Medical University – Varna

Faculty of Medicine

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Robotic myomectomy. A comparative analysis of clinical outcomes compared with abdominal and laparoscopic approaches.

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Abstract

of a dissertation

for the award of a scientific educational degree "doctor"

Supervisor

Prof. Ivan Kostov, PhD MD

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The dissertation contains a total of 157 pages, illustrated with 35 graphs and 60 tables. The bibliographic reference includes 357 titles, of which 2 are from Bulgarian authors and 355 are from foreign authors. There are 4 publications related to the dissertation work.

The studies for the dissertation work were carried out in "Doverie" Hospital, "Dr. Shterev" Hospital and SBALAG "Maichin Dom", Sofia.

Note: The numbers of tables and figures in the abstract do not correspond to those in the dissertation.

The dissertation was discussed and referred for pubic defense by the council of the Department of Obstetrics and Gynecology at the Faculty of Medicine of the University of Medicine - Varna.

Scientific jury:

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The defense of the dissertation will take place on .....2023 from..... at ...., at an open meeting of the Scientific Jury.

The materials are available at the Scientific Department of the Medical university-Varna and are published on the MU-Varna website (www.mu-varna.bg).

CONTENTS

1. **Abbreviations used in the abstract**

AAGL – American Association of Gynecologic Laparoscopists

AM – abdominal myomectomy

BMI – body mass index

EBL - estimated blood loss

FDA – Food and Drug Administration

IGF – insulin growth factor

LAM – laparoscopically assisted myomectomy

LM – laparoscopic myomectomy

LOS – longitude of hospital stay

LUVO – laparoscopic uterine vessel occlusion

MITT – myoma interstitial thermo – therapy

MRI – magnetic resonance imaging

RM/ RAM– robot-assisted myomectomy

QoL – quality of life

YAG laser – yttrium aluminium garnet laser

UAE – uterine artery embolization

2. Introduction

Myomectomy is an operational technique to remove uterine fiobroids in order to preserve fertility. The main surgical techniques used for myomectomy are open (abdominal) myomectomy, laparoscopic myomectomy, and robot-assisted (robotic) myomectomy.

Myomectomy has been first described by Victor Bonney in 1931, a famous British gynaecologist. The operation remains the gold standard surgical procedure for women wishing to become pregnant in future and to preserve the uterus. He developed a surgical clamp to reduce hemorrhage after myomectomy and established operative techniques to reduce postoperative hematomas. (Bonney V. The technique and results of myomectomy, 1931).

Laparoscopic myomectomy was introduced by Kurt Carl Zemm in 1979, bringing a number of benefits, including smaller scars, reduced postoperative pain, less need for postoperative analgesia, less blood loss, and a shorter recovery period followed by a rapid return to normal activity. Kurt Carl Zemm is a German gynecologist and a pioneer in minimally invasive surgery. He is called the "father of modern laparoscopy". With its acceptance by general surgery, minimally invasive surgery is expanding its applications. Laparoscopy has evolved significantly in the recent decades with improved hand instruments, electrosurgical devices, and high-intensity light sources.

The latest generation of minimally invasive surgery is the robot-assisted surgery. The most widely used robotic system is the da Vinci system, which was developed for the purposes of the US Army in order to provide the possibility of performing surgical operations under military conditions by a remote control. Very soon it finds its civilian application. In April 2005, the da Vinci surgical system was the first robot approved by the FDA for gynecological applications. Thanks to the special tools, conditions are created to improve dexterity and allow the surgeon to manipulate and dissect the tissue in a delicate and controlled manner.

Robotic technology improves the efficiency, accuracy, ease and comfort associated with performing laparoscopic surgeries. Since the approval of the use of the robotic system for gynecological surgery and the presentation of its advantages over conventional laparoscopy, it has become increasingly

widespread in the field of reproductive surgery. Currently, there are several robotic systems created by competing companies - the most common Da Vinci system, the English Versius system, as well as The Hugo™ RAS system, which provide an increasingly wide range of technical characteristics to achieve increasingly better results in intra and postoperative plan.

Uterine fibroids are the most common benign tumors of the female genital tract. Many women at reproductive age with this condition prefer robot-assisted surgeries to preserve fertility. Representing a relatively new method of treatment, it is necessary to carry out a thorough analysis of the results of robotic myomectomy, which will be the goal of the present work, as well as to draw conclusions from the results obtained from the conducted studies.

3. **Objective and tasks**

OBJECTIVE To analyze the perioperative outcomes of robot-assisted myomectomy, evaluate its clinical significance in the treatment of uterine fibroids, and determine its place in modern gynecologic surgery.

3.2.TASKS

1. To study the indicators - age, BMI, indications for surgery, number, size and type of the fibroids.

2. To analyze the intra- and postoperative indicators - operative time, hospital stay, postoperative complications in robot-assisted myomectomy.

3. To conduct a comparative analysis of the perioperative indicators - operative time, hospital stay, BMI, size, number and localization of fibroids in robotic, laparoscopic and abdominal myomectomy.

4. To evaluate the factors that affect the duration of robotic myomectomy.

5. To make an economic analysis of the costs of the three types of myomectomies.

6. To determine the place of robotic myomectomy in the modern treatment of fibroid disease.

4. Robot-assisted myomectomy

Surgical technique

At the beginning of the operation, we place a uterine manipulator. This device facilitates the enucleation process by providing another focal point for traction and countertraction. During the enucleation, the manipulator is critical to keep the uterus in the pelvis and the field of view and to act as countertraction when it is applied to the fibroid. Based on the data on the size of the myoma, an 8-mm trocar is inserted umbilically or supraumbilically through direct access. The abdominal cavity is visualized with a camera and is insufflated with gas to 15 mmHg pressure. The remaining trocars are introduced under visual control. The two 8-mm robotic trocars are placed in the patient's right lower quadrant and left lower quadrant, 2-3 cm above the anterior superior iliac line and caudal to the chamber port in an imaginary arc centered on the symphysis. In patients with a uterus larger than approximately 14-week gestational size, a supraumbilical camera port is often required. We typically use a three-arm technique using three 8mm telerobotic trocar ports and a 12mm Airseal assistant port trocar. There should be at least an arm's length between ports to minimize arm collision and maximize range of motion. Although the 12 mm Airseal trocar is available in various lengths (75–150 mm), we strongly recommend and use the 100 mm trocar. We usually use the following robotic instruments to perform myomectomy: tenaculum, monopolar scissors and bipolar forceps, needle holder. Next is the injection of Vasopressin, which causes vasospasm and contraction of the uterine muscles and reduces blood loss during the operation, we introduce it into the serosa of the fibroid. We prefer transverse hysterotomy. During enucleation, we minimize the use of thermal energy.

Using a tenaculum, the assistant grasps and lifts the fibroid away from the fixed uterus. This step is not intended to enucleate the fibroid by force, but to apply traction and position the fibroid to best outline and approach the anterior edge of the pseudocapsule, which lies between the fibroid and the myometrium. Dissection can then proceed using the push and spread technique, dividing the natural plane between the fibroid and the myometrium. Sometimes the fibrous attachments of the pseudocapsule can be transected using bipolar forceps and

monopolar scissors. We recommend intermittent use of minimal heat energy to facilitate this process and achieve temporary hemostasis. As the dissection progresses, the fibroid may recapture closer to the border with the myometrium, causing the fibroid bed to expand. We proceed to multilayer closure with repair of the myometrium and serosal edges to achieve hemostasis and prevent hematoma.

5. Material and methods

To establish the purpose and tasks of the dissertation, the author will use a retrospective analysis covering 300 patients with performed myomectomy, divided as follows: 100 robot-assisted myomectomies, 100 laparomyomectomies and 100 laparoscopic myomectomies from Doverie Hospital, Dr. Shterev Hospital and SBALAG" Maichin dom", Sofia, for the period 2016-2020. The criteria on which the analysis will be carried out are the following:

- Age of the patient - 20-35 years/ 35-50 years
- Parity (number of births)
- Size of the uterus
- Number of fibroids
- Size of myomas
- Location of myomas
- Duration of operative intervention
- Blood loss
- BMI of the patient
- Intraoperative complications

1. Early complications
2. Late complications

- Cost of the surgery

Statistical methods used for data processing, subject of this dissertation, the SPSS 26 software product was used and the following analyses were applied:

A. Descriptive statistics

1. Quantitative variables – frequency analysis including absolute frequencies and relative frequencies, average value, minimum, maximum;

2. Qualitative variables – frequency analysis including absolute frequencies and relative frequencies;

3. Graphical images to visualize the obtained results

B. Hypothesis testing

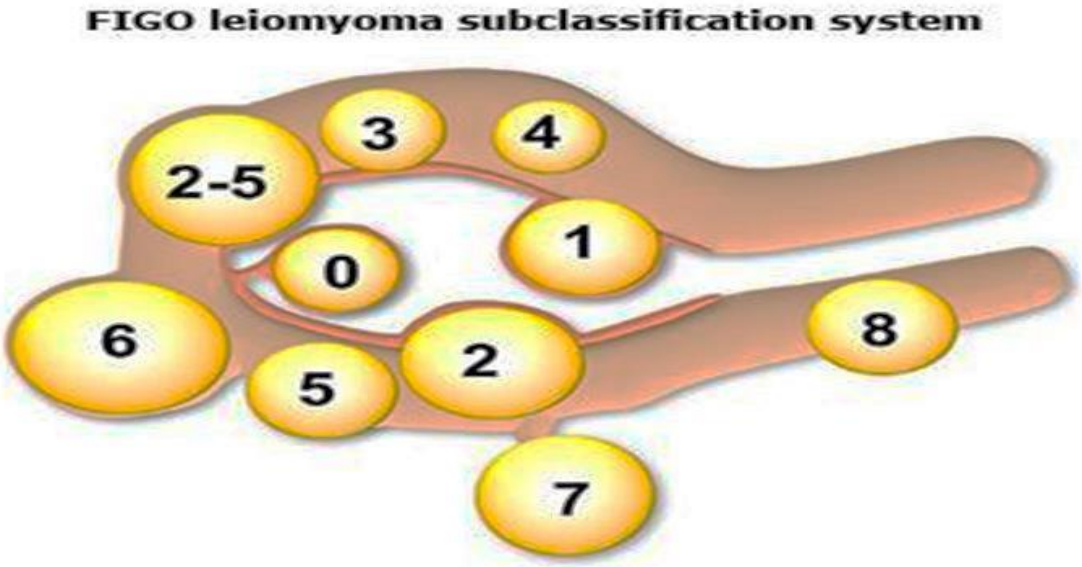
1. One-way analysis of variance (Oneway ANOVA – independent samples) – checking for equality of more than two average values - statistical procedure for testing statistical significance of the difference between the arithmetic means for several independents groups of the independent variable (factor) by the decomposition of the total variance in the dependent variable of effects accounted for by different levels (values) of the independent variable (factor), plus variance error.

1.1. Tukey HDS post hoc statistical test (Honestly Significant Difference) (Tukey's test for true statistical significance) – At distinguishing is applied to find out exactly which ones groups have differences;

2. Chi-square test or Fisher's exact test – search for a relationship between two qualitative variables at small volume incisions;

3. Student's t-test for two independent samples – examines whether there is statistical difference between the arithmetic avegare for the two samples. The critical significance level used in this development is $\alpha = 0.05$. The presence of a relationship or regularity can be claimed when P value is less than 0.05.

Grouping of the fibroids according to their location



0, 1 and 2 represent a submucosal location of myoma, the surgical treatment of which is not the subject of the present work.

3, 4 and 5 are summarized in a group of intramural fibroids.

6 and 7 are separated into a group of subserous fibroids.

8 are in a group of cervical fibroids.

6. Results - discussion, economic indicators

- Distribution of the examined women by the type of surgical intervention

- Distribution of the examined women by age

- Age from 20 to 35 years - blood loss and duration by type of operation

- Age from 36 to 50 years - blood loss and duration by type of operation

- Distribution of the examined women by parity

- Patients with children - blood loss and duration by type of operation

- Patients without children - blood loss and duration by type of operation

- Distribution of the examined women according to the size of the uterus

- Uterus size up to 70 mm - blood loss and duration by type of operation

- Size of the uterus 71 mm and more - blood loss and duration by type of operation

- Distribution of the examined women by number of fibroids

- Patients with one myoma - blood loss and duration depending on the operative approach

- Patients with two or three fibroids - blood loss and duration depending on the operative approach

- Patients with four or more fibroids - blood loss and duration depending on the operative approach- Distribution of the examined women according to the size of the nodules

- Patients with fibroid/s up to 7 cm - blood loss and duration depending on the surgical approach

- Patients with at least one myoma between 7 and 10 cm - blood loss and duration depending on the surgical approach

- Patients with at least one myoma larger than 10 cm - blood loss and duration depending on the surgical approach

- Myoma size and complications

- Patients with fibroids(s) up to 7 cm - complications

- Patients with at least one myoma between 7 and 10 cm – complications

- Female patients with at least one fibroid over 10 cm - complications

- Distribution of the examined women according to the location of the fibroids

- Patients with intramural fibroids – blood loss and duration depending on the surgical approach

- Patients with subserosal fibroids – blood loss and duration depending on the surgical approach

- Patients with cervical fibroids – blood loss and duration depending on the surgical approach

- Patients with four or more fibroids, of which at least one is intramural - blood loss and duration depending on the surgical approach

- Distribution of the studied women by BMI

- Patients with BMI 35 or less - blood loss and duration depending on the surgical approach

- Patients with BMI 36 and above - blood loss and duration depending on the surgical approach

- BMI and complications

- BMI up to 35 - complications

- BMI 36 and more - complications

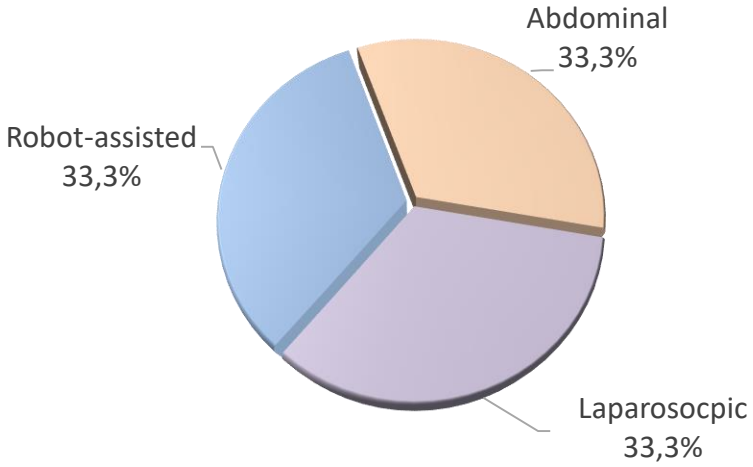
- **Distribution of the examined women by the type of the surgical approach**

Table 1. Distribution of operated women by the syrgical approach

Surgical approach	Number of women	Relative share
Laparoscopic	100	33,3%
Robot-assisted	100	33,3%
Abdominal	100	33,3%
Total	300	100%

-

- **Graphic 1. Distribution of operated women by the syrgical approach**



- **Distribution of the examined women by age**

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Table 2. Distribution of the operated women by age

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Age	Number	Relative share	Average age
20-35 years	146	48,7%	32
36-50 years	154	51,3%	43
Total	300	100%	38

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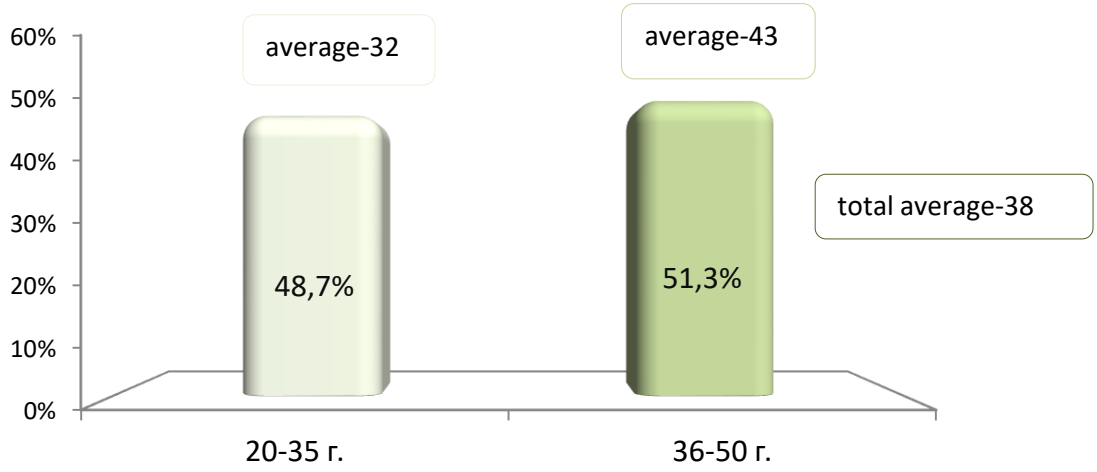
- **Graphic 2. Distribution of operated women by age**



- Age from 20 to 35 years - blood loss and duration depending on the surgical approach

- One-way analysis of variance (ANOVA) was applied to the data in order to determine whether there is a difference in blood loss and duration depending on the applied operative method in patients aged 20 to 35 years.

