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Systematic Review

Robotic intersphincteric resection of low rectal cancer versus laparoscopic intersphincteric resection of low rectal cancer

Ahmed Z. Alotaibi*

Department of Surgery, College of Medicine, Qassim University, Kingdom of Saudi Arabia

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***Correspondence:**
Dr. Ahmed Z. Alotaibi,
E-mail: a.alotaibi@qu.edu.sa

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ABSTRACT

This systematic review evaluated and compared the two currently available intersphincteric resection techniques (robotic and laparoscopic intersphincteric resection) for low rectal cancer, with the final aim of comparing associated factors between the two techniques. The assessed factors included surgical duration, hospital stay, complications, overall survival, local recurrence, and low anterior resection syndrome (LARS). A literature search of the search engines "PubMed", "SCOPUS", and "Web of Science" was conducted, with a time interval set between 2015 and 2023. The initial search yielded 57 studies, of which 10 met the inclusion and exclusion criteria. Hence, data was extracted from only these 10 studies. The average reported robotic surgery time varied between 197 and 472 mins, while the laparoscopic surgery time varied between 240 and 325 mins. Conversely, the overall survival and local recurrence rates were 89.7% and 6.7% for robotic and 87.9% and 6.2% for laparoscopic resection, respectively. In addition, complications were reported in 16.5% and 18.2% of robotic and laparoscopic resection cases, respectively. This systematic review showed that although the surgery duration is longer in robotic resection compared to laparoscopic resection, the former technique is associated with lower rates of complications and local recurrence, and improved overall survival. In addition, few studies have reported on the prevalence of LARS; therefore, we recommend that this field be studied and included in the reported data of the upcoming studies to allow more conclusive evidence regarding prevalence of LARS among the two groups of intersphincteric resections.

Keywords: Low anterior resection, Laparoscopic, Robotic, LARS, Systematic review

INTRODUCTION

Colorectal cancer is the second most prevalent gastrointestinal malignancy worldwide, with rectal cancer accounting for one-third of cases.[1,2] Further, low rectal cancer accounts for 70-80% of the total number of rectal cancer cases, which has been suggested to be linked to dietary habits, social environment, genetic, and other factors.[3,4] In the UK, approximately 41000 patients are diagnosed with colorectal cancer annually, of which 33% are rectal in origin.[5] In China, colorectal cancer is the most prevalent gastrointestinal malignancy.[6]

Preservation of the organ and long-term survival of the patient are the foremost challenges encountered during treatment.[7] Radical abdominoperineal resection (APR) was introduced in 1908 as a management strategy for colorectal cancer. This surgery involves a less aggressive approach; however, it was found to have a negative effect on patients' quality of life and body image.[8] Later, in 1979, Heald et al introduced the concept of total mesorectal excision (TME) in conjunction with rectal resection. TME, which involves the sharp and precise dissection in the avascular areolar plan, has since become the standard of care.[9]

One of the essential requirements of rectal cancer surgery is intestinal anastomosis, which is commonly complicated by anastomotic complications.[10,11] Although many scientific and technological advancements, including improvements in surgical techniques, have been achieved in recent years, anastomotic complications remain associated with substantial morbidity and occasional mortality.[6] Conversely, technological advancements have reduced the changes in local recurrence of rectal cancer among treated patients.[12]

Despite the numerous technological advancements achieved in the field of medical sciences, low rectal cancer (LRC) remains a clinical challenge, even for experienced colorectal surgeons.[13] The objectives of surgery, including deep pelvic dissection and restoration of colorectal/anal continuity, make it technically demanding.[14] In addition, risk factors including male gender with a narrow pelvis, morbid obesity, previous pelvic sepsis, and neoadjuvant radiotherapy, make the procedure even more complicated.[15] Very few reviews have so far been conducted to compare the robotic and laparoscopic resection techniques. Therefore, the present review was designed to compare these two techniques in terms of surgery time, hospital stay, and post-operative factors, such as complications, recurrence, and prevalence of LARS.

