DOI: 10.1590/0100-6991e-20192361

Predictive factors of low anterior resection syndrome following anterior resection of the rectum.

Síndrome da ressecção anterior do reto: fatores preditivos.

Fernanda Letícia Cavalcante Miacci[1]; Camila Roginski Guetter, AcCBC-PR[2]; Paula Heroso Moreira[2]; Maria Cristina Sartor, TCBC-PR[1]; Mariane Christina Savio[1]; Antonio Baldin Júnior[1]; Norton Luiz Nóbrega[1]

A B S T R A C T

Objective: to identify predictors of low anterior resection syndrome (LARS) that can contribute to its early diagnosis and treatment. **Methods:** we conducted a retrospective cohort study of patients undergoing anterior resection of the rectum between 2007 and 2017 in the Coloproctology Service of the Federal University of Parana Clinics Hospital. We performed Receiver Operating Characteristic Curve (ROC) analysis to identify LARS predictive factors. **Results:** we included 64 patients with complete data. The men's age was 60.1±11.4 years and 37.10% were male. Twenty patients (32.26%) had LARS. The most reported symptoms were incomplete evacuation (60%) and urgency (55%). In the univariate analysis, the distance from the anastomosis to the anal margin (p<0.001), neoadjuvant therapy (p=0.0014) and ileostomy at the time of resection (p=0.0023) were predictive of LARS. The ROC curve analysis showed a 6.5cm cut-off distance from the anastomosis to the anal margin as a predictor of LARS. **Conclusion:** distance between the anastomosis and the anal margin, neoadjuvant therapy history and preparation of stoma are conditions that can help predict the development of LARS. Guidance and involvement in patient education, as well as early management, can potentially reduce the impact of these symptoms on patients' quality of life.

Keywords: Colorectal Surgery. Postoperative Complications. Rectal Neoplasms. Anastomosis, Surgical. Surgical Stomas.

INTRODUCTION

For Brazil, there are estimated 17,380 new cases of colon and rectal cancer in men and 18,980 in women for each year of the 2018-2019 biennium. These values correspond to an estimated risk of 16.83 new cases per 100,000 men and 17.90 per 100,000 women. It is the third most common cancer in men and the second among women[1].

The main objectives of surgical treatment for rectal cancer patients are complete tumor excision with adequate surgical margin, sphincter preservation, and low morbidity and mortality rates[2].

Despite the evolution of the surgical technique and concern with the preservation of pelvic innervation, many patients develop severe urinary, sexual and intestinal alterations after anterior rectal resection (ARR). These changes are referred to as Low Anterior Resection Syndrome, or LARS[3].

Symptoms of LARS include increased bowel movement frequency, stool of liquid consistency, fecal impaction, urgency, and fecal incontinence. These may occur in up to 80% of post-ARR cases[4]. Symptoms appear shortly after the intestinal transit is restored, are more intense in the first months, and may improve in the first two years, when they reach stability and become a chronic condition[5].

The diagnosis of LARS is predominantly clinical and to assess functional outcomes after ARR, tools are commonly used to evaluate fecal incontinence, given the impact of this symptom on the patient's quality of life, such as the *Wexner-Jorge score*[6]. Two tools were introduced in an attempt to identify and quantify the impact of symptoms on post-ARR quality of life, the Memorial Sloan Kettering Cancer Center Intestinal Function Instrument (MSKCC) (BFI)[7] and the LARS score[8].

1 - Federal University of Paraná, Clinics Hospital Complex, Coloproctology Service, Curitiba, PR, Brazil. 2 - Federal University of Paraná, Health Sciences Center, Medicine Course, Curitiba, PR, Brazil.

In order to identify LARS in patients submitted to ARR in the Coloproctology Service of the Clinics Hospital Complex of the Federal University of Paraná (CHC/UFPR), this study seeks to determine the incidence of LARS symptoms and to identify predictive factors for the development of the syndrome.

METHODS

The project was approved by the Ethics in Research Committee of the Clinics Hospital of the Federal University of Paraná (number of the Certificate of Presentation for Ethical Appreciation - CAAE: 89684218.0.0000.0096).

This is a longitudinal cohort study. We obtained the study data retrospectively from the medical records of patients submitted to ARR at the Coloproctology Service of the Clinics Hospital of the Federal University of Paraná (HC-UFPR), from January 2007 to December 2017.

