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Translation of the article

# Quality of life after extended lymph node dissection for colon cancer

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**ABSTRACT** *AIM: to evaluate the effect of the lymphadenectomy (LD) level on the quality of life (QoL) in patients who underwent laparoscopic colon resection for colon cancer.*

*PATIENTS AND METHODS: the study included 86 patients who underwent surgery for colon cancer from January 2018 to August 2020. The patients were randomized in 2 groups: the main group — with D3 lymphadenectomy — 41 patients and the control group — with D2 — 45 patients. Two validated QoL questionnaires (QLQ-C30 v. 3.0, QLQ-CR29 v. 2.1) of the European Organization for Research and Treatment of Cancer (EORTC) were applied by the patients on the day before the surgery and on the 30th day after the surgery and were used for the further analysis.*

*RESULTS: there were no significant differences between the groups in gender, age, weight, height, BMI, assessment of functional and physical status according to the ASA and ECOG scales, incidence of comorbidities, tumor site, type and volume surgical of procedures. Regardless of the level of lymphadenectomy, the significant improvement in QoL after surgery was obtained ($p_{QoLD3} = 0.005$, $p_{QoLD2} = 0.023$) in both groups. The significant increase in the incidence of diarrhea by 2.65 times was detected after laparoscopic right hemicolectomies with extended lymphadenectomy ($p = 0.042$). Also, there was a significant 2.45 fold increase in the risk of developing erectile dysfunction (ED) after D3 lymphadenectomy in the patients who underwent laparoscopic resections of the left colon in the early postoperative period ($p = 0.031$).*

*CONCLUSION: the analysis of physical, social functioning and symptomatic scales has established that in patients who underwent colon resection for cancer of the left colon erectile dysfunction occurred to a greater extent after D3 LD, whereas diarrhea was more likely to develop after resection of the right colon with D3 LD than with D2 LD.*

**KEYWORDS:** *colon cancer, quality of life, lymphadenectomy, diarrhea, erectile dysfunction*

**CONFLICT OF INTEREST:** *the authors declare no conflict of interest.*

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## INTRODUCTION

To date, surgery remains the method of choice in the treatment of colon cancer.

As an assessment of the extent of radical surgery, the following basic criteria are used to describe the quality of the removed macro-specimen:

1) preservation of the integrity of the mesocolic fascia
2) removal of paracolic (201, 211, 221, 231, 241, 251 groups), intermediate (202, 212, 222, 232, 242, 252 groups) lymph nodes (LN) with D2 lymph node dissection (LD) and with enhanced lymphadenectomy (D3), as well as apical (203, 213, 223, 253 groups) LN (Fig. 1).

Surgery should not only meet all the oncologic surgery principles, but also not reduce the quality of life (QoL) [1,2].

According to the recommendations of the World Health Organization, QoL refers to the perception by individuals of their position in life in the context of the culture and value system in which they live, in accordance with the goals, expectations, norms, and concerns of this person [3].

It should be noted that the introduction of laparoscopic technologies in colon cancer surgery in 1991 contributed to the improvement of the physical and mental state of the operated patients, as well as their social rehabilitation [4–6]. However, in addition to studying surgical access, researchers are currently paying considerable attention to assessing the safety of extended lymph node dissection in the volume of D3. The problem of quality of life after such a procedure is only indirectly studied [7,8]. In the few papers that were devoted to the study of the QoL after D3 lymph node dissection for colon cancer, the specific complications that reduce it were: diarrhea, developing in 6% of the patients operated on for cancer of the right colon, and a decrease or complete loss of erectile function in 47.7% of the patients after surgeries for cancer of the left colon [9,10]. At the same time, in existing studies, the assessment of QoL depending on the volume of lymphadenectomy performed was made independently of surgical access.

Therefore, in order to study the effect of LD volume on the QoL, we analyzed the results of treatment of the patients who underwent laparoscopic resections of the colon with LD in the volume of D2 and D3.

## PATIENTS AND METHODS

From January 2018 to August 2020, a randomized prospective study of the QoL of the patients operated on for colon cancer in the A.N.Ryzhikh National Research Medical Center of Coloproctology of the Health Ministry of Russia included 100 patients with colon cancer. The selection criteria were:

1) colon cancer with T1-4aN0-2M0;
2) histological confirmation of adenocarcinoma;
3) ECOG status — 0–2 points;
4) ASA status — 1–3 class;
5) age of 18 years and older;
6) informed consent.

A preoperative checkup included computed tomography (CT) of the chest, abdomen and pelvis with intravenous contrast, colonoscopy, and pathomorphology of the biopsy material. Tumor staging was performed using the TNM classification (8th edition, 2018) [11,12]. The assessment of the LN status was made in accordance with the accepted Japanese clinical and anatomical classification (Fig. 1) [13].

