RESEARCH ARTICLE

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Low Anterior Resection Syndrome (LARS) and Related Factors Variation Pattern in Indonesian Tertiary Hospital: Case-Controlled Study

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ABSTRACT

Background: Dysfunctional bowel movement, also referred to as low anterior resection syndrome (LARS), is a regular issue correlated with rectal cancer, which significantly impacts overall well-being. This study intended to look for the LARS incidence in patients with colorectal cancer where rectal preservation was not possible and identify factors affecting major LARS incidence in Indonesia.

Method: This study follows a case-control design. Patients with rectal cancer over 18 years old who underwent tumour removal with mesorectal excision and colorectal anastomosis at Dr. Cipto Mangunkusumo General Hospital, Indonesia, from January to March 2019. The control group includes patients of eligible age who had anal sphincter preservation, stoma closure, and fall into the No LARS or Minor LARS category. Data were collected from medical records and scored with a validated LARS questionnaire.

Results: Among 40 patients included, 42.5% had major LARS. The surgical procedure of low anterior resection (LAR) was significantly associated with 31.7% of major LARS patients (p = 0.04). Preoperative radiotherapy [OR 0.1 (0.02–0.49)] and anastomosis levels [OR 0.07 (0.01–0.39)] were associated with major LARS. The ROC curve revealed an AUC of 0.77, indicating significant results with the threshold for anastomosis level was 5 cm. Biofeedback revealed group differences in resting anal and maximal squeeze pressures, indicating sphincter impairment and preoperative treatment impact LARS progression.

Conclusion: Major LARS development was heightened by surgical methods, preoperative radiotherapy, and lower anastomotic levels, emphasizing the role of sphincter dysfunction and preoperative interventions in LARS development.

INTRODUCTION

Globally, colorectal cancer (CRC) is the third most frequently diagnosed cancer. Over 1.9 million recent CRC-identified cases with more than 930.000 deaths were recorded by GLOBOCAN in 2020. In Indonesia, it settled among the fourth most widespread cancer with a higher incidence noted in males (the ratio of males to females is 6:5 per 100,000 individuals), while the largest age group is aged. As a part of colorectal cancer, rectal cancer also plays a crucial role, as it was known to be globally responsible for an estimated 339,022 deaths and 732,210 new cases reported in 2020 [1].

Surgery remains the primary management for colorectal cancer, with low anterior resection (LAR) and total mesorectal excision (TME) seen to be an established approach for resectable tumors [2]. To minimize the risk of serious complications like anastomosis leaks, a temporary stoma is usually created, which is typically maintained for 3 to 6 months but can sometimes extend beyond a year. Prolonged stoma use can greatly affect patients' physical health, as well as their psychological and social quality of life, emphasizing the importance of managing the importance of managing these impacts during recovery [2,3].

Multiple surgical techniques have been developed for treating rectal cancer. For a low-risk tumor with a lower likelihood of lymphatic node invasion, targeted excision is preferred, e.g., transanal minimally invasive surgery (TAMIS). Whereas a higher-risk tumor could benefit from radical resection, e.g., transanal total mesorectal excision (TaTME), anterior resection (AR), LAR, ultra-low anterior resection (ULAR), intersphincteric resection (ISR), or abdominoperineal resection (APR) [4]. However, radical resection of LAR with TME often leads to loss of reservoir function, significantly reducing rectal compliance. This condition is closely linked to the anastomotic level, as anastomosis neared the anal verge showed a worsened ampullary function. A minimum of 4 cm of remaining rectum had better functional outcomes. Furthermore, rectosigmoid removal in surgery could potentially exacerbate the low anterior resection syndrome (LARS) symptoms due to loss of function of rectal filling limitation, which is the responsibility of the retrograde motoric pattern of rectosigmoid [5].