Initially, we selected 110 patients whose operation was rectosigmodectomy. We excluded 48 patients, 33 because they underwent procedures other than those registered and 15 that met the exclusion criteria adopted: permanence of the transit-deriving stoma, incomplete medical records, inflammatory bowel disease, Hirschsprung's disease, and early pelvic recurrence of the rectal tumor (Figure 1).

To assess the possible interference of comorbidities on the incidence of LARS, we used the Charlson Comorbidity Index (CCI)[9]. We considered the surgical description report to identify the type of surgery performed and the distance from the anastomosis to the anal margin. To evaluate TNM staging[10], we used the pathological examination of the surgical specimen.

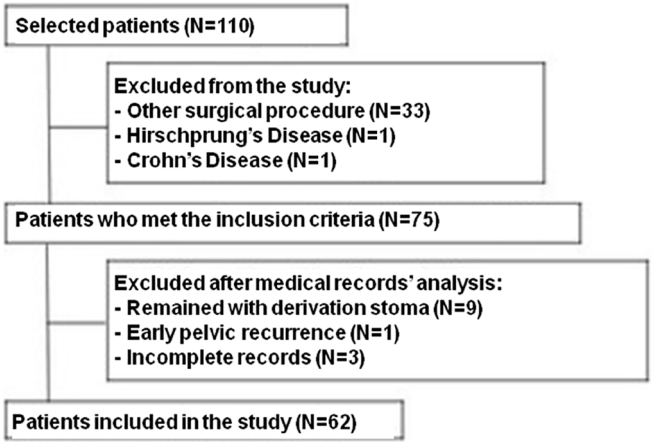

Figure 1. *Inclusion method.*

Finally, 62 patients remained in the study and were divided into two groups: with and without LARS. From then on, we applied inferential statistics to both groups.

We analyzed the collected data using the R statistical software (R Core Team (2018). R: *A language and environment for statistical computing. R Foundation for Statistical Computing,* Vienna, Austria[11]. For the descriptive analysis, we expressed the measures of central tendency and dispersion as means and standard deviation (mean±SD) for continuous variables of normal distribution and medians and interquartile ranges (median, 25%-75%) for those of non-normal distribution. We expressed categorical and ordinal values as absolute and relative frequencies, and we applied the Shapiro-Wilk test to determine the normality of the samples.

In the univariate data analysis, we used the Student's t-tests for normal continuous dependent variables, and the Mann-Whitney test for non-normal continuous dependent variables. We applied the Chi-square and the Fisher tests for binary or categorical dependent variables. Finally, we performed the Receiver Operating Characteristic Curve (ROC) analysis to identify the distance from the anastomosis to the anal margin that was predictive of LARS symptoms. We considered a significance level of 5% for this study.

RESULTS

Of the 62 patients included, 39 (63%) were female. The average age was 60.1 years, ranging from 33 to 85. The average distance from the anastomosis to the anal border was 9.57cm, ranging from 2,0 to 15 cm (Table 1).

Table 1. *Characteristics of the patients included in the study.*

Variable	
Age (years), mean ± standard deviation	60.1±11.4
Gender*	
Male	23 (37.10%)
Female	39 (62.90%)
Smoking*	
Former	14 (22.58%)
Current	9 (14.52%)
Never	39 (62.90%)
Alcohol consumption*	
Former	5 (8.06%)
Current	1 (1.61%)
Never	56 (90.32%)
CCI Points**	
0	2 (3.22%)
1	5 (8.06%)
2	16 (25.81%)
3	15 (24.19%)
4	5 (8.06%)
5	11 (17.74%)
6	6 (9.68%)
7	1 (1.61%)
8	1 (1.61%)
Prior pelvic surgery*	
Yes	13 (20.97%)
No	49 (79.03%)
Diagnosis for surgical indication*	
Neoplasia	42 (66.13%)
Nonmalignant pathology	20 (32.26%)
Tumor site, if neoplasm*	
Distal rectum	1 (2.44%)
Medium rectum	14 (34.15%)
Proximal rectum	9 (21.95%)
Rectosigmoid junction	4 (9.76%)
Sigmoid colon	13 (31.71%)
TNM staging, if neoplasia*	
T0	3 (7.32%)
T1	4 (9.76%)
T2	14 (34.15%)
T3	15 (36.58%)
T4	5 (12.19%)

continue...

