

Laparoscopic Surgery Compared to Open Surgery in Excision of Rectal Cancer: A Systematic Review

Saud Abdulaziz Musa Alqahtani, Abdulsalam Siddiq Mohammed Arishi, Meshal Salem Ahmed Bajoned, Meshari Fahad Abdullah Alasmari, Moath Abdullah Yahya Qadri, Mohammad Abdallah Yahya Alhakamy, Ahmad Sameer Ahmad Alrefaie, Alalaa Hussain Othman Hakami

Faculty of Medicine, Jazan University, Saudi Arabia

*Corresponding author: Saud Abdulaziz Musa Alqahtani, E-Mail: dr.expert333@gmail.com

ABSTRACT

Background: The laparoscopic surgery for rectal cancer, such as open surgery, is associated with many surgical complications, especially if the surgeon does not have sufficient experience in open total mesorectal excision and advanced laparoscopic surgery. This review aiming at comparing the effectiveness and the complications rate of laparoscopic surgery to those of open surgery.

Methods: The comprehensive electronic search was conducted in Medline and Embase databases. The search resulted in 102 relevant clinical trials, which were subjected to primary screening and exclusion of ineligible studies. Finally, 32 potentially relevant clinical trials were included in the secondary screening from which nine clinical trials were included in this review. Data were collected from included studies using data extraction forms, then the qualitative synthesis of extracted data was conducted.

Results: Small differences between interventions were reported by the included studies. Five-years survival rates tend to be slightly higher in the open surgery, whereas 3-years survival rates were higher in the laparoscopic surgery. It be attributed to the wider safe margin for tumor excision obtained in open surgery. The complications rates were slightly lower in the laparoscopy groups among most of the included studies.

Conclusions: This review found comparable outcomes of laparoscopy and open surgery in treatment of rectal cancer with minimal differences in survival and complications rates.

Keywords: Rectal cancer; Laparoscopic; Open Surgery; Survival; Death.

INTRODUCTION

Rectal cancer is one of the common digestive tract tumors⁽¹⁾.

World widely, colororectal cancer is the third most common neoplasm and approximately 1.4 million new cases and 694,000 deaths reported every year. Approximately one third of all colorectal cancers are localized in the rectum⁽²⁾. Surgical operation is the first-choice method to treat rectal cancer⁽¹⁾.

Multicenter studies and meta-analyses comparing laparoscopic with open surgical treatment of colonic cancer have demonstrated short-term advantages for the laparoscopic approach, including less postoperative pain, rapid recovery of intestinal function and short length of hospital stay, but similar long-term oncological outcomes and survival⁽³⁾.

However, less is known about the role of laparoscopy in rectal cancer surgery, where outcomes are more closely linked to the surgical technique for several reasons⁽⁴⁾. First, the anatomical position of the rectum makes access more difficult; second, total mesorectal excision (TME) is important for reducing local recurrence and improving survival; and, finally, preservation

of the autonomic nerves and sphincter apparatus are important to maintain bladder, sexual function and continence, which represent important aspects of quality of life after surgery⁽⁵⁾.

Laparoscopy, as a surgical intervention, has identified as the treatment of choice of many digestive diseases, including benign colorectal pathologies. However, the oncologic safety of this approach still is controversial, so laparoscopic methods have been less widely applied to colorectal malignancy⁽⁶⁾.

An open surgery as a laparotomy has to be performed and closed, as well as closure of the perineal wound. Despite the longer operating time, most studies report a shorter hospital stay for patients having laparoscopy⁽⁷⁾.

Laparoscopic surgery for rectal cancer, such as open surgery, is associated with many surgical complications, especially if the surgeon does not have sufficient experience in open TME and advanced laparoscopic surgery⁽⁸⁾.

This review aiming at comparing the effectiveness and the complications rate of laparoscopic surgery to those of open surgery.

METHODS

The comprehensive electronic search was conducted in Medline and Embase databases. The search used terms of (rectal cancer OR rectal neoplasms) AND (laparoscopic) AND (surgery OR excision) AND (success OR failure OR death OR mortality OR cure OR survival). The search resulted in 102 relevant clinical trials, which were subjected to primary screening and exclusion of ineligible studies. Finally, 32 potentially relevant clinical trials were included in the secondary screening from which nine clinical trials were included in this review.