- Table 3. Average values of blood loss in patients from 20 to 35 years old according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdominal
Number	n	51	50	45
Average	$\overline{X}$	163,7	134,5	147,1
Min	*Min*	50	50	50
Max	*Max*	400	370	375
F-statistics	*F*	2,382		
Significance	*P*	0,062		
Statistically significant difference		No		

- The difference is statistically insignificant (p>0,05) which means there is not a difference between the average blood loss in the three different surgical approaches among the women up to 35 years of age.

Table 4. Average values of the operating time for patients from 20 to 35 years of age according to the surgical approach

Time in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	51	50	45
Average	$\overline{X}$	110,2	97,2	91,6
Min	*Min*	40	40	50
Max	*Max*	190	180	180
F-statistics	*F*	2,252		
Significance	*P*	0,060		
Statistically significant difference		No		

- The difference is statistically insignificant (p>0,05) which means there is not a difference in the average operating time for the different surgical approaches for the women up to 35 years of age.

- **Age between 36 and 50 years- blood loss and operating time according to the type of operation**

  - One-way analysis of variance (ANOVA) was applied to the data in order to determine whether there is a difference in blood loss and duration of the operation depending on the operative method applied to patients aged 36 to 50 years.

- **Table 5. Average values of blood loss for patients aged 36 to 50 years, according to the surgical approach**

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	49	50	55
Average	$\overline{X}$	177,4	167,2	144,4
Min	*Min*	50	50	50
Max	*Max*	1000	500	600
F-statistic	*F*	2,050		
Significance	*P*	0,064		
Statistically significant difference		No		

- The difference is statistically insignificant (p>0,05) which means there is not a difference in the average blood loss for the different operations for women from 36 to 50 years of age.

Table 6. Average values of the operating time for patients from 36 to 50 years of age according to the surgical approach

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	49	50	55
Average	$\overline{X}$	113,3	103,6	108,4
Min	*Min*	40	45	45
Max	*Max*	280	260	220
F-statistics	*F*	0,899		
Significance	*P*	0,551		
Statistically significant difference		No		

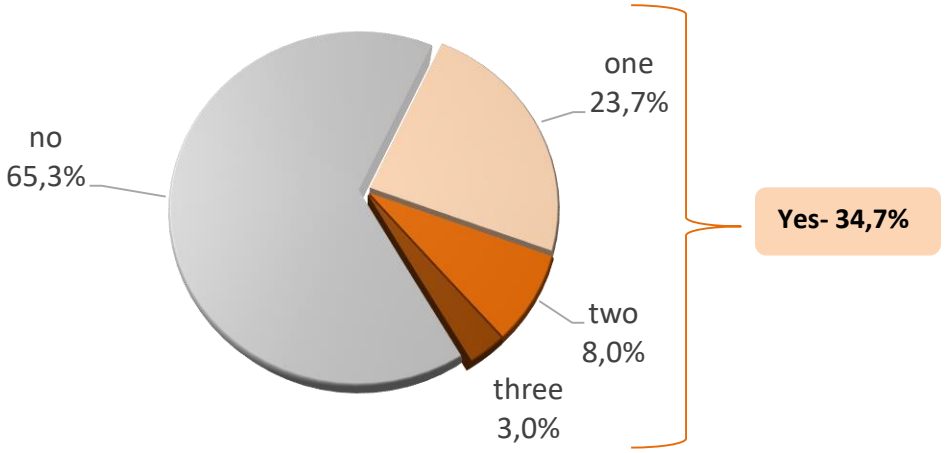
The difference is statistically insignificant (p>0,05) which means there is not a difference in the average operating times in the differenet surgical approaches.

Distribution of the examined women by parity

Table 7. Distribution of the women operated by parity

Parity	Number of women	Relative shares
Null	196	65,3%
One	71	23,7%
Two	24	8,0%
Three	9	3,0%
Total	300	100%

Graph 3. Distribution of the operated women by parity



Patients with 2 children – blood loss and duration for the different surgical approaches

One-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the surgical approach used in patients with at least one child.

Table 8. Average values of blood loss for patients with at least one child depending on the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	24	32	48
Average	$\overline{X}$	161,4	124,7	150
Min	*Min*	50	50	50
Max	*Max*	400	350	365
F-statistics	*F*	3,893		
Significance	*P*	0,081		
Statistically significant difference		No		

The difference is statistically insignificant (p>0,05) which means there is not a difference in the average blood loss in the different surgical approaches for the patients with at least one child.

Table 9. Average values of diration in patients with at least one child depending on the surgical approach

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	24	32	48
Average	$\overline{X}$	109,6	106,3	112,7
Min	*Min*	50	45	60
Max	*Max*	210	135	190
F-statistics	*F*	3,893		
Significance	*P*	0,072		
Statistically significant difference		No		

The difference is statistically insignificant (p>0,05) which means there is not a difference in the average operating times in the different surgical approaches in patients with at least one child.

Patients without children – blood loss and duration for the different types of operations

A One-way Analysis of Variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative method used in the nulliparous patients.

Table 10. Average values of blood loss in nulliparous patines depending on the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	76	68	52
Average	$\overline{X}$	170	162,8	141,4
Min	*Min*	50	50	50
Max	*Max*	1000	500	600
F-statistics	*F*	2,762		
Significance	*P*	0,066		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the average blood loss in the different types of surgery among the women without children.

Table 11. Average values of the duration in patients without parity according to the operative intervention

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	76	68	52
Average	$\overline{X}$	119,2	105,9	102
Min	*Min*	40	40	45
Max	*Max*	280	260	220
F-statistics	*F*	2,762		
Significance	*P*	0,066		
Statistically significant difference		No		

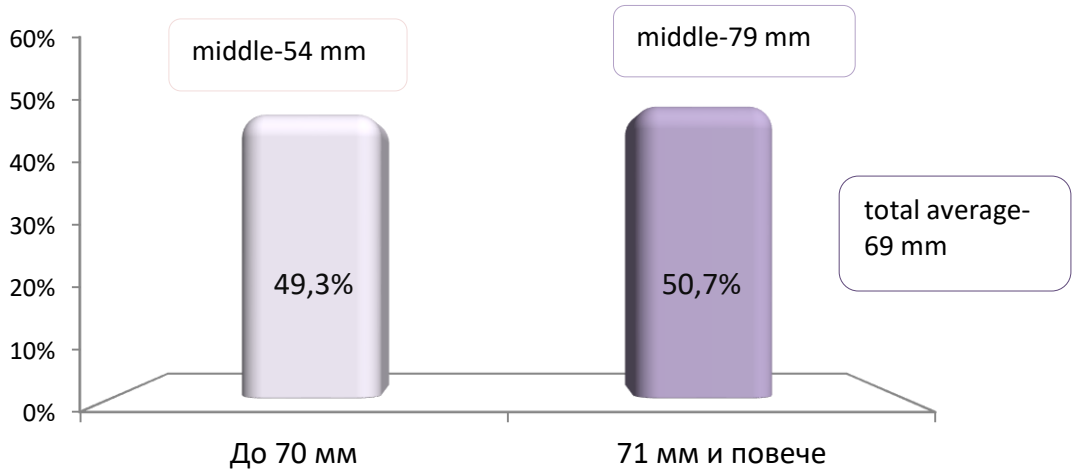
The difference is statistically insignificant (p>0.05), which means that there is no difference in the average duration of the different types of surgery among women without children.

Distribution of the operated women by uterine size

Table 12. Distribution of the operated women by uterine size

Uterine size	Number	Relative share	Average age
Up to 70 mm	148	49,3%	54,4
71 mm and more	152	50,7%	77,4
Total	300	100%	67,9

Graph 4. Distribution of the operated women by uterine sizea



Uterine size up to 70mm – blood loss and duration for the different operations

A One-way Analysis of Variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative method used in patients with uterine size up to 70 mm.

Table 13. Average values of blood loss in patients with uterine size up to 70 mm according to the operative approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	87	48	13
Average	$\overline{X}$	145	131,3	140,1
Min	*Min*	50	50	50
Max	*Max*	200	250	260
F-statistics	*F*	2,360		
Significance	*P*	0,098		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the mean blood loss in the different types of surgery among women with uterine size up to 70 mm.

Table 14. Average values of the duration of the operation in patients with a uterus size up to 70 mm according to the operative intervention

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	87	48	13
Average	$\overline{X}$	110,5	105,5	109,3
Min	*Min*	40	40	45
Max	*Max*	280	260	220
F-statistics	*F*	1,480		
Significance	*P*	0,073		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the average duration of the different types of operations among women with a uterus size up to 70 mm.

Size of the uterus 71 mm and more - blood loss and duration by type of surgery

A one-way analysis of variance (ANOVA) is applied to the data to determine whether there is a difference in blood loss and duration depending on the operative method used in patients with a uterine size of 71 mm or more.

Table 15. Average values of blood loss in patients with uterine size 71 mm and more according to operative intervention

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	13	52	87
Average	$\overline{X}$	174,3	160,2	150,5
Min	*Min*	100	100	100
Max	*Max*	1000	500	600
F-statistics	*F*	1,295		
Significance	*P*	0,071		
Statistically significant		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the average blood loss between the different types of surgery among women with a uterine size of 71 mm and more.

Table 16. Average values of the duration of the operation in patients with a uterus size of 71 mm and more according to the operative intervention

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	13	52	87
Average	$\overline{X}$	125,5	122,2	115,8
Min	*Min*	80	70	80
Max	*Max*	280	240	220
F-statistics	*F*	1,687		
Significance	*P*	0,077		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), meaning that there is no difference in the average duration of the different types of surgery among women with a uterine size of 71 mm and more.

Distribution of the examined women by number of fibroids

Table 17. Distribution of the examined women by number of fibroids

Fibroids	Women	Relative share
One	138	46,0%
Two-three	115	38,3%
Four and more	47	15,7%
Total	300	100%

Graph 5. Distribution of the examined women by number of fibroids

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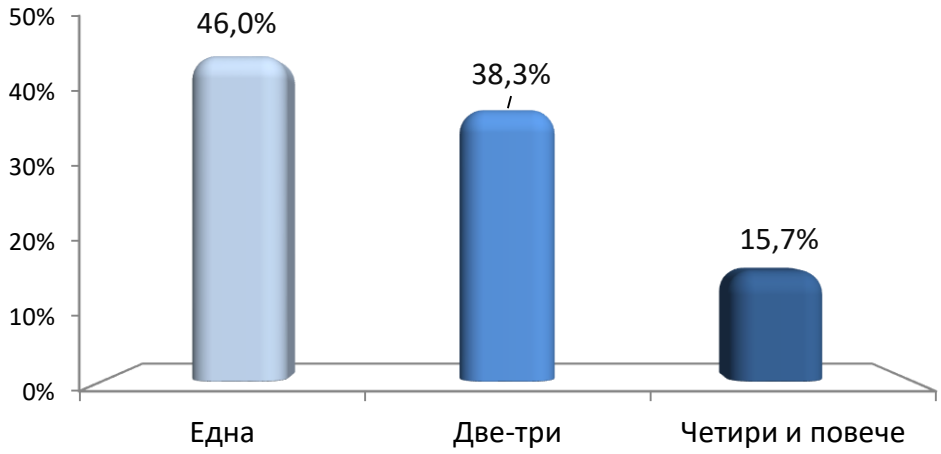


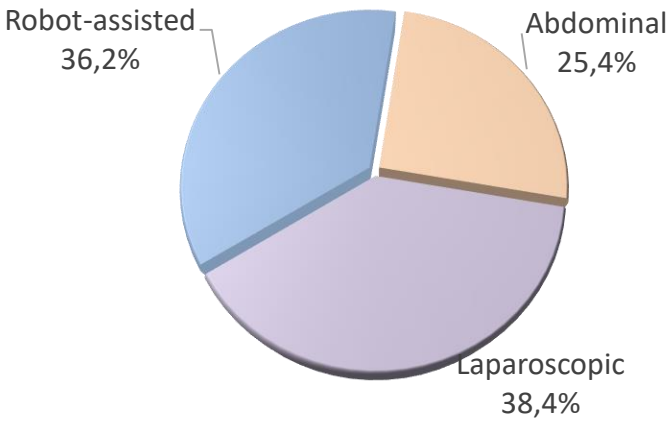
Through a correlation analysis, we will establish the presence or absence of a relation between the number of fibroids and two indicators that largely characterize the success of a surgical intervention - blood loss in milliliters and duration of the operation in minutes.

Patients with one fibroid – blood loss and duration of the operation depending on the surgical approach

Table 18.Distribution of the patients with one fibroid for the different approaches

Surgical approach	Women	Relative share
Laparoscopic	53	38,4%
Robot-assisted	50	36,2%
Abdominal	35	25,4%
Total	138	100,0%

Graph 6. Distribution of the patients with one fibroid



A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative method used in patients with one fibroid.

Table 19. Average values of blood loss in patients with a single fibroid according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	53	50	35
Average	$\overline{X}$	115,1	120,3	118,3
Min	*Min*	50	50	50
Max	*Max*	1000	280	375
F-statistics	*F*	0,610		
Significance	*P*	0,545		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the mean blood loss in the different types of surgery among women with a single fibroid.