Laparoscopic resection

Abdominoperineal resection with permanent colostomy and sphincter-preserving (SP) resection, including low anterior resection (LAR) intersphincteric resection (ISR) are the standard and most efficient surgical options for the treatment of rectal cancer.[16,17] However, the long-term consequences of the APR stoma procedures, such as stoma formation, can be lifestyle altering.[18]

The greatest advancement in rectal cancer treatment in recent years was the establishment of laparoscopic surgery, along with the description of TME and neoadjuvant chemoradiation.[19] Laparoscopic TME was initially associated with oncological safety challenges; however, the outcomes in both the short and long term were found to be superior to TME. Indeed, many randomized control trials (RCTs) found improved short-term postoperative outcomes, as well as noninferiority of short- and long-term oncological outcomes.[20-22] In addition, laparoscopic surgery is associated with more rapid post-surgical recovery in the treatment of colonic carcinomas compared to non-laparoscopic techniques and reduces the post-operative complications compared with non-laparoscopic/traditional surgery.[23]

Therefore, laparoscopic total mesorectal excision (LTME) is currently considered the gold standard technique for the surgical treatment of rectal cancer.[24] However, the outcome of LTME is directly associated with the quality of surgery as it remains a challenging procedure to perform.[25] In comparison to open TME, laparoscopic TME is associated with improved post-operative outcomes, including the faster return of bowel function, shorter length of stay, and shorter recovery period.[26]

Robotic resection

When used on a narrow male pelvis in patients with visceral obesity, the robotic resection approach was found to be more effective than other approached.[19] Furthermore, the use of the robotic platform provides improved optical vision with stable 3D visualization, combined with fully endo-wristed instrumentation that provides a 360-degree range of motion, improved ergonomics, and a third arm of robotic traction, counter traction, and dissection.[19] Thus, robotic assisted surgeries are being increasingly used for low rectal cancers globally.[27] In addition, utilization of this approach is more likely to increase because of the availability of a greater number of options in robotic platforms which include three-dimensional high-definition and allow surgeons to navigate the four arms without the physical limits.[28] However, studies evaluating the short- and long-term benefits of robotic assisted surgeries remain limited. The short-term benefits of robotic assisted surgeries thus far revealed in published studies included a reduced length of hospital stay, faster bowel recovery, and fewer complications.[29-31] Nevertheless, the advantages of using robotic technology for advanced stage rectal cancer remains poorly understood. One existing study investigating patients with pathological T4 rectal cancer divided into two groups (the robotic and laparoscopic groups) revealed a 50% reduction in conversion rates when the robotic platform was used, in addition to a shorter hospital stay.[32]

LARS

A considerable number of patients struggle with impaired anorectal functions after undergoing sphincter-preserving surgeries; a condition termed LARS.[33] The symptoms of LARS include changes in bowel habits after rectal surgery, including increased stool frequency, urgency, soiling, incontinence, and other evacuatory dysfunctions.[34] Thus, an international working group established that not only the symptoms but also the consequences, of LARS need to be considered in its definition and evaluation.[34]

In 2012, Emmertsen et al established a questionnaire to evaluate the prevalence and severity of LARS.[35] This questionnaire comprises five questions, all of which are close-ended, with a predefined score for each option. The score obtained from each of the five questions is summed to obtain the final score, which is then classified into three categories: no LARS (0-20), minor LARS (21-29), and major LARS (30-42). The most important items were “incontinence for flatus”, “incontinence for liquid stools”, “frequency”, “clustering”, and “urgency”.[35]

