



Health related quality of life of patients after robotic-assisted colorectal resections

Z zdravjem povezana kakovost življenja bolnikov po robotsko asistiranih resekcijah debelega črevesa in danke

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Slovenian Journal of Gastroenterology / Gastroenterolog 2025; 1: 5–14

Keywords: colorectal cancer, health-related quality of life, low anterior resection syndrome, sexual function, surgical outcomes, postoperative cognitive dysfunction

Ključne besede: rak debelega črevesja in danke, z zdravjem povezana kakovost življenja, sindrom nizke sprednje resekcije, kirurški izidi, postoperativna kognitivna disfunkcija

Disclosure: No potential conflicts of interest were disclosed.

ABSTRACT

Background: The proportion of robotic-assisted colorectal operations is increasing worldwide and has also risen in Slovenia in recent years. Previous studies have demonstrated the safety and clinical equivalence of this surgical approach.

Aim: This study aimed to investigate the impact of robotic-assisted surgery compared to laparoscopically assisted surgery on health-related quality of life in colorectal cancer patients.

Methods: In a retrospective observational study, we included 79 patients who underwent robotic-assisted colorectal resections between January 1, 2020, and

IZVLEČEK

Izhodišče: Delež robotsko asistiranih kolorektalnih operacij po svetu na področju abdominalne kirurgije narašča, v zadnjih letih pa tudi v Sloveniji. Raziskave potrjujejo varnost in klinično enakovrednost tovrstnega načina operiranja.

Namen: Z raziskavo smo želeli oceniti vpliv robotsko asistiranih operacij raka debelega črevesa in danke na kakovost življenja bolnikov, ki je povezano z zdravjem, ter jo primerjati s kakovostjo po primerljivih laparoskopskih operacijah.

Metode: V retrospektivno opazovalno raziskavo smo vključili 79 pacientov, ki so bili med 1. 1. 2020 in

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December 31, 2021, and compared them with 197 patients who underwent laparoscopic-assisted colorectal resections between January 1, 2016 and December 31, 2017, in the Department of Abdominal Surgery at the University Medical Centre in Ljubljana. We used the EORTC QLQ-C30 version 3, EORTC QLQ-C29, and LARS version 1 questionnaires to analyse health-related quality of life.

Results: Patients who underwent robotic-assisted surgery had a significantly shorter hospital stay than those in the laparoscopic group ($p < 0.001$). When comparing the quality of life between the two groups, differences were found in cognitive function ($p = 0.017$) in favour of the laparoscopic group. Patients who underwent robotic-assisted surgery reported significantly better quality of life in the area of sexuality compared to those who had laparoscopic surgery ($p < 0.001$ for both men and women). Analysis of the LARS results showed that severe LARS syndrome occurred more frequently in the laparoscopic group than in the robotic-assisted surgery group.

Conclusions: Our study found statistically significant differences in quality of life between robotic- and laparoscopic-assisted surgery, with lower scores for cognitive function but higher scores for sexual function and a lower likelihood of developing low anterior resection syndrome after robotic-assisted surgery.

31. 12. 2021 operirani z robotsko asistirano operacijo, ter jih primerjali s 197 pacienti, ki so bili operirani z laparoskopskimi asistiranimi operacijami med 1. 1. 2016 in 31. 12. 2017 zaradi raka debelega črevesa in danke. Vsi pacienti so bili operirani na Kliničnem oddelku za abdominalno kirurgijo v Univerzitetnem kliničnem centru Ljubljana. Za analizo kakovosti življenja smo uporabili standardizirana vprašalnika EORTC QLQ-C30, verzija 3, in EORTC QLQ-CR29 ter vprašalnik LARS, verzija 1.