...continue

Variable	
Neoadjuvace, if neoplasia*	
Yes	13 (31.71%)
No	28 (68.29%)
Anastomosis type*	
Manual	20 (32.26%)
Stapled	42 (67.74%)
Distance from anal margin to anastomosis (cm)†	10.00 (6.25-12.00)
Protective stoma*	
Yes	31 (50%)
Not	31 (50%)
Post-rectosigmoidectomy time to stoma closure (months)†	7.36 (4.70-10.92)

** Absolute frequency (relative frequency); ** CCI: Charlson comorbidity index; † Median (interquartile range 25%-75%).*

The diseases that led to the anterior resection of the rectum were diverticular disease of the sigmoid colon, rectovaginal fistula after radiotherapy, sigmoid perforation during colonoscopy, rectal prolapse, Chagas megacolon, sigmoid volvulus, sigmoid-vesical fistula, and neoplasms of the distal sigmoid, of the rectosigmoid junction, and of the proximal, middle and distal rectum.

Of the 62 patients evaluated, 20 (32%) had symptoms of LARS. All patients had more than one symptom, and the most common complaints related to the gastrointestinal tract were incomplete bowel movement (60%), bowel movement urgency (55%) and alteration of bowel habits such as diarrhea (45%) and constipation (45%). Non-gastrointestinal tract symptoms were less frequent, with four patients (20%) with urinary symptoms and only one patient (5%) with complaints related to sexual function (Table 2).

The most common cause leading to anterior resection of the rectum was malignant neoplasia, in 42 patients (67%), followed by diverticular disease, in ten (16%), and chagasic megacolon, in five (8%). Of the patients with neoplasia, the most common locations were in the middle rectum, distal sigmoid and proximal rectum, with 34%, 31% and 22%, respectively.

From the inferential statistics, the factors that were statistically relevant for the development of the syndrome were neoadjuvant therapy (p=0.0014), distance between the anal border and the anastomosis (p<0.001), and the use of stoma (p=0.0023) (Table 3).

The analysis of the ROC curve showed a cutoff point of 6.5cm in the distance from the anastomosis to the anal border. Below this point, the risk of developing the syndrome is higher (Figure 2).

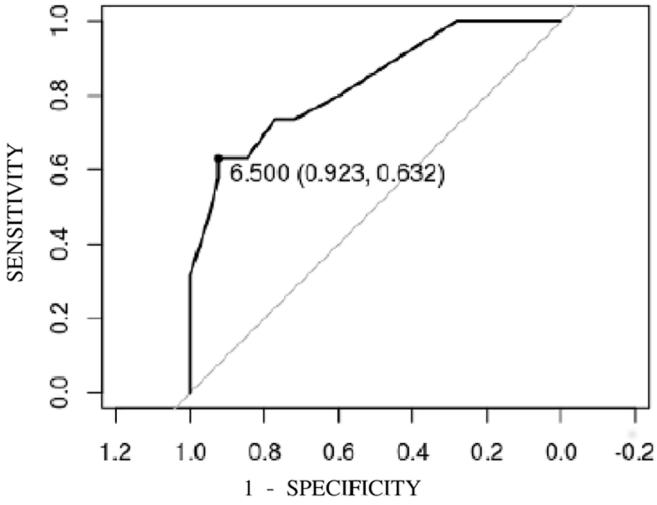

Figure 2. *ROC curve: Area below the curve: 0.831, 95% CI 0.7191-0.9435.*

Table 2. *LARS diagnosis and treatment.*

Variable	
LARS symptoms*	
Yes	20 (32.26%)
No	42 (67.74%)
Reported symptom type**	
Fecal incontinence	7 (35%)
Fecal urgency	11 (55%)
Incomplete evacuation	12 (60%)
Diarrhea	9 (45%)
Constipation/Obstructed evacuation	9 (45%)
Sexual complaints	1 (5%)
Urinary symptoms	4 (20%)
Postoperative time to symptoms onset (months)†	3.35 (2.22-5.75)
LARS diagnosis**	
Yes	15 (24.19%)
No	47 (75.81%)
Diagnostic form**	
Clinical	13 (86.67%)
Clinician associated with complementary exams	2 (13.33%)
Treatment type**	
Pelvic physiotherapy only	1 (6.67%)
Pharmacological treatment only	12 (80%)
Physiotherapy and pharmacological treatment	2 (13.33%)
Report of symptom improvement**	
Yes	11 (73.33%)
No	3 (20%)
Not reported	1 (6.67%)
Report of complete symptom improvement**	
Yes	6 (40%)
No	8 (53.33%)
Not reported	1 (6.67%)