Table 20. Average values of the duration of surgery in patients with a single fibroid according to the surgical approach

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	53	50	35
Average	$\overline{X}$	116,9	100,4	100,9
Min	*Min*	40	40	40
Max	*Max*	280	240	210
F-statistics	*F*	1,982		
Significance	*P*	0,421		
Statistically significant difference		No		

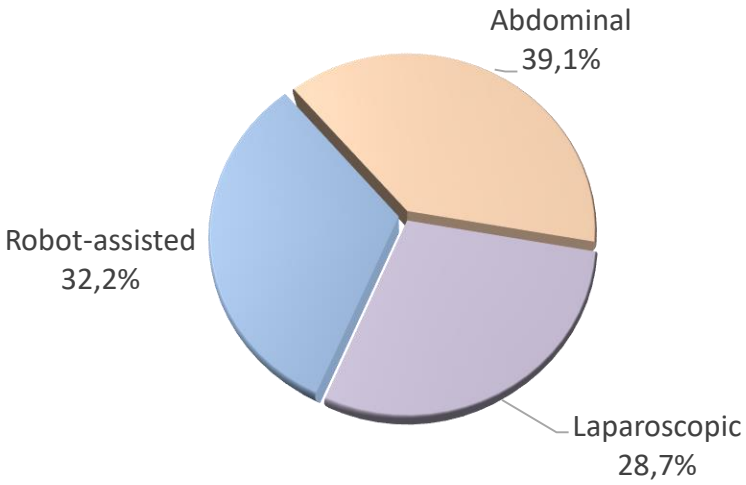
The difference is statistically insignificant (p>0,05) which means there is no difference in the average operating time for the different surgical approaches in women with a single fibroid.

Patients with two- three fibroids- blood loss and duration of the operation depending on the surgical approach

Table 21. Distribution of the patients with two-three fibroids depending on the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	33	28,7%
Robot-assisted	37	32,2%
Abdominal	45	39,1%
Total	115	100,0%

Graph 7. Distribution of the patients with two-three fibroids depending on the surgical approach



A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative method used in patients with two or three fibroids.

Table 22. Average values of blood loss in patients with two or three fibroids according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	33	37	45
Average	$\overline{X}$	121,8	123,7	119,5
Min	*Min*	50	50	60
Max	*Max*	280	370	500
F-statistics	*F*	2,217		
Significance	*P*	0,113		
Statistically significant difference		No		

The difference is statistically insignificant (p>0.05), which means that there is no difference in the average blood loss in the different types of surgery among women with two or three fibroids.

Table 23. Average values of the duration of the operation in the patients with two or three nodules according to the operative intervention

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	33	37	45
Average	$\overline{X}$	119,7	106,5	106,8
Min	*Min*	50	45	45
Max	*Max*	280	260	220
F-statistics	*F*	1,015		
Significance	*P*	0,365		
Statistically significant difference		No		

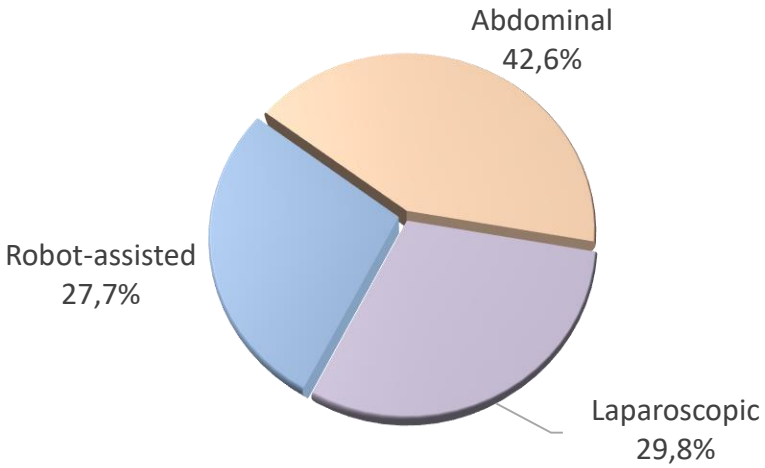
The difference is statistically insignificant (p>0.05), which means that there is no difference in the average duration of the different types of surgery among women with two or three fibroids.

Patients with four or more fibroids - blood loss and duration depending on the surgical approach

Table 24. Distribution of patients with at least four fibroids according to the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	14	29,8%
Robot-assisted	13	27,7%
Abdominal	20	42,6%
Total	47	100,0%

Graph 8 Distribution of patients with at least four fibroids according to the surgical approach



A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration of surgery depending on the operative method used in patients with four or more fibroids.

Table 25. Average blood loss in patients with at least four fibroids according to surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	14	13	20
Average	$\overline{X}$	251,3	240,5	195
Min	*Min*	240	170	150
Max	*Max*	600	500	600
F-statistics	*F*	10,982		
Significance	*P*	0,002		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in blood loss in the different types of surgery. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operation-comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,853	No
Laparoscopic	Abdominal	0,007	Yes
Robot-assisted	Abdominal	0,005	Yes

A statistically significant difference in the amount of blood loss between the three types of surgery was found in patients with a minimum of 4 fibroids. A Tukey HDS (Tukey) post-hoc test was used, which showed that the average blood loss in abdominal operations of patients with a minimum of 4 nodes was significantly less than in laparoscopic and robotic operations.

Graph 9. Average blood loss in patients with at least four fibroids according to the surgical approach– statistically significant differences

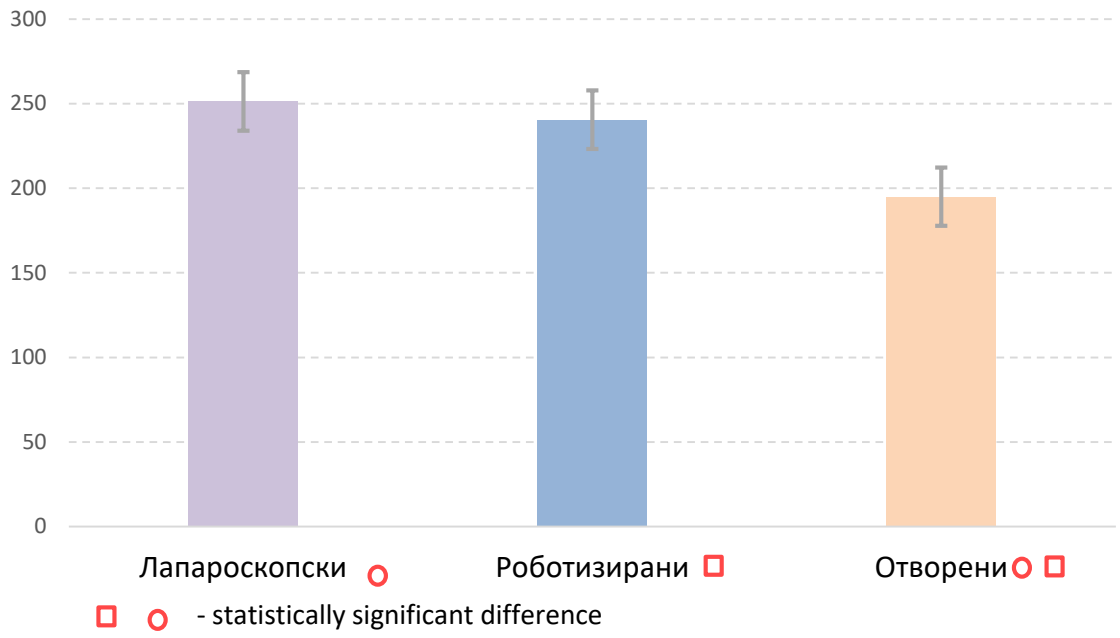


Table 26. Average duration of the surgery in patients with at least four fibroids according to the surgical approach

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	14	13	20
Average	$\overline{X}$	134,7	133,5	115,3
Min	*Min*	80	65	60
Max	*Max*	280	240	220
F-statistics	*F*	12,198		
Significance	*P*	0,001		
Statistically significant difference		Yes		

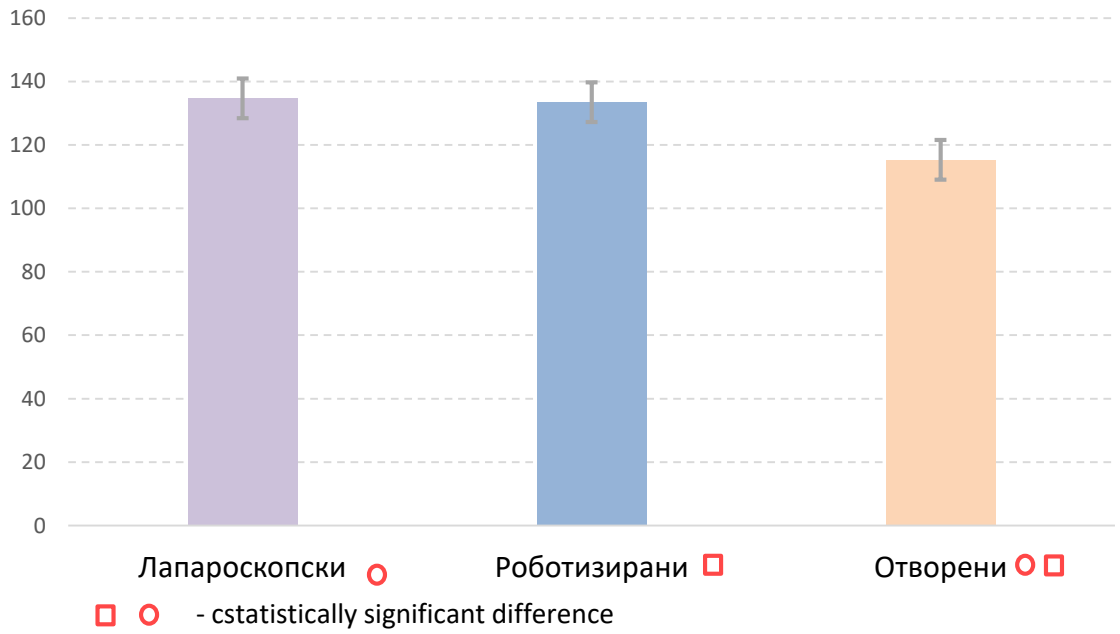
The difference is statistically significant (p<0,05), which means that there is a difference in duration for different types of operations. By applying the Tukey

HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Surgery- comparison		P	Stat. significant difference
Laparoscopic	Robot-assisted	0,290	No
Laparoscopic	Abdominal	0,008	Yes
Robot-assisted	Abdominal	0,043	Yes

A statistically significant difference in duration was found between the three types of operations in patients with a minimum of 4 fibroids. Tukey's HDS (Tukey) post hoc test was used, which showed that the mean duration of open operations for patients with a minimum of 4 fibroids was significantly shorter than for laparoscopic and robotic operations.

Graph 10. Average duration of the surgery in patients with at least four fibroids according to the surgical approach– statistically significant differences

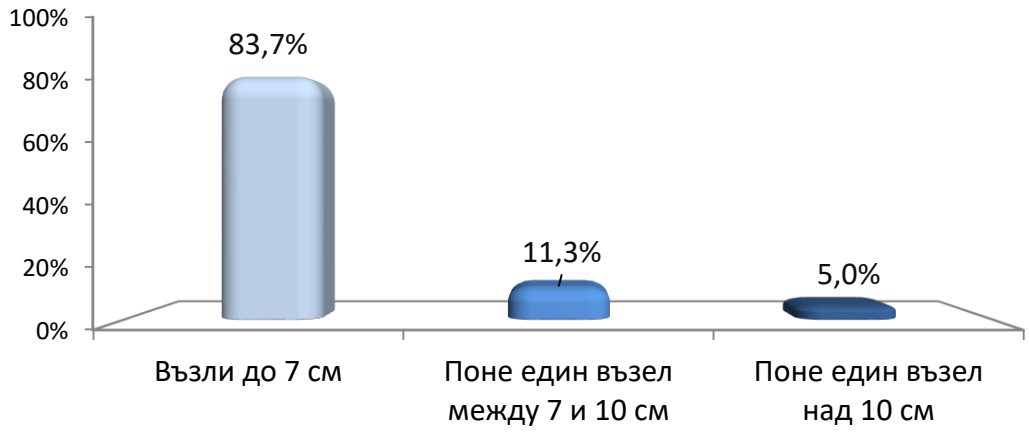


Distribution of the examined women by fibroid size

Table 27. Distribution of the operated women according to the size of the fibroids

Fibroid size	Number	Relative share
Up to 7 cm	251	83,7%
At least one fibroid 7-10 cm	34	11,3%
At least one fibroid over 10 cm	15	5,0%
Total	300	100%

Graph 11. Distribution of the operated women according to the fibroid size

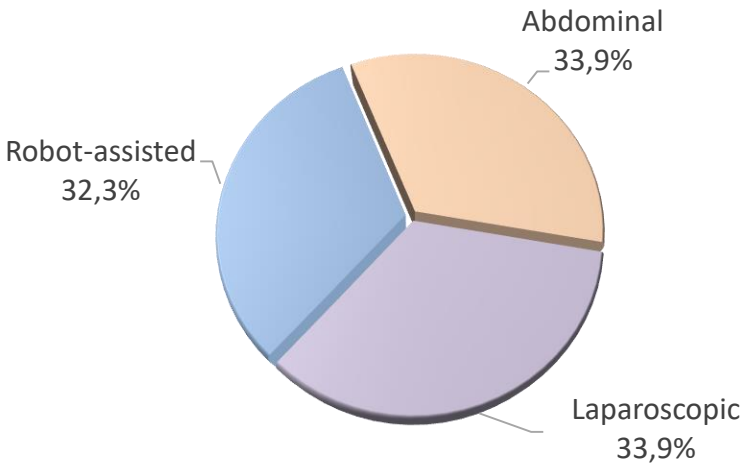


Patients with fibroid/s up to 7 cm - blood loss and duration depending on the surgical approach

Table 28. Distribution of patients with fibroids up to 7 cm according to the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	85	33,9%
Robot-assisted	81	32,3%
Abdominal	85	33,9%
Total	251	100%

Graph 12. Distribution of patients with fibroids up to 7 cm according to the surgical approach



A one-factor analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration of the surgery depending on the surgical method used in patients with fibroids up to 7 cm.

Table 29. Average values of blood loss in patients with fibroid(s) up to 7 cm according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	85	81	85
Average	$\overline{X}$	125,7	116,3	121,5
Min	*Min*	50	50	50
Max	*Max*	1000	310	600
F-statistics	*F*	1,971		
Significance	*P*	0,063		
Statistically significant difference		No		

The difference is not statistically significant (p>0.05), which means that there is no difference in blood loss in the different types of surgery.