The short-term symptoms of LARS can disappear within 6 to 12 months after surgery, while long-term symptoms can take more than 12 months to disappear; as such, these symptoms are more likely to involve permanent changes.[36] However, prior studies have reported that 46-49% of patients still experience LARS symptoms 11.1-14.6 years after sphincter-sparing surgery.[37-39] It was also reported that 80-90% of patients who underwent low anterior resection developed major LARS, and its symptoms were evident even 11 years after surgery.[36] Shen et al published a study in which they included only patients treated with intersphincteric resection or low anterior resection. The presence of LARS was investigated in both groups of patients for a minimum of 12 months after surgery. The incidence of major LARS was 26.6% in the intersphincteric resection group and 14.1% in the low anterior resection group.[40] Another prior study showed that the quality of the life of patients classified as having minor or major LARS was significantly impacted compared to those with no LARS.[36] The major risk factors associated with LARS include neoadjuvant and adjuvant radiotherapy, with major LARS found to be particularly prominent among patients receiving this treatment.[41,42] In addition, conflicting evidence has been reported regarding age as a risk factor of LARS. One study found an increased odds of major LARS in patients aged 70 or more.[37] However, a few other studies did not find any association between age and the risk of major LARS.[43,44]

METHODS

Study design and search strategy

A comprehensive literature search for this retrospective study was conducted in February 2024. This systematic review was conducted in accordance with the preferred reporting items for systematic reviews and meta-analysis (PRISMA). The search engines used for this literature search were PubMed, SCOPUS and Web of Science. No language or data restrictions were initially applied. The medical subject heading (MeSH) terms used for the literature search were as follows: “robotic intersphincteric resection”, “laparoscopic intersphincteric resection”, “low rectal cancer” and “low anterior resection syndrome”. The search was conducted for articles published between 2015 to 2023.