** LARS: low anterior resection syndrome; ** absolute frequency (relative frequency); † median (interquartile range 25%-75%).*

The variables gender, age, smoking, history of alcoholism, previous history of pelvic surgery, comorbidities (CCI), staging, type of anastomosis, and tumor location were not predictive of the development of LARS.

DISCUSSION

The etiology of low anterior rectal syndrome is multifactorial. LARS is believed to be related to the reduction of the rectal reservoir, denervation of the left colon and rectum during its mobilization[12] and a potential sphincter lesion during the construction of the stapled anastomosis[13].

The 32% incidence of symptoms after anterior resection of the rectum in this sample is consistent with the literature[14]. The difficulty in establishing the true incidence of the syndrome lies in the wide spectrum of symptoms and the lack of consistency in the active search for risk factors[15].

Similar to what other studies have reported[16-18], we found no statistical significance between the incidence of LARS and gender, although Liu *et al*.[19] reported being female as an independent risk factor for the syndrome and Gadan *et al*.[20] have described a higher frequency of incontinence and flatus in women.

Table 3. *Univariate analysis comparing patients with and without symptoms of LARS.*

Variable	With LARS* (N=20)	Without LARS* (N=42)	*p*
Male gender**	5 (25%)	18 (42.86%)	0.2804
Age (in years), mean±SD	61.86±11.32	59.31±11.51	0.4143
Smoking*			1.00
Former	4 (20%)	10 (23.81%)	
Current	3 (15%)	6 (14.29%)	
Never	13 (65%)	26 (61.9%)	
Alcohol consumption**			1.00
Former	2 (10%)	3 (7.14%)	
Current	0 (0%)	1 (2.38%)	
Never	18 (90%)	38 (90.48%)	
History of previous pelvic surgery**	7 (35%)	6 (14.29%)	0.1237
JRC***	3 (2.5-5)	3 (2-5)	0.2789
TNM staging, if neoplasia**			0.0773
T0	3 (18.75%)	0 (0%)	
T1	1 (6.25%)	3 (12%)	
T2	6 (37.5%)	8 (32%)	
T3	6 (37.5%)	9 (36%)	
T4	0 (0%)	5 (20%)	
Neoadjuvance, if neoplasia**	10 (62.5%)	3 (12%)	0.0014
Anastomosis type**			1.00
Manual	6 (30%)	14 (33.34%)	
Stapled	14 (70%)	28 (66.66%)	
Distance between anastomosis and anal margin (cm)†	5 (3-10)	12 (9-15)	<0.001§
Distance between anastomosis and anal margin (cm)**			<0.001§
<8cm	14 (73.68%)	9 (23.08%)	
>8cm	5 (26.32%)	30 (76.92%)	
Protective stoma**	16 (80%)	15 (35.71%)	0.0023§
Time to stoma closure (months)†	7.61 (5.93-8.86)	7.36 (4-11.83)	0.9213
Tumor site, if neoplasm**			0.0056§
Distal rectum	0 (0%)	1 (4%)	
Medium rectum	10 (62.5%)	4 (16%)	
Proximal rectum	4 (25%)	5 (20%)	
Rectosigmoid junction	1 (6.25%)	3 (12%)	
Sigmoid colon	1 (6.25%)	12 (48%)	

** LARS: low anterior resection syndrome; ** absolute frequency (relative frequency); *** CCI: Charlson comorbidity index; † median (interquartile range 25%-75%); § results with statistical significance (p<0.05).*

Regarding age, we found a global average of 60.1 years, compatible with data from Scheer *et al*.[15] and from Ekkarat *et al*.[16]. Because this average age is associated with comorbidities due to aging, we performed the risk assessment of developing LARS with the CCI index[9]. There was no statistical significance between them. We found no other reports in the literature.

When considering other conditions and lifestyle, such as smoking and alcoholism, these were not statistically relevant. We found no other reports in the literature for comparison.