Alongside surgical intervention, radiotherapy has an essential role in the comprehensive treatment of choice for rectal cancer patients. One of the methods is neoadjuvant radiotherapy (nRT), has notably enhanced sphincter integrity by facilitating tumor reduction and staging down, making it the standard treatment for stage II or III rectal cancer [5,6]. The research of Zhao et al. [6] indicated nRT as a more effective treatment option for T3/4N+M0 patients compared to adjuvant radiotherapy or combined surgery and chemotherapy because it could improve the survival rate of the patient (8.71 years vs. 7.83 years vs. 7.8 years, respectively). However, nRT has also been linked to several adverse effects and is regarded as a significant contributing factor for LARS. Radiotherapy could damage rectal function and change the colonic lining and mesenteric tissue, thus resulting in neuropathy, primarily due to leftover rectal fibrosis and disruption of autonomic neural pathways [5]. Besides radiotherapy, the regular treatment usually given for rectal cancer patients would be chemotherapy. Widely used chemotherapy drugs like Capecitabin and Oxaliplatin commonly cause gastrointestinal issues, such as abdominal discomfort, nausea, vomiting, diarrhea, and constipation. Moreover, these agents are also known to cause peripheral neuropathy, highlighting the need for careful management of their side effects during treatment. This neuropathy may manifest as sensory disturbances, such as reduced sensitivity to stimuli in the perianal area, and motor impairments, such as the loss of control over the internal sphincter, leading to encopresis. These effects can contribute to the development of LARS [7].

However, 60% to 90% of rectal cancer patients who undergo rectal resection experience significant functional issues, even with the preservation of anal sphincter [8]. Impairments include incontinence, urgency, frequent defecation, and stool retention. These manifestations are typically categorized as LARS [5]. LARS is still a notable burden for patients after rectal cancer surgery, as this functional disability often alters patients' daily life [3]. Elements limited rectal or mesorectal removal, preoperative radiation therapy, and vascular dissection are known to adversely affect the function of the colon and neo-rectum, significantly diminishing patients' quality of life (QoL) [5]. Many patients with post-rectal resection were primarily noted for incontinence, which often results from other uncontrollable symptoms or conditions. This necessitated the development of a comprehensive scoring tool to identify the incidence of LARS, such as the LARS score. It is a proven assessment tool used to gauge the severity LARS in postoperative patients, with higher scores of LARS presenting more severe symptoms [5].

Although, there are still no targeted treatments for LARS, and most current methods focus on managing symptoms, employing conventional therapies for bowel control problems, including loperamide, rectal irrigation, anal plugs, and neuromodulation techniques. In addition, biofeedback therapy (BFT), known for being safe, non-invasive, and cost-effective, is often advised for patients experiencing fecal incontinence who do not show improvement with medication [9]. The BFT is employed to improve the function of the external anal sphincter involved in tracking perineal and abdominal muscle strength through visual and auditory feedback corresponding to pressure levels. It is applied by having patients gradually contract and relax their external anal sphincter while seated with a sensor positioned near the anus. Biofeedback measurements, including mean resting pressure (MRP), maximal squeeze pressure (MSP), maximal rectal sensory threshold (Max RST), and rectal compliance (RC) assessed [10].

Considering the widespread occurrence of LARS, its detrimental effects on post-operative quality of life, and the low chances of full recovery, it is essential to examine the factors that contribute to LARS after Low Anterior Resection for enhancing patient care and long-term outcomes. Numerous studies have focused on determining the underlying contributing factors related to the development of LARS, but the factors examined have varied across research and failed to demonstrate statistical significance. The objective of this research was to look for the LARS incidence in patients with colorectal cancer where rectal preservation was not possible, so it needed resection, and to determine factors that affect major LARS incidence in Indonesia.

METHODS

This study analyzes medical records of rectal cancer patients treated at Dr. Cipto Mangunkusumo General Hospital between January and March 2019 using a case-control study method. Eligible participants were those aged 18 or older who had undergone rectal tumor resection with mesorectal excision, preservation of the anal sphincter, colorectal anastomosis, and stoma closure at our Digestive Surgery unit at Dr. Cipto Mangunkusumo General Hospital from January to March 2019. The case group consisted of individuals with major LARS, while those classified with no LARS or minor LARS were included in the control group. While exclusion was patients with incomplete medical records.

Data collection

Data were collected from medical records using a non-probability sampling method, specifically consecutive sampling, with patients categorized into case and control groups based on criteria eligible in this study and their LARS score (**Supplement 1**). The LARS score was derived from patients' evaluation during postoperative follow-up visits. A range of 0 to 20 points classifies as a patient with no LARS, 21 to 29 points categorizes as minor LARS, and 30 to 42 points as major LARS. Other variables analyzed as they are predicted to contribute to LARS were gender, age, surgical type (AR, LAR, and ULAR), protective stoma, duration of stoma closure, preoperative radiation, adjuvant chemotherapy, biofeedback profile, and anastomosis level. A total of 40 patients were included in this study, with 23 patients (57.5%) included in the no LARS-minor LARS category, while 17 patients (42.5%) were included in the major LARS category.