Table 30. Average values of duration of the surgery in patients with fiborid/s up to 7 cm according to the surgical approach

Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	85	81	85
Average	$\overline{X}$	113	98,1	98,9
Min	*Min*	40	40	45
Max	*Max*	235	260	190
F-statistics	*F*	1,401		
Significance	*P*	0,071		
Statistically significant difference		No		

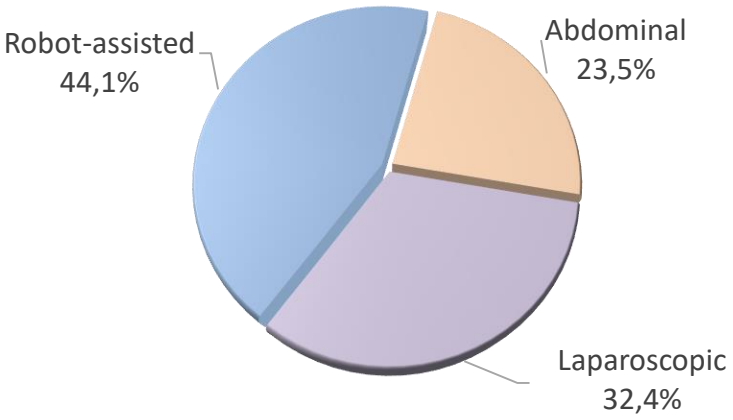
The difference is not statistically significant (p>0.05), which means that there is no difference in blood loss in the different types of surgery.

Patients with at least one fibroid between 7 and 10 cm - blood loss and duration depending on the surgical approach

Table 31. Distribution of the patients with at least one fibroid 7-10 cm according to the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	11	32,4%
Robot-assisted	15	44,1%
Abdominal	8	23,5%
Total	34	100%

Graph 13. Distribution of patients with at least one fibroid between 7 and 10 cm according to the surgical approach



A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative approach used in patients with at least one fibroid between 7 and 10 cm.

Table 32. Average values of blood loss in patients with at least one fibroid between 7 and 10 cm according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	11	15	8
Average	$\overline{X}$	150,5	121,6	155,3
Min	*Min*	70	80	50
Max	*Max*	450	400	400
F-statistics	*F*	14,024		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in blood loss in the types of surgery. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operations-comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,003	Yes
Laparoscopic	Abdominal	0,284	No
Robot-assisted	Abdominal	0,000	Yes

There was no statistically significant difference between laparoscopic and abdominal operations (P=0.284 was greater than alpha), but there was a statistically significant difference with robotic operations (P=0.003 and P=0.000). The statistically significant difference found means that we should expect less blood loss if robot-assisted surgery is performed in women who have at least one fibroid between 7 and 10 cm.

Graph 14. Average values of blood loss in patients with at least one fibroid between 7 and 10 cm according to the surgical approach - statistically significant differences

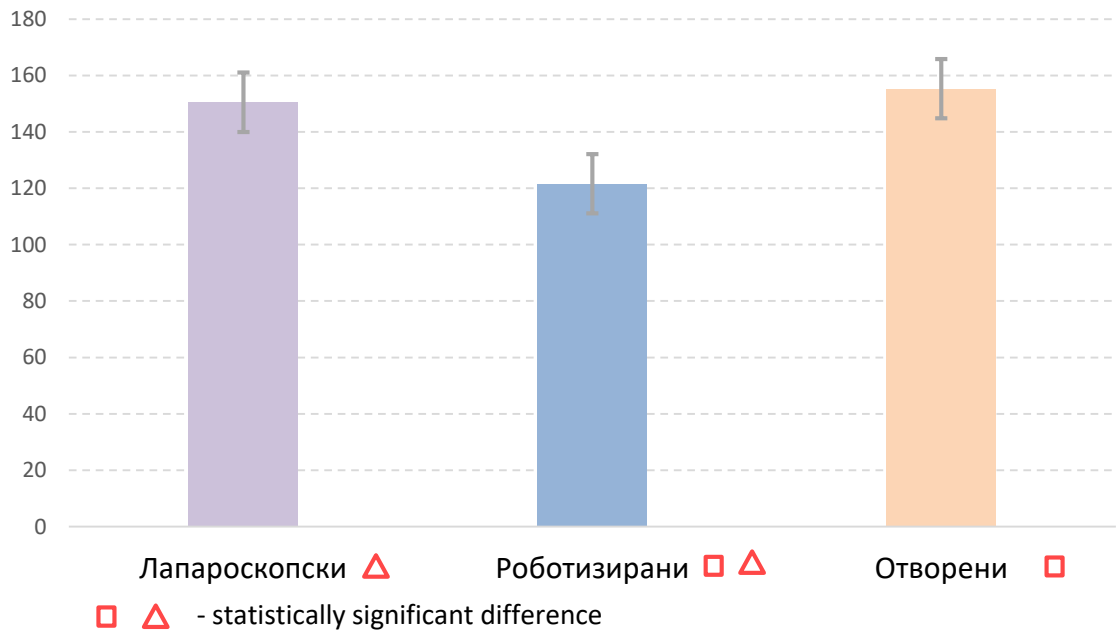


Table 33. Average values of the duration of the surgery in patients with at least one fibroid between 7 and 10 cm according to the surgical approach

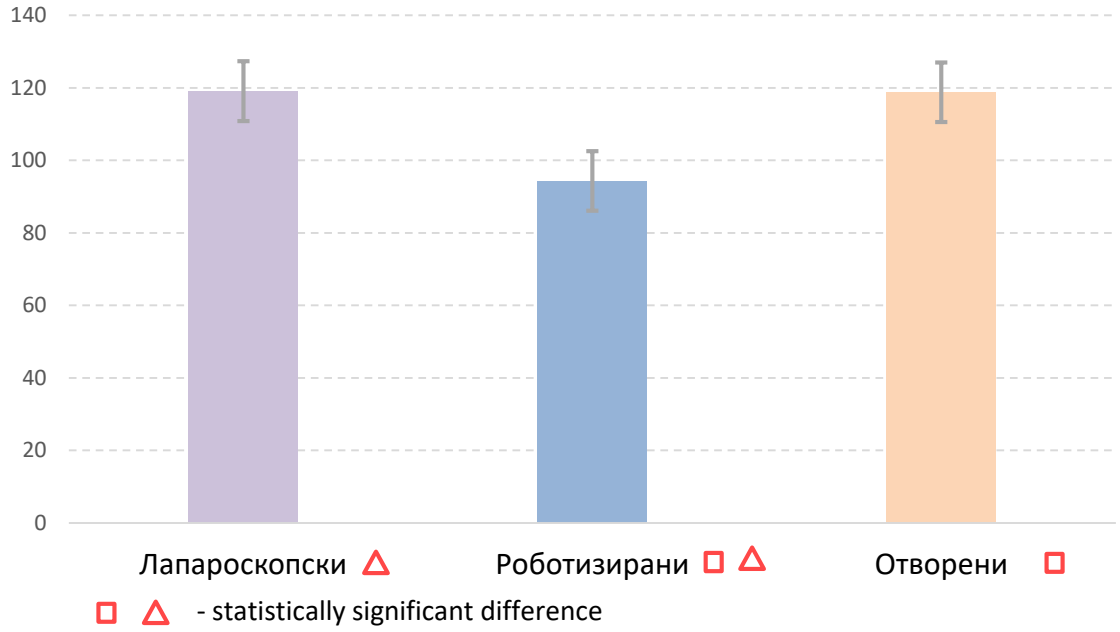
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	11	15	8
Average value	$\overline{X}$	119,1	94,3	118,8
Min value	*Min*	40	70	70
Max value	*Max*	280	140	220
F-statistics	*F*	10,024		
Significance	*P*	0,042		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in the duration for different types of operations. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Surgery- coparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,032	Yes
Laparoscopic	Abdominal	0,354	No
Robot-assisted	Abdominal	0,044	Yes

There was no statistically significant difference between laparoscopic and abdominal operations (P=0.354 was greater than alpha), but there was a statistically significant difference with robotic operations (P=0.032 and P=0.044). The statistically significant difference found means that we should expect a shorter duration of surgery if robotic surgery is used in women who have at least one fibroid between 7 and 10 cm.

Graph 15. Average values of the duration of the surgery in patients with at least one fibroid between 7 and 10 cm according to the surgical approach - statistically significant differences

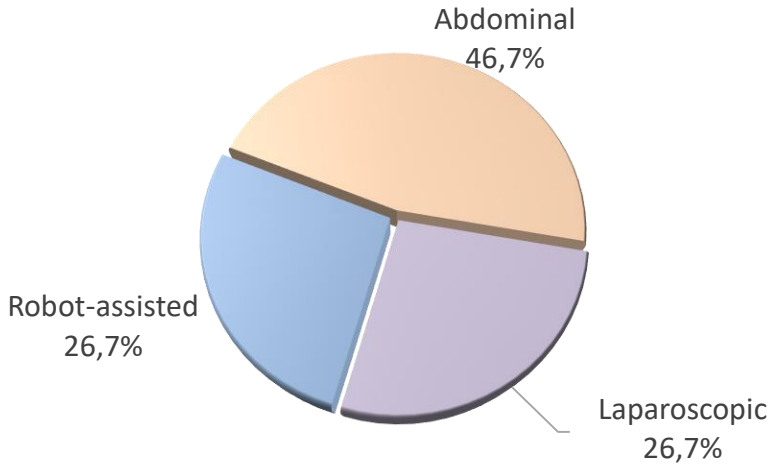


Patients with at least one fibroid larger than 10 cm - blood loss and duration depending on the surgical approach

Table 34. Distribution of the patients with at least one fibroid larger than 10 cm according to the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	4	26,7%
Robot-assisted	4	26,7%
Abdominal	7	46,7%
Total	15	100%

Graph 16. Distribution of the patients with at least one fibroid larger than 10 cm



A one-factor analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the surgical approach used in patients with a fibroid larger than 10 cm.

Table 35. Average values of blood loss in patients with a fibroid larger than 10 cm according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	4	4	7
Average value	$\overline{X}$	637,5	387,5	270
Min value	*Min*	550	150	150
Max value	*Ma*	900	500	400
F-statistics	*F*	10,024		
Significance	*P*	0,035		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in the blood loss in the different types of surgery. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operation- comparison		P	Stat. significant difference
Laparoscopic	Robot-assisted	0,121	No
Laparoscopic	Abdominal	0,041	Yes
Robot-assisted	Abdominal	0,032	Yes

There was no statistically significant difference between laparoscopic and robot-assisted surgery (P=0.121 was greater than alpha), but there was a statistically significant difference with abdominal surgery (P=0.041 and P=0.032). The statistically significant difference found means that we should expect a smaller amount of blood loss if abdominal surgery is performed in women who have at least one fibroid larger than 10 cm.

Graph 17. Average values of blood loss in patients with a fibroid larger than 10 cm according to the surgical approach – statistically significant differences

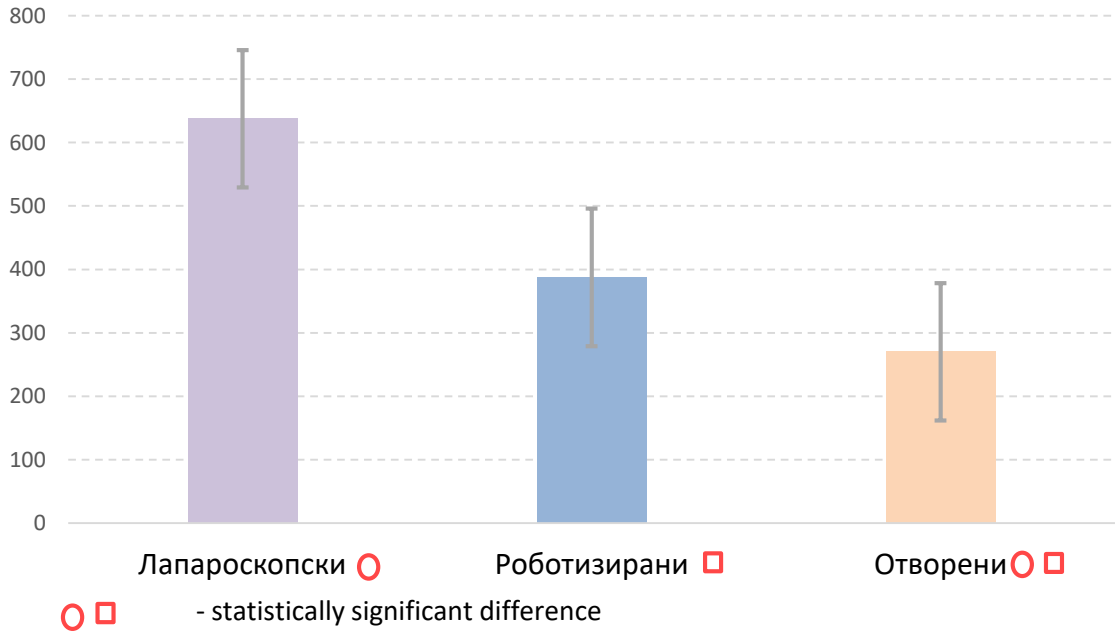


Table 36. Average values of the duration of the operation in patients with a fibroid larger than 10 cm according to the surgical approach

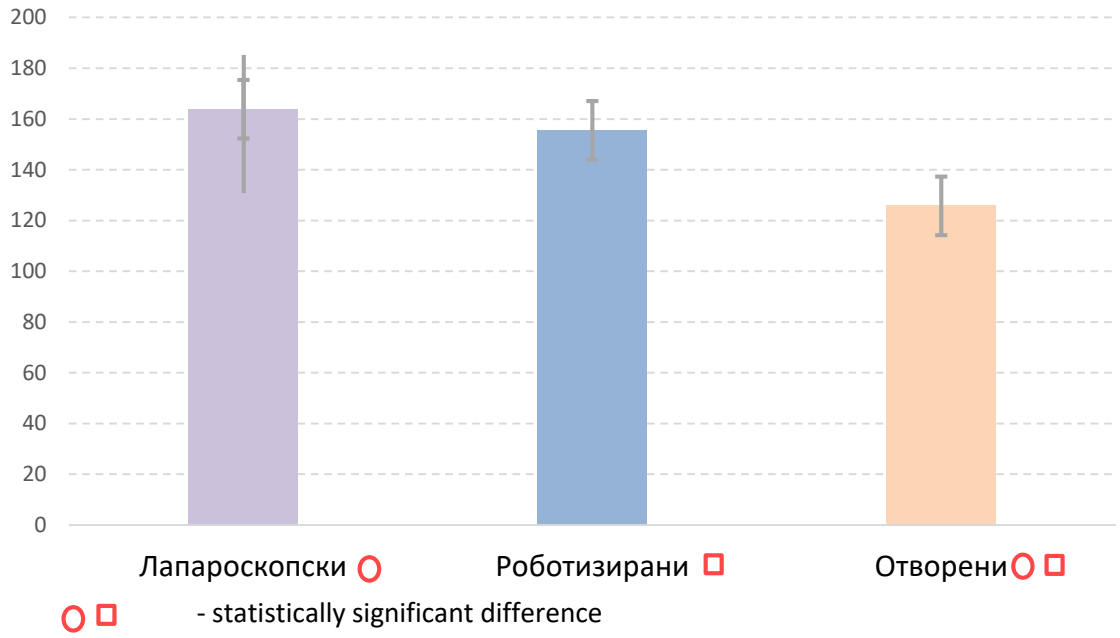
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	4	4	7
Average value	$\overline{X}$	163,8	155,5	125,8
Min value	*Min*	145	140	80
Max value	*Max*	210	180	180
F-statistics	*F*	15,960		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in duration for different types of operations. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operation – comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,450	No
Laparoscopic	Abdominal	0,001	Yes
Robot-assisted	Abdominal	0,006	Yes

There was no statistically significant difference between laparoscopic and robot-assisted operations (P=0.450 was greater than alpha), but there was a statistically significant difference with abdominal operations (P=0.001 and P=0.006). The statistically significant difference found means that we should expect a shorter average duration if abdominal surgery is performed in women who have at least one 10 cm fibroid.