The patients who met the selection criteria were randomized into 2 groups: the main group included the patients who underwent laparoscopic colon resection with expanded lymph node dissection in the volume of D3 (48 patients), the control group included the patients who underwent procedures with the volume of LD D2 (52 patients). Randomization was carried out using the Internet resource random number generator (www.randomizer.org). Intraoperatively, 14 patients were excluded from the study due to the conversion to the open one — 7 people in each group. Thus, the analysis included 41 and 45 patients in the main and control groups, respectively (Fig. 2).

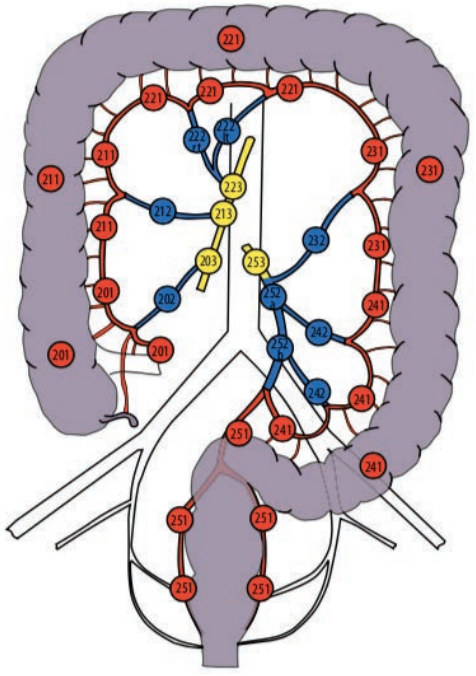


**Figure 1.** *Layout of regional colonic LNs: paracolic LNs are highlighted in red (201, 211, 221, 231, 241, 251 group), intermediate LNs — in blue (202, 212, 222, 232, 242, 252 group), apical LNs — in yellow (203, 213, 223, 253 group)*

**Table 1**. *Characteristics of the studied groups*

| Parameters | | Main group (*n* = 41) | Control group (*n* = 45) | *p* |
|---|---|---|---|---|
| Gender | Male | 17 (41.5%) | 18 (40%) | 0.890 |
| | Female | 24 (58.5%) | 27 (60%) | |
| Age, fullyears | | 64 [60–72] | 62 [57–71] | 0.345 |
| Anthropometric data | Height, m | 1.65 [1.6–1.75] | 1.68 [1.62–1.75] | 0.589 |
| | Body weight, kg | 76 [68–86] | 73 [61–87] | 0.502 |
| | BMI, kg / m2 | 27.4 [25.47–29.74] | 26.5 [22.4–30.3] | 0.189 |
| ASA | I | 6 (14.6%) | 11 (24.4%) | 0.520 |
| | II | 33 (80.5%) | 32 (71.1%) | |
| | III | 2 (4.9%) | 2 (4.5%) | |
| ECOG | 0 | 22 (53.7%) | 28 (62.2%) | 0.246 |
| | I | 19 (46.3%) | 15 (33.3%) | |
| | II | 0 (0%) | 2 (4.5%) | |
| Comorbidities | | 35 (85.4%) | 41 (91.1%) | 0.508 |
| Tumor Site | Right Colon | 20 (48.8%) | 23 (51.1%) | 0.715 |
| | Left Colon | 21 (51.2%) | 22 (48.9%) | |
| Surgery Type | *Right Hemicolectomy* | 20 (48.8%) | 23 (51.1%) | 0.505 |
| | Left Hemicolectomy | 7 (17.1%) | 4 (8.9%) | |
| | Distal Sigmoid Resection | 13 (31.7%) | 17 (37.8%) | |
| | Colon Resections of Hartmann's type | 1 (2.4%) | 0 | |
| | Subtotal ColonResection | 0 | 1 (2.2%) | |

The data was analyzed using the IBM SPSS Statistics 26 Version program. To check the normality of the distribution, the Shapiro-Wilk criteria were used with the Lillie force correction of the significance, the histograms were analyzed, as well as the indicators of asymmetry and kurtosis. The groups were compared using the Mann-Whitney test for quantitative variables, and the Fisher exact test for qualitative variables. Descriptive statistics for qualitative variables are presented as the number of patients (percentage of observations) and for quantitative variables as medians (Q1–Q3 quartiles).

When comparing the effect of the lymph node dissection in the study groups on the QoL of the patients before and after treatment, the Student paired t-test was used for normally distributed values, and the Wilcoxon test was used for quantitative values whose distribution was different from the normal one. In order to take into account the possible influence of various factors on the dependence of the quality of life of patients on the LD volume, a univariate covariance analysis of ANCOVA and a two-variate dispersion analysis of ANOVA with repeated observations were performed. The differences were considered statistically significant at $p < 0.05$.

The study groups were comparable in terms of the basic clinical and anthropometric characteristics, such as gender, age, weight, height, BMI, assessment of functional and physical status according to the ASA and ECOG scales, comorbidities, tumor site, and the surgery performed ($p > 0.05$) (Table 1).