Statistical analysis

Comparisons between variables in the case and control groups were assessed using bivariate analysis of the chi-squared test. The relationship between anastomosis level and the risk of LARS was assessed using a Receiver Operating Characteristic (ROC) curve, which identified an optimal cut-off point to optimize sensitivity and specificity. The analysis was carried out using IBM SPSS software (version 20).

RESULTS

Data were gathered from 40 patients that being diagnosed with rectal cancer and having anal sphincter preservation treatment at Dr. Cipto Mangunkusumo General Hospital. Among these patients, the majority were female (25 out of 40; 62.5%), with an average age of 55 years, and most were under 65 years old (32 out of 40; 80%), as shown in **Table 1**. The predominant treatment was LAR (22 out of 40; 55%), followed by anterior resection (AR) (11 out of 40; 27.5%), and ULAR (7 out of 40; 17.5%). Protective stoma was applied in most of the patients (38 out of 40; 95%), and stoma closure was done on an average of > 6 months (36 out of 40; 90%). Most patients received adjuvant chemotherapy (39 out of 40; 97.5%), and only 35% of patients (14 out of 40) received preoperative radiotherapy (**Table 1**). The findings from biofeedback measurement in this study revealed that the average squeeze biofeedback was 57.90 ± 55, while the average rest feedback was 26.26 ± 3.544, and the anocutaneous line (ACL) was 5.78 ± 0.337 (**Table 2**).

Table 1. Distribution of patients' characteristics and factors related to LARS

Variable	N	%
LARS score		
No / minor LARS	17	42.5
Major LARS	23	57.5
Gender		
Male	15	37.5
Female	25	62.5
Age (years)		
< 65	32	80
> 65	8	20
Mean	55 years	
Operating technique		
AR	11	27.5
LAR	22	55
ULAR	7	17.5
Protective stoma		
Yes	38	95
No	2	5
Duration of stoma closure (months)		
< 6	4	10
> 6	36	90
Preoperative radiation		
Yes	14	35
No	26	65
Adjuvant chemotherapy		
Yes	39	97.5
No	1	2.5
Anastomosis Level		
< 5 cm	15	37.5
> 5 cm	25	62.5

AR: anterior resection; LAR: low anterior resection; ULAR: ultra-low anterior resection; LARS: low anterior resection syndrome

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Table 2. Mean of characteristic biofeedback profile and anastomosis level in patients

Biofeedback profile	**Mean**
Squeeze biofeedback	57.90 ± 55
Rest feedback	26.26 ± 3.5
Anastomosis level (cm)	
ACL	5.78 ± 0.337

ACL: anocutaneous line

Table 3. Bivariate analysis of LARS significant relationship variable

Variable	**OR**	**95% CI**	**p**
Preoperative radiation	0.1	(0.02–0.49)	0.002
Anastomosis level	0.07	(0.01–0.39)	0.001

OR: odds ratio; CI: confidence interval

Table 4. Bivariate analysis of LARS and median biofeedback profile

Median (Min-Max)	**Case (Major LARS)**	**Control (No/minor LARS)**	**p**
Biofeedback profile			
MSP	25 (-11–50)	80 (20–110)	0.000
MRP	4 (-26–60)	40 (20–60)	0.000

Table 5. Bivariate analysis of LARS influencing factors

Variables	**Case (Major LARS)**		**Control (No/minor LARS)**		**OR**		**p**
	N	**%**	**N**	**%**			
Case total	17	42.5	23	57.5			
Gender							0.283
Male	8	20	7	17.5	0.492		
Female	9	22.5	16	40	2.031		
Age (years)							0.537
< 65	14	35	18	45	0.771		
> 65	3	7.5	5	12.5	1.296		
Surgery procedure							0.040
AR	1	2.5	10	25	(OR $_{ARvsLAR}$) 10	(OR $_{ARvsULAR}$) 25	
LAR	11	27.5	11	27.5	(OR $_{LARvsULAR}$) 2.5	(OR $_{LARvsAR}$) 0.1	
ULAR	5	12.5	2	5	(OR $_{ULARvsLAR}$) 0.4	(OR $_{ULARvsAR}$) 0.04	
Anastomosis level							
< 5 cm	8	20	7	17.5	2.031		0.001
> 5 cm	9	22.5	16	40	0.492		
Protective stoma							0.174
Yes	15	37.5	23	57.5	-		
No	2	5			0.000		
Duration of stoma closure (months)					0.212		0.294
< 6	3	7.5	1	2.5	4.714		
> 6	14	35	22	55			
Preoperative radiation							0.002
Yes	10	25	3	7.5	0.09		
No	6	15	20	50	11.11		
Adjuvant chemotherapy							0.425
Yes	16	40	23	57.5	-		
No	1	2.5			0.000		