Rezultati: V primerjavi bolnikov po laparoskopsko in robotsko asistiranih operacijah je bila dolžina hospitalizacije ($p < 0,001$) pri bolnikih po robotsko asistiranih operacijah statistično krajša. Pri primerjavi kvalitete življenja med skupinama smo ugotovili razlike v kognitivnem funkcioniranju ($p = 0,017$). Statistično pomembno je kakovost na področju spolnosti po robotsko asistiranih operacijah boljša tako pri moških ($p < 0,001$) kot pri ženskah ($p < 0,001$). Analiza rezultatov o sindromu nizke sprednje resekcije je (LARS) pokazala, da se je v skupini po laparoskopsko asistiranih operacijah pogosteje pojavil hud LARS v primerjavi s skupino po robotsko asistiranih operacijah.

Zaključki: Naša raziskava je pokazala statistično pomembne razlike v kakovosti življenja po robotsko in laparoskopsko asistiranih operacijah, z nižjo kognitivno funkcijo, vendar boljšimi rezultati spolne funkcije in zmanjšano verjetnostjo za razvoj sindroma nizke sprednje resekcije po robotsko asistiranih operacijah.

INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer worldwide and the second leading cause of cancer-related mortality (1). Robotic-assisted surgery (RAS) has emerged as an evolution of laparoscopic-assisted surgery (LAS), with the da Vinci system leading the way since 2000 (2). This system, which consists of a surgical console and a patient-side cart, allows surgeons to control robotic arms equipped with surgical

instruments from the console (3). It provides 3D visualisation and, importantly, improved dexterity of the instruments, ensuring a high level of precision in the surgery. RAS also eliminates hand tremors, resulting in more precise surgery. RAS provides better ergonomics for the surgeon by alleviating the tedious, uncomfortable postures often required during open or laparoscopic surgeries (2, 4, 5). However, challenges such as high equipment costs and longer operating times remain (6). RAS allows easier construction of intra-

corporeal anastomosis, which avoids median laparotomies and facilitates specimen retrieval through non-midline incisions. This technique results in less blood loss, smaller incisions, faster postoperative recovery, and a lower incidence of hernia (7). Although RAS is typically associated with a longer operating time (operative time is 21–37% longer than LAS) due to docking of the robotic system, the actual operating time is comparable between RAS and LAS (8). One study has shown that RAS results in lower blood loss and reduced transfusion requirements due to better visualisation and precision, as well as lower conversion rates (by 27–63% compared to LAS) and shorter hospital stays (by 0.4–1 day) (8). Morbidity and mortality rates are similar between RAS and LAS, but RAS offers faster recovery of bladder and sexual functions, especially in patients with rectal cancer (8).

MATERIALS AND METHODS

Study Design and Participants

This retrospective observational study, conducted with a patient-centric approach, included 95 patients diagnosed with colorectal cancer (CRC) and treated with RAS at the Department of Abdominal Surgery, Ljubljana University Medical Centre, from January 2020 to December 2021. We selected 95 patients based on the inclusion criteria (adults, diagnosed with colorectal cancer, with no other gastrointestinal diseases, treated with RAS from January 2020 to December 2021, still alive on December 31, 2021). We sent them the questionnaires and informed consent forms, ensuring their active participation in the study. Of 95 eligible patients, 79 returned the completed questionnaires, demonstrating their commitment to the research. The questionnaires were processed and standardised according to the EORTC guidelines. Participation was anonymous. The RAS group was comprehensively compared to patients who underwent LAS between January 1, 2016, and December 31, 2017, at the Department of Abdominal Surgery, Ljubljana University Medical Centre, providing a comprehensive view of the treatment outcomes.

Questionnaires

The EORTC QLQ-C30 questionnaire was developed to assess **cancer patients'** physical, psychological and social functioning. It consists of functional scales, symptom scales and individual items on general quality of life (QoL) (9). The scales consist of one or more questions, rated on a 4-point scale from 1 (not at all) to 4 (very much). A higher score means a worse result and more symptoms present. However, the general quality of life scales is rated on a 7-point analogue-linear scale, with a higher number indicating better well-being and quality of life (10–12).

The EORTC QLQ-C29 questionnaire is used to assess quality of life and evaluate the efficacy of adjuvant therapy. It consists of functional scales and individual symptom items (9). The answers range from 1 to 4, with a higher score indicating poorer results. An exception is the questions on sexual desire, where higher scores indicate better results and well-being (10, 12).

