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Are there any advantages of 3D laparoscopic technologies in surgery for rectocele and rectal prolapse?

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ABSTRACT *AIM: to assess results of 3D laparoscopic ventral mesh rectopexy versus traditional 2D laparoscopy for rectocele and rectal prolapse.*

PATIENTS AND METHODS: a prospective randomized study (NCT 04817150) included patients aged 18 to 70 years who underwent laparoscopic ventral mesh rectopexy for rectocele and/or rectal prolapse. The assessment included operation time, intraoperative blood loss, complications rate and their severity by Clavien-Dindo scale, the pain intensity by VAS, the volume of the fluid collection in the implant site 2–3 days and 2–3 weeks after the procedure. The surgeon's comfort and ergonomics when using 3D systems was evaluated using POMS questionnaire. The late results were assessed by recurrence rate, functional results — by Cleveland Clinic Constipation scale score, Incontinence scale score, P-Qol, and PGII.

RESULTS: the study included 29 patients of the main and 32 patients of the control group. The follow-up was 21 ± 20.3 months. One complication developed in the control group (p = 1.0). The operation time in the main group was 74.1 ± 14 minutes (87.1 ± 24.3 minutes in controls, p = 0.01). The intraoperative blood loss was 19.8 ± 9.6 ml in the main group (55 ± 39.2 ml in controls, p = 0.001). The pain intensity was significantly lower in the main group (18.0 vs 22.5 points, p = 0.03). The volume of fluid collection 2–3 after surgery mesh site was 21.2 ± 9.7 cm^3 in the main group (30.7 ± 25.6 cm^3 in the control group, p = 0.02). The POMS scale assessment for a surgeon in the main group was 56.4 ± 33.5 points (87.3 ± 30.8 points in the control group). A follow-up examination 12 months postop revealed no recurrence in both groups (p = 1.0). The main and the control group showed no significant differences in functional outcomes.

CONCLUSIONS: the use of 3D laparoscopic ventral mesh rectopexy for rectocele and rectal prolapse is comparable in late results with traditional laparoscopic procedure. However, it takes less operation time, lower pain intensity, less intraoperative blood loss, smaller fluid collection at mesh site, better comfort and ergonomics for surgeon.

KEYWORDS: *rectocele, rectal prolapse, 3D laparoscopy, ventral mesh rectopexy*

CONFLICT OF INTEREST: *The authors declare no conflict of interest*

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INTRODUCTION

Due to the worldwide increase in life expectancy of the population, as well as increased requirements for its quality, the problem of pelvic prolapse, and in particular, rectocele, is becoming more and more urgent. According to epidemiology, various degrees of pelvic prolapse of some compartments can be detected in 41–50% of females during gynecological check-up; however, clinical symptoms are detected only in 3% of them.

Among the subgroup of patients who underwent hysterectomy, the risk of rectocele requiring surgery is already about 12.6% [1,2]; and in the presence of clinical symptoms of posterior

compartment prolapse, every 5th woman has a risk of being operated by the age of 80 [1]. It is expected that due to the increasing trend towards an increase in life expectancy, by 2050 the incidence of pelvic organ prolapse (POP) will be 46% of the female population [3]. The treatment of pelvic organ prolapse undoubtedly requires a comprehensive and multidisciplinary approach, the interaction of gynecologists, urologists and colorectal surgeons. An important role in treatment approach for these patients is also assigned to specialists in instrumental diagnostics [4,5].

To date, a significant number of studies have been done, which have demonstrated the advantages of transabdominal laparoscopic and robotic access in the treatment of rectocele and rectal prolapse, in comparison with perineal access [6–8]. The most common transabdominal surgery used to correct severe rectocele, especially in combination with apical pelvic prolapse, as well as to eliminate full-layer prolapse and intussusception of the rectum, is laparoscopic ventral rectopexy with a mesh implant. This technique was first proposed by the Belgian surgeon A. D'Hoore in 2004 as a technique that allows the correction of rectal prolapse without increasing the incidence of obstructive defecation and *de novo* constipation syndrome by limiting the area of tissue dissection along the rectum exclusively by its anterior surface and, as a consequence, preserving the autonomous innervation of the bowel walls [9]. The essence of the method consists in dissection in the area of the rectovaginal septum from the deepest point of the rectovaginal recess along the rectovaginal fascia to the level of the pelvic floor muscles, followed by the installation of a mesh implant in the form of a ribbon and fixing its opposite end to the anterior longitudinal ligament of the spine in the area of the sacrum cape, as shown in Figure 1. The technique is recognized as a low-traumatic, effective, having a low recurrence rate, and is used everywhere.