OR: odds ratio; AR: anterior resection; LAR: low anterior resection; ULAR: ultra-low anterior resection
Bold values indicate significant results ($p < 0.05$).

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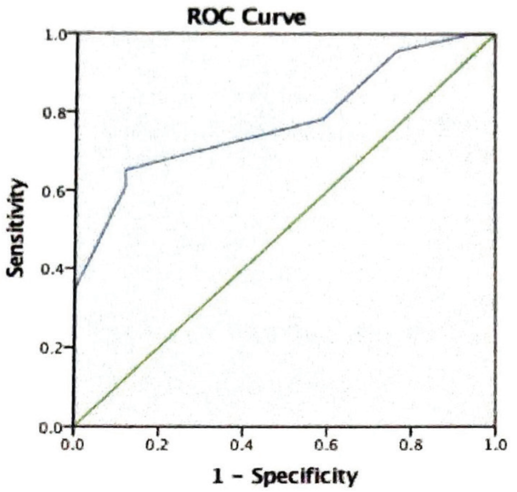

Figure 1. ROC curve analysis for anastomosis location

This study assessed the strength of the relationship for statistically significant factors, as shown in **Table 3**. The risk of developing LARS with preoperative radiation had an OR of 0.1 with a 95% CI of 0.02–0.49 and a p-value of 0.002. This result indicates that preoperative radiation is associated with a significantly reduced risk of developing LARS, potentially lowering the risk by about 90%. The finding is statistically significant, and the confidence interval supports a protective effect. An anastomosis level of less than 5 cm is statistically significantly to a reduced risk of major LARS (p = 0.001) with a 93% lower risk (OR 0.07), and the confidence interval (95% CI 0.01–0.39) reinforces a protective effect against major LARS.

Meanwhile, the biofeedback measurement profile revealed a significant difference with a p-value of 0.000 regarding MRP and MSP between the two groups (**Table 4**). The statistically significant p-value indicates a strong association between LARS and biofeedback measurements, with maximal squeeze and resting pressures potentially playing a role in LARS risk.

In this study, a bivariate test was done to analyze potential factors that influence the development of LARS. The test results can be seen in **Table 5**. The results indicate that preoperative radiation (p = 0.003), surgical technique (p = 0.040), and anastomosis level (p = 0.014) were the only variables with statistically significant relations to LARS.

A more advanced ROC curve analysis evaluated the relationship between anastomosis level and major LARS **(Figure 1).** The area under the 0.77 curve represents the intersection of sensitivity and specificity at anastomotic levels of 5 cm and 6 cm. According to this data, a cut-off point of 5 cm was selected, yielding a sensitivity of 65.2% and a specificity of 99.8%. For anastomosis levels below 5 cm (**Table 4**)**,** a statistically significant association (p = 0.014) was also found with major LARS events.

DISCUSSION

Our findings indicate that around 43.3% of rectal cancer patients who had anal sphincter preservation developed major LARS. This aligns with broader literature suggesting that up to 80% of patients post-surgery face bowel issues related to LARS, with about 50% experiencing severe symptoms (major LARS) [11]. Previous meta-analysis studies have reported varying LARS incidence rates, with some showing a range of 17.8% to 56% [12], and others, such as Parnasa et al. [13], noting a higher incidence of 64%.

This study found that gender did not have a significant difference as a cause of major LARS. This is consistent with several previous studies, including research by Nicotera et al. [14], Croese et al. [15], Nuytens et al. [16], Ri et al. [17], that gender does not affect the occurrence of major LARS. However, a study by Dulskas et al. [18] found a different result, which was significantly sex influenced LARS. Whereas female participants had higher LARS scores than male participants, they also found a statistically significant difference.