The Low Anterior Resection Syndrome (LARS) score, which has been widely used and validated for the Slovenian language, serves as an assessment tool to evaluate altered bowel function in patients after low anterior resection with sphincter preservation and complete or partial removal of the mesorectum, which is the gold standard for the treatment of cancers of the middle and lower third of the rectum. Especially after preoperative radiation and very low rectal resections, patients often experience significant changes in bowel function, a condition known as LARS (13).

Statistical analysis

Each scale, whether it is a single question (e.g. anxiety in the EORTC QLQ-CR29 questionnaire) or several questions (e.g. cognitive performance in the EORTC-CR29 questionnaire), was meticulously calculated to obtain its raw score (RS). This rigorous process ensures the accuracy and reliability of our data. The RS was then standardised using a linear transformation, ensuring a reliable and robust range from 0 to 100 (12).

Standardising the RS using a linear transformation was a crucial step. This process ensured that the scores were on a consistent scale, ranging from 0 to 100, making it easier to interpret and compare the results (12).

Higher scores on the functioning scales indicate better functioning, and higher scores on the general health scale reflect better quality of health. However, higher symptom scale scores indicate worse or more severe symptomatology (12).

The descriptive variables are presented as frequencies and percentages, and the numerical variables as medians and interquartile ranges (IQR). This presentation was chosen based on the results of the Shapiro-Wilk test, which indicated a non-normal distribution for the latter. The age of rectal cancer patients is presented as mean and standard deviation to ensure comparability of the descriptive statistics between 2022 and 2018. Differences between patients who responded to the study invitation (respondents) and those who did not respond (non-respondents) were analysed using the Mann-Whitney test, a non-parametric test used to compare two independent groups when the dependent variable is not normally distributed, for numerical variables and the chi-square test, a statistical test used to examine the association between two categorical variables, for descriptive variables.

In addition, we used the Mann-Whitney U test to evaluate the differences in quality of life, age at the time

of surgery, and length of hospital stay between patients who underwent laparoscopic and robotic colorectal resection. The relationship between the type of surgery and the descriptive variables was examined using the chi-square test or the likelihood ratio test when the expected frequencies in the table were less than 5. The chi-square test was also used to examine the association between the timing of the study and LARS in patients with rectal cancer. All analyses were performed at a significance level of $\alpha = 0.05$, which is a commonly used threshold for determining statistical significance, using the SPSS version 28 programme.

RESULTS

Quality of life (QoL) questionnaires were sent to 110 patients following robotic-assisted colorectal resections, and we were pleased to receive responses from 79 (72%) patients. This high response rate is significant as it enhances the credibility of our study by providing a more representative sample of the patient population. The comparison between respondents and non-respondents revealed that there were significantly fewer women among the respondents (38% vs. 66.7%, $p = 0.007$). The median age (IQR) of respondents was 67.5 (57.8–82) years, while for non-respondents, it was 72 (60–78) years ($p = 0.227$).

The patients in the LAS in the RAS group are comparable in terms of gender ($p = 0.392$), age ($p = 0.715$) and occurrence of postoperative complications ($p = 0.105$).

Table 1. Patients characteristics according to the type of surgery

	Type of surgery		P
	Laparoscopic n = 67	Robotic n = 79	
Gender			0.392 ^a
Female	31 (46.3%)	31 (39.2%)	
Male	36 (53.7%)	48 (60.8%)	
Median (IQR) age on the day of surgery	72 (60–78)	70 (61–79)	0.715 ^b
Median (IQR) length of hospitalization	7 (6–9)	6 (5–7)	< 0.001 ^b

Notes: Data are presented as frequencies and proportions unless otherwise indicated

a = chi-square test; b = Mann-Whitney U test; c = likelihood ratio test; IQR = interquartile range

On the other hand, a significant finding was the shorter hospitalisation duration in RAS patients ($p < 0.001$), with a median stay of 6 days or less (IQR 5–7) compared to 7 days or less (IQR (6–9) for the LAS group. This shorter hospital stay for RAS patients suggests potential cost savings and reduced risk of hospital-acquired infections, which are important considerations in the current healthcare landscape (Table 1).