To assess the patients' QoL, they were surveyed on the day before and on the 30th day after the surgery using two validated questionnaires from the

European Organization for Research and Treatment of Cancer (EORTC, https://www.eortc.org).

The first questionnaire for assessing the quality of life of cancer patients QLQ — C30 v. 3.0 is a set of questions grouped into multi-element scales and individual subjects [11].

We assessed the severity of diarrhea in the groups, which meant frequent emptying of the intestine with liquid or unformed intestinal contents, corresponding to type 6–7 on the Bristol Scale, up to 3 times a day or more [14,15].

The patients were previously explained the answers to the question about the presence of diarrhea, which were divided into 4 types: "not at all" — the absence of diarrhea, "slightly" — the frequency of stool up to 4 times a day was regarded as a mild form of diarrhea, "significantly" — episodes of defecation up to 5–6 times a day in the form of liquid or unformed stool, "very strongly" — the number of emptying per day was more than 7 times [16].

The second questionnaire is an additional module for patients with colorectal cancer QLQ-CR29 v.2.1, which is designed to assess QoL in patients with different stages of the disease and treatment methods. The module contains 29 questions that also form functional and symptomatic scales. Each of these scales contains from 2 to 7 questions. The answers to the questions are presented in the form of simple statements of the Likert Scale [17]. The results of the answers are reflected in points from 0 to 100. When assessing functional status, an increase in the number of points corresponds to a better quality of life, while in the analysis of symptomatic scales and individual subjects, the opposite trend is observed — a higher number of points is consistent with a worse assessment of QoL.

## RESULTS

The QoL of patients before and after surgery, as well as depending on the volume of LD, was compared using the EORTC QLQ — C30 questionnaire as part of the ITT (intention-to-treat) analysis.

As a result of processing the EORTC QLQ — C30 questionnaires before and after treatment, it was found that 30 days after treatment, regardless of the volume of LD, there was a significant improvement in the level of QoL ($p_{QoLD2}$ = 0.023, $p_{QoLD3}$ = 0.005), as well as physical ($p_{PF2D2}$ = 0.017, $p_{PF2D3}$ = 0.036), role ($p_{RF2D2}$ = 0.048, $p_{RF2D3}$ = 0.001)

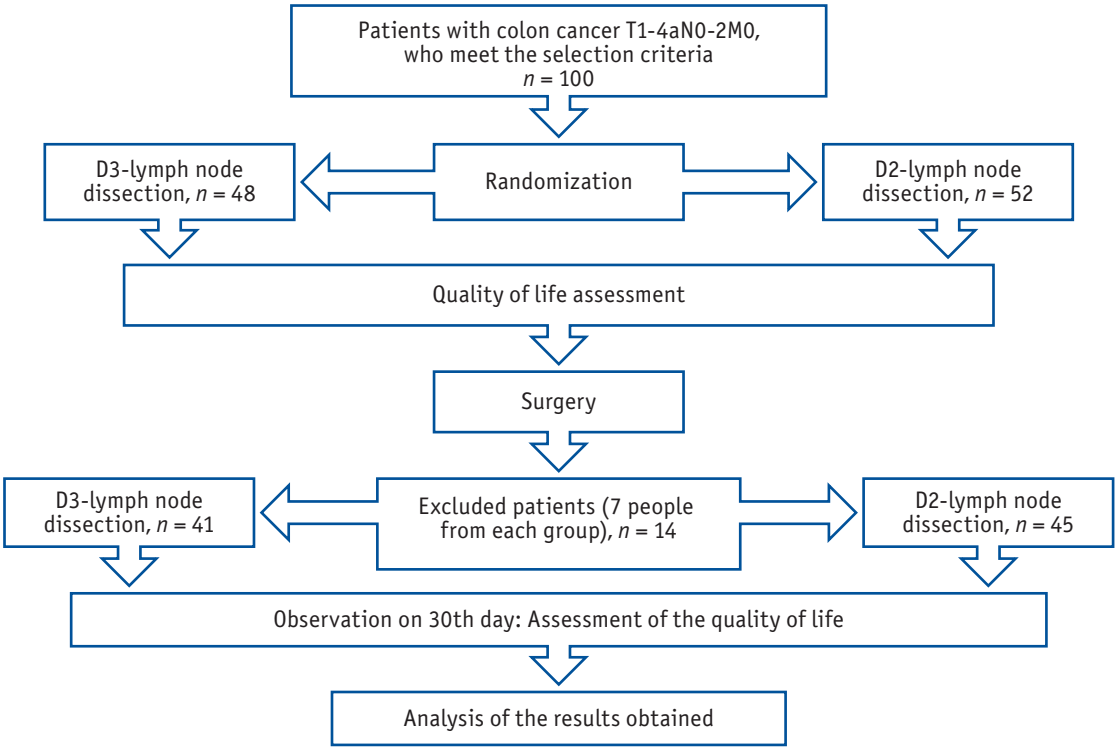


**Figure 2.** *Block diagram of the study*

**Table 2.** *Assessment of the quality of life of patients before and after surgery depending on the volume of lymphadenectomy performed (EORTC QLQ — C30 questionnaire)*