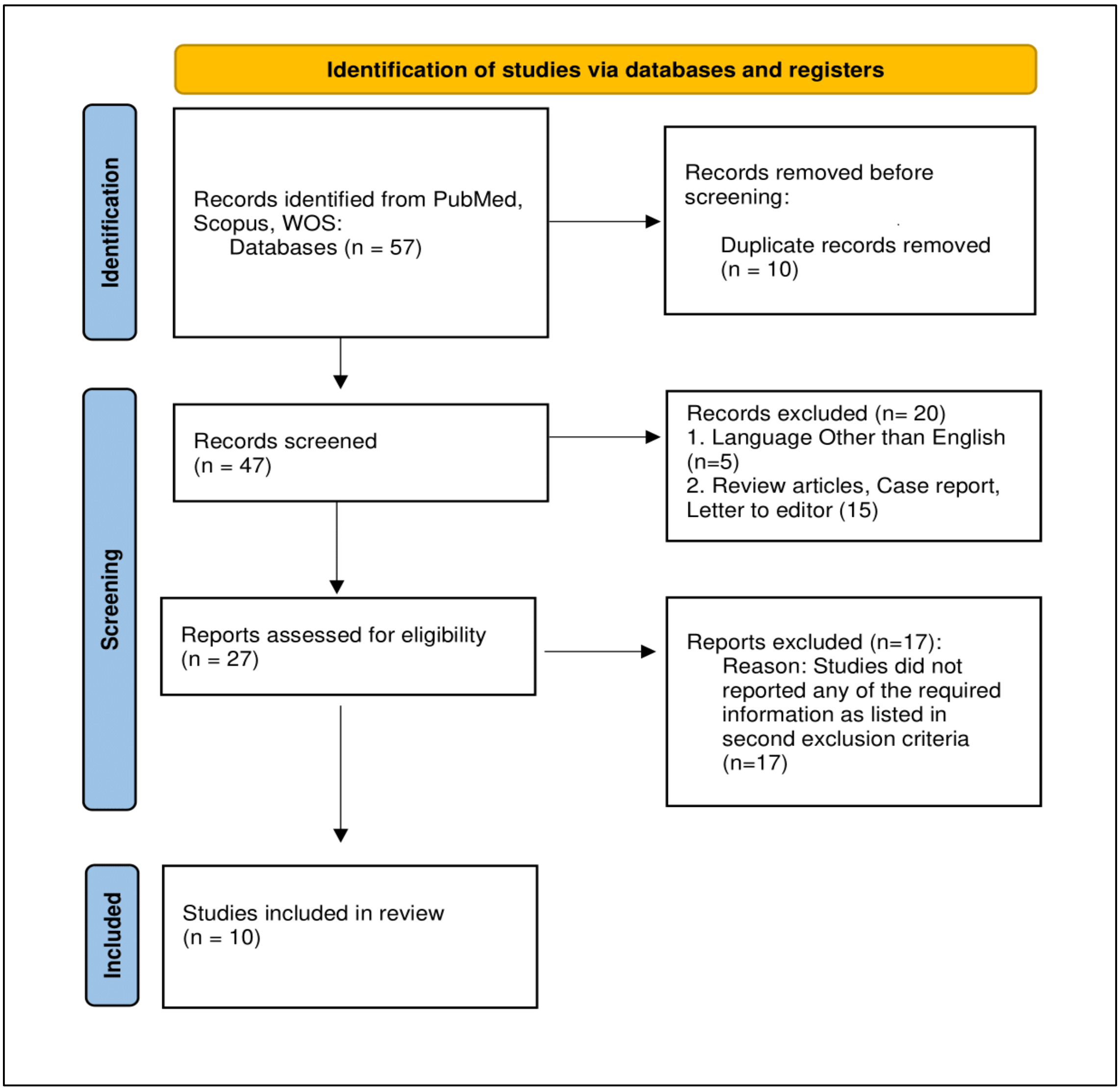

Figure 1: PRISMA flowchart.

Eligibility criteria

A total of 57 studies were identified on the initial search. The titles of these studies were screened, and 10 duplicates were excluded. The abstracts of the remaining 47 studies were screened, and the following exclusion criteria were applied: studies published in a language other than English; and studies other than original articles. Overall, 5 studies published in languages other than English, one case report, one editorial, and 13 review articles were excluded. Overall, 20 studies were excluded after applying the first exclusion criteria. Therefore, 27 remaining studies were further reviewed for data extraction.

The second set of exclusion criteria applied to the remaining 27 studies were: studies that did not use robotic or laparoscopic surgery and studies that did not report any one of the following; post-operative prognosis and rate of recurrence, post operative recovery and complication, incidence of LARS. Overall, only 10 studies passed through the second exclusion session. Figure 1 demonstrates the processes involved in the literature search and the application of the inclusion and exclusion criteria.

Data extraction

The information reported in those 10 articles which were included in the study was tabulated in the tables. The data extracted by the researchers included the surgical duration, hospital stay, follow-up period, post-operative complications (Clavien-Dindo classification system/ anastomotic leak/infection), overall survival, local recurrence, and LARS.

RESULTS

Surgical duration, hospital stay and follow up period

Out of the 10 articles which satisfied the inclusion and exclusion criteria, six reported surgical duration, post-operative hospital stay, and follow period (Table 1). The two studies published by Kazi et al and Piozzi et al reported data from both laparoscopic and robotic techniques, while the study published by Kim et al only included robotic technique and the studies by Liao et al, Chen et al, and Pontallier et al only included patients who underwent laparoscopic surgery.[34,35,46-49]

The data reported by Kazi et al showed that the median surgical duration was 450 mins for robotic surgery and 328 mins for laparoscopic surgery. In addition, the mean post-operative hospital stay lasted 7 and 8 days for laparoscopic and robotic surgery, respectively. The median follow up periods were 18 and 19 months for laparoscopic and robotic surgery cases respectively.[34] Piozzi et al reported on the duration of surgery for both laparoscopic and robotic surgery cases, finding average surgery durations of 287 mins and 295 mins for laparoscopic and robotic surgeries, respectively.[45] In the study by Kim et al all patients underwent robotic surgeries, with a median surgery duration of 197 mins, varying between 156 mins to 238 mins, and a median post-surgery hospital stay of 8 days.[46] Liao et al further included 26 patients who underwent laparoscopic surgery, with a surgery time of 272 mins (range 209-415 mins) and a hospital stay of 8 days.[47] Similarly, Chen et al enrolled 27 patients who received laparoscopic surgery, with a median surgery time and hospital stay of 240 mins and 13 days, respectively. The reported follow-up period was 37 months.[48] Pontallier et al included 34 patients all of whom were treated with the laparoscopic surgery procedure, among whom the surgery time and hospital stay were 260 mins and 8 days.[49]

Post-operative complications, overall survival, and local recurrence

Regarding the reporting of post-operative complications, overall survival, and local recurrence of the low rectal cancer, 9 out of 10 studies reported the relevant statistics. Three of 9 studies included both groups of patients (laparoscopic and robotic surgeries), while five studies only had laparoscopic surgery cases and one study included only robotic surgery cases.

