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EFFECT OF THE RECTUS SHEATH BLOCK ON HEMODYNAMIC CHANGES IN TOTAL ABDOMINAL HYSTERECTOMY AS A PART OF MULTIMODAL ANESTESIA

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Abstract

Background: Total abdominal hysterectomy (TAH) is associated with substantial postoperative pain and discomfort. Rectus sheath block (RSB) is used to block the sensory nerves of the anterior abdominal wall and thereby contribute to pain relief after lower abdominal surgeries.

Aim of Study: The aim of this study is to evaluate the effect of bilateral Ultrasound (US)-guided RSB on hemodynamic changes after TAH.

Patients and Methods: This prospective randomized study was carried out on 10 females, ASA I or II, presented for elective TAH under general anesthesia (GA) and randomly classified into 2 equal groups R and C of 5 patients each; patients in Group R received RSB with 40 ml ropivacaine 0.375% (20ml each side) before surgery and standard endotracheal anesthesia and patients in Group C received only standard general endotracheal anesthesia. Mean arterial Blood pressure (MAP) and Heart rate (HR) were measured as baseline, after induction of GA, every 15 min till end of surgery, immediately after recovery, at 6h, 12h and 24 h postoperatively.

Conclusion: Patients in group R with bilateral US-guided RSB and standard general anesthesia had at the start and during the hysterectomy higher values of systolic and diastolic pressure, mean arterial blood pressure and heart rate, compared to the control group C which had a calm hemodynamic initial course, while the measured postoperative values showed stable parameters and a certain decrease in the values of the hemodynamic parameters in the control group R compare to the patients in the group C, showing an approximation to the values of the parameters of group C.

Keywords: hemodynamic changes, Rectus Sheath Block, Total Abdominal Hysterectomy

Introduction

Multimodal anesthesia (MMA) involves the use of combinations of multiple analgesics to achieve clinically necessary analgesia. Such combinations minimize the adverse post-operative effects associated with the use of high doses of opioids (fentanyl, remifentanil, etc.). MMA strategies for managing postoperative pain are increasingly becoming important components in anesthesia protocols for conducting surgical interventions aimed at faster recovery after surgery (Enhanced recovery after Surgery - ERAS). This protocol aims to optimize the patient's condition, standardize analgesic drugs perioperatively, minimize adverse effects, and improve the quality of analgesia and the final outcome of the patient [1].

The multimodal analgesic protocol should be specific to the surgical intervention, and may include opioids, non-opioid systemic analgesics such as acetaminophen, nonsteroidal anti-inflammatory drugs, gabapentinoids, ketamine and local anesthetics administered by infiltration, regional block or via intravenous route [2].

H. Willschke introduced the rectus sheath block (RSB) in 2006 as an abdominal truncal block guided (identified) by ultrasound (3). With the development of ultrasound, RSB has become popular in the anesthesia of various abdominal surgeries due to its high success rate and rare complications [4, 5].

RSB is a regional anesthetic technique in which a local anesthetic is injected into the space between the rectus abdominis muscle and its posterior sheath using ultrasound. It provides analgesic effect for midline incisions by blocking the 7th to 11th intercostal nerve branches located in the rectus abdominis sheath [6].

Objective

The aim of this study is to evaluate the effect of the rectus abdominis sheath block (RSB) on intraoperative and postoperative hemodynamic variables (systolic and diastolic blood pressure, mean arterial pressure and heart rate) in two groups of patients during open gynecological surgeries [7].

Materials and Methods

This prospective clinical study was conducted at the Special Hospital for Gynecology and Obstetrics "Mother Teresa" – Skopje, North Macedonia. The study included 10 patients that met the inclusion criteria.

Inclusion criteria: Patients scheduled for open gynecological surgery, age between 20-60 years, BMI < 32%, no serious comorbidities (ASA-American Society of Anesthesiologists classification) of 1-2.

Exclusion criteria: Any history of allergy to ropivacaine, ketoprofen and tramadol, coagulopathy, needle site infection and patients with an ASA classification >2.

Patients were randomized into two groups: R and C. In Group R (n = 5) standard general anesthesia and ultrasound-guided RSB bilaterally para-umbilically with 0.375% ropivacaine 20 ml was administered, and Group C was a control group (n = 5) receiving standard general anesthesia.

All patients included in the study (n = 10) were anesthetized under general anesthesia according to the following protocol:

1. Preoperative preparation: Premedication of 8 mg dexamethasone and 4 mg ondansetron was administered, as prevention for postoperative nausea and vomiting.

2. Induction into general endotracheal anesthesia was performed with the application of propofol 2 mg/kg, fentanyl 0.4 μg/kg and rocuronium 0.8 mg/kg, to facilitate intubation. 3. Maintenance, with propofol 20 μg/kg/h and remifentanil 25 μg/kg/h.