| QoL scales | | Method of lymph node dissection | Observation stages | | | | *p* |
|---|---|---|---|---|---|---|---|
| | | | Before treatment | | After 30 days | | |
| | | | Me | $Q_1$-$Q_3$ | Me | $Q_1$-$Q_3$ | |
| Quality of life /QoL, points | | D2 | 66.7 | 50–66.7 | 66.7 | 58.3–83.3 | 0.023* |
| | | D3 | 58.3 | 41.7–66.7 | 66.7 | 58.3–75 | 0.005* |
| | | | *p* = 0.359 | | *p* = 0.646 | | – |
| Functional scales, points | PF2 | D2 | 80 | 80–93.3 | 86.7 | 80–93.3 | 0.017* |
| | | D3 | 86.7 | 80–93.3 | 86.7 | 86.7–93.3 | 0.036* |
| | | | *p* = 0.288 | | *p* = 0.509 | | – |
| | RF2 | D2 | 100 | 66.7–100 | 100 | 83.3–100 | 0.048* |
| | | D3 | 83.3 | 66.7–100 | 100 | 100–100 | 0.001* |
| | | | *p* = 0.624 | | *p* = 0.3 | | – |
| | EF | D2 | 100 | 66.7–100 | 75 | 66.7–91.7 | 0.016* |
| | | D3 | 83.3 | 66.7–100 | 83.3 | 66.7–91.7 | 0.553 |
| | | | *p* = 0.624 | | *p* = 0.279 | | – |
| | CF | D2 | 100 | 83.3–100 | 100 | 100–100 | 0.001* |
| | | D3 | 100 | 83.3–100 | 100 | 100–100 | 0.012* |
| | | | *p* = 0.745 | | *p* = 0.803 | | – |
| | SF | D2 | 100 | 83.3–100 | 100 | 100–100 | 0.01* |
| | | D3 | 100 | 83.3–100 | 100 | 100–100 | 0.075 |
| | | | *p* = 0.919 | | *p* = 0.641 | | – |
| Symptomatic scales, points | FA | D2 | 33.3 | 22.2–44.4 | 22.2 | 11.1–33.3 | 0.023* |
| | | D3 | 33.3 | 22.2–33.3 | 33.3 | 11.1–33.3 | 0.1 |
| | | | *p* = 0.120 | | *p* = 0.883 | | – |
| | NV | D2 | 0 | 0–45 | 0 | 0–16.7 | 0.194 |
| | | D3 | 0 | 0–16.7 | 0 | 0–48.3 | 0.577 |
| | | | *p* = 0.871 | | *p* = 0.255 | | – |
| | PA | D2 | 16.7 | 0–33.3 | 16.7 | 0–16.7 | 0.03* |
| | | D3 | 16.7 | 0–16.7 | 0 | 0–16.7 | 0.026* |
| | | | *p* = 0.913 | | *p* = 0.470 | | – |
| | DY | D2 | 33.3 | 0–33.3 | 0 | 0–33.3 | 0.003* |
| | | D3 | 0 | 0–33.3 | 0 | 0–33.3 | 0.127 |
| | | | *p* = 0.019* | | *p* = 0.091 | | – |
| | SL | D2 | 33.3 | 0–33.3 | 0 | 0–33.3 | 0.001* |
| | | D3 | 33.3 | 0–33.3 | 0 | 0–16.7 | 0.003* |
| | | | *p* = 0.550 | | *p* = 0.398 | | – |
| | AP | D2 | 0 | 0–33.3 | 0 | 0–56.7 | 0.591 |
| | | D3 | 0 | 0–63.3 | 0 | 0–63.3 | 0.868 |
| | | | *p* = 0.495 | | *p* = 0.943 | | – |
| | CO | D2 | 33.3 | 0–50 | 0 | 0–33.3 | 0.001* |
| | | D3 | 33.3 | 0–66.7 | 0 | 0–33.3 | < 0.001* |
| | | | *p* = 0.394 | | *p* = 0.541 | | – |
| | DI | D2 | 0 | 0–33.3 | 0 | 0–33.3 | 0.038* |
| | | D3 | 33.3 | 0–33.3 | 0 | 0–66.7 | 0.597 |
| | | | *p* = 0.128 | | *p* = 0.037* | | – |
| Financial problems, points | | D2 | 33.3 | 0–66.7 | 33.3 | 0–33.3 | 0.569 |
| | | D3 | 33.3 | 0–33.3 | 33.3 | 0–33.3 | 0.319 |
| | | | *p* = 0.956 | | *p* = 0.563 | | – |

** Differences in indicators are statistically significant at p ⩽ 0.05. PF2 — physical functioning; RF2 — role functioning; EF — emotional functioning; CF — cognitive functioning; SF — social functioning; FA — fatigue; NV — nausea and vomiting; PA — pain; DY — dyspnea; SL — sleeplessness/insomnia; AP — loss of appetite; CO — constipation; DI — diarrhea.*

and cognitive ($p_{CFD2}$ = 0.001, $p_{CFD3}$ = 0.012) functioning (Table 2).