Graph 18. Average values of the duration of the surgery in patients with a fibroid larger than 10 cm according to the surgical approach - statistically significant differences



Fibroid size and complications

Patients with fibroid/s up to 7 cm - complications

Table 37. Complications occurred in patients with a fibroid up to 7 cm

Complications	Laparoscopic	Robot-assisted	Abdom.
n	85	81	85
Yes	2,4%	1,2%	4,7%
No	97,6%	98,8%	95,3%
Total	100%	100%	100%
Exact test of Fisher	3,710		
Significance	0,171		
Statistically significant difference	No		
Blood transfusion	1	1	1
Inflammation of an operative wound	1	0	2
Subfascial hematoma	0	0	1

By Fisher's exact test, no statistically significant difference was found in the presence of complications in the different types of operations (P=0.171).

Patients with at least one fibroid between 7 and 10 cm of size- complications

Table 38. Complications occurred in patients with a 7 to 10 cm fibroid

Complications	Laparoscopic	Robot-assisted	Abdom.
n	11	15	8
Yes	18,2%	0,0%	12,5%
No	81,8%	100,0%	87,5%
Total	100%	100%	100%
Exact test of Fisher	2,158		
Significance	0,062		
Statistically significant difference	No		
Blood transfusion	2	0	0
Inflammation of an operative wound	0	0	1

By Fisher's exact test, no statistically significant difference was found in the presence of complications in the different types of surgery (P=0.305).

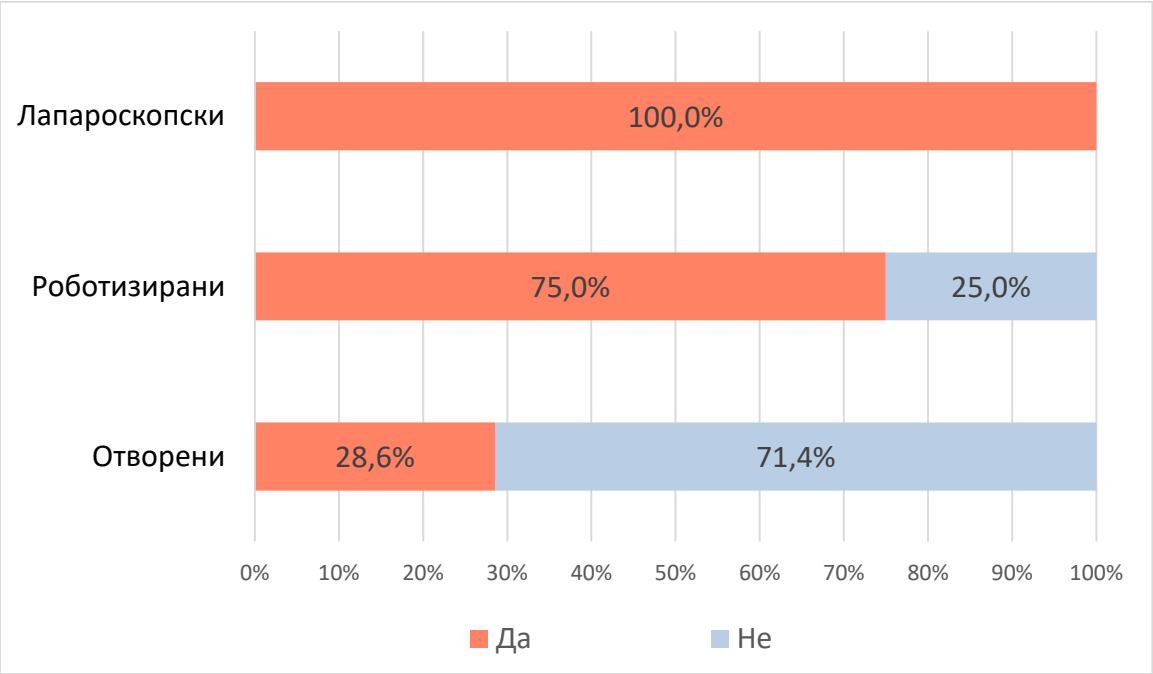
Patients with at least one fibroid larger than 10 cm- complications

Table 39. Complications occurred in patients with an intramural fibroid larger than 10 cm

Complications	Laparoscopic	Robot-assisted	Abdom.
n	4	4	7
Yes	100,0%	75,0%	28,6%
No	0,0%	25,0%	71,4%
Total	100%	100%	100%
Fisher’s exact test	5,34		
Significance	0,049		
Statistically significant difference	Yes		
Blood transfusion	3	3	0
Conversion	1	0	0
Wound inflammation	0	0	1

Using Fisher's exact test, a statistically significant difference in the presence of complications was found in the different types of operations (P=0.049) - in abdominal operations performed on women with an intramural fibroid larger than 10 cm, we would expect a lower relative proportion of complications.

Graph 19. Complications occurred in patients with an intramural fibroid larger than 10 cm

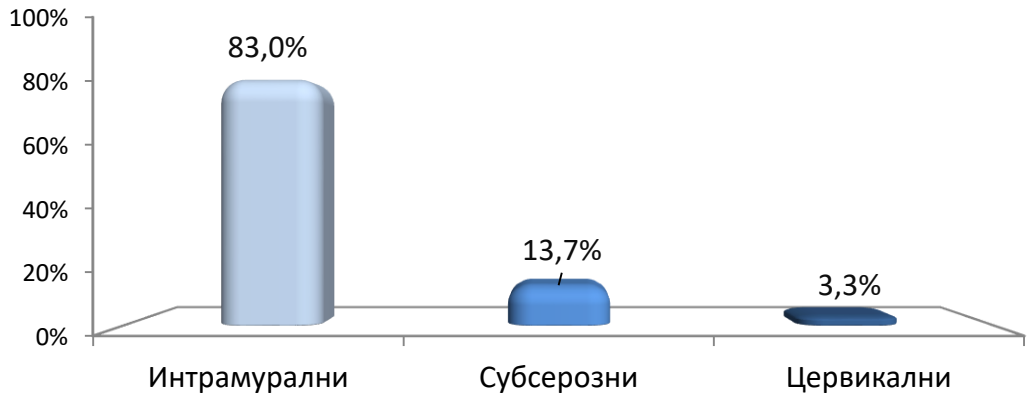


Distribution of the examined women according to the location of the fibroids

Table 40. Distribution of the operated women according to the location of the fibroids

Fibroids location	Number	Relative share
Intramural	249	83,0%
Subserosal	41	13,7%
Cervical	10	3,3%
Total	300	100%

Graph 20. Distribution of the operated women according to the location of the fibroids

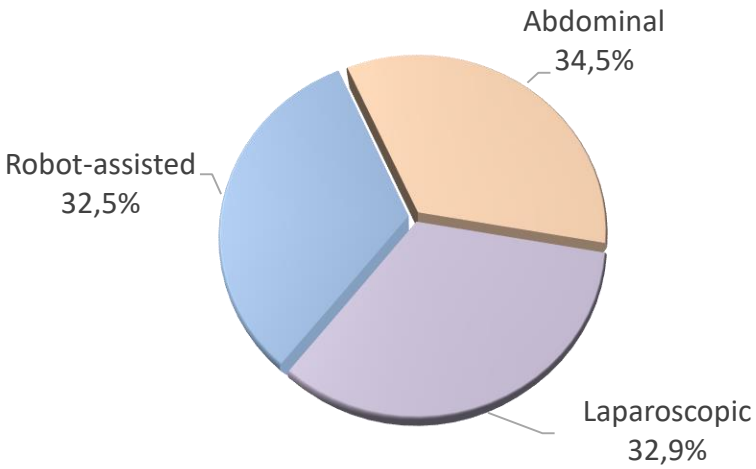


Patients with intramural fibroids - blood loss and duration depending on the surgical approach

Table 41. Distribution of patients with intramural fibroids according to the surgical approach

Surgical approach	Number	Relative share
Laparoscopic	82	32,4%
Robot-assisted	81	44,1%
Abdominal	86	23,5%
Total	249	100%

Graph 21. Distribution of the patients with intramural fibroids according to the surgical approach



A one-factor analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the surgical approach used in patients with intramural fibroids.

Table 42. Average values of blood loss in patients with intramural fibdroids according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	82	81	86
Average value	$\overline{X}$	168,3	161,3	112,6
Min value	*Mi*	100	50	50
Max value	*M*	1000	500	600
F-statistics	*F*	11,622		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in the blood loss in the different types of surgery. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operations – comparison		P	Stat. significant difference
Laparoscopic	Robot-assisted	0,253	No
Laparoscopic	Abdominal	0,023	Yes
Robot-assisted	Abdominal	0,018	Yes

There was no statistically significant difference between laparoscopic and robot-assisted operations (P=0.253 was greater than alpha), but there was a statistically significant difference with abdominal operations (P=0.023 and P=0.018). The statistically significant difference found means that we should expect less blood loss if abdominal surgery is performed in women who have intramural fibroids.

Graph 22. Average values of blood loss in patients with intramural fibroids according to the surgical approach - statistically significant differences

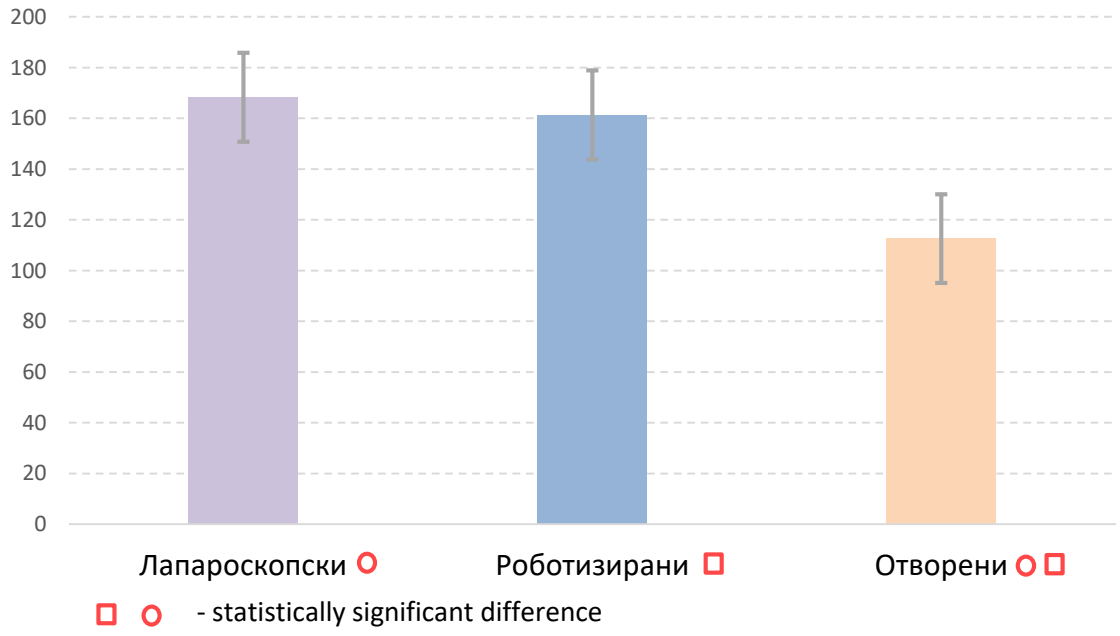


Table 4. Average values of the duration of the operation in patients with intramural fibroids according to the surgical approach

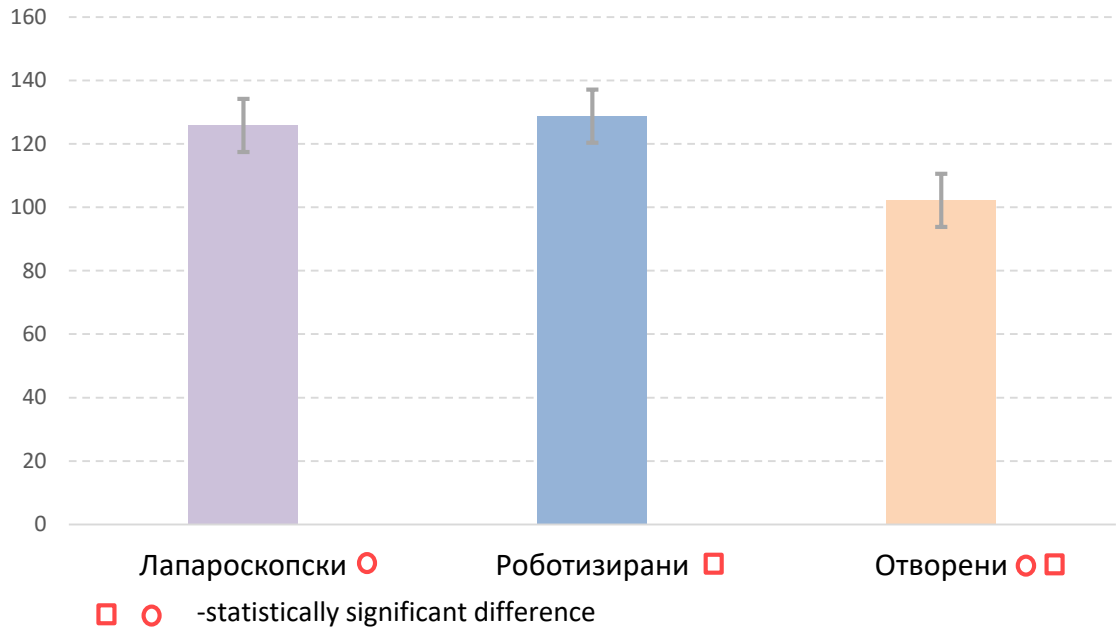
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	82	81	86
Average value	$\overline{X}$	125,8	128,7	102,2
Min value	*Mi*	40	45	45
Max value	*M*	280	260	180
F-cstatistics	*F*	9,458		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in the duration for the different types of operations. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operation – comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,102	No
Laparoscopic	Abdominal	0,043	Yes
Robot-assisted	Abdominal	0,041	Yes

There was no statistically significant difference between laparoscopic and robot-assisted operations (P=0.102 was greater than alpha), but there was a statistically significant difference with abdominal operations (P=0.043 and P=0.041). The statistically significant difference found means that we should expect a shorter duration if an abdominal surgery is performed in women who have intramural fibroids.

Graph 23. Average values of duration in patients with intramural fibroids according to the surgical approach - statistically significant differences

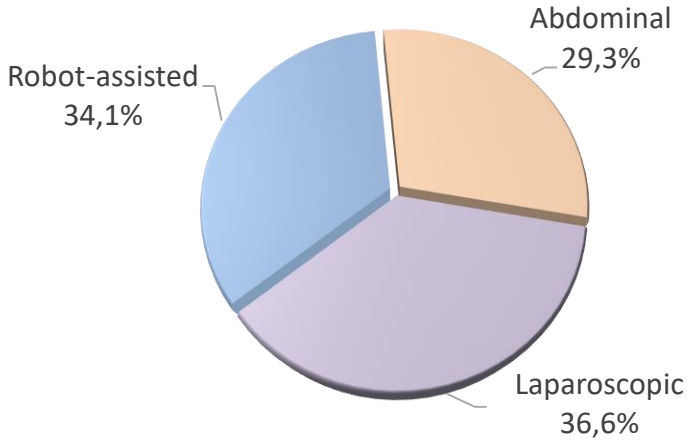


Patients with subserosal fibroids – blood loss and duration depending on the surgical approach

Table 44. Distribution of patients with subserosal fibroids according to the surgical approach

Surgical approach	Number women	Relative share
Laparoscopic	15	36,6%
Robot-assisted	14	34,1%
Abdominal	12	29,3%
Total	41	100%

Graph 24. Distribution of the patients with subserosal fibroids accoroding to the surgical approach



A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the operative method used in patients with subserosal fibroids.