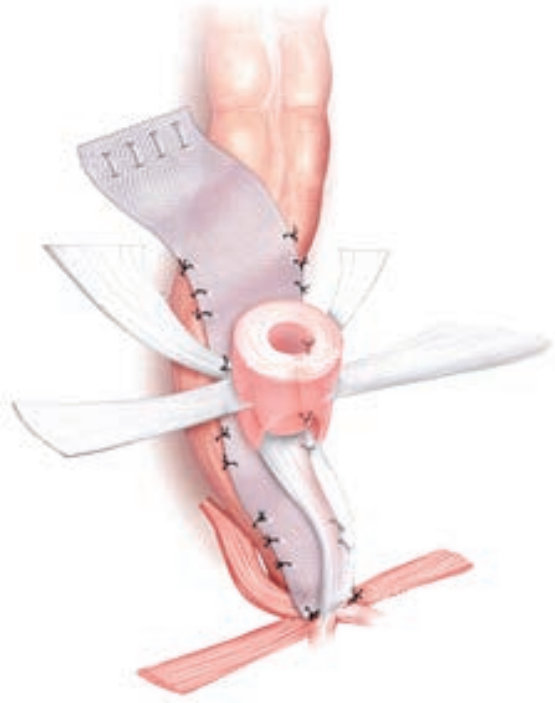

Figure 1. *Schematic representation of the mesh position during laparoscopic ventralmesh rectopexy*

According to the literature, laparoscopic ventral rectopexy is a highly effective procedure for anatomical correction of posterior pelvic prolapse, has a low risk of complications and a short recovery [10–26].

However, performing this procedure involves a rather long learning curve for the surgeon due to the technical complexity of tissue dissection in the limited spaces of the pelvis and the need to apply low endocorporal sutures to fix the mesh to the pelvic floor muscles and mesorectal fascia on the anterior surface of the rectum.

In this connection, since the first robotic rectopexy was performed in 2004, the research has been actively conducted to study the advantages of the new high-tech access [27,28]. According to a number of randomized trials, robotic access has an efficiency comparable to laparoscopic one in restoring the anatomical interposition of the pelvic organs. Among the advantages of robotic ventral rectopexy, the authors highlight a less intraoperative blood loss, better visual control in the limited anatomical spaces of the pelvis and greater ergonomics for the surgeon [27–33] (Table 1).

However, the disadvantages of this technique include the high cost of equipment, the need for a complete reorganization of the surgery room, as well as a longer operation time, which, in addition to the early outcomes, is also

Table 1. *Studies of laparoscopic and robotic-assisted ventral mesh rectopexy*

Studies, Authors	Year	Number of patients, total (robotic/ laparoscopic subgroups)	Recurrence of abs., robotic / laparoscopic subgroups	Operation time excluding docking, min, robotic/ laparoscopic subgroups	Complications, *n* (%)	Observation period, months
Makela-Kaikkonen et al. [29]	2016	30 (16/14)	0/0	202/195	5 (31)/1 (7)	3
Mehmood et al. [30]	2014	51 (17/34)	0/0	138/115	0/6 (17)	12
Makela-Kaikkonen et al. [31]	2014	40 (20/20)	1/1	231/234	2 (10)/1 (5)	3
Mantoo et al. [32]	2013	118 (44/74)	3/6	191/163	5 (11)/15 (20)	16
Faucheron et al. [33]	2016	20 (10/10)	0/0	94/52,5	0/1 (10)	1

reflected in the 'cost-effectiveness' ratio due to the longer work of the entire operating team to perform a single procedure [29–33].

At the time of writing this article, we have not found any reports in the Russian and foreign literature about the use of laparoscopic ventral rectopexy with a mesh implant using 3D equipment. The undoubted advantage of this access is a three-dimensional image of the surgical field, which allows precise differentiation and dissection of tissues and the detection of anatomical landmarks — hypogastric nerves, right ureter, right common and internal iliac arteries, median sacral artery and vein, longitudinal ligament of the sacrum. In addition, more precise manipulations in the confined space of the pelvis provide thorough hemostasis, which generally creates conditions for safer performance of all stages of the procedure in comparison with traditional laparoscopic access. The 3D system makes it possible to reduce the operation time at a significantly lower cost of equipment and the absence of time spent on 'docking' a robotic installation in comparison with robotic procedure.

AIM

The aim of the study is to compare the early and late results of the use of 3D and traditional 2D laparoscopic ventral mesh rectopexy in the treatment of patients with rectocele and rectal prolapse.

PATIENTS AND METHODS

The study is a randomized prospective comparative study *(NCT 04817150)* in the main (29 patients) and control (32 patients) groups, which included patients aged 18–70 years, who underwent laparoscopic surgery for rectocele and/or rectal prolapse in 2015–2020.

The inclusion criteria are:

— Rectocele of the 3rd degree (according to the Russian classification [34]) and the 3rd-4th stages according to POP-Q [35] and/or rectal prolapse;
— Female gender;
— Age between 18 and 70 years.

The exclusion criteria are:

— severe and decompensated comorbidities (class III-IV according to ASA [American Society of Anesthesiologists]),
— oncological, hematological diseases, inflammatory bowel disease and inflammatory disease of pelvic organs,
— pregnancy.

The patients were randomly assigned to 2 groups: the main group (3D laparoscopic correction, 29 women) and the control group (2D laparoscopy, 32 women). For the distribution, the method of simple fixed randomization using computer random number generation was used. All the procedures were performed by one surgeon, whose experience had been over 50 laparoscopic rectopexies by the time the study began.