As a result of the assessment of the symptomatic scales, a significant decrease in the includence of detection of constipation ($p_{COD3}$ < 0.001, $p_{COD2}$ = 0.001), pain syndrome ($p_{PAD3}$ = 0.026, $p_{PAD2}$ = 0.03) and insomnia ($p_{SLD3}$ = 0.003, $p_{SLD2}$ = 0.001) was revealed in each of the groups. In an intergroup comparison after treatment, we obtained a significant increase in the severity of diarrhea in the patients in the D3 group ($p$ = 0.037) (Table 2).

Subsequently, to compare the incidence of diarrhea depending on the volume of lymph dissection, we performed an analysis using a four-field conjugacy table. It was revealed that diarrhea developed more often on the 30th day after surgery with expanded lymphadenectomy — in 16 (39%) of 41 patients, than in 9 (20%) of 45 patients with D2 — volume LD ($p$ = 0.05). At the same time, the expansion of the volume of lymph node dissection increased the risk of diarrhea by 1.56 times (95% CI: 1.03–2.38).

Due to the fact that according to the literature, diarrhea is the most common specific complication of the right hemicolectomy, we compared the frequency of defecation in this category of patients, regardless of gender, age, and baseline parameters of the preoperative questionnaire. To analyze the changes of the severity of diarrhea in the patients with cancer of the right colon and to level the influence of the gender factor on this indicator, a two-variate dispersion ANOVA analysis with repeated measurements was performed. To analyze the differences in the severity of diarrhea between the groups after treatment, an ANCOVA univariate covariance analysis was performed with the inclusion of age and baseline parameters of the preoperative questionnaire as correction covariates.

Thus, it was found that in the main group there was an increase in the severity of diarrhea from 21.6 points (95% CI: 12.65–30.54) before the surgery to 26.7 points (95% CI: 13.97–39.44) on the 30th day after the surgery, while in the control group there was a decrease from 13.1 points (95% CI: 4.77–21.44) to 11.6 points (95% CI: 0.31–23.4) (Fig. 3).

Regardless of the initial values of the preoperative questionnaire, on day 30 after resection of the right colon, the severity of diarrhea was on average 2.65 times higher in patients after LD in the volume of D3 — 27.9 ± 6.0 points compared to the control group — 10.5 ± 5.6 points ($p$ = 0.042). When analyzing the other scales of the questionnaire, significant differences in the quality of life of the patients depending on the volume of lymph node dissection were not revealed.The analysis of the questionnaires of the EORTC QLQ-CR29 supplementary module questionnaire revealed significant changes in the QoL, both on the functional and symptomatic scales (Table 3).

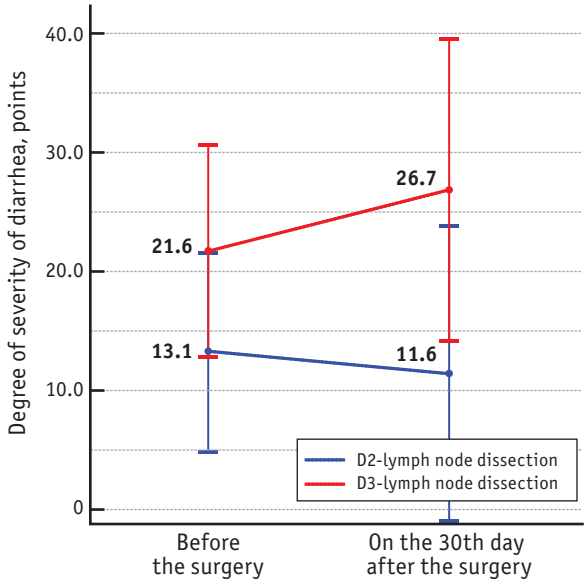


**Figure 3.** *Histogram of the diarrhea severity in patients with cancer of the right colon*

**Table 3.** *Assessment of the quality of life of patients before and after surgery depending on the volume of lymphadenectomy (EORTC QLQ-CR29 questionnaire)*