Table 45. Average values of blood loss in patients with subserosal fibroids according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	15	14	12
Average value	$\overline{X}$	136,3	138,8	175,5
Min.	*Mi*	50	50	100
Max	*M*	280	200	350
F-statistics	*F*	18,299		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in blood loss in the different types of surgery. By applying Tukey's HDS (Tukey) post hoc test, it will be established between which types of operation there is a difference:

Operation – comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,995	No
Laparoscopic	Abdominal	0,000	Yes
Robot-assisted	Abdominal	0,000	Yes

A statistically significant difference in the amount of blood loss was found between the three types of operations in patients with subserosal fibroids. A Tukey HDS (Tukey) post hoc test was used, which showed that the average blood loss in robot-assited and laparoscopic operations of patients with subserosal fibroids was significantly less than in abdominal operations.

Graph 25. Average values of blood loss in patients with subserosal fibroids according to the surgical approach - statistically significant differences

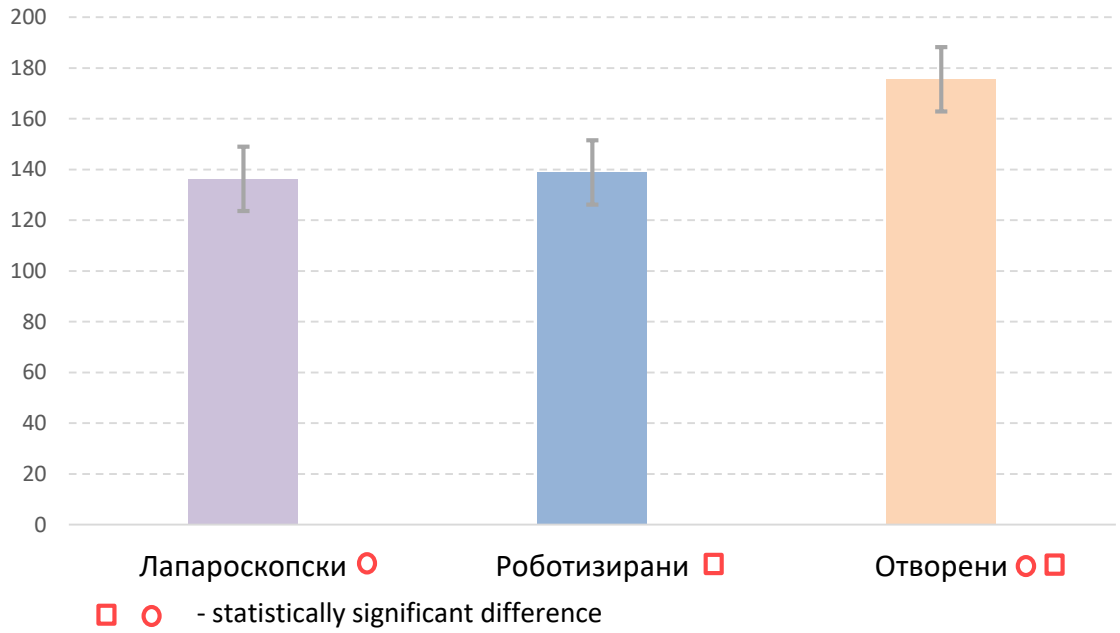


Table 46. Average duration of the operation for patients with subserosal fibroids according to the surgical approach

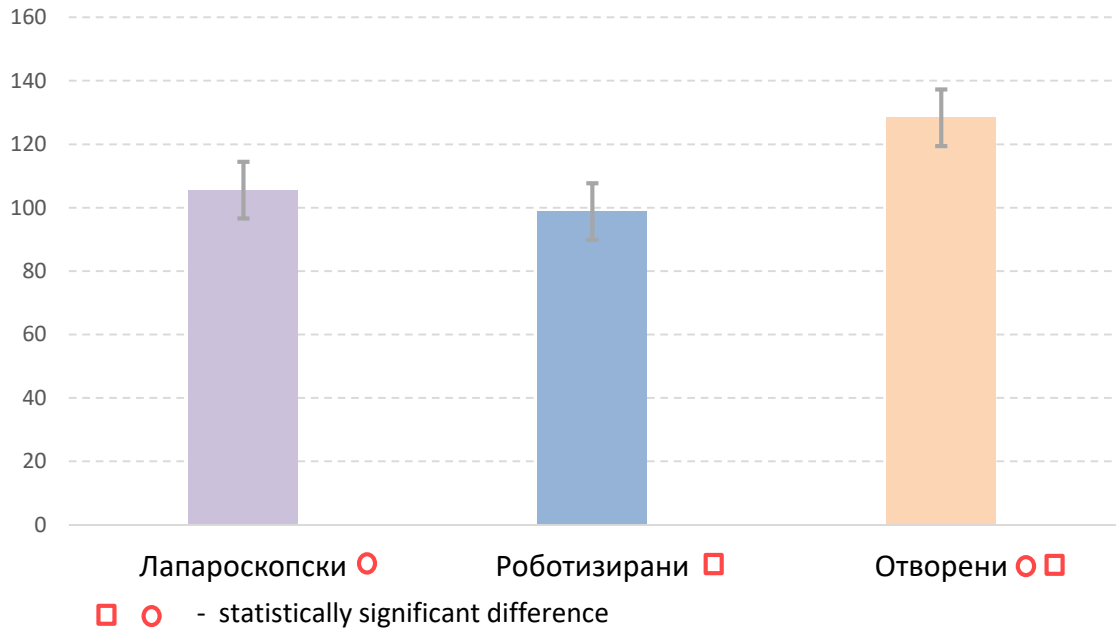
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	15	14	12
Average	$\overline{X}$	105,5	98,8	128,3
Min	*Mi*	60	40	80
Max	*M*	200	110	220
F-statistisc	*F*	3,925		
Significance	*P*	0,047		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in the duration for the different types of operations. By applying Tukey's HDS (Tukey) post hoc test, it will be established between which types of operation there is a difference:

Operation – comparison		P	Stat. significant difference
Laparoscopic	Robot-assisted	0,997	No
Laparoscopic	Abdominal	0,089	Yes
Robot-assisted	Abdominal	0,109	Yes

A statistically significant difference in duration was found between the three types of operations in patients with subserosal fibroids. Tukey's HDS (Tukey) post hoc test was used, which showed that theaverage duration in robot-assisted and laparoscopic operations of patients with subserosal fibroids was significantly shorter than in abdominaloperations.

Graph 26. Average duration of the operation in patients with subserosal fiborids according to the surgical approach - statistically significant differences



Patients with cervical fibroids – blood loss and duration depending on the surgical approach

Using the Student's t-test for two independent samples, we will check whether there are differences in the average blood loss in the different surgical approaches for patients with cervical fibroids.

Table 47. Average blood loss according to the surgery

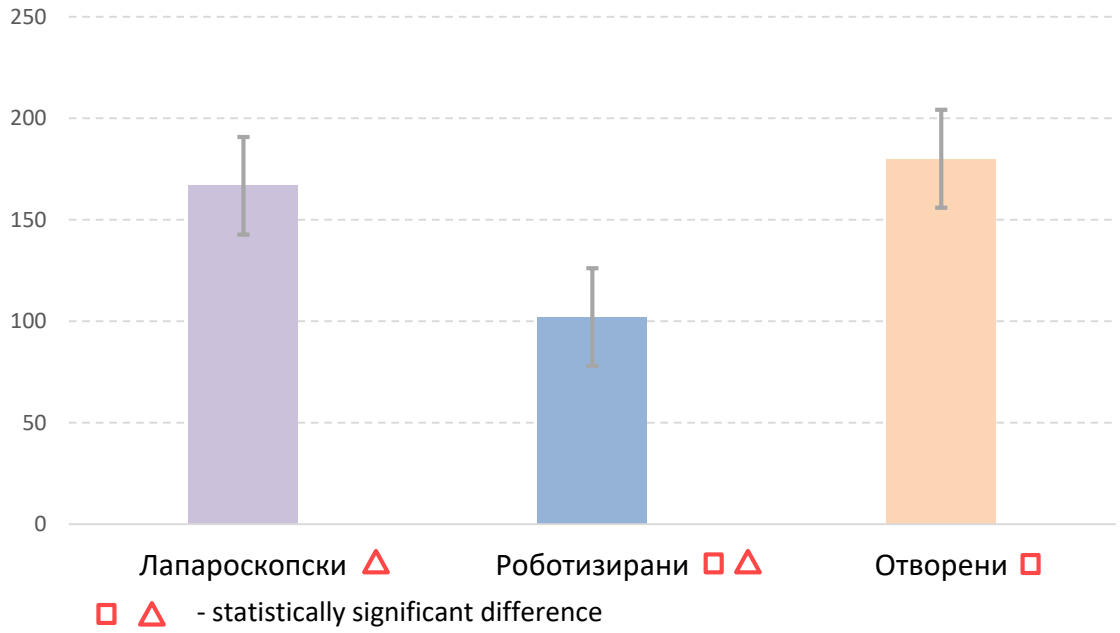
Surgical approach	Number	Min	Max	Average blood loss
Laparoscopic	3	100	300	166,7
Robot-assisted	5	60	150	103
Abdominal	2	180	300	240

Table 48. Results of the t-test applied for average blood loss in the different surgical approaches for patients with cervical fibroids

Surgical approach – comparison		t- statistics	Level of significance (p)	Stat. significant difference
Laparoscopic	Robot-assisted	9,231	0,000	Yes
Laparoscopic	Abdominal	2,049	0,133	No
Robot-assisted	Abdominal	11,366	0,000	Yes

There was no statistically significant difference between laparoscopic and abdominal operations (P=0.133 was greater than alpha), but there was a statistically significant difference with robot-assisted ones (both significance levels tended to 0). The statistically significant difference found means that we should expect less mean blood loss if robot-assisted surgery is applied to women who have cervical fibroids.

Graph 27. Average values of blood loss in patients with cervical fibroids according to the surgical approach - statistically significant differences



Using the Student's t-test for two independent samples, we will check whether there are differences in the average duration of the different approaches for patients with cervical fibroids.

Table 49. Average duration according to the type of surgery

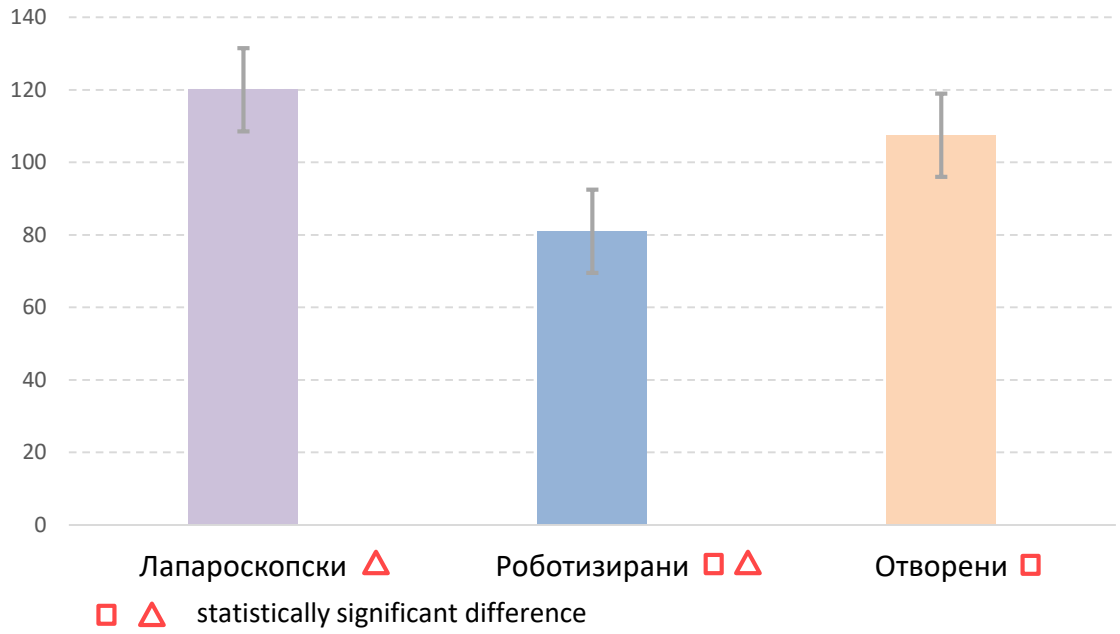
Surgical approach	Number	Min	Max	Average duration
Laparoscopic	3	70	210	120,0
Robot-assisted	5	45	110	81,0
Abdominal	2	105	110	107,5

Table 50. Results of the t-test applied to the average duration of the different surgical approaches for patients with cervical fibroids

Surgical approach - comparison		t- statistics	Level of significance (p)	Stat. significant difference
Laparoscopic	Robot-assisted	2,121	0,044	Yes
Laparoscopic	Abdominal	0,832	0,466	No
Robot-assisted	Abdominal	1,297	0,047	Yes

There was no statistically significant difference between laparoscopic and abdominal operations (P=0.466 was greater than alpha), but there was a statistically significant difference with robot-assisted operations (P=0.044 and P=0.047). The statistically significant difference found means that we should expect a shorter mean duration if robotic surgery is applied to women who have cervical fibroids.

Graph 28. Average duration of the operation in patients with subserosal fibroids according to the surgical approach - statistically significant differences



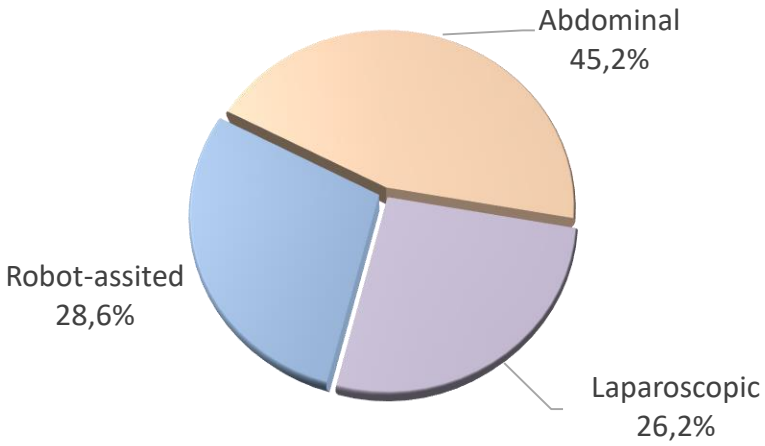
Patients with four or more fibroids, of which at least one is intramural - blood loss and duration depending on the surgical approach

The number of fibroid nodules has been shown to affect blood loss and duration. The next action is to check whether the number, in combination with the most numerous group of fibroids - the intramural ones, has a statistically significant influence on blood loss and duration in the different types of operations.