Two studies were published by Kazi et al; in one study, post-operative complications were reported among 8.2% of the laparoscopic group patients vs. 6.4% of patients who underwent robotic surgery.[50] However, in the second study 18% and 28% of laparoscopic and robotic surgery patients experienced post-operative complications, respectively (Table 2). In addition, the overall survival rates were reported as 87.9% and 92.6% in the laparoscopic and robotic surgery groups, respectively. Similarly, local recurrence occurred in 5.7% of laparoscopic and 7% of robotic surgery cases.[34] Piozzi et al included both groups in their study, and reported a local recurrence rate of 13.2% and 10.6% in the laparoscopic and robotic surgery cases respectively.[45] Kim et al published their study on only the robotic surgery cases, and reported complications, overall survival, and local recurrence in 15.2%, 86.7%, and 2.5% of cases, respectively.[46] Liao et al and Beppu et al included only laparoscopic surgery cases and reported that post-operative complications were found among 26.7% and 26.1% of the treated patients, respectively.[12,47] In the studies published by Zhang et al, Sankaran et al, and Chen et al which included laparoscopic surgery cases only, complications were reported in 11%, 9.3%, and 29.6% respectively. They further reported local recurrence rates of 3.6%, 4.6%, and 3.7% of cases, respectively.[48,51,52]

LARS

Among the studies included in this review, four reported on the occurrence of LARS. Among those four studies, only one included both laparoscopic and robotic surgery cases and reported the prevalence of LARS among each group. The rest of the studies involved only laparoscopic surgery cases (Table 3).

Table 1: Summary of the data report surgical duration, hospital stay and follow up.

Authors	Surgical procedure	Median (IQR) Surgical duration (minutes)	Hospital stay (days)	Follow up (months)
Kazi et al[34]	LAP (n=341)	325 (240-495)	7.0 (5-11)	18 (10–27)
	ROB (n=74)	472 (335-600)	8.0 (6-12)	19 (10.7-46.7)
Liao et al[47]	LAP (n=26)	272(209-415)	8(6-16)	
Piozzi et al[45]	LAP (n=38)	287 (251-365)	-	-
	ROB (n=123)	295 (270-337)	-	-
Kim et al[46]	ROB (n=897)	197(156-238)	8(5-11)	-
Chen et al[48]	LAP (n=27)	240 (190-310)	13 (6-19)	37 (3-92)
Pontallier et al[49]	LAP (n=34)	260 (197-390)	8(2-49)	-

LAP: Laparoscopic; ROB: Robotic; IQR: Inter-quartile range.

Table 2: Summary of the reported complications, overall survival, and local recurrence.

Authors	Surgical procedure	Complication (%)	Overall survival (%)	Local recurrence (%)
Kazi et al[50]	LAP (n=85)	8.2	-	-
	ROB (n=47)	6.4	-	-
Kazi et al[34]	LAP (n=341)	18	87.9	5.7
	ROB (n=74)	28	92.6	7.0
Liao et al[47]	LAP (n=15)	26.7	-	-
Piozzi et al[45]	LAP (n=38)	-	-	13.2
	ROB (n=123)	-	-	10.6
Zhang et al[51]	LAP (n=56)	11	-	3.6
Kim et al[46]	ROB (n=897)	7.2	86.7	2.5
Sankaran et al[52]	LAP (n=41)	9.3	-	4.6
Chen et al[48]	LAP (n=27)	29.6	-	3.7
Beppu et al[12]	LAP (n=46)	26.1	-	-

LAP: Laparoscopic; ROB: Robotic.