Data were collected from included studies using data extraction forms, then the qualitative synthesis of extracted data was conducted. The protocol of this review was approved by technical and ethical committee at Jazan University.

RESULTS

The search resulted in 102 eligible studies, from which 32 potentially relevant studies were found. These 32 studies were randomized clinical trials compared the laparoscopic with open surgery intervention in excision of rectal cancer.

Twenty-three studies were excluded, three of them because they used different methodologies, four studies were duplicated studies and 16 studies used different measures of outcomes. Thus, nine studies were finally included in this review (table 1).

Overall sample size in the included studies was ranged between 54 patients⁽⁹⁾ to 1103 patients⁽¹⁰⁾, aged between 18 to 80 years old. The age was not reported in four studies. All included studies focused with malignant rectal tumors almost adenocarcinomas with different stages from stage one to stage four. The aim of treatment was curative in all included studies with different age groups and neoplasm stages.

Only three studies reported 5-years survival, assessed for both laparoscopic and open surgery. It was 85.9%⁽¹¹⁾, 90.8%⁽⁹⁾ and 80%⁽¹²⁾

for laparoscopic surgery. The 5-years survival rate for open surgery was 91.3%⁽¹¹⁾, 88.5%, and 68.9%⁽¹²⁾. Three-years survival rate was also evaluated in five studies, for laparoscopic surgery it was ranged between 76.2%⁽⁷⁾ and 82.7%⁽²⁾, compared to open surgery in which it was ranged between 70.8%⁽¹⁰⁾ and 82.8%⁽¹⁾. Sphincters preserving rate was reported in only one study which was 65.7% for laparoscopic surgery compared with 60.6% in open surgery⁽³⁾.

Complication rate was assessed in two studies; the first study was curative treatment with 5-years survival rate of 90.8% in laparoscopic surgery compared with 88.5% in open surgery. Local recurrence had a complication rate of 22.2% in laparoscopic surgery compared with 32.4% in open surgery⁽⁹⁾.

The other study reported treatment of 204 patients with mean age of 66 years old, their tumor was malignant with late stages and 5-years survival rate was 76.2% in laparoscopic surgery compared with 78.6% in open surgery. Complications occurred in 34 patients (33%) in open surgery group and 34 (34%) in the laparoscopic group⁽⁷⁾.

Morbidity and mortality rates were similar, laparoscopic surgery (24.4% and 1% respectively) and open surgery (23.6% and 2.2% respectively) in a curative study, with 5-years survival rate of 80% for laparoscopic surgery and 68.9% for open surgery⁽¹²⁾. Many complications were noted such as anastomotic leakage, obstruction, wound infection in a curative study reported by included study⁽³⁾.

Wound infection and abdominal abscess were seen in a randomized controlled trial, with 3-years survival rate of 76% for laparoscopic surgery, and 82.8% for open surgery⁽¹⁾. Anastomotic fistulas were reported in one included study with 5-years survival of 80% in laparoscopic surgery group, and 68.9% in open surgery group⁽¹²⁾.

Table (1): Outcomes of laparoscopic surgery versus open surgery in the excision of rectal cancer

Title of article	Sample size	Age of patients (mean or max-min)	Type of tumor (malignant/benign)	Stage of tumor	Outcome of laparoscopic (survival rate)	Outcomes of open surgery (survival rate)	Complications
Jeong <i>et al.</i> ⁽¹³⁾	340	18–80 years	Malignant adenocarcinomas	T3	79.2%	3 years survival of 72.5%	Less fatigue, less micturition, and fewer gastrointestinal and defecation symptoms
Bonjer <i>et al.</i> ⁽¹⁰⁾	1103	Mean age 66 years	Malignant solitary adenocarcinoma	T3 & T4	74.8%	70.8%	Locoregional recurrence
Ng <i>et al.</i> ⁽¹¹⁾	80	61 years	Malignant lesion	T3, T4	5 years survival 85.9%	91.3 %	Closure of Ileostomy, incomplete urinary bladder denervation, and erectile dysfunction
Baik <i>et al.</i> ⁽⁹⁾	54	60 years	Malignant lesion	T1-T3	5 years survival 90.8%	5 years survival 88.5%	Locoregional recurrence
Green <i>et al.</i> ⁽¹⁴⁾	794	Non-reported	Malignant lesion	T3	82.7%	78.3 %	Wound/port-site and distant recurrence
Lujan <i>et al.</i> ⁽⁷⁾	204	66 years	Malignant lesion	T2&T3	76.2%	78.6%	A defunctioning ileostomy was created
Morino <i>et al.</i> ⁽¹²⁾	191	Non-reported	Malignant adenocarcinoma	T3&T4	5 years survival rate 80%	5 years survival rate 68.9%	Anastomotic fistulas
Liang <i>et al.</i> ⁽¹⁾	343	Non-reported	Malignant lesions	T1-T3	3 years survival rate 76%	3 years survival rate 82.8%	Wound infection and abdominal abscess
Gong <i>et al.</i> ⁽¹⁵⁾	138	Non-reported	Malignant lesion	T3&T4	The sphincter-preserving rate was 65.7%	60.6%	Anastomotic leakage, obstruction and wound infection