| QoL scales | | Method of lymph node dissection | Observation stages | | | | *p* |
|---|---|---|---|---|---|---|---|
| | | | Before treatment | | After 30 days | | |
| | | | Me | $Q_1$-$Q_3$ | Me | $Q_1$-$Q_3$ | |
| Functional scales, points | ANX | D2 | 33.3 | 33.3–66.7 | 0 | 0–33.3 | 0.002* |
| | | D3 | 33.3 | 33.3–66.7 | 0 | 0–33.3 | 0.003* |
| | | | $p = 0.985$ | | $p = 0.715$ | | – |
| | WEI | D2 | 66.7 | 66.7–100 | 66.7 | 66.7–100 | 0.058 |
| | | D3 | 66.7 | 66.7–100 | 66.7 | 66.7–100 | 1.0 |
| Functional scales, points | | | $p = 0.460$ | | $p = 0.631$ | | – |
| | BI | D2 | 88.9 | 66.7–100 | 100 | 88.9–100 | < 0.001* |
| | | D3 | 88.9 | 77.8–100 | 100 | 88.9–100 | 0.048* |
| | | | $p = 0.203$ | | $p = 0.595$ | | – |
| | SEXM | D2 | 66.7 | 33.3–100 | 50 | 33.3–100 | 0.796 |
| | | Д3<br>D3 | 66.7 | 33.3–66.7 | 33.3 | 33.3–66.7 | 0.480 |
| | | | $p = 0.352$ | | $p = 0.256$ | | – |
| | SEXW | D2 | 100 | 66.7–100 | 100 | 66.7–100 | 0.236 |
| | | D3 | 100 | 66.7–100 | 100 | 66.7–100 | 0.903 |
| | | | $p = 0.948$ | | $p = 0.585$ | | – |
| Symptomatic scales, points | UF | D2 | 33.3 | 16.7–50 | 16.7 | 16.7–33.3 | 0.02* |
| | | D3 | 16.7 | 0–50 | 16.7 | 0–33.3 | 0.104 |
| | | | $p = 0.390$ | | $p = 0.832$ | | – |
| | UI | D2 | 0 | 0 | 0 | 0 | 0.059 |
| | | D3 | 0 | 0 | 0 | 0 | 1.0 |
| | | | $p = 0.009$* | | $p = 0.174$ | | – |
| | DY | D2 | 0 | 0 | 0 | 0 | 0.18 |
| | | D3 | 0 | 0 | 0 | 0 | 0.564 |
| | | | $p = 0.924$ | | $p = 0.548$ | | – |
| | AP | D2 | 33.3 | 0–33.3 | 33.3 | 0–33.3 | 0.106 |
| | | D3 | 33.3 | 0–33.3 | 0 | 0–33.3 | < 0.001* |
| | | | $p = 0.439$ | | $p = 0.038$* | | – |
| | BP | D2 | 0 | 0–33.3 | 0 | 0 | 0.012* |
| | | D3 | 0 | 0–33.3 | 0 | 0 | 0.002* |
| | | | $p = 0.670$ | | $p = 0.906$ | | – |
| | BF | D2 | 33.3 | 0–33.3 | 33.3 | 0–33.3 | 0.554 |
| | | D3 | 33.3 | 0–33.3 | 0 | 0–33.3 | 0.004* |
| | | | $p = 0.924$ | | $p = 0.024$* | | – |
| | BMS | D2 | 16.7 | 0–33.3 | 0 | 0 | < 0.001* |
| | | D3 | 16.7 | 0–33.3 | 0 | 0 | < 0.001* |
| | | | $p = 0.572$ | | $p = 0.286$ | | – |
| | DM | D2 | 33.3 | 0–33.3 | 0 | 0–33.3 | 0.011* |
| | | D3 | 0 | 0–33.3 | 0 | 0–33.3 | 0.014* |
| | | | $p = 0.465$ | | $p = 0.915$ | | – |