Table 51. Distribution of patients with 4 or more fibroids of which at least one is intramural, according to the surgical approach

Surgical approach	Number women	Relative share
Laparoscopic	11	26,2%
Robot-assisted	12	28,6%
Abdominal	19	45,2%
Total	42	100%

Graph 29. . Distribution of patients with 4 or more fibroids of which at least one is intramural, according to the surgical approach



A one-way analysis of variance (ANOVA) was applied to the data in order to determine whether there is a difference in blood loss and duration depending on the surgical approach used in patients with 4 or more nodes, of which at least one is intramural.

Table 52. Average values of blood loss and duration in patients with 4 and more fibroids of which at least one is intramural- according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	11	12	19
Average	$\overline{X}$	252,3	242,5	200
Min	*Mi*	240	170	150
Max	*M*	600	500	600
F-statistics	*F*	10,174		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in blood loss in the different types of surgery. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Surgery – comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,936	No
Laparoscopic	Abdominal	0,006	Yes
Robot-assisted	Abdominal	0,002	Yes

A statistically significant difference in the amount of blood loss was found between the three types of operations in patients with a minimum of 4 fibroids, of which at least 1 was intramural. A Tukey HDS (Tukey) post hoc test was used, which showed that the average blood loss in abdominal operations for patients with a minimum of 4 fibroids, of which at least 1 was intramural, was significantly less than in laparoscopic and robot-assisted operations.

Graph 30. Average values of blood loss in patients with 4 or more fibroids, of which at least one was intramural according to the surgical approach – statistically significant differences

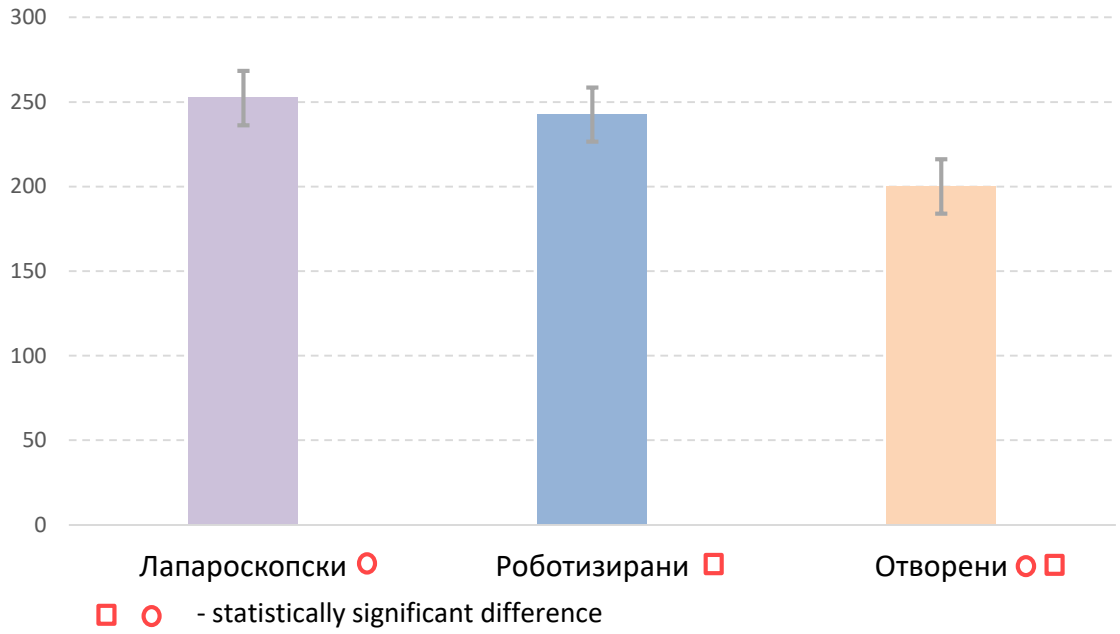


Table 53. Average values of duration of the operation in patients with 4 or more fibroids, of which at least one was intramural according to the surgical approach – statistically significant differences

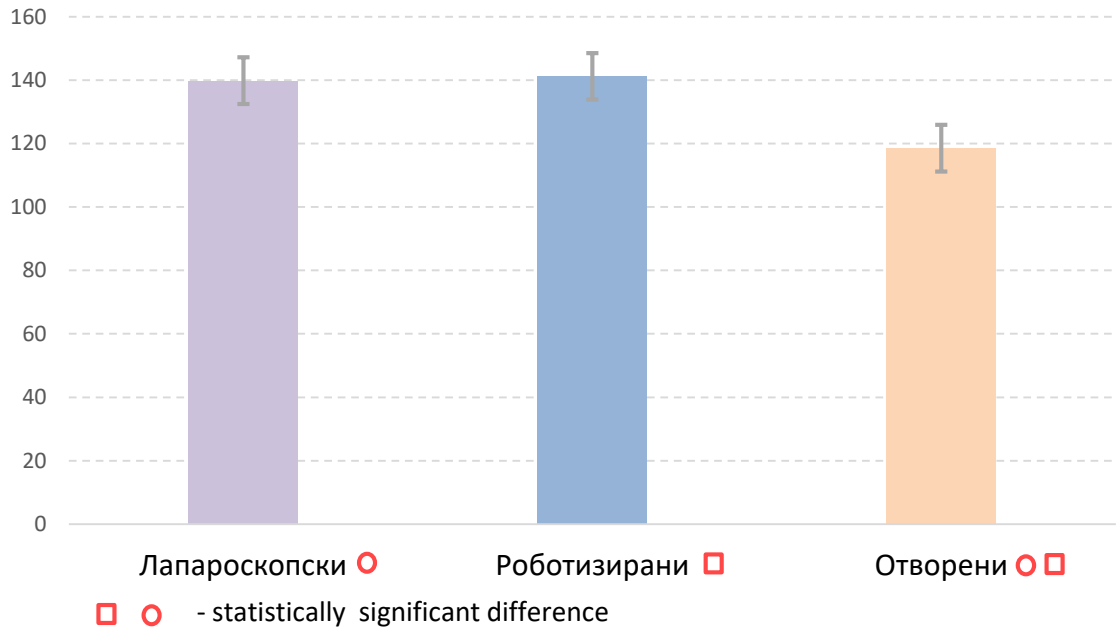
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	11	12	19
Average	$\overline{X}$	139,8	141,2	118,5
Min	*Mi*	90	70	60
Max	*M*	280	240	190
F-statistics	*F*	15,960		
Significance	*P*	0,000		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in duration for different types of operations. By applying the Tukey HDS (Tukey) post hoc test, it will be established between which types of surgery there is a difference:

Operation – comparison		P	Stat. significant difference
Laparoscopic	Roobt-assisted	0,450	No
Laparoscopic	Abdominal	0,001	Yes
Robot-assisted	Abdominal	0,006	Yes

There was no statistically significant difference between laparoscopic and robot-assisted operations (P=0.450 was greater than alpha), but there was a statistically significant difference with abdominal operations (P=0.001 and P=0.006). The statistically significant difference found means that we should expect a shorter mean duration if an abdominal surgery is performed in women who have 4 or more fibroids, of which at least one is intramural.

Graph 31. Average values of the duration of the surgery in patients with 4 or more fibroids, of which at least one is intramural according to the surgical approach - statistically significant differences

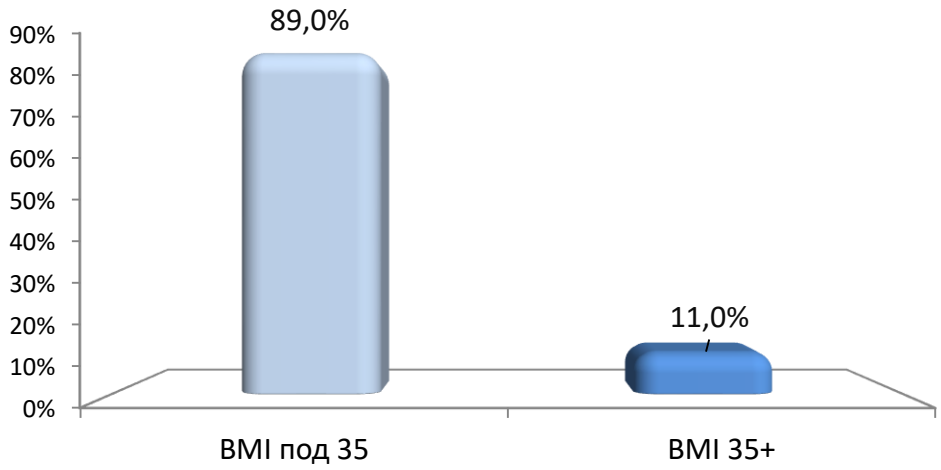


Distribution of the studied women by BMI

Table 54. Distribution of the studied women by BMI

BMI	Number of women	Relative share
BMI under 35	267	89,0%
BMI 35+	33	11,0%
Total	300	100%

Graph 32. Distribution of the studied women by BMI



Patients with BMI up to 35 - blood loss and duration or the surgery according to the surgical approach

A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the surgical approach for patients with BMI up to 35.

Table 55. Average values of blood loss in patients with BMI up to 35 according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	n	89	86	92
Average value	$\overline{X}$	153,5	148,3	133,3
Min value	*Mi*	50	50	50
Max value	*M*	1000	500	500
F-statistics	*F*	1,079		
Significance	*P*	0,075		
Statistically significant difference		No		

The difference was not statistically significant (p>0.05), meaning that there was no difference in blood loss between the different types of surgery for women with a BMI of up to 35.

Table 56. Average values of the duration for patients with BMI up to 35 according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	89	86	92
Average value	$\overline{X}$	114,7	101,9	98,5
Min value	*Mi*	40	60	45
Max value	*M*	210	260	210
F-statistics	*F*	1,530		
Significance	*P*	0,072		
Statistically significant difference		No		

The difference is not statistically significant (p>0.05), which means that there is no difference in the duration of the different types of operations in women with BMI up to 35.

Patients with BMI 36 and above - blood loss and duration depending on the surgical approach

A one-way analysis of variance (ANOVA) was applied to the data to determine whether there was a difference in blood loss and duration depending on the surgical approach for patients with BMI 36+.

Table 57. Average values of the blood loss in patients with BMI 36 + according to the surgical approach

Blood loss in ml		Laparoscopic	Robot-assisted	Abdom.
Number	*n*	11	14	8
Average value	$\overline{X}$	181,3	151,8	185,3
Min value	*Mi*	100	50	110
Max value	*M*	390	310	600
F-statistics	*F*	4,036		
Significance	*P*	0,025		
Statistically significant difference		Yes		

The difference is statistically significant (p<0.05), which means that there is a difference in blood loss in different types of surgery. By applying Tukey's HDS (Tukey) post hoc test, it will be established between which types of operation there is a difference:

Operation – comparison		P	Stat.significant difference
Laparoscopic	Robot-assisted	0,044	Yes
Laparoscopic	Abdominal	0,327	No
Robot-assisted	Abdominal	0,020	Yes

A statistically significant difference in the amount of blood loss was found between the three types of surgery in patients with a BMI of 36+. A Tukey HDS (Tukey) post hoc test was used, which showed that the average blood loss in robot-assited surgery in patients with a BMI of 36+ was significantly less than in laparoscopic and abdominal surgery.

Graph 33. Average values of blood loss in patients with BMI 36+ according to the surgical approach – statistically significant differences

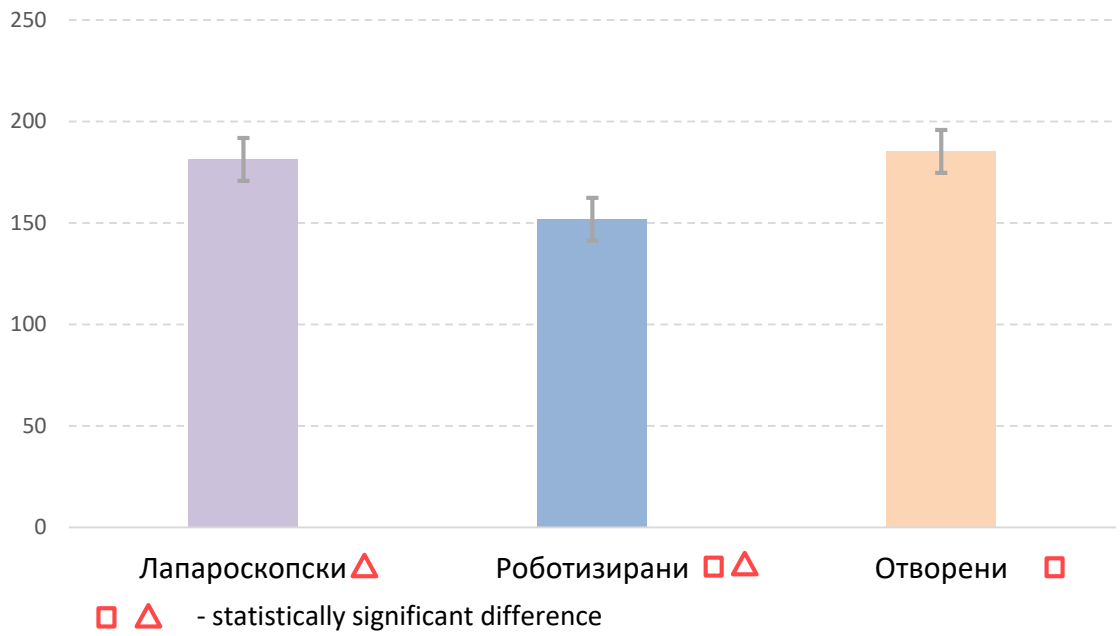


Table 58. Average duration of surgery in patients with BMI 36+ and above according to the surgical approach

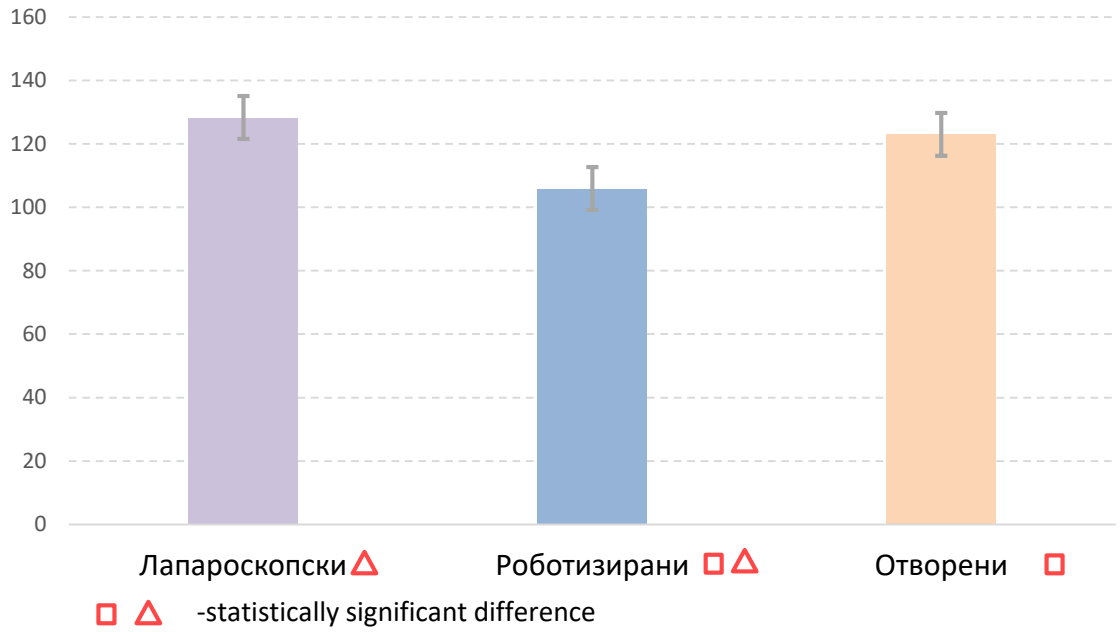
Duration in minutes		Laparoscopic	Robot-assisted	Abdom.
Number	n	11	14	8
Average value	$\overline{X}$	128,3	105,9	123
Min value	*Mi*	100	70	90
Max value	*M*	210	110	220
F-statistics	*F*	4,279		
Significance	*P*	0,021		
Statistically significant difference		Yes		

The difference is statistically significant ($p<0.05$), which means that there is a difference in duration for different types of operations. By applying Tukey's HDS (Tukey) post hoc test, it will be established between which types of operation there is a difference:

Operation – comparison		P	Stat. significant difference
Lalaroscopic	Robot-assisted	0,026	Yes
Laparoscopic	Abdominal	0,924	No
Robot-assisted	Abdominal	0,043	Yes

A statistically significant difference in duration was found between the three types of surgery in patients with a BMI of 36 and above. A Tukey HDS (Tukey) post hoc test was used, which showed that the mean duration of robot-assisted surgery for patients with a BMI of 36+ was significantly shorter than for laparoscopic and abdominal surgery.