The assessment of the two patient groups using the EORTC QLQ-C30 scales showed comparable quality of life, except cognitive function ($p = 0.017$). At least half of the patients who underwent LAS had a standardised score of 100 on this scale (IQR: 83–100), while half of the patients with RAS had a score of 83.3 or less (IQR: 75–100) (Table 2). In addition, the EORTC QLQ-CR29 scales showed that patients

who underwent robotic-assisted surgery reported significantly better quality of life in the area of sexuality compared to those who had laparoscopic surgery ($p < 0.001$ for both men and women).

Our study revealed that, apart from sexuality, the two patient groups demonstrated comparable quality of life in all other domains. This reassuring finding suggests that the overall outcomes of the two surgical approaches are similar, providing a comprehensive view of the patients' postoperative experiences. This should provide a sense of reassurance to medical professionals and researchers interested in colorectal surgery outcomes, as it indicates that both surgical approaches yield similar results in terms of patient QoL (Table 3).

Table 2. Comparison of all scales of the EORTC QLQ-C30 questionnaire based on the type of surgery

	Laparoscopic surgery		Robotic surgery		P
	Me (IQR)	n	Me (IQR)	n	
Functional scales					
Physical functioning	93 (87–100)	67	93 (87–100)	79	0.845
Role functioning	100 (67–100)	67	100 (83–100)	79	0.077
Cognitive functioning	100 (83–100)	67	83 (75–100)	78	0.017
Emotional functioning	92 (75–100)	67	83 (67–100)	78	0.636
Social functioning	100 (83–100)	67	100 (83–100)	78	0.125
Symptom scales					
Dyspnoea	0 (0–0)	67	0 (0–0)	79	0.752
Insomnia	0 (0–33)	67	0 (0–33)	79	0.418
Appetite loss	0 (0–0)	66	0 (0–0)	79	0.509
Nausea and vomiting	0 (0–0)	66	0 (0–0)	79	0.070
Constipation	0 (0–33)	66	0 (0–33)	78	0.828
Diarrhoea	0 (0–0)	66	0 (0–0)	78	0.446
Fatigue	11 (0–33)	67	23 (10–33)	78	0.802
Pain	0 (0–17)	66	0 (0–17)	78	0.964
Financial difficulties	0 (0–0)	67	0 (0–0)	78	0.161
Global health status / QoL					
Global health status/QoL	67 (58–83)	67	67 (50–83)	78	0.884

Note: The comparison was made using Mann-Whitney U test

Table 3. Comparison of all scales of the EORTC QLQ-C29 questionnaire based on the type of surgery

	Laparoscopic surgery		Robotic surgery		P
	Me (IQR)	n	Me (IQR)	n	
Illness symptoms					
Urinary frequency	33 (0–33)	67	33 (17–50)	78	0.131
Urinary incontinence	0 (0–17)	67	0 (0–33)	79	0.757
Dysuria	0 (0–0)	67	0 (0–0)	78	0.804
Abdominal pain	0 (0–33)	67	0 (0–0)	78	0.265
Buttock pain	0 (0–0)	67	0 (0–0)	78	0.629
Bloated feeling	33 (0–33)	67	33 (0–33)	78	0.800
Blood and mucus in stool	0 (0–0)	67	0 (0–0)	78	0.786
Dry mouth	0 (0–33)	67	0 (0–33)	78	0.776
Hair loss	0 (0–0)	67	0 (0–0)	78	0.140
Trouble with taste	0 (0–0)	67	0 (0–0)	78	0.269
Flatulence	0 (0–33)	54	33 (0–33)	74	0.148
Faecal incontinence	0 (0–0)	55	0 (0–0)	74	0.689
Sore skin around anus	0 (0–33)	55	0 (0–33)	74	0.850
Stool frequency	0 (0–7)	55	0 (0–17)	74	0.329
Embarrassed by defecation pattern	0 (0–0)	54	0 (0–0)	74	0.071
Mental well being					
Anxiety	67 (33–67)	65	67 (33–67)	78	0.287
Weight	100 (67–100)	66	100 (67–100)	78	0.514
Body image	100 (78–100)	66	100 (77–100)	78	0.563
Male:					
Sexual functioning	33 (33–67)	33	67 (33–100)	47	< 0.001
Impotence	16,5 (0–33)	32	33 (0–67)	44	0.626
Female:					
Sexual functioning	0 (0–33)	29	67 (67–100)	27	< 0.001
Dyspareunia	0 (0–0)	26	0 (0–0)	23	0.823