Table 2. *Preoperative characteristics of patients*

Clinical groups	Main group — 3D laparoscopic rectopexy (*n* = 29)	Control group — 2D laparoscopic rectopexy (*n* = 32)	Statistical Differences
Age, years, Me [Q_1;Q_2]	58 [50;63]	57 [48;62.5]	$p = 0.47$
Number of births, abs., Me [Q_1;Q_2]	3 [2;4]	2 [1;3]	$p = 0.123$
BMI, kg/m^2, Me [Q_1;Q_2]	30.2 [25.1;32.2]	30.4 [28.6;32.3]	$p = 0.31$
Menstrual pause, abs. (%)	16 (55.2%)	19 (59.4%)	$p = 0.741$
Surgeries on the pelvic organs and anorectal area in the anamnesis	4 extirpations of the uterus with appendages, 12 CS, 3 hemorrhoidectomies 2 posterior colporraphy, 1 sphincterolevatoroplasty	6 hysterectomies, 10 CS, 1 anterior colporraphy 4 hemorrhoidectomies	–
Duration of symptoms, years, Me [Q_1;Q_2]	8 [5;10]	8.5 [5;11.5]	$p = 0.58$
Total points as per Cleveland Clinic Constipation score (max — 30), Me [Q_1;Q_2]	13 [10;19]	11 [9;18,5] 11 [9;18.5]	$p = 0.58$
Total points as per Incontinence score (max — 20), Me [Q_1;Q_2]	2 [1;3]	1 [0;3]	$p = 0.066$
Stress urinary incontinence, abs. (%)	8 (27.6%)	9 (28.1%)	$p = 0.96$
Total points as per P-Qol scale (max — 115), Me [Q_1;Q_2]	55 [49;71]	65.5 [56;71]	$p = 0.06$

*Note: *The differences are significant at $p \leq 0.05$.*

For three-dimensional visualization in the main group, surgery was performed using the Olympus VISERA ELITE II system (Olympus Corporation, Japan).

Preoperative check-up included a standard clinical examination, examination in a gynecological chair, as well as functional Valsalva tests, cough, examination in a squatting position, staging of pelvic prolapse according to the POP-Q system, tonoperineometry, anoscopy, colonoscopy, defecography, as well as transperineal, transvaginal and transrectal ultrasound in the search of defects in the pelvic floor muscles and anal sphincter.

The severity of clinical symptoms and their impact on quality of life were assessed using the Prolapse-Quality of Life questionnaire [36] before surgery and at a follow-up 12 months after the surgery.

The patients were also surveyed according to the Cleveland Clinic Constipation Scoring System and Wexner's anal Incontinence scale at similar time [37].

When performing the surgery, its duration, the intraoperative blood loss, complications and their severity on the Clavien-Dindo scale were recorded. In the early postoperative period, the severity of the pain syndrome was assessed according to the VAS, 24 hours after the end of the procedure, and the patients' need for narcotic and non-narcotic analgesics.

It seems extremely important to assess the site of the installed mesh, as well as the state of the rectovaginal space at the mesh site.

The size of this space is directly related to the volume of fluid collection due to the tissue reaction to the mesh, the anatomical installation of the mesh, its adequate fixation to the

mesorectum and pelvic floor muscles, as well as the presence of postoperative seroma or hematoma.

To assess this, we used transvaginal ultrasound examination with a convex sensor on the 3rd day after the surgery.

This test was also repeated during a follow-up control in 2–3 weeks after laparoscopic rectopexy was performed.

Another question of the study was the evaluation of the convenience and ergonomics of the surgeon when using 3D systems. To determine the degree of complexity of the procedure for an experienced endoscopic surgeon, we selected a validated questionnaire — the POMS (Profile of Mood States) fatigue and psychoemotional state assessment scale [38], consisting of 65 questions with answer options on a five-point Likert scale from 'not at all' to 'very much'. The operating surgeon was asked to fill out a questionnaire immediately after performing each procedure within the framework of this study to determine the degree of fatigue and strain after performing ventral mesh rectopexy by traditional laparoscopic access and using 3D systems.

All the data obtained were collected and structured into one database using the MS Excel 12 program (MicroSoft, USA). A descriptive and comparative statistical analysis was carried out using the software SPSS Statistic 26.0 (IBM, USA) and Statistica 10.0 (StatSoft, USA). At the first stage, all quantitative data were checked for compliance with the normal distribution law (NDL) using the Shapiro-Wilk test, since the volumes of all samples were less than 50 (the main group $n = 29$, the control group $n = 32$). In the cases where the sample comply with the NDL (when the significance level was $p > 0.05$), the description was planned to be carried out in the form of a mean and standard deviation (M ± SD), and the comparison of independent (between the study groups) and dependent samples (before/after the study in the same group) was carried out using the Student's-test.

In the cases where the sample did not comply with the NDL (significance level $p < 0.05$), the description was planned to be carried out in the form of median, 25% and 75% quartiles (Me [Q1;Q2]), and the comparison of independent (between the study groups) and dependent (before/after the study in the same group) samples was carried out using the Mann-Whitney test. Absolute (quantity) and relative (percent) data were used to describe categorical (nominal) data, and the χ^2-Pearson test was used to compare them. In the comparative analysis, significant differences between the study groups were considered when the significance level of P was less than 0.05 ($p < 0.05$). The preoperative characteristics of the patients are presented in Table 2.