DISCUSSION

Rectal-cancer surgery, regardless of which technique is used, is technically demanding and requires sufficient training to be performed safely⁽¹⁶⁾. A clear view is of paramount importance to accomplish a resection of the cancer with sufficient margins. As a result of tapering of the mesorectum at the level of the pelvic floor, tissue margins around low rectal cancers are smaller than those around tumors located in the middle or upper rectum, which predisposes such tumors to incomplete radical resection. Therefore, a procedure called extralevatory abdominoperineal rectum extirpation (ELAPE), in which a part of the pelvic floor musculature is resected through a perineal approach, has been introduced⁽¹⁷⁾. The laparoscopic approach was associated with earlier postoperative recovery, lower short-term and long-term morbidity rates, comparable functional outcomes, and similar oncologic clearance and long-term survival compared with the open counterpart⁽¹¹⁾. The laparoscopic procedure for colon cancer provides enhanced rapid postoperative recovery and better cosmetic results without oncologic risk⁽¹²⁾.

Two included studies had small sample size^(9,11) with 5-years survival was evaluated for both laparoscopic and open surgery. They reported survival rates of 85.9% for laparoscopic surgery and 91.3% for open surgery⁽¹¹⁾, while **Baik *et al.***⁽⁹⁾ found that the survival rate was 90.8% for laparoscopic surgery and 88.5% for open surgery. these included studies may reflect low statistical power to detect any significant differences related to the small sample size.

Complications associated with open surgery can be divided into intraoperative and postoperative complications. Occurrence of intraoperative complications such as bleeding, bowel injury, ureteral lesions and bladder injuries are caused by intraabdominal adhesions, anatomic problems, the experience of the surgeon and many other factors. Major postoperative complications include wound infection, anastomotic leakage, ileus and bleeding⁽¹⁸⁾. A study done by **Ng *et al.***⁽¹¹⁾ was with survival rate 85.9% for laparoscopic surgery, which is lower than that of open surgery 91.3%. This may be attributed to the late stage of the cancer (T3 and T4 lesions), and laparoscopic resection of these large tumors is very difficult and could result in less-than complete resection with subsequent higher rates of locoregional recurrence. Many surgeons do not recommend the laparoscopic

surgery in patients with T4 or T3 rectal cancers to allow for safe margins excision conducted in open surgery⁽¹⁰⁾.

CONCLUSION

This review found comparable outcomes of laparoscopy and open surgery in treatment of rectal cancer. Small differences between interventions were reported by the included studies. Five-years survival rates tend to be slightly higher in the open surgery, whereas 3-years survival rates were higher in the laparoscopic surgery. It be attributed to the wider safe margin for tumor excision obtained in open surgery. The complications rates were slightly lower in the laparoscopy groups among most of the included studies.

Conflict of interests

The authors declared no conflicts of interests.

