of abdominoparineal resection and low anterior resection in lower and middle rectal cancer. Journal of Egyptian National cancer institute, 151-160.

Source of Support: None Declared
Conflict of Interest: None Declared