The age of the patients in the study groups was 55.3 ± 10.3 years (32–70 years, 58 [49;63]), the number of births was 2.4 ± 1.4 (0–5 births, 2 [1;3]), the average BMI was 29.26 ± 4.49 kg/m^2 (18.1–36 kg/m^2, 30.4 [28.2;32.3]). Previously performed surgical procedures were in 36% of the patients who underwent cesarean section, 16.4% underwent hysterectomy, 11.5% underwent hemorrhoidectomy, 4.9% underwent colporrhaphy, and 1.6% underwent sphincterolevatoroplasty for grade 3 perineal rupture.

The duration of existing symptoms of pelvic prolapse was 8.16 ± 4.0 years (2–20 years, 8 [5;11]). The score on the Cleveland Clinic Constipation scale among patients — 13,8 ± 5,7 (6–28, 12 [9;19]) points, stress urinary incontinence was observed in 27.9% of patients.

The total score on the P-Qol scale before surgery was 61.7 ± 15.2 points (25–100, 63 [50;71]).

There were no significant differences in baseline parameters among the patients, in all cases $p > 0.05$.

After discharge from the hospital, the patients were at follow-up 121 ± 20.3 months.

In 12 months after the surgery, the patients underwent a control clinical assessment, during which the anatomical and functional results of the surgery were evaluated.

At the same time, the stage of prolapse according to POP-Q, repeated questionnaires on the CCCS, Wexner Incontinence scale, P-QOL, the presence of stress urinary incontinence and the patient's overall satisfaction with treatment according to the PGII (Patient Global

Impression of Improvement) questionnaire were taken into account [39].

The correction of rectocele was considered successful if it was detected during control on a gynecological chair with functional tests in the early postoperative period of the degree of POP 0–1 according to POP-Q. With a degree of POP-Q ⩾ 2, the correction was considered unsuccessful.

Anatomical relapse was defined as the omission of the pelvic organs POP-Q ⩾ 2 during a control examination on a gynecological chair in 12 months after.

Since, according to the developed design of the study, all the surgeries were performed in the same unit by the same surgeon, in order to improve the quality of the data obtained. Also, the assessment of early and late results of the surgery was carried out by two blinded specialists.

Operative Technique

All the procedures were performed under general anesthesia in the spinal position in the Trendelenburg position. The bladder was catheterized with a Foley catheter. The surgeon was located at the head end of the operating table on the left, the assistant — at the head end on the right, as shown in Figure 2. Then 5 trocars were installed: 10 mm paraumbilical, 12 mm in the right hypogastric area and 3–5 mm trocars in the left hypogastric area, as shown in Figure 3.

Stage I. After an overview laparoscopy, the sigmoid colon was removed to the left with an atraumatic clamp through the left lateral port, and a J-shaped dissection of the parietal peritoneum was performed from the projection area of the longitudinal presacral ligament at the level of the sacrum cape to the deepest point of the Douglas pouch by monopolar coagulation (Fig. 4). After that, anatomical landmarks of dissection were visualized: hypogastric nerves, right ureter, right common and internal iliac arteries, median sacral artery and vein, and the longitudinal ligament of the sacrum were identified. In the area of the rectal-uterine pouch, dissection was performed in the plane of the rectovaginal space along the anterior surface of the rectum to the level of levators. Additional control of the level of dissection and integrity of the vaginal mucosa and rectum was carried out using digital rectal and vaginal examinations by a third assistant.

Stage II. A prolenemesh 3 × 20 cm, was inserted into the abdominal cavity. The mesh was fixed with an endogerniostapler to the levators for the convenience of further application of intracorporal sutures (Fig.5). Then the lateral margins of the mesh were fixed along the anterior surface of the rectum to the mesorectal fascia with a continuous suture with a 2–0 PDS thread at one end (Fig.6).