Previous studies have shown that age and general health significantly influence the likelihood of developing LAR Syndrome. Older adults and individuals with other medical conditions, such as diabetes or cardiovascular disease, are at a greater risk. This heightened risk may be attributed to various factors, including decreased muscle tone, reduced nerve function, and poorer health [18]. However, in this study, it appears that age does not affect the likelihood of developing major LARS. This aligns with findings from Nicotera et al. [14], Nuytens et al. [16], Ri et al. [17], Hughes et al. [19], that age does not affect the occurrence of major LARS. In contrast, a study by Dulskas et al. [18] reported that major LARS prevalence increases with age, especially in females towards the age of 75. It peaks at 22.7% in those aged 51–57, then continues increasing in men over 75, while declining in women of the same age. Research has presented mixed evidence, with some suggesting age as a minor factor, however, the consensus suggests it is less predictive of LARS outcomes than other surgical and physiological factors.

The more advanced tumors often require more extensive resections, thereby increasing the risk of LARS in addition tumor's location also plays a role, with tumors located closer to the anus more likely to result in LAR Syndrome due to the greater amount of rectal tissue that needs to be removed. The amount of rectum removed is another significant consideration. The rectum acts as a storage for feces, allowing bowel movements to be controlled and infrequent. When a larger portion of this tissue is removed, the remaining rectum and colon may struggle to maintain this function, leading to increased frequency, urgency, and incontinence. Huang et al. demonstrated that tumor location, proximity to the anus, surgical technique, use of a diverting stoma, and insufflation were the most influential factors affecting LARS, with a significant impact (p < 0.001) [20]. Other studies in Turkish also observed that major LARS is significantly influenced by surgical techniques [21]. Our study also supports the conclusion that surgical techniques significantly impact major LARS development (p = 0.040). Major LARS was most common in patients undergoing LAR (27.5%), with 55% of all LAR patients experiencing major or minor LARS. This aligns with previous findings on the importance of surgical techniques. However, other studies stated that no significant correlation was found between operation techniques and the risk of LARS [14,16,17,19].

The anastomosis level is widely recognized as a key factor influencing functional impairment after rectal carcinoma resection, though there is some debate on this issue. Benli et al. found that the anastomosis level has a crucial influence on the onset of LARS, with anastomosis placed 8.5 cm below the anal verge being more likely to trigger LARS [21]. Similarly, a study by Nicotera et al. [14], reported that 58.5% of patients with lower anastomosis, specifically those within 5 cm of the anal margin, developed major LARS. In this study, an anastomosis level below 5 cm was found to influence the occurrence of major LARS significantly (p = 0.014). The finding of the ROC curve (**Figure 1**) shows an AUC of 0.77, indicating a fair to good ability of anastomosis level to predict major LARS. A 5 cm cutoff serves as a strong threshold, offering high specificity and moderate sensitivity. This cutoff is clinically useful for identifying low-risk patients, though some high-risk cases may be missed due to moderate sensitivity.

Ri et al. [17] study identified several unique risk factors associated with LARS through multivariate analysis, including the height of the anastomosis, tumors in the lower and middle rectal regions, lymph node status, and a protective ileostomy or stoma. The research employed the Wexner score for univariate analysis and contrasted it with the Fecal Incontinence Quality of Life (FIQL) scale. This study's findings suggest that protective stomas do not affect the incidence of major LARS. While stomas reduce immediate postoperative complications, they may not impact long-term risks of severe outcomes like major LARS. This aligns with other studies, highlighting the need to evaluate stoma use based on patient profiles rather than assumed benefits for LARS prevention. There were no significant differences in bowel movement frequency, the ease of bowel emptying, or urgency between those with a stoma and those without. A protective stoma serves as a temporary diversion to ensure that the new bowel connection heals properly and to prevent complications like leaks, which can lead to serious infections or the need for further surgical intervention.

The findings of this study did not find a direct link between the timing of stoma reversal and the incidence of major LARS. Nevertheless, the duration between the start of surgical treatment and stoma reversal appears to significantly influence the risk of developing major LARS. Hughes et al. reported that patients who had their stoma closed more than six months after surgery faced a 3.7-fold increased risk of major LARS, likely due to the effects of adjuvant therapy [19]. Despite these observations, there remains a gap in research regarding the optimal timing for stoma closure with long-term follow-up.