Because pelvic surgeries may negatively compromise the innervation of the region and act as a confounding factor in the development of LARS, we compared the incidence of LARS in patients with

and without previous pelvic surgery. There was no statistical relevance, which was compatible with the literature[16].

In this study, the sample consisted of patients with benign and malignant diseases, and the literature reports usually use patients submitted to ARR for cancer, thus limiting its comparison with other studies. Most patients (67%) had colorectal neoplasia. Of these, 40% developed the syndrome, which is compatible with the literature[14].

The proportion of patients suffering from this syndrome seems to increase as the level of the anastomosis approaches the anal sphincter. The anterior resection of the rectum with coloanal anastomosis may be associated with increased incidence of incontinence. After surgery, anal resting pressure decreases significantly and does not recover during the first year. The second major effect on the function of the anal sphincter is possible disappearance of the Rectoanal Inhibitory Reflex (RAIR), depending on the resection level[14]. Although the treatment of middle and distal rectal tumors requires procedures with anastomoses closer to the anal border, the simple localization of the tumor showed, in this study, only a tendency towards statistical significance (p=0.056). Interestingly, when analyzing the height of the colorectal anastomosis, the data revealed, as a risk factor for the development of LARS, anastomosis performed up to 6.5cm from the anal border (p<0.001). In other studies, the value of distance from the anal margin was 5cm[16,20].

Although in this series we did not find statistically significance when comparing manual with mechanical anastomosis and the incidence of the syndrome (p=1.00), there is divergence in the literature on the subject. In the review by Pucciani[14], the author reported a higher incidence of the stapled anastomosis syndrome, since there are direct damage to the anal sphincter resulting from anal dilation due to transanal introduction of the stapler, as shown by endoanal ultrasound examinations[13]. Up to 18% of patients undergoing anterior resection with stapled low anastomosis have evidence of long-term internal sphincter injury[21].

In this case series, and consistent with the literature[3-5,7,8,14,15,22-24], neoadjuvance was an important risk factor for the development of the syndrome (p=0.014), as well as worse results related to the frequency and intensity of symptoms, when compared to patients treated by surgery alone. The mechanism seems to be related to direct nerve damage and pelvic fibrosis induced by pelvic irradiation. This treatment can also cause sexual and urinary dysfunction due to nerve damage[25].

Finally yet importantly, endoanal ultrasound shows more anal sphincter scarring in patients who had radiotherapy for neoadjuvant or adjuvant therapy than in non-irradiated patients[26].

Ileostomy for intestinal transit deviation causes structural and functional changes in the lower colon and rectal stump segments. These include atrophy of the intestinal wall and anal sphincter musculature, villous atrophy, and mucosal inflammation, leading to disuse colitis. It is postulated that these changes may contribute to the symptoms of LARS after restoration of intestinal transit. There is divergence in the literature on this subject. In the work of Floodeen *et al*.[27], there was no significant change in the anorectal function from the first to the fifth year of follow-up in patients who did not have transit derivation. However, the patients who were randomly assigned to a temporary stoma construction most often reported incontinence for flatus and liquid stools, as well as a higher total LARS score when followed over a 12-year period[20].

The analysis of this series showed that the performance of the stoma is a risk factor for the development of the syndrome (p=0.0023) and the onset of symptoms occurred on average 5.69 months after intestinal transit reestablishment.

In the systematic review of 128 articles by Keane *et al*.[3] fecal incontinence was the most frequent symptom, reported in 97% of the studies used in that meta-analysis. The same finding was reported in the review by Bryant *et al*.[28], showing 71% of patients with this complaint. In the case of the Paraná Clinics Hospital, of the gastrointestinal symptoms, incomplete evacuation was the most frequent (60%), followed by evacuatory urgency (55%), diarrhea (45%), constipation (45%) and fecal incontinence (35%). The difficulty in assessing the frequency of symptoms is due to the lack of standardization of LARS diagnostic tools.

Non-gastrointestinal tract symptoms were less frequent in this series with four (20%) patients with urinary symptoms and only one (5%) patient with complaints related to sexual function. Despite the strong association between sexual and urinary symptoms and LARS, the literature on the subject is scarce.

The main limitation of our study is that it is retrospective, which precludes direct questioning of the patient regarding the symptom. Other limitations are the number of patients and surgeries performed by surgeons other than the Coloproctology Service.