Table 3: Summary of the reported prevalence of LARS.

Authors	Surgical procedure	LARS (%) No	Minor	Major
Kazi et al[50]	LAP (n=85)	49.4	32.9	17.6
	ROB (n=47)	42.6	42.6	14.9
Zhang et al[51]	LAP (n=56)	32	14	54
Sankaran et al[52]	LAP (n=41)	39.0	53.7	7.3
Beppu et al[12]	LAP (n=46)	10.9	21.7	67.4

LAP: Laparoscopic; ROB: Robotic; LARS: Low anterior resection syndrome.

Kazi et al reported that the prevalence of minor and major LARS was 32.9% and 17.6% among the laparoscopic surgery cases, and 42.6% and 14.9% among the robotic surgery cases, respectively.[50] Zhang et al found that 54% of the laparoscopic surgery patients had major LARS, while 14% had minor LARS symptoms.[51] In the study by Sankaran et al minor and major LARS were reported among 53.7% and 7.3% of laparoscopic surgery cases.[52] Similarly, Beppu et al reported that the prevalence of major and minor LARS among laparoscopic surgery cases were 67.4% and 21.7%.[12]

DISCUSSION

In this systematic review study, we collated evidence from published studies regarding the difference between two currently available rectal cancer surgery procedures: robotic intersphincteric resection and laparoscopic intersphincteric resection. Ten studies which met the inclusion and exclusion criteria were collated, and the data was extracted, of which three studies contained both patient groups (robotic and laparoscopic), one study reported only robotic surgery cases, and six studies reported only laparoscopic surgery cases.

Comparison of the extracted data revealed that the average time for robotic resection was higher than for laparoscopic resection. However, the length of post-operative hospital stay was lower for robotic resection compared to laparoscopic. Similarly, on average, 18.2% of laparoscopic resection patients experienced complications while only 16.5% of robotic resection patients experienced complications. In addition, the local recurrence and overall survival rates were 6.2% and 87.9% for laparoscopic resection and 6.7% and 89.7% for robotic resection, respectively. A prior meta-analysis, published by Trastulli et al which compared robotic and laparoscopic resection for rectal cancer revealed that the requirement for conversion to open surgery was significantly lower for robotic resection than for laparoscopic surgery ($p \leq 0.001$). However, the study did not find any significant difference in operation time, length of hospital stay, time to resume regular diet, postoperative morbidity and mortality, or the oncological accuracy of resection.[53]

LARS is a common complication after anterior resection, especially low anterior resection.[54] However, healthcare professionals commonly underestimate the risk of this functional disorder after rectal cancer surgery. In addition, the use of screening tools to predict LARS is relatively uncommon and the provided to patients is often insufficient.[55] This pattern was also evident in the present review, for which very few studies evaluated and reported the occurrence of LARS. Indeed, we were only able to identify one study that reported LARS among patients who underwent robotic intersphincteric resection. These results indicate that clinicians should utilize the LARS prediction tools more frequently and should provide more comprehensive post-operative supportive care regarding the functional complaints. In addition, appropriate counselling and therapy regarding this functional disorder should be provided following low anterior resection.

This review only included two resection techniques: laparoscopic and robotic resection. The inclusion of other resection techniques may have broadened the study spectrum, which is one of this study's limitations. Furthermore, the current review only reported published data from other studies; however, conducting a meta-analysis of the extracted data could provide a more robust finding that may help to generalize the results. Furthermore, inferential statistics was not performed in this study because only a very small number of studies reported the variables included in the study.

CONCLUSION

Overall, the results of this review suggest that although robotic surgery is associated with a longer operative time than laparoscopic resection, the post-operative results, including length of hospital stay, complications, overall survival, and local recurrence, were superior following robotic resection. In addition, our results suggest that it is important that a greater number of clinicians utilize the LARS prediction tools, and appropriate counseling and therapy regarding this functional disorder after low anterior resection.

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