While surgery alone has demonstrated positive results for rectal cancer in the initial stage, the average overall survival rate for patients having locally advanced stages (T3/4N0M0) is 88.96 months. This survival rate improves with the addition of neoadjuvant radiotherapy, adjuvant radiotherapy, or a combination of surgery and chemotherapy [7]. Radiotherapy's role in treating resectable rectal cancer is to target remnant tumor cells post-surgery, thereby improving resection completeness. Recurrence after total mesorectal excision (TME) frequently happens in the lower two-thirds of the pelvis, likely due to residual tumor cells from the primary tumor or lymph node metastases, indicating incomplete excision [22]. Bowel obstruction is the most frequently reported adverse effect across nearly all studies, with a consensus that patients who undergo radiation therapy are at a higher risk of experiencing anal incontinence, urgency, or difficulty with evacuation compared to those who have surgery alone. Therefore, it is crucial to carefully select patients to determine whether radiotherapy is truly necessary in their treatment plan [22].

Preoperative radiation has been consistently reported to negatively affect bowel function following rectal resection. The Cochrane Collaboration study found that patients who underwent both radiotherapy and surgery had a significantly higher risk of incontinence, compared to those who had surgery alone. Hughes' research showed that patients who received neoadjuvant chemotherapy (nCRT) were 20 times more likely to develop major LARS [17]. A study by Sun et al. [23] similarly revealed that patients receiving long-course neoadjuvant radiotherapy (nRT) suffered from more intense LARS symptoms and a diminished quality of life. Multivariate analysis further established a significant association between neoadjuvant radiotherapy and heightened LARS severity, with an odds ratio (OR) of 2.20 and multivariate p = 0.007. Several other studies also confirmed that preoperative radiation contributes to the development of major LARS [14,15,16,21,24]. This is consistent with this study that preoperative radiation influences the occurrence of major LARS and could act as a protective factor in the development of LARS, with an odds ratio of 0.1 (p = 0.002) as presented in **Table 3**.

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A retrospective analysis by Huang et al. [20] found that adjuvant chemotherapy substantially raised the risk of LARS, likely due to radiation causing nerve plexus damage and muscle fibrosis, resulting in worsened incontinence and diminished rectal sensation. Nuytens et al. [16] also highlighted neoadjuvant chemotherapy as a key distinct risk factor for major LARS, particularly in 51 affected patients with a significant association (p = 0.04). However, this study did not find a link between adjuvant chemotherapy and major LARS. It aligns with other research that only identified postoperative chemoradiotherapy as a risk factor for severe LARS in CRC treatment [17]. Other studies have also concluded that chemotherapy alone has no significant association with LARS [14,19].

Biofeedback therapy has been recognized for its beneficial effects on managing fecal incontinence. Several studies have evaluated this significant impact. Kim et al. [25] retrospective analysis involving 70 patients revealed that biofeedback therapy resulted in a notable enhancement in continence function. Similarly, Lee et al. [26] assessed 31 patients experiencing LARS after sphincter-saving surgery. They offered biofeedback therapy to 16 patients and supportive therapy to 15 patients, finding that patients in the biofeedback group exhibited a more significant decrease in their Wexner score and an improvement in rectal capacity. Wu et al. [27] prospective randomized trial in China, which included 109 patients, compared three groups: a control group, a pelvic floor muscle exercise group, and a combined approach led to more significant improvement in anal function and LARS symptoms compared to pelvic floor exercises alone or no intervention. All studies measure anal sphincter function using biofeedback profiles alongside biofeedback therapy. This reference supports our study findings, which demonstrated a statistically significant p-value of 0.000, suggesting a strong correlation between LARS and biofeedback measurements, with maximal squeeze and resting pressures potentially playing a role in LARS risk. This suggests sphincter impairment could influence LARS progression, and biofeedback profiles could help with further major LARS assessment. It is also projected to be an effective therapeutic option for better treatment of patients with LARS.

The highlight of this study is its focus on specific variables, like anastomosis level and type of surgical procedure, which enables a detailed examination of factors influencing postoperative results, adding depth to the analysis. It includes well-defined criteria for grouping variables, such as age and stoma closure duration, which allow for clear comparisons and meaningful analysis of patient outcomes. Additionally, by using a substantial sample size, the study provides a robust data set, increasing the reliability of the findings and enhancing the study's relevance for clinical applications.