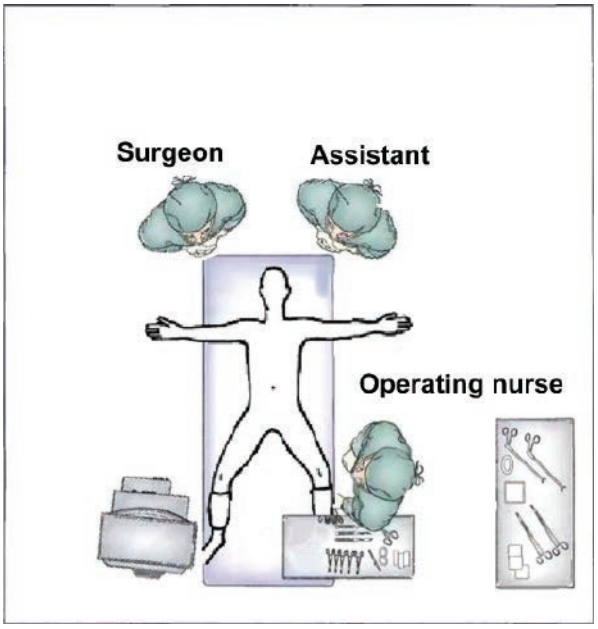

Figure 2. *Patient position and the location of the operating team*

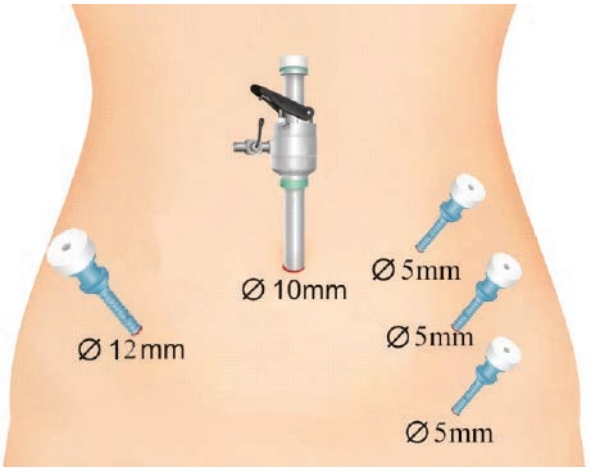

Figure 3. *Port sites on the anterior abdominal wall*

After fixation, the third assistant additionally performed digital control of the integrity of the mucosa of the rectum and vagina.
Stage III. The opposite end of the mesh was fixed to the longitudinal ligament of the sacrum with two separate sutures of 2–0 without tension (Fig. 7).
Stage IV. The peritoneum was sutured with a continuous absorbable suture over a mesh implant (Fig. 8).
No drainages were used as a standard.
For three-dimensional visualization in the main group, surgical procedure was performed using the Olympus VISERA ELITE II system (Olympus Corporation, Japan).

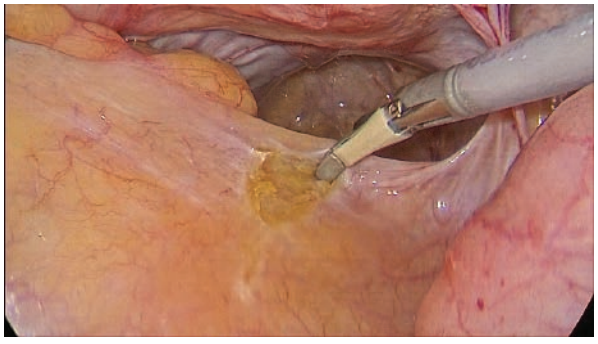

Figure 4. *Intraoperative photo: the beginning of the parietal peritoneum opening in the region of the sacral promontory*

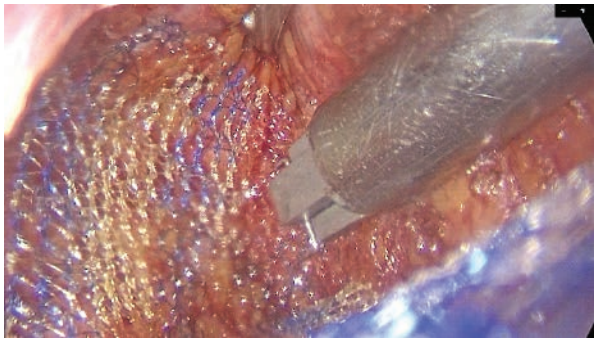

Figure 5. *Fixation of the implant to the levators using an endostepler*

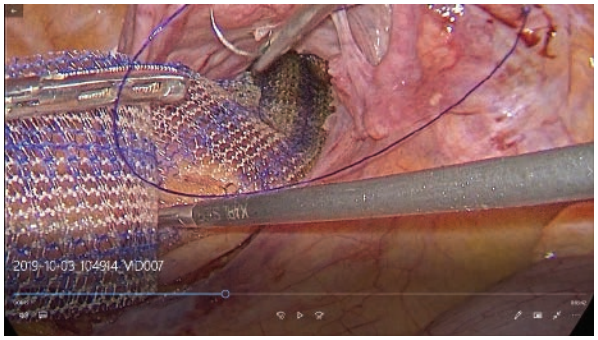

Figure 6. *The mesh implant is positioned as required, its lateral edges are fixed to the mesorectal fascia along the anterior surface of the rectum with absorbable suture material*

RESULTS

Eighty-seven operated patients in 2015–2020 were included in the study.
Of these, 24 patients were excluded according to the criteria, and 2 refused to participate. As a result, 61 patients underwent the randomization: 29 were randomly assigned to the main group, and 32 to the control group, as shown in the CONSORT (Consolidated Standards of Reporting Trials) diagram (Fig. 9) [40]. At the follow-up stage, there was no dropout of the patients. Thus, the present study includes the data on the treatment of 61 patients. The follow-up period for the patients was 1.75 ± 1.69 (0–7.1 [0;3]) years.
The operative time in the main group was 74.1 ± 14.0 minutes vs87.1 ± 24.3 minutes in the controls.
The intraoperative blood loss in the main group was 19.8 ± 9.6 ml, in the control one– 55.0 ± 39.2 ml.