Notes: The comparison was made using the Mann-Whitney U test

Patients with rectal cancer who completed the LARS questionnaire in 2018 were, on average, 9 years older than those who completed it in 2022. Additionally, a larger proportion of 2018 participants had more advanced cancer stages (T3–T4: 48% vs. 21% in 2022). There was a statistically significant association between the study year and LARS scores ($p < 0.001$; Table 5),

with severe low anterior resection syndrome being more prevalent in the 2018 cohort.

DISCUSSION

The increasing prominence of HRQoL in chronic patients underscores its vital role. The patient's psych-

Table 4. Demographic and clinical characteristics of colon resection patients according to type of surgery who completed the LARS questionnaire

	Date of research	
	2018 n = 100	2022 n = 38
Gender		
Female	31 (31%)	12 (31.6%)
Male	69 (69%)	26 (68.4%)
Mean age (SD) at the time of operation	63.4 (10.5)	64.7 (11.9)
Mean age (SD) at the time of research	73.5 (10.6)	64.9 (11.9)
Stage of cancer		
T1-T2	52 (52%)	30 (79%)
T3-T4	48 (48%)	8 (21%)

Notes: SD = standard deviation

Table 5. Relationship between LARS score and survey time

	Date of research		P
	2018 n = 100 (%)	2022 n = 38 (%)	
0-20 (no LARS)	21 (21)	27 (71.1)	< 0.001
21-29 (minor LARS)	21 (21)	7 (18.4)	
30-42 (major LARS)	58 (58)	4 (10.5)	

Notes: the link was made using the chi-squared test

hological, emotional, social and financial status is not only important but it significantly influences the positive outcomes of treatment, benefiting both the physician and the patient.

The study achieved a high response rate, but women were significantly less likely to respond. In a survey by Grosek et al. examining the quality of life of colorectal cancer patients, women scored lower on emotional, physical and cognitive functioning. They reported higher levels of insomnia (14). The lower scores for quality of life could explain the reduced participation of women, who might also feel uncomfortable answering specific questions. Response rates did not significantly vary by stage of disease. The psychological burden of cancer, including anxiety in 2-25% of

patients and depression in 20-50%, may also influence participation (15).

Our study used the EORTC QLQ-CR29 questionnaire, a widely accepted tool in the field, to assess urinary and faecal incontinence, stoma-related problems, and gender-related concerns (16).

Our findings reveal a promising aspect of RAS, indicating a significantly improved sexual quality of life compared to LAS ($p < 0.001$). This aligns with Tang et al.'s report of enhanced sexual function in RAS patients at three months post-surgery; although, this difference was not significant at six and twelve months (17). The improved sexual function after RAS is likely due to the robotic platform's magnification, which allows precise dissection and better nerve sparing (18).

Mass et al. found that the damage to the lower hypogastric plexus causes impotence, while damage to the upper plexus impairs ejaculation (19). In contrast to the LAS, where the narrow space and rigid instruments increase the risk of nerve damage, the flexibility, high manoeuvrability, elimination of tremor and improved visualisation of the RAS help to protect the nerve structures (17, 20).