However, this study has several limitations. First, postoperative anal function and quality of life (QOL) were not addressed, as no QOL questionnaires were collected; the focus was solely on the LARS score to assess anorectal function after rectal resection. Second, the LARS score was derived from medical record reports during postoperative follow-up visits, rather than direct patient responses, which may affect accuracy. Finally, while some confounding factors were adjusted, other variables may not have been fully considered.

CONCLUSIONS

Low Anterior Resection Syndrome (LARS) is a significant challenge in managing rectal cancer patients, with an impact beyond physical symptoms to affect the quality of life and psychological well-being of patients. Our study highlights the prevalence of LARS significantly influenced by factors such as surgical technique, preoperative radiotherapy, and anastomosis level, with the latter two potentially offering protective effects against LARS. The findings emphasize the importance of a personalized strategy for rectal cancer surgery, depending on the patient's condition, and carefully considering these factors to minimize LARS risks. Biofeedback therapy, with its observed benefits in sphincter functionality, presents a promising option for managing symptoms in major LARS cases. Given the high incidence of LARS and its profound impact on patients' quality of life, further research is warranted to develop and refine treatment protocols that enhance postoperative outcomes and long-term functionality.

DECLARATIONS

Competing interest

The author(s) declare no competing interest associated with this study.

Ethics approval and consent to participate

The study protocol adheres to ethical standards and has been approved by the local ethical committee. This study has been approved by the ethics committee of the Faculty of Medicine, Universitas Indonesia (KET-112/ UN2.FI/ETIK/PPM.00.02/2019).

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REFERENCES

1. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209–49.