REFERENCES

1. **Liang X, Hou S, Liu H, Li Y, Jiang B, Bai W *et al.* (2011):** Effectiveness and safety of laparoscopic resection versus open surgery in patients with rectal cancer: a randomized, controlled trial from China. *J Laparoendosc Adv Surg Tech.*, 21(5):381-385.
2. **Van Leersum NJ, Snijders HS, Henneman D, Kolfshoten NE, Gooiker GA, ten Berge MG *et al.* (2013):** The Dutch surgical colorectal audit. *Eur J Surg Oncol.*, 39(10):1063-1070.
3. **Jayne DG, Guillou PJ, Thorpe H, Quirke P, Copeland J, Smith AM *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(21):3061-3068.
4. **Scott N, Jackson P, Al-Jaberi T, Dixon MF, Quirke P and Finan PJ (1995):** Total mesorectal excision and local recurrence: a study of tumour spread in the mesorectum distal to rectal cancer. *Br J Surg.*, 82(8):1031-1033.
5. **Heald RJ (1995):** Total mesorectal excision is optimal surgery for rectal cancer: a Scandinavian consensus. *Br J Surg.*, 82(10):1297-1299.
6. **Franklin ME, Rosenthal D, Abrego-Medina D, Dorman JP, Glass JL, and Norem R (1996):** Prospective comparison of open vs. laparoscopic colon surgery for carcinoma. Five-year results. *Dis Colon Rectum.*, 39(10):35-46.
7. **Lujan J, Valero G, Hernandez Q, Sanchez A, Frutos MD, and Parrilla P (2009):** Randomized clinical trial comparing laparoscopic and open surgery in patients with rectal cancer. *Br J Surg.*, 96(9):982-989.
8. **Reza MM, Blasco JA, Andradas E, Cantero R and Mayol J (2006):** Systematic review of laparoscopic

- versus open surgery for colorectal cancer. *Br J Surg.*, 93(8):921-928.
9. **Baik S H, Gincherman M, Mutch MG, Birnbaum EH, and Fleshman JW (2011):** Laparoscopic vs open resection for patients with rectal cancer: comparison of perioperative outcomes and long-term survival. *Dis Colon Rectum.*, 54(1):6-14.
 10. **Bonjer HJ, Deijen CL, Abis GA, Cuesta MA, Van der Pas MH, de Lange-de Klerk ES *et al.* (2015):** A randomized trial of laparoscopic versus open surgery for rectal cancer. *N Engl J Med.*, 372(14):1324-1332.
 11. **Ng SS, Lee JF, Yiu RY, Li JC, Hon SS, Mak TW *et al.* (2014):** Laparoscopic-assisted versus open total mesorectal excision with anal sphincter preservation for mid and low rectal cancer: a prospective, randomized trial. *Surg Endosc.*, 28(1):297-306.
 12. **Morino M, Allaix ME, Giraudo G, Corno F, and Garrone C (2005):** Laparoscopic versus open surgery for extraperitoneal rectal cancer: a prospective comparative study. *Surg Endosc.*, 19(11):1460-1467.
 13. **Jeong SY, Park JW, Nam BH, Kim S, Kang SB, Lim SB *et al.* (2014):** Open versus laparoscopic surgery for mid-rectal or low-rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial): survival outcomes of an open-label, non-inferiority, randomised controlled trial. *Lancet Oncol.*, 15(7):767-774.
 14. **Green BL, Marshall HC, Collinson , Quirke P, Guillou P, and Brown JM (2013):** Long-term follow-up of the Medical Research Council CLASICC trial of conventional versus laparoscopically assisted resection in colorectal cancer. *Br J Surg.*, 100(1):75-82.
 15. **Gong J, Shi DB, Li XX, Cai SJ, Guan ZQ, and Xu Y (2012):** Short-term outcomes of laparoscopic total mesorectal excision compared to open surgery. *WJG.*, 18(48): 7308-7315.
 16. **Harrysson IJ, Cook J, Sirimanna P, Feldman LS, Darzi A, and Aggarwal R (2014):** Systematic review of learning curves for minimally invasive abdominal surgery: a review of the methodology of data collection, depiction of outcomes, and statistical analysis. *Ann Surg.*, 260(1):37-45.
 17. **Marr R, Birbeck K, Garvican J, Macklin CP, Tiffin NJ, Parsons WJ *et al.* (2005):** The modern abdominoperineal excision: the next challenge after total mesorectal excision. *Ann Surg.*, 242(1):74.
 18. **Artinyan A, Nunoo-Mensah JW, Balasubramaniam S, Gauderman J, Essani R and Gonzalez-Ruiz C (2008):** Prolonged postoperative ileus-definition, risk factors, and predictors after surgery. *World J Surg.*, 32(7):1495-1500.