Analysis of the EORTC QLQ-C30 questionnaire showed that the overall quality of life of patients who underwent RAS treatment was comparable to that of LAS. This analysis aligns with previous studies by Kamali et al (20) and Kim et al (21). However, our study found significantly lower cognitive function in the RAS group ($p = 0.017$). The assessment of cognitive function suggested the possibility of postoperative cognitive dysfunction (POCD), especially in older patients. Monk et al. found a POCD rate at discharge of 36.6% in patients aged 18–39 years, 30.4% in patients aged 40–59 years and 41.4% in patients over 60 years, with 12.7% of the latter still affected three months after surgery (22). Özgün et al. and Kavrut Ozturk et al. suggested that factors such as anaesthesia and the Trendelenburg position, in addition to older age, may contribute to POCD by impairing the oxygen supply to the brain (23, 24). However, Maerz and Beck compared POCD rates between open supine surgery and RAS in the Trendelenburg position and found no significant difference in the incidence of POCD (25, 26). Given these results, one would expect cognitive function to be comparable in patients after RAS and LAS, which contradicts our results. The lower cognitive function scores after surgery could be due to the older age of patients, who may experience memory and concentration problems. Further comprehensive cognitive testing before and after surgery is recommended to determine whether RAS affects cognitive function explicitly.

LARS is characterised by impaired bowel function after rectal resection, causing symptoms such as faecal incontinence, urinary urgency, frequent small bowel movements, and a persistent feeling of incomplete evacuation, which significantly affects quality of life

(27). The study found that fewer patients in the RAS group experienced severe LARS, likely due to fewer early postoperative complications such as anastomotic leakage, leading to a faster recovery. Robotic surgery also allows for precise dissection in the narrow pelvic cavity, probably reducing the risk of sphincter nerve damage (28). While the cohorts were comparable in terms of gender and age at the time of surgery, there were notable differences in mean age at the time of the study (RAS about 9 years younger) and cancer stage, with robotic surgery generally affecting earlier stages (T1–T2), which likely influenced the LARS results.

The study showed a significant difference in hospital length of stay between the two groups, with RAS patients having a shorter stay. However, discharge criteria vary worldwide, which affects the study results. In our department, discharge requires that patients have their pain controlled with oral medication, are free of nausea, can tolerate food, are mobile, can care for themselves and consent to discharge (29). Scotton et al. compared intracorporeal anastomosis for RAS with extracorporeal anastomosis for LAS and found that RAS patients recovered faster: Gas evacuation (2.5 vs. 3.1 days), first bowel movement (3.2 vs. 4.0 days) and solid food intake (4.0 vs. 4.6 days) occurred earlier (30). Mangalath et al. also found that fewer analgesics were needed within the first 24 hours in the RAS group (31). The minimally invasive nature of RAS contributes to fewer postoperative complications, faster conversion to a soft diet and shorter hospital stays (29, 32). Tam et al. reported shorter hospital stays in RAS patients (4.00 days) compared to LAS (4.41 days) (33). Zhang et al. attributed this to lower conversion rates in RAS (34). Despite the shorter stay, readmission rates in RAS are comparable to those of LAS (35).

Our study, while providing valuable insights, also has its limitations. We acknowledge that the results would be more comparable to other studies if quality of life had been assessed at different time intervals (3, 6 and 12 months after surgery). In addition, preoperative assessments are recommended to gain a better under-

standing of changes after RAS. We are aware of the subjective nature of the questionnaires, which were completed at home without supervision, making it difficult to ensure accuracy. Patients were not grouped by time elapsed since surgery, making comparisons difficult as physical recovery varies. The different patient groups for LAS and RAS also make it difficult to compare results objectively. We recognize that more comparable groups regarding age and cancer stage would strengthen the results, favouring RAS.

CONCLUSION

Robotic surgery, a promising alternative to traditional laparoscopic methods, offers significant advantages regarding patient quality of life and recovery parameters. These results support the continued introduction and development of robotic technologies in colorectal surgery, and inspire hope for further advancements that will optimise patient outcomes.

ACKNOWLEDGEMENT

We want to thank Ms. Vanja Erčulj, statistician, who performed all necessary statistical calculations, including (**opis metode - specific type of calculations**).