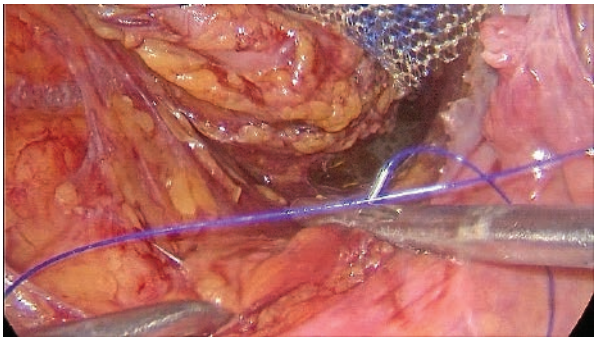

Figure 7. *Mesh fixation to the longitudinal sacral ligament with a non-absorbable suture*

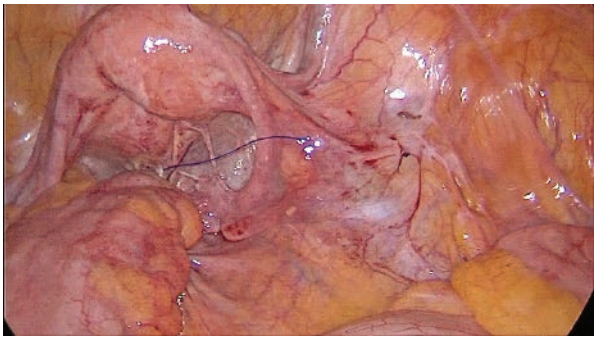

Figure 8. *Peritonization is performed*

Table 4 shows the medial values, 25% and 75% quartiles, since the sample data did not comply with the NDL according to the Shapiro-Wilk test. According to the Mann-Whitney test, there were no significant differences in the hospital stay between the groups ($p > 0.05$). The early results of surgery of the patients are summarized in Table 3.

According to the results of transvaginal ultrasound 2–3 days after rectopexy, a volume of the fluid collection at the mesh site in the main group was 21.2 ± 9.7 (3–115) cm^3, and in the control group — 30.7 ± 25.6 cm^3 (5–120).

With control ultrasound within 2–3 weeks from the moment of the surgery, the volume of the