Intraoperatively, hemodynamics and respiratory parameters were monitored with noninvasive methods for continuous perioperative monitoring. Cardiac activity was monitored with electrocardiography (ECG), mean arterial pressure (MAP), heart rate per minute (bpm), peripheral arterial saturation (SpO2), and end-tidal carbon dioxide (EtCO2), recorded at identical 15-minute intervals throughout the operation (15min,30 min, 45 min, 1 hour and 1,5 hours for measurement of the parameters) and on 6h,12h and 24h after the operation.

Statistical analysis

Data processing was performed using the statistical software programs Microsoft Excel, MedCalc 23.0, and JASP. The data are presented with their mean, standard deviation (SD), standard error (SE) and 95% CI, and for the descriptive parameters of the populations of interest with absolute numbers and percentages.

The Mann-Whitney U-test and ANOVA tests were used when comparing and testing hypotheses. Statistical significance level was set to a value of $p < 0.05$.

Results

The characteristics of the study group including age, ethnicity, ASA classification, education use of medicaments, cigarette and alcohol consumption are presented in Table 1, including some other important medical data.

Table 1. Statistical demographic patient data

Patients	**n**	**Mean (SD) or %**
Age	10	49.90 (7.370)
Ethnicity	10	
Albanian	3	30%
Bosnian	0	0%
Macedonian	5	50%
Roma	2	20%
Turkish	0	0%
Medicament therapy-hypertension	10	
Yes	8	80%
No	2	20%
Hight	10	161.80(6.088)
Weight	10	81.80(13.750)
Body mass index	10	31.37(5.760)
ASA		
1	8	80%
2	2	20%
Education		
Elementary school	2	20 %
High school	8	80 %
Smoking		
Yes	0	0%
No	10	100%
Alcohol		
Yes	0	0%
No	10	100%

Chart 1 shows the patient demographic distributions. The ages of patients range between 44 and 66 years, with an average of 49.90 (7.370). The BMI distribution has an average of 31.37 (5.760). The patients are mainly distributed in ASA score-American Society of Anesthesiology score of 1 (80%).

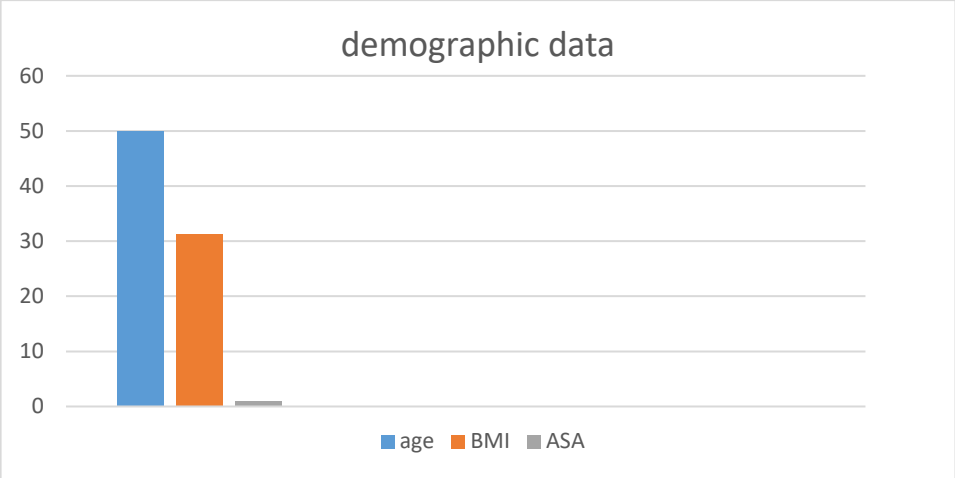

Chart 1. Patient demographic data.

Table 2. Statistical data and results for patient systolic blood pressure during and after operation in gr C

Systolic pressure/ mmHg	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	mean	median	St.Dev	margin of error	95% CI
15 min.	97	108	126	124	127	116.40	124	13.315	4.764	111.64-121.16
30 min.	112	87	151	153	95	119.60	112	13.932	11.068	108.53-130.64
45 min.	98	95	133	137	98	112.20	98	20.897	7.477	104.72-119.68
1 h	91	95	128	127	99	108	99	18.027	6.451	101.55-114.45
1.5 h	93	97	127	132	99	109.60	99	18.379	6.576	103.02-116.18
after op.6 h	125	127	118	129	130	125.80	127	4.764	1.704	124.1-127.5
after op.12 h	175	127	118	120	120	132	120	24.279	8.688	123.31-140-69
after op.24 h	129	139	130	130	125	129.20	129	6.180	2.211	126.99-131.41

Table 3. Statistical data and results for patient systolic blood pressure during and after operation in gr R

Systolic pressure/ mmHg	**Patient 1**	**Patient 2**	**Patient 3**	**Patient 4**	**Patient 5**	**mean**	**median**	**St.Dev**	**margin of error**	**95% CI**
15 min.	207	165	111	121	96	140	121	45.420	16.253	123.75-156.25
30 min.	163	125	122	135	121	133.20	125	17.555	6.282	126.92-139.48
45 min.	160	119	127	145	113	132.80	127	19.395	6.940	125.86-139.74
1 h	150	120	127	128	96	124.20	127	19.370	6.931	117.27-131.13
1.5 h	123	120	127	143	106	123.80	123	13.330	4.770	119.03-128.57
after op.6 h	125	127	118	129	130	125.80	127	4.764	1.704	124.1-127.5
after op.12 h	175	127	118	120	120	132	120	24.279	8.688	123.31-140.69
after op.24 h	129	139	130	123	125	129.20	129	6.180	2.211	126.99-131.41