References

1. Sawicki T, Ruskowska M, Danielewicz A, et al. A Review of Colorectal Cancer in Terms of Epidemiology, Risk Factors, Development, Symptoms and Diagnosis. *Cancers*. 2021; 13 (9).
2. Addison P, Agnew JL, Martz J. Robotic Colorectal Surgery. *Surg Clin North Am*. 2020; 100(2): 337–60.
3. Leung T, Vyas D. Robotic surgery: Applications. *Am J Robot Surg*. 2014; 1 (1): 1–64.
4. Sheng S, Zhao T, Wang X. Comparison of robot-assisted surgery, laparoscopic-assisted surgery, and open surgery for the treatment of colorectal cancer: A network meta-analysis. *Medicine*. 2018; 97 (34): e11817.
5. Gutt CN, Oniu T, Mehrabi A, et al. Robot-assisted abdominal surgery. *Br J Surg*. 2004; 91(11): 1390.
6. Martin RF. Robotic Surgery. *Surg Clin North Am*. 2020; 100 (2): 13–14.
7. Lujan HJ, Plasencia G, Rivera BX, et al. Advantages of Robotic Right Colectomy With Intracorporeal Anastomosis. *Surg Laparosc Endosc Percutan Tech*. 2018; 28 (1): 36–41.
8. Kinross JM, Mason SE, Mylonas G, et al. Next-generation robotics in gastrointestinal surgery. *Nat Rev Gastroenterol Hepatol*. 2020; 17 (7): 430–40.
9. EORTC – Quality of Life: Questionnaires EORTC - Quality of Life [Internet]. 2017 [citirano 2024 Jun 23]. Dostopno na: <https://qol.eortc.org/questionnaires/> (datum ogleda).
10. Ganesh V, Agarwal A, Popovic M, et al. Comparison of the FACT-C, EORTC QLQ-CR38, and QLQ-CR29 quality of life questionnaires for patients with colorectal cancer: a literature review. *Support Care Cancer*. 2016; 24 (8): 3661-8.
11. Kaasa S, Bjordal K, Aaronson N, et al. The EORTC core quality of life questionnaire (QLQ-C30): validity and reliability when analysed with patients treated with palliative radiotherapy. *Eur J Cancer*. 1995; 31A (13–14): 2260–2263.
12. Fayers PM, Aaronson NK, Bjordal K, et al. The EORTC QLQ-C30 scoring manual (3rd Edition). Brussels: European Organisation for Research and Treatment of Cancer; 2001.
13. Grosek J, Košir JA, Novak J, et al. Validation of The Slovenian Version of the Low Anterior Resection Syndrome Score for Rectal Cancer Patients after Surgery. *Zdr Varst*. 2019; 58 (4): 148–54.
14. Grosek J, Novak J, Kitek K, et al. Health-related quality of life in Slovenian patients with colorectal cancer: a single tertiary care center study. *Radiol Oncol*. 2019; 53 (2): 231–7.
15. Simon AE, Thompson MR, Flashman K, et al. Disease stage and psychosocial outcomes in colorectal cancer. *Colorectal Dis*. 2009; 11 (1): 19–25.
16. Chen JH, Ayscue JM, Bayasi M, et al. Quality of life after minimally invasive surgery for rectal cancer. *Mini-invasive surg*. 2018; 2: 42.
17. Tang X, Wang Z, Wu X, et al. Robotic versus laparoscopic surgery for rectal cancer in male urogenital function preservation, a meta-analysis. *World J Surg Oncol*. 2018; 16 (1): 196. 22. Moriya Y. Function preservation in rectal cancer surgery. *Int J Clin Oncol*. 2006; 11 (5): 33–43.
18. Maas CP, Moriya Y, Steup WH, et al. A prospective study on radical and nerve-preserving surgery for rectal cancer in the Netherlands. *Eur J Surg Oncol*. 2000; 26 (8): 751–7.
19. Baik SH, Ko YT, Kang CM, et al. Robotic tumor-specific mesorectal excision of rectal cancer: short-term outcome of a pilot randomized trial. *Surg Endosc*. 2008; 22 (7): 1601–8.
20. Kamali D, Reddy A, Imam S, et al. Short-term surgical outcomes and patient quality of life between robotic and laparoscopic extralevator abdominoperineal excision for adenocarcinoma of the rectum. *Ann R Coll Surg Engl*. 2017; 99 (8): 607–13.
21. Kim HJ, Choi GS, Park JS, et al. The impact of robotic surgery on quality of life, urinary and sexual function following total mesorectal excision for rectal cancer: a propensity score- matched analysis with laparoscopic surgery. *Colorectal Dis*. 2018; 20 (5): 103–13.