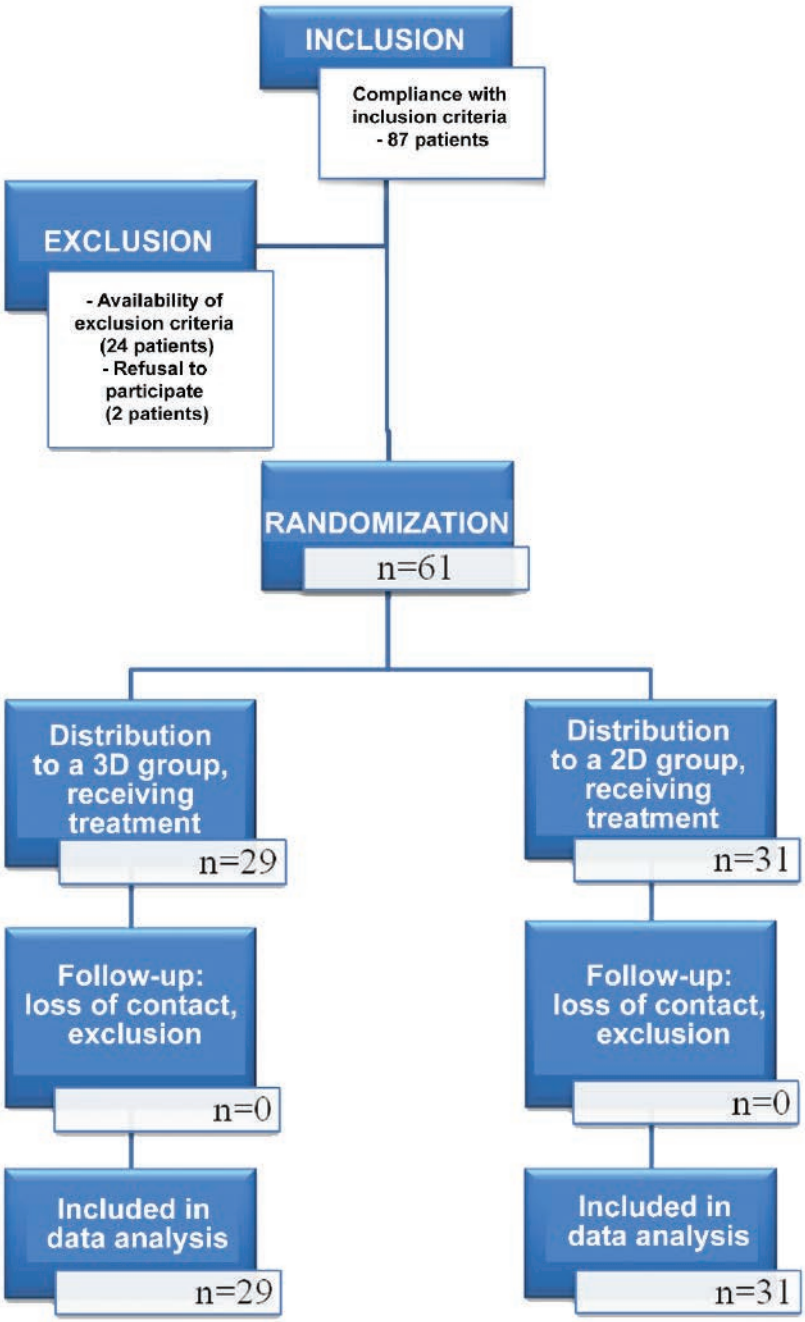

Figure 9. *CONSORT diagram*

Table 3. *Early results of laparoscopic 3D and 2D ventral rectopexy*

	Main group — 3D laparoscopic rectopexy (*n* = 29)	Control group — 2D laparoscopic rectopexy (*n* = 32)	Statistical differences
Operative time, min., Me [Q_1;Q_2]	70 [63;80]	80.5 [69;96]	***p = 0.01****
Blood loss, ml., Me [Q_1;Q_2]	15 [15;30]	50 [17.5;90]	***p = 0.001****
Hospital stay, days, Me [Q_1;Q_2]	4 [3;6]	5 [4;6.5]	*p* = 0.35
Pain intensity by VAS 24 hours after surgery, Me [Q_1;Q_2]	18 [11;31]	22.5 [8.5;37.5]	***p = 0.03****
Transvaginal ultrasound, volume of fluid collection at mesh site on 2nd-3rd days after surgery, cm^3, Me [Q_1;Q_2]	20 [14;29.3]	15.5 [8;56]	***p = 0.02****
Transvaginal ultrasound, volume of fluid collectionin2-3 weeks after surgery, cm^3 Me [Q_1;Q_2]	6 [2;8]	5.5 [2.3;10.5]	*p* = 0.27
Complications requiring reoperation	–	–	***p = 1.0***
Complications, abs. (%)	–	1 (3.1%) case of rectovaginal septum hematoma	***p = 1.0***
Points on POMS scale immediately after surgery (max — 160), Me [Q_1;Q_2]	48 [26;93]	74 [65.5;96.5]	***p = 0.004****

*Note: *The differences are significant at p < 0.05 according to the Mann-Whitney test for independent samples.*

fluid collection decreased, 5.4 ± 3.6 cm^3 and 6.7 ± 5.3 cm^3 in the main and control groups, respectively. Since the samples did not comply with the NDL according to the Shapiro-Wilk test, the medial and quartile data were presented in Table 3. There were no complications requiring re-operation among patients in both groups. In the early postoperative period, 1 patient of the control group was found to have a hematoma in the site of the rectovaginal septum, which was successfully evacuated by aspiration (grade 3a according to the Clavien-Dindo classification).

According to the results obtained, the score on the fatigue scale for the surgeon after traditional laparoscopic rectopexy was 87.3 ± 30.8 (57–160) points, whereas after the surgery using 3D equipment, the average score was 56.4 ± 33.5 (14–117).

We explain such differences by the lower psycho-emotional stress of the surgeon in visual control and convenience of basic surgical maneuvers when using 3D laparoscopy.

It was found that in 12 months after surgery, there was no anatomical recurrence among the patients of both groups. When studying the functional results, it was revealed that according to the Cleveland Clinic constipation scale, there was a significant decrease in the symptoms of obstructive defecation in both groups as well: 14.3 ± 3.5 points before surgery and 6.8 ± 1.3 in the main group, and 13.5 ± 4.2 points versus 7.1 ± 1.8 in the control group. According to the Mann-Whitney test for dependent samples, the differences before/after were significant in both groups $p < 0.05$ in each case. The patients noted a significant improvement in the quality of life, which is reflected in the P-Qol questionnaire: 5.6 ± 4.1 in the main group and 6.1 ± 5.1 in the control group after surgery vs 57.9 ± 25.3 and 65.1 ± 29.3 before surgery, respectively (according to the Mann-Whitney test for dependent

Table 4. *Late results of laparoscopic 3D and 2D ventral mesh rectopexy (follow-up 21.0 ± 20.3 months).*

	Main group — 3D laparoscopic rectopexy (*n* = 29)	Control group — 2D laparoscopic rectopexy (*n* = 32)	Statistical differences
Recurrence after 12 months according to POP-Q, abs. (%)	0	0	–
Cleveland Clinic Constipation scale score after surgery (max — 30), Me [Q_1;Q_2]	7 [6;8]	8 [7;8]	$p = 0.42$
Incontinence scale score (max — 20), Me [Q_1;Q_2]	0 [0;1]	1 [0;1]	$p = 0.06$
Stress urinary incontinence, % (abs.)	3.5% (1)	9.4% (3)	$p = 0.35$
P-Qol score (max — 115) after 12 months, Me [Q_1;Q_2]	6 [1;9]	4 [2;11.5]	$p = 0.64$
PGII (Patient Global Impression of Improvement), Me [Q_1;Q_2]	1 [1;1]	1 [1;2]	$p = 0.4$

*Note: *The differences are statistically significant at $p \leq 0.05$.*

samples, the differences before/after were significant in both groups $p < 0.05$ in each case).

DISCUSSION

Laparoscopic ventral rectopexy is currently a widespread type of surgery in the correction of posterior compartment prolapse, as indirectly evidenced by a large number of studies on the effectiveness and safety of this surgery, as well as comparing its results with other methods of correction of POP [4, 8–31].

The D'Hoore procedure includes dissection of tissues in the rectovaginal septum from the deepest point of the rectovaginal pouch along the rectovaginal fascia to the level of the pelvic floor muscles, followed by the ribbon mesh and fixing its opposite end to the anterior longitudinal ligament of the spine in the area of the promontorium.

Recently the widespread implementation of robotic surgery into practice took place.