| QoL scales | | Method of lymph node dissection | Observation stages | | | | *p* |
|---|---|---|---|---|---|---|---|
| | | | Before treatment | | After 30 days | | |
| | | | Me | $Q_1$-$Q_3$ | Me | $Q_1$-$Q_3$ | |
| Symptomatic scales, points | HL | D2 | 0 | 0 | 0 | 0 | 0.357 |
| | | D3 | 0 | 0 | 0 | 0 | 0.059 |
| | | | *p* = 0.931 | | *p* = 0.349 | | – |
| | TA | D2 | 0 | 0 | 0 | 0 | 0.206 |
| | | D3 | 0 | 0 | 0 | 0 | 0.058 |
| | | | *p* = 0.115 | | *p* = 0.103 | | – |
| | FL | D2 | 0 | 0–33.3 | 0 | 0–33.3 | 1.0 |
| | | D3 | 33.3 | 0–33.3 | 0 | 0 | 0.002* |
| | | | *p* = 0.166 | | *p* = 0.103 | | – |
| | FI | D2 | 0 | 0 | 0 | 0 | 0.564 |
| | | D3 | 0 | 0 | 0 | 0 | 0.705 |
| | | | *p* = 0.924 | | *p* = 0.749 | | – |
| | SS | D2 | 0 | 0 | 0 | 0 | 0.366 |
| | | D3 | 0 | 0 | 0 | 0 | 0.860 |
| | | | *p* = 0.515 | | *p* = 0.420 | | – |
| | SF | D2 | 16.7 | 0–16.7 | 16.7 | 0–16.7 | 0.349 |
| | | D3 | 0 | 0–16.7 | 0 | 0–16.7 | 0.901 |
| | | | *p* = 0.804 | | *p* = 0.562 | | – |
| Symptomatic scales, points | EMB | D2 | 0 | 0 | 0 | 0 | 0.603 |
| | | D3 | 0 | 0 | 0 | 0 | 0.161 |
| | | | *p* = 0.334 | | *p* = 0.777 | | – |
| | STO | D2 | 0 | 0 | 33.3 | 33.3–50 | – |
| | | D3 | 0 | 0 | 16.7 | 0–33.3 | – |
| | | | – | | *p* = 0.554 | | – |
| | IMP | D2 | 33.3 | 0–66.7 | 0 | 0–33.3 | 0.075 |
| | | D3 | 0 | 0–33.3 | 33.3 | 33.3–66.7 | 0.004* |
| | | | *p* = 0.1 | | *p* = 0.003* | | – |
| | DYS | D2 | 0 | 0 | 0 | 0 | 1.0 |
| | | D3 | 0 | 0 | 0 | 0 | 1.0 |
| | | | *p* = 0.879 | | *p* = 0.879 | | – |

** Differences in indicators are statistically significant at p ⩽ 0.05. ANX–anxiety; WEI –body weight; BI — body image; SEXM — sexual interest (men); SEXW — sexual interest (women); UF — frequency of urination; UI — urinary incontinence; DY — dysuria; AP — abdominal pain; BP — buttock pain; BF — bloating; BMS — blood and mucus in the stool; DM–dry mouth; HL — hair loss; TA — taste change; FL — flatulence; FI — fecal incontinence; SS — skin sensitivity; SF — stool frequency; EMB — embarrassment; STO — problems with stoma care; IMP — impotence (erectile dysfunction); DYS — dyspareunia.*

**Table 4.** *Comparison of the incidence of erectile dysfunction depending on the volume of lymph node dissection*

| Scope of surgery | Volume of lymph node dissection | Erectile dysfunction | *p* | OR; 95% CI |
|---|---|---|---|---|
| Resection of the right colon | D3 (*n* = 5) | 2 (40%) | 0.51 | – |
| | D2 (*n* = 8) | 1 (12.5%) | | |
| Resection of the left colon | D3 (*n* = 12) | 7 (58.3%) | **0.031*** | 2.45; 1.16–5.18 |
| | D2 (*n* = 10) | 1 (10%) | | |

As a result of processing the data obtained during the patient survey, significant differences were found between the main and control groups after surgical treatment according to the following functional and symptomatic scales: patients' anxiety decreased ($p_{ANXD3}$ = 0.003, $p_{ANXD2}$ = 0.002), patients were significantly more satisfied with their appearance ($p_{BID3}$ = 0.048, $p_{BID2}$ < 0.001), they complained less of pain ($p_{BPD3}$ = 0.002, $p_{BPD2}$ = 0.012), blood admixture and mucus in the stool ($p_{BMSD3}$ < 0.001, $p_{BMSD2}$ < 0.001) and dry mouth ($p_{DMD3}$ = 0.014, $p_{DMD2}$ = 0.011), in the main group, patients were more likely to complain about problems with erectile function ($p_{IMP}$ = 0.004). When analyzing the QoL in patients, depending on the volume of lymph node dissection, significant differences were obtained only in the following parameters of the symptomatic scale of the questionnaire: in the main group, the incidence of erectile dysfunction significantly increased compared to the controls ($p$ = 0.003).

Also, in the early postoperative period, patients of the control group were significantly more likely than in the main group to complain of pain ($p$ = 0.038) and bloating ($p$ = 0.024).

The subsequent intergroup analysis of the incidence of erectile dysfunction depending on the LD volume separately in patients after resection of the right and left colon revealed an increase in this indicator in the patients with extended LD volume for cancer of the left colon. Thus, ED developed in 7/12 (58.3%) and 1/10 (10%) cases in the main and control groups, respectively ($p$ = 0.031). At the same time, the risk of developing impotence as a result of an increase in the LD volume increased by 2.45 times (95% CI: 1.16–5.18). The analysis of the incidence of the ED development depending on the LD volume during resection of the right colon did not reveal significant differences (Table 4).

In order to level out the possible influence of age and the initial value of erectile function factors on the severity of impotence, depending on the LD volume, a one-dimensional covariance analysis was performed using a linear regression model and including the above values as correction covariates. As a result, we found a significant effect of the LD volume on the incidence of erectile dysfunction in operated patients for cancer of the left colon ($p$ = 0.001).