22. Rundshagen I. Postoperative cognitive dysfunction. *Dtsch Arztebl Int.* 2014; 111 (8): 119–25.
23. Kavrut Ozturk N, Kavakli AS, Arslan U, et al. S100B level and cognitive dysfunction after robotic-assisted laparoscopic radical prostatectomy procedures: a prospective observational study. *Brazilian Journal of Anesthesiology (English Edition).* 2020; 70 (6): 573–82.
24. Özgün A, Sargin A, Karaman S, et al. The relationship between the Trendelenburg position and cerebral hypoxia in patients who have undergone robot-assisted hysterectomy and prostatectomy. *Turk J Med Sci.* 2017; 47 (6): 1797–803.
25. Maerz DA, Beck LN, Sim AJ, et al. Complications of robotic-assisted laparoscopic surgery distant from the surgical site. *Br J Anaesth.* 2017; 118 (4): 492–503.
26. Beck S, Zins L, Holthusen C, et al. Comparison of Cognitive Function After Robot-Assisted Prostatectomy and Open Retropubic Radical Prostatectomy: A Prospective Observational Single-Center Study. *Urology.* 2020; 139: 110–7.
27. Sun R, Dai Z, Zhang Y, et al. The incidence and risk factors of low anterior resection syndrome (LARS) after sphincter-preserving surgery of rectal cancer: a systematic review and meta-analysis. *Support Care Cancer.* 2021; 29 (12): 7249–58.
28. Miura T, Sakamoto Y, Morohashi H, et al. Robotic surgery contributes to the preservation of bowel and urinary function after total mesorectal excision: comparisons with transanal and conventional laparoscopic surgery. *BMC Surg.* 2022; 22 (1): 147.
29. Fiore JF Jr, Browning L, Bialocerkowski A, et al. Hospital discharge criteria following colorectal surgery: a systematic review. *Colorectal Dis.* 2012; 14 (3): 270–81.
30. Scotton G, Contardo T, Zerbinati A, et al. From Laparoscopic Right Colectomy with Extracorporeal Anastomosis to Robot-Assisted Intracorporeal Anastomosis to Totally Robotic Right Colectomy for Cancer: The Evolution of Robotic Multi-quadrant Abdominal Surgery. *J Laparoendosc Adv Surg Tech A.* 2018; 28 (10): 1216–22.
31. Mangalath AS, Kumar L, Sawant AB, et al. Comparison of analgesic requirements in robot-assisted versus conventional laparoscopic abdominal surgeries. *J Anaesthesiol Clin Pharmacol.* 2021; 37 (1): 79–84.
32. Baik SH, Kwon HY, Kim JS, et al. Robotic versus laparoscopic low anterior resection of rectal cancer: short-term outcome of a prospective comparative study. *Ann Surg Oncol.* 2009; 16 (6): 1480–7.
33. Tam MS, Kaoutzani C, Mullard AJ, et al. A population-based study comparing laparoscopic and robotic outcomes in colorectal surgery. *Surg Endosc.* 2016; 30 (2): 455–63.
34. Zhang X, Wei Z, Bie M, et al. Robot-assisted versus laparoscopic-assisted surgery for colorectal cancer: a meta-analysis. *Surg Endosc.* 2016; 30 (12): 5601–14.
35. Junquera-Olay S, Baleato-González S, Canedo-Antelo M, et al. Rectal cancer survival: A retrospective analysis of MRI features and their association with prognosis. *Curr Probl Diagn Radiol.* 2022; 51 (1): 30–7.