We conclude, therefore, that the incidence of LARS at the Coloproctology Service of the Clinics Hospital of the Federal University of Paraná, from January 2007 to December 2017, was 32%, and the risk factors for developing the syndrome were neoadjuvance, anastomoses below 6.5cm from the anal border, and protective stoma.

The high incidence of LARS symptoms, even in specialized centers, shows that functional and structural changes caused by removal of the rectum may be minimized but not prevented. Thus, orientation, involvement in patient education and early diagnosis become important to establish therapeutic strategies that minimize the symptoms after anterior resection of the rectum and the impact of these symptoms on patients' quality of life.

R E S U M O

Objetivo: *identificar fatores preditivos da síndrome da ressecção anterior do reto (SRAR) que podem contribuir para o seu diagnóstico e tratamento precoces.* **Métodos:** *estudo de coorte retrospectivo de pacientes submetidos à ressecção anterior do reto entre 2007 e 2017 no Serviço de Coloproctologia do Hospital de Clínicas da Universidade Federal do Paraná. Foram realizadas análises de curva ROC (Receiver Operating Characteristic Curve Analysis) ou COR (Característica de Operação do Receptor) para identificar os fatores preditivos da SRAR.* **Resultados:** *foram incluídos 64 pacientes com dados completos. A idade dos homens foi de 60,1±11,4 anos e 37,10% eram do sexo masculino. Vinte pacientes (32,26%) apresentaram SRAR. Os sintomas mais relatados foram evacuação incompleta (60%) e urgência (55%). Na análise univariada, a distância da anastomose à margem anal (p<0,001), terapia neoadjuvante (p=0,0014) e confecção de ileostomia no momento da ressecção (p=0,0023) foram preditivos da SRAR. Análise da curva ROC mostrou um ponto de corte de 6,5cm na distância da anastomose à margem anal como preditor da SRAR.* **Conclusão:** *distância entre anastomose e margem anal, história de terapia neoajuvante e confecção de estoma são condições que podem ajudar a predizer o desenvolvimento da SRAR. A orientação e o envolvimento na educação do paciente, bem como, o manejo precoce podem reduzir potencialmente o impacto desses sintomas na qualidade de vida dos pacientes.*

Descritores: *Cirurgia Colorretal. Complicações Pós-Operatórias. Neoplasias Retais. Anastomose Cirúrgica. Estomas Cirúrgicos.*