At the same time, regardless of the initial state of erectile function, as a result of comparing the marginal averages, problems with erection in the main group developed 5.08 times more often than in the control group (Fig. 4). The contribution to the variance dispersion of the impotence incidence of the lymph node dissection volume factor is 0.490, that is, in 49% of cases, the ED development was due to the expanded volume of lymphadenectomy (D3 LD).

When analyzing the remaining scales of the EORTC QLQ-CR29 questionnaire, there were no significant differences in the quality of life of

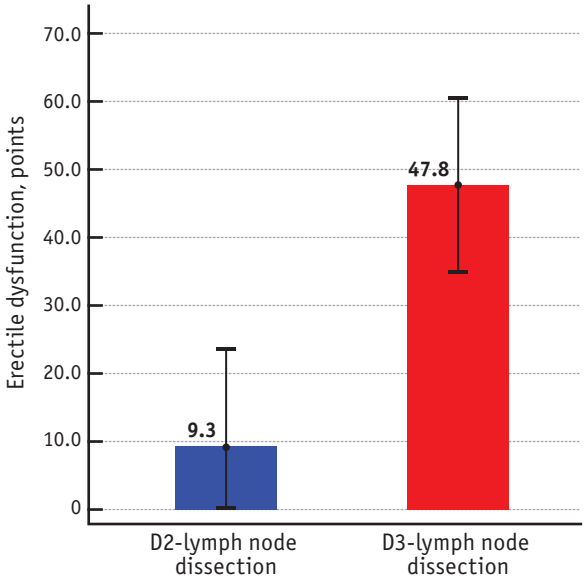


**Figure 4.** *Erectile dysfunction in patients after surgical treatment for left colon cancer depending on the level of LD*

patients depending on the volume of lymph node dissection.

## DISCUSSION

Traditionally, the assessment of the quality of life of patients operated on for colon cancer is made using special questionnaires that characterize their functional and symptomatic condition. For example, the EORTC QLQ-C30 quality of life questionnaire was developed back in 1987 [18]. Each of the questionnaires given by us has its own criteria and evaluation scale. With their help it is possible to determine the conditional norm of quality of life before treatment, and, in the future, to compare it with this indicator after surgery. This approach allows to determine even small changes in QoL that occurred after treatment for cancer.

In the course of the study of the quality of life of patients with colon cancer, it was found that, regardless of the volume of lymph node dissection, there was a significant improvement in the general condition of patients after surgery ($p_{QoLD3}$ = 0.005, $p_{QoLD2}$ = 0.023). However, a detailed analysis of the data revealed a significant ($p$ = 0.022) increase in the severity of diarrhea after resection of the right colon with extended LD: from 21.6 to 26.7 points. In the control group, on the contrary, there was a decrease in this indicator from 13.1 points to 11.6 points. The results obtained are consistent with the data of other studies. Thus, according to Thorsen, Y. (2016), performing extended LD during right hemicolectomy led to an increase in the frequency of defecation up to 3 times a day in 32.7% of the studied patients, and in 12% of cases there was an increase in the frequency of stool up to 4 times a day; whereas the madence of this indicator at D2 LD was equal to 12.3%. The revealed differences were significant ($p$ = 0.022). The authors associated the development of diarrhea with denervation of the small intestine as a result of damage to the nerve plexus located along the superior mesenteric artery [19]. When performing LD in the volume of D3 in cancer of the right and left colon in the postoperative period, there was a significant increase in the incidence of nocturnal defecation after right hemicolectomy, compared with left hemicolectomy — 13.2% and 2.1%, respectively ($p \leqslant 0.05$) [20].

The analysis of the answers to the questions of the special module for patients with colorectal cancer (QLQ-CR29 v.2.1) revealed that in the early postoperative period, patients were more likely to suffer from erectile dysfunction after lymph node dissection in the volume of D3 in cancer of the left colon ($p$ = 0.031). Such an increase in the incidence of impotence development can most likely be associated with damage to the structures of the upper hypogastric plexus, since the influence of age and the initial ED values factors were leveled during the analysis. Thus, the conducted analysis suggests that erectile dysfunction in 49% of cases of the left colon resection was due to intraoperative impact on the hypogastric plexus when removing the 253 group of LNs.

## CONCLUSION

The analysis of differences in the indicators of the scales of physical and social functioning, as well as symptomatic scales allowed us to establish that the QoL in patients operated on for colon cancer decreases to a greater extent due to impaired sexual function after resection of the left colon and the process of defecation after surgery for the right colon cancer. There were no significant changes in the assessment of physical and emotional well-being.

The obtained results suggest that the removal of 253, 203, 213, and 223 groups of LN may lead to similar functional disorders in the early postoperative period. To determine the feasibility of further development and widespread implementation of the extended LD, it is necessary to continue the study with an analysis of long-term results, as well as to assess the level of QoL at a later date.

**AUTHORS' CONTRIBUTION**

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