The evaluation of the 'cost–effectiveness' ratio was not the purpose of this study. However, it is known that robotic rectopexy in comparison with laparoscopic surgery is more expensive due to the high cost of re-equipment of the operating room, as well as a longer operation time, and, accordingly, the labor costs of the entire operating team for the treatment of one patient.

The use of 3D laparoscopy makes it possible to realize the advantages of robotic surgery, such as a better visual control in narrow spaces of the pelvis, providing more accurate dissection along with a lower risk of injury to anatomical structures and small blood vessels, without significantly increasing economic costs.

Another advantage of using 3D laparoscopy from the point of view of the healthcare system is the issue of the learning curve for the surgeon. The use of robotic surgical systems implies special training not only for the operating surgeon, but also for the entire team. On the contrary, the use of 3D laparoscopy does not require special training of a surgeon who has the skills of laparoscopic procedures.

At the time of writing this article, there were no trials in the available literature on laparoscopic ventral rectopexy using 3D equipment. The study included 61 patients with severe rectocele and/or rectal prolapse. These patients consisted the main group (29 patients) and the control one (32 patients). The follow-up period was 21.0 ± 20.3 months. One of the indications for choosing the laparoscopic method for rectocele was the absence of severe defects in the patient of the 3rd level of fixation of the pelvic organs according to De Lancey, that is, the absence of changes in the anatomy of the perineum, since transabdominal techniques do not imply correction of these defects.

The study showed significant advantages of using 3D laparoscopy in reducing the time of a procedure, the intraoperative blood loss, and the postoperative pain intensity. The operative time in the main group was 74.1 ± 14.0 minutes, while in the control group — 87.1 ± 24.3 minutes. The intraoperative blood loss in the 3D laparoscopy group was 19.8 ± 9.6 ml, in the group of traditional 2D laparoscopy — 55.0 ± 39.2 ml. The three-dimensional image allowed the surgeon to perform maneuvers with a better visual control and convenience of basic techniques, which indirectly affected the precision of the installation and fixation of the mesh. The assessment of the trauma of the procedure was carried out indirectly by the severity of the pain syndrome according to the VAS in 24 hours after the surgery. The mean pain intensity in the 3D laparoscopy group was 18 mm, in the subgroup of traditional 2D laparoscopy — 22.5 mm.

The important question of the postoperative follow-up was the assessment of the rectovaginal space and the mesh site fluid collection, the hematomas and seromas here revealed by ultrasound on the 2nd-3rd days after rectopexy. The volume of fluid collection in the mesh site in the main group was 21.2 ± 9.7 (3–115) cm^3 vs 30.7 ± 25.6 (5–120) cm^3. With ultrasound control 2–3 weeks later from the moment of surgery, the volume of the fluid collection decreased, amounting to 5.4 ± 3.6 cm^3 and 6.7 ± 5.3 cm^3 in the main and control groups, respectively. The volume of the fluid collection in the mesh site indirectly indicates the accuracy of tissue dissection and the physiology of the mesh installation and reflects the result of the most technically difficult stage of the procedure — separation of the rectovaginal septum.

The ergonomics of the surgeon and better conditions for visual control also affected the psycho-emotional strain and fatigue.

The score on the POMS scale for a surgeon after traditional rectopexy was 87.3 ± 30.8 points, whereas after surgery using 3D equipment it was 56.4 ± 33.5.

With the identical technique of procedure, there were no significant differences in the functional results of the surgery. At a follow-up after 12 months, no anatomical recurrence was detected among the patients of both groups. According to the Cleveland Clinic constipation scale, a significant decrease in obstructive symptoms was observed in both groups: 14.3 ± 3.5 points before surgery and 6.8 ± 1.3 in the main group, and 13.5 ± 4.2 points vs 7.1 ± 1.8 in the control group.

The patients noted a significant improvement in the quality of life, which is reflected in the P-Qol questionnaire: 5.6 ± 4.1 in the main group vs 6.1 ± 5.1 in the controls after surgery vs 57.9 ± 25.3 and 65.1 ± 29.3 before the surgery. We considered a follow-up 1 year after the surgery to be an adequate follow-up for this comparative study.

Thus, the use of 3D laparoscopy makes the procedure of ventral mesh rectopexy less traumatic compared to traditional 2D laparoscopy, which is reflected by the intraoperative blood loss, the operative time, and a lower postoperative pain intensity.

These factors make it possible to achieve a more physiological laying of the mesh, which is indirectly evidenced by a decrease in the volume of the fluid collection in the mesh site.

CONCLUSIONS

The use of 3D laparoscopy when performing ventral mesh rectopexy in patients with rectocele and/or rectal prolapse is comparable in late anatomical and functional results with traditional laparoscopic technique.

However, with regard to the surgical injury, the first one has better results due to more accurate visual control of anatomical landmarks in the confined spaces of the pelvis, more precise dissection, which is confirmed by a decrease in the operative time, a lower postoperative pain, a less intraoperative blood loss.

The decrease in the degree of injury to anatomical structures and the physiology of mesh position indirectly allows to judge the decrease in tissue reaction, expressed in the volume fluid collection at the mesh site.

The advantages of 3D laparoscopy can also include greater convenience and ergonomics of work for the surgeon, reflected in the reduction of fatigue on the POMS scale after the surgery, with a slight increase in the economic costs of installing and using the necessary 3D equipment.

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