REFERENCES

1. Instituto Nacional de Câncer José de Alencar Gomes da Silva. Coordenação de Prevenção e Vigilância. Estimativa 2018: incidência de câncer no Brasil. Rio de Janeiro: INCA; 2017.
2. Lopez-Kostner F, Lavery IC, Hool GR, Rybicki LA, Fazio VW. Total mesorectal excision is not necessary for cancers of the upper rectum. Surgery. 1998;124(4):612-7; discussion 617-8.
3. Keane C, Wells C, O'Grady G, Bissett IP. Defining low anterior resection syndrome: a systematic review of the literature. Colorectal Dis. 2017;19(8):713-22.
4. Martellucci J. Low anterior resection syndrome: a treatment algorithm. Dis Colon Rectum. 2016;59(1):79-82.
5. Ziv Y, Zbar A, Bar-Shavit Y, Igov I. Low anterior resection syndrome (LARS): cause and effect and reconstructive considerations. Tech Coloproctol. 2013;17(2):151-62.
6. Jorge JMN, Wexner SD. Etiology and management of fecal incontinence. Dis Colon Rectum. 1993;36(1):77-97.
7. Temple LK, Bacik J, Savatta SG, Gottesman L, Paty PB, Weiser MR, et al. The development of a validated instrument to evaluate bowel function after sphincter-preserving surgery for rectal cancer. Dis Colon Rectum. 2005;48(7):1353-65.
8. Emmertsen KJ, Laurberg S. Low anterior resection syndrome score: development and validation of a symptom-based scoring system for bowel dysfunction after low anterior resection for rectal cancer. Ann Surg. 2012;255(5):922-8.
9. Hall WH, Ramachandran R, Narayan S, Jani AB, Vijayakumar S. An electronic application for rapidly calculating Charlson comorbidity score. BMC Cancer. 2004;4:94.
10. Weiser MR. AJCC 8th Edition: Colorectal Cancer. Ann Surg Oncol. 2018;25(6):1454-5.
11. The R Project for Statistical Computing [software]. 2019 Jul 05 [cited 2019]. Available from: https://www.r-project.org/
12. 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.
13. Ho YH, Tsang C, Tang CL, Nyam D, Eu KW, Seow-Choen F. Anal sphincter injuries from stapling instruments introduced transanally: randomized, controlled study with endoanal ultrasound and anorectal manometry. Dis Colon Rectum. 2000;43(2):169-73.
14. Pucciani F. A review on functional results of sphincter-saving surgery for rectal cancer: the anterior resection syndrome. Updates Surg. 2013;65(4):257-63.
15. Scheer AS, Boushey RP, Liang S, Doucette S, O'Connor AM, Moher D. The long-term gastrointestinal functional outcomes following curative anterior resection in adults with rectal cancer: A systematic review and meta-analysis. Dis Colon Rectum. 2011;54(12):1589-97.
16. Ekkarat P, Boonpipattanapong T, Tantiphlachiva K, Sangkhathat S. Factors determining low anterior resection syndrome after rectal cancer resection: a study in Thai patients. Asian J Surg. 2016;39(4):225-31.
17. Lange MM, den Dulk M, Bossema ER, Maas CP, Peeters KC, Rutten HJ, Klein Kranenbarg E, Marijnen CA, van de Velde CJ; Cooperative Clinical Investigators of the Dutch Total Mesorectal Excision Trial. Risk factors for faecal incontinence after rectal cancer treatment. Br J Surg. 2007;94(10):1278-84.
18. Nilsson S, Norlén BJ, Widmark A. A systematic overview of radiation therapy effects in prostate cancer. Acta Oncol. 2004;43(4):316-81.
19. Liu F, Guo P, Shen Z, Gao Z, Wang S, Ye Y. [Risk factor analysis of low anterior resection syndrome after anal sphincter preserving surgery for rectal carcinoma]. Chinese J Gastrointest Surg. 2017;20(3):289-94. Chinese.
20. Gadan S, Floodeen H, Lindgren R, Matthiessen P. Does a defunctioning stoma impair anorectal function after low anterior resection of the rectum for cancer? A 12-year follow-up of a randomized multicenter trial. Dis Colon Rectum. 2017;60(8):800-6.

21. Farouk R, Duthie GS, Lee PW, Monson JR. Endosonographic evidence of injury to the internal anal sphincter after low anterior resection: long-term follow-up. Dis Colon Rectum. 1998;41(7):888-91.
22. Campelo P, Barbosa E. Coloproctology Functional outcome and quality of life following. J Coloproctol. (Rio J.) [Online]. 2016 Dec [cited 2019];36(4):251-61. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S2237936320160004002 51&lng=en.
23. Emmertsen KJ, Chen TYT, Laurberg S. Functional results after treatment for rectal cancer. J Coloproctol. (Rio J.) [Online]. 2014 Mar [cited 22019];34(1):55-61. Available from: http://www.scielo.br/scielo.php?script= sci_arttext&pid=S2237-93632014000100055&lng=en.
24. Martin ST, Heneghan HM, Winter DC. Systematic review of outcomes after intersphincteric resection for low rectal cancer. Br J Surg. 2012;99(5):603-12.
25. Buzatti KCLR, Petroianu A. Pathophysiological aspects of the low anterior resection syndrome for treatment of rectal cancer. Rev Col Bras Cir. 2017;44(4):397-402.
26. Pollack J, Holm T, Cedermark B, Holmström B, Mellgren A. Long-term effect of preoperative radiation therapy on anorectal function. Dis Colon Rectum. 2006;49(3):345-52.
27. Floodeen H, Lindgren R, Hallböök O, Matthiessen P. Evaluation of long-term anorectal function after low anterior resection: a 5-year follow-up of a randomized multicenter trial. Dis Colon Rectum. 2014;57(10):1162-8.
28. Bryant CLC, Lunniss PJ, Knowles CH, Thaha MA, Chan CLH. Anterior resection syndrome. Lancet Oncol. 2012;13(9):e403-8.

Received in: 09/22/2019
Accepted for publication: 10/22/2019
Conflict of interest: none.
Source of funding: none.

Mailing address:
Paula Heroso Moreira
E-mail: paulaheroso@gmail.com
fernanda.miacci@gmail.com