P-ISSN: 1978-3744 E-ISSN: 2355-6811

2. Vogel I, Reeves N, Tanis PJ, et al. Impact of a defunctioning ileostomy and time to stoma closure on bowel function after low anterior resection for rectal cancer: a systematic review and meta-analysis. Tech Coloproctol. 2021;25(8):751–60.
3. Vaughan-Shaw PG, Gash K, Adams K, et al. Protocol for a multicentre, dual prospective and retrospective cohort study investigating timing of ileostomy closure after anterior resection for rectal cancer: The CLOSurE of Ileostomy Timing (CLOSE-IT) study. BMJ Open. 2018;8(10):e023305.
4. Waters PS, Heriot AG. Development of surgical concepts in rectal cancer resection and challenges in minimally invasive surgical proctectomy. Ann Laparosc Endosc Surg. 2021;6:18.
5. Rosen H, Sebesta CG, Sebesta C. Management of low anterior resection syndrome (LARS) following resection for rectal cancer. Cancers (Basel). 2023;15(3):778.
6. Zhao F, Wang J, Yu H, et al. Neoadjuvant radiotherapy improves overall survival for T3/4N+M0 rectal cancer patients: a population-based study of 20,300 patients. Radiat Oncol. 2020;15(1):49.
7. Ye L, Huang M, Huang Y, et al. Risk factors of postoperative low anterior resection syndrome for colorectal cancer: A meta-analysis. Asian J Surg. 2022;45(1):39–50.
8. Xu LL, Cheng TC, Xiang NJ, et al. Risk factors for severe low anterior resection syndrome in patients with rectal cancer undergoing sphincter preserving resection: A systematic review and meta-analysis. Oncol Lett. 2023.
9. Dulskas A, Smolskas E, Kildusiene I, Samalavicius NE. Treatment possibilities for low anterior resection syndrome: A review of the literature. Int J Colorectal Dis. 2018;33(3):251–60.
10. Cho HM, Kim H, Yoo R, et al. Effect of biofeedback therapy during temporary stoma period in rectal cancer patients: A prospective randomized trial. J Clin Med. 2021;10(21):5172.
11. Pieniowski EH, Palmer GJ, Juul T, et al. Low anterior resection syndrome and quality of life after sphincter-sparing rectal cancer surgery: a long-term longitudinal follow-up. Dis Colon Rectum. 2019;62(1):14–20.
12. Croese AD, Lonie JM, Trollope AF, et al. A meta-analysis of the prevalence of low anterior resection syndrome and systematic review of risk factors. Int J Surg. 2018;56:234–41.
13. Parnasa SY, Mizrahi I, Helou B, et al. Incidence and risk factors for low anterior resection syndrome following trans-anal total mesorectal excision. J Clin Med. 2024;13(2):437.
14. Nicotera A, Falletto E, Arezzo A, et al. Risk factors for low anterior resection syndrome (LARS) in patients undergoing laparoscopic surgery for rectal cancer. Surg Endosc. 2022;36(8):6059–66.
15. Croese AD, Lonie JM, Trollope AF, et al. A meta-analysis of the prevalence of low anterior resection syndrome and systematic review of risk factors. Int J Surg. 2018;56:234–41.
16. Nuytens F, Develtere D, Sergeant G, et al. Perioperative radiotherapy is an independent risk factor for major LARS: A cross-sectional observational study. Int J Colorectal Dis. 2018;33(8):1063–9.
17. Ri H, Kang H, Xu Z, et al. The risk factors of low anterior resection syndrome after colorectal cancer surgery: A retrospective study of 566 patients in a single institution in China. Front Surg. 2022;9:844456.
18. Dulskas A, Kavaliauskas P, Kulikauskas E, et al. Low anterior resection syndrome: What have we learned assessing a large population? J Clin Med. 2022;11(16):4752.
19. Hughes D, Cornish J, Morris C. Functional outcome following rectal surgery predisposing factors for low anterior resection syndrome. Int J Colorectal Dis. 2017;32(5):691–7.
20. Huang MJ, Ye L, Yu KX, et al. Development of prediction model of low anterior resection syndrome for colorectal cancer patients after surgery based on machine learning technique. Cancer Med. 2022;12(2):1501–19.
21. Benli S, Çolak T, Türkmenoğlu MÖ. Factors influencing anterior/low anterior resection syndrome after rectal or sigmoid resections. Turk J Med Sci. 2021;51(2):623–30.
22. AlQudah M, Salmo E, Haboubi N. The effect of radiotherapy on rectal cancer: A histopathological appraisal and prognostic indicators. Radiat Oncol J. 2020;38(2):77.
23. Sun W, Dou R, Chen J, et al. Impact of long-course neoadjuvant radiation on postoperative low anterior resection syndrome and quality of life in rectal cancer: Post hoc analysis of a randomized controlled trial. Ann Surg Oncol. 2018;26(3):746–55.
24. Nguyen TH, Chokshi RV. Low anterior resection syndrome. Curr Gastroenterol Rep. 2020;22(10):50.
25. Lee KH, Kim JS, Kim JY. Efficacy of biofeedback therapy for objective improvement of pelvic function in low anterior resection syndrome. Ann Surg Treat Res. 2019;97(4):194–201.
26. Wu XD, Wu CF, Chen YL, et al. Intervention effect of biofeedback combined with pelvic floor muscle exercise on low anterior resection syndrome in patients with low anus-preserving rectal cancer. Zhonghua Yi Xue Za Zhi. 2019;99(30):2337–43.
27. Sacomori C, Lorca LA, Martinez-Mardones M, et al. A randomized clinical trial to assess the effectiveness of pre- and post-surgical pelvic floor physiotherapy for bowel symptoms, pelvic floor function, and quality of life of patients with rectal cancer: CARRET protocol. Trials. 2021;22(1):448.

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Supplement 1. LAS score

Low Anterior Resection Syndrome Score (LARS Score)

• Do you ever have occasions when you cannot control your flatus (wind)?	□ No, never	0
	□ Yes, less than once per week	4
	□ Yes, at least once per week	7
• Do you ever have any accidental leakage of liquid stool?	□ No, never	0
	□ Yes, less than once per week	3
	□ Yes, at least once per week	3
• How often do you open your bowels?	□ More than 7 times per day (24 hours)	4
	□ 4-7 times per day (24 hours)	2
	□ 1-3 times per day (24 hours)	0
	□ Less than once per day (24 hours)	5
• Do you ever have to open your bowels again within one hour of the last bowel opening?	□ No, never	0
	□ Yes, less than once per week	9
	□ Yes, at least once per week	11
• Do you ever have such a strong urge to open your bowels that you have to rush to the toilet?	□ No, never	0
	□ Yes, less than once per week	11
	□ Yes, at least once per week	16

0-20 = No LARS 21-29 = Minor LARS 30-42 = Major LARS

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