Graph 34. Average duration of surgery in patients with BMI 36+ and more according to the surgical approach – statistically significant differences



BMI and complications

BMI less than 35- complications

Table 59. Complications in patients with BMI less than 35

Complication	Laparoscopic	Robot-assisted	Abdom.
N	89	86	92
Yes	6,7%	3,5%	3,3%
No	93,3%	96,5%	96,7%
Total	100%	100%	100%
Fisher’s exact test	0,989		
Significance	0,667		
Statistically significant difference	No		
Blood transfusion	5	3	0
Conversion	1	0	0
Wound inflammation	0	0	3

By Fisher's exact test, no statistically significant difference was found in the presence of complications among the different types of surgery in women with a body mass index of 35 and less (P=0.667).

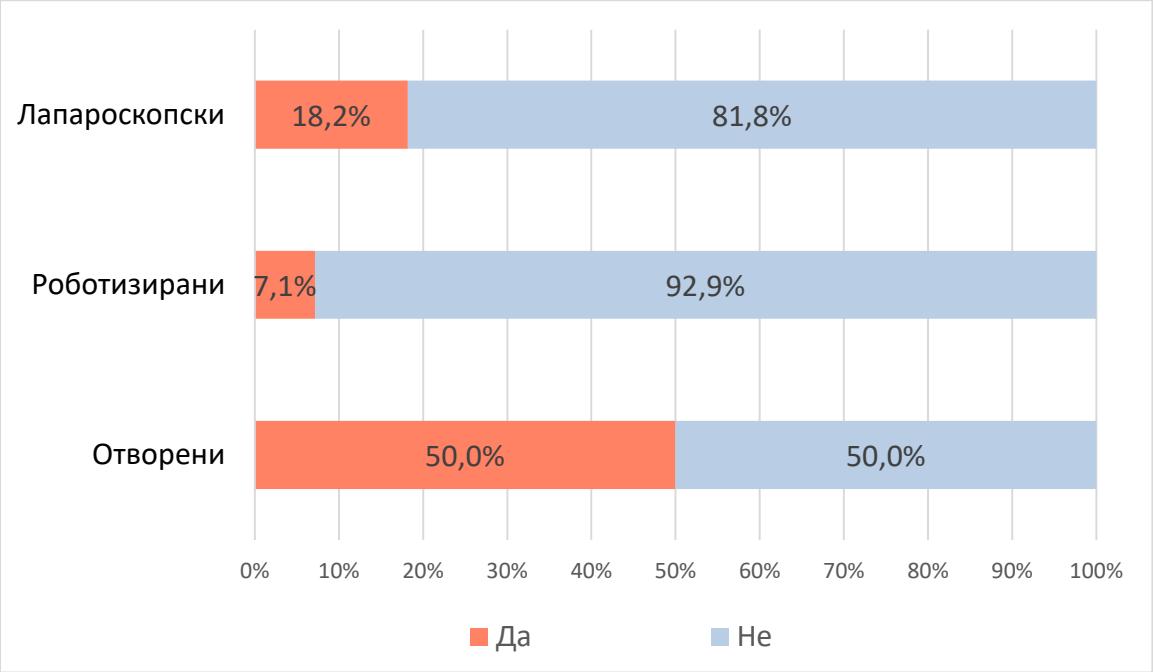
BMI 36 plus - complications

Table 60. Compalications for patients with BMI 36 plus

Complication	Laparoscopic	Robot-assisted	Abdom.
N	11	14	8
Yes	18,2%	7,1%	50,0%
No	81,8%	92,9%	50,0%
Total	100%	100%	10%
Fisher’s exact test	7,356		
Significance	0,015		
Statistically significant difference	Yes		
Wound inflammation	1	0	2
Subfascial hematoma	0	0	1
Blood transfusion	1	1	1

Using Fisher's exact test, a statistically significant difference in the presence of complications was found in the different types of surgery (P=0.015) - in robot-assisted surgeries performed on women with a body mass index of 36 and above, we would expect a lower relative proportion of complications and in abdominal operations – the largest.

Graph 35. Complications in patients with BMI 35 and above



Economic analysis of the costs of the three types of myomectomies

Expenses for the robot-assisted myomectomy

Type of expense	Kind of expense	Single price	Note	Total
Hospital stay	1 day in hospital	140 BGN	2 days	280 BGN
	1 day in resuscitation	450 BGN	1 day	450 BGN
Surgical team	1 hour in op.room	140 BGN	1 hour and 40 min	233,3 BGN
	1 hour anesthesiologist	65 BGN		108,3 BGN
	1 hour surgeon	32 BGN		53,3 BGN
	1 hour assistent	32 BGN		53,3 BGN
Permanent expenses	Histology	30 BGN		30 BGN
	Research	40 BGN		40 BGN
	Medications	100 BGN		100 BGN
	Set of oper.clothes	135 BGN		135 BGN
Specific instruments	1 monopolar scisors	1 190 BGN		1 190 BGN
	1 bipolar clamp	1 000 BGN		1 000 BGN
	1 needleholder	820 BGN		820 BGN
	Sterile sleeves for the robotic hands	580 BGN		580 BGN
	Filter for aspiration	300 BGN		300 BGN
	12mm assistant port	280 BGN		280 BGN
	V loc sutures	52 BGN	2	104 BGN
	Robotic troacars	204 BGN		204 BGN
	Tenaculum	1419 BGN	For 30 operations	47 BGN
	Morcelator	1500 BGN	For 10 operations	150 BGN
	Instruments' cover	75 BGN		75 BGN
	Other	150 BGN		150 BGN
			Общо	6 383,20 BGN

Expenses for laparoscopic myomectomy

Type of expense	Kind of expense	Single price	Note	Total
Hospital stay	1 day in hospital	140 BGN	2 days	280 BGN
	1 day in resuscitation	450 BGN		450 BGN
Surgical team	1 hour in oper.room	140 BGN	1 hour and 50 minutes	256,7 BGN
	1 hour anesthesiologist	65 BGN		119,2 BGN
	1 hour surgeon	32 BGN		58,7 BGN
	1 hour assistant	32 BGN		58,7 BGN
Permanent expenses	Histology	30 BGN		30 BGN
	Research	40 BGN		40 BGN
	Medications	100 BGN		100 BGN
	Set of oper.clothes	135 BGN		135 BGN
Specific instruments	1 monopolar scissors	1 340 BGN	For 40 operations	34 BGN
	1 bipolar clamp	2 100 BGN		53 BGN
	2 needleholders	30 BGN		28 BGN
	5mm troacars - 2	1 300 BGN		32,5 BGN
	12mm troacars - 2	1 500 BGN		37,5 BGN
	V loc sutures	104 BGN		104,0 BGN
	Tenaculum	1 419 BGN	For 30 operations	47 BGN
	Morcelator	1 500 BGN	For 20 operations	75 BGN
	Other	150 BGN		150 BGN
			Total	2 089 BGN

Expenses for an abdominal myomectomy

Expenses	Type of expenses	Single proce	Note	Total
Hospital stay	1 day in hospital	140 BGN	4 days	560 BGN
	1 day in resuscitation	450 BGN		450 BGN
Surgical team	1 hour in oper.room	140 BGN	1 hour and 40 minutes	233,3 BGN
	1 hour anesthesiologist	65 BGN		108,3 BGN
	1 hour surgeon	32 BGN		53,3 BGN
	1 hour assistant	32 BGN		53,3 BGN
Permanent expenses	Histology	30 BGN		30 BGN
	Research	40 BGN		40 BGN
	Medications	100 BGN		100 BGN
	Set of oper.clothes	135 BGN		135 BGN
Specific instruments	Reusable instruments	60 BGN		60 BGN
	1 electric knife	100 BGN		100 BGN
	Suturing materials	75 BGN		75 BGN
	Other	150 BGN		150 BGN
			Total	2 148,2 BGN

Expenses for robot-assisted, laparoscopic and abdominal myomectomies

Expense	Type of myomectomy					
	Robot-assisted		Laparoscopic		Abdominal	
	Sum	%	Sum	%	Sum	%
Hospital stay	730 BGN	11,4	730 BGN	34,9	1 010 BGN	47,0
Surgical team	448,2 BGN	7,0	493,3 BGN	23,6	448,2 BGN	20,9
Permanent exp.	305 BGN	4,8	305 BGN	14,6	305 BGN	14,2
Specific instruments	4 900 BGN	76,8	561 BGN	26,9	385 BGN	17,9
Total	6 383,2 BGN	100	2 089,3 BGN	100%	2 148,2 BGN	100%

This economic analysis is based on the indicators used in SBALAG "Maichin dom" in Sofia. It does not include the initial investment for the acquisition of the equipment necessary to perform the laparoscopic and the robot-assisted myomectomy, but it takes into account all the ongoing costs of performing each of the mentioned operations.

Conclusions

1. After a comparative analysis, we come to the conclusion that an intramural myoma up to 7 cm in size should be removed by laparoscopic myomectomy, given the lowest cost of surgery, short hospital stay and with similar parameters regarding duration of surgery and blood loss.

2. In the presence of an intramural fibroid between 7 and 10 cm in size, robotic myomectomy should be recommended, due to the availability of a shorter operative time, less blood loss and the possibility of robotic arms for more precise restoration of the fibroid bed, despite the higher costs of operative technique.

3. In our study, it is recommended that an intramural fibroid larger than 10 cm should be operated by open access because of the shorter operative time, less blood loss, fewer peri- and postoperative complications, and the possibility of quality repair of the uterine incision.

4. In the study of groups with cervical fibroids, it can be concluded that cervical myomas should be operated by robotic myomectomy because of the better intraoperative indicators and the possibility of precise reconstruction of the cervical incision.

5. From the research performed on a group with subserous fibroids, it can be concluded that they can be operated on through a laparoscopic approach due to the relatively close perioperative indicators, but a more economically advantageous method.

6. For patients with a BMI over 35 and an intramural fibroid, surgical treatment by robotic method is recommended due to the shorter operative time, shorter hospital stay and the presence of fewer peri- and postoperative complications compared to the other two groups.

7. Open access is recommended for fibroids of very large sizes and many in number.

7. Contributions

8.1 Contributions of an original nature:

1. For the first time in our country, a study has been conducted that compares indicators in different operational approaches to myomectomy - open, laparoscopic and robot-assisted myomectomy. Perioperative and postoperative outcomes are covered.

2. For the first time, a recommendation is made for the operative approach regarding the size of the fibroid.

3. For the first time, a recommendation is reached for the operative approach regarding the location of the fibroid.

4. For the first time, a recommendation for the operative approach is reached in terms of the number of fibroids present.

5. For the first time, the relationship between high BMI and perioperative complications is investigated with a recommendation for an approach.

8.2. Contributions of a confirmatory nature

1. From an economic point of view, robot-assisted myomectomy is the most expensive option of surgical treatment, as it finds its place in the following cases: high BMI, cervical myoma, as well as intramural myomas between 7 and 10 cm in size.

2. Based on the research done, in patients with 4 or more fibroids it is recommended to apply the open method due to the better peri- and post-operative indicators.

8. Conclusion

In the last years the operative techniques for treatment of myoma disease are increasing. The robot-assisted myomectomy is gaining increasingly wide application along with the open and laparoscopic approaches. We should note that laparoscopic myomectomy is emerging as the gold standard in view of the lower cost of operative intervention and less trauma to the patient.

Representing a revolutionary step in surgical innovation with its features of 3D panoramic vision, rich wrist instrumentation, tremor filtration and motion scaling, robotic myomectomy is increasingly expanding its application in practice. As can be seen from the analysis, both open and laparoscopic myomectomy find their indispensable application. The high cost of robotic surgery still remains a problem, but despite this, more and more centers will have robotic systems in the future. Their costs will certainly decrease as market competition emerges and the various platforms improve. Each company that has developed a robotic system conducts its own training course and allows the development of psychomotor skills and robotic didactic education. Despite the controversy, robotic surgery will continue to evolve in a changing demographic society and we are waiting for the emergence and proliferation of newer robotics platforms to continue this evolution.

In addition, the field of robotic surgery has made significant progress in the last decade and its application is becoming more common in gynecological surgery. Some of the potential future directions include the use of fewer robotic instruments, implementing measures to reduce setup and surgical time, including assisted docking, introduction of single-incision operations, and the ability to perform telesurgery using the robotic system.

These potential directions may offer numerous opportunities for clinical research in the field of robotic surgery. Further prospective research studies are needed to obtain a complete picture regarding the long-term prospects in robotic surgery and the cost-effectiveness of this surgical technique.

The data obtained from our study clearly support the safety and applicability of the robotic technique in myomectomy. The analysis showed satisfactory surgical results in terms of low morbidity, low conversion rate and short hospitalization time. However, the published data are preliminary results and there are still many aspects of robotic myomectomy to be researched to fully appreciate its contribution and impact.

10. Publications related to the dissertation

1. Myoma previa during cesarean section: a case report and review of the literature. S. Slavov, V. Diavolov, D. Mitev, R. Tocev, Ts. Popova. MedCrave-2022.

2. "Introduction of robotic surgery in the obstetrics and gynecology", Prof. Ivan Kostov, Dr. Radko Totsev, 01/2021

3. "The place of robotic myomectomy in the modern treatment of fibroid disease", Journal of Reproductive Health, 35/2022.

4. "Preoperative 3T magnetic resonance to determine the surgical treatment of uterine fibroids", K. Sirakova, R. Tocev, D. Zlatareva