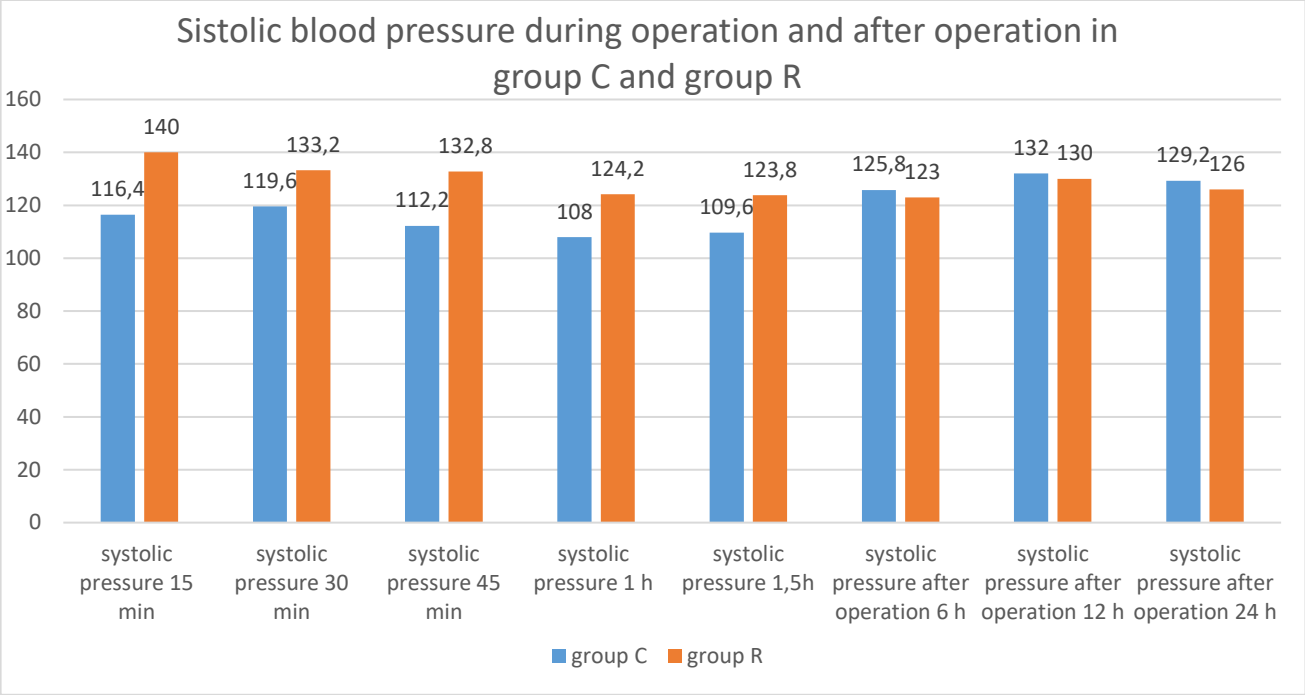

Chart 2. Statistical data and results for patient systolic blood pressure during and after operation in groups C and group R

At the beginning, patients in group R, with applied bilateral US-guided RSB and standard general anesthesia, had mean systolic pressure of 140 mmHg (123.75-156.25) and during the hysterectomy had mean systolic pressure of 132.80 mmHg (125.86-139.74), which are higher compared to the control group C, with mean systolic pressure of 116.40 mmHg (111.64-121.16) who had a calm hemodynamic initial course.

In the postoperative period, measurements were stable and showed a slight decrease in the values of the hemodynamic parameters in group R, with mean systolic pressure of 125.80 mmHg (124.1-127.5) compared to the patients in the control group C, with mean systolic pressure of 127.80 mmHg (124.1-127.5). The last postoperative parameters show a tendency of approximation and equalization of the parameters between the two groups, with mean systolic pressure of 129.20 mmHg (126.99-131.41) in group C and group R.

Table 4. Statistical data and results for patient diastolic blood pressure during and after operation in gr C

Diastolic pressure /mmHg	**Patient 1**	**Patient 2**	**Patient 3**	**Patient 4**	**Patient 5**	**mean**	**median**	**St.Dev**	**margin of error**	**95% CI**
15 min.	63	76	83	97	78	79.40	78	12.300	4.401	75-83.8
30 min.	79	65	91	107	49	78.20	79	22.476	6.117	70.16-86.24
45 min.	65	66	83	102	61	75.40	66	17.096	6.117	69.28-81.52
1 h	63	68	79	95	62	73.40	68	13.831	4.949	68.45-78.35
1.5 h	59	77	64	95	63	71.60	64	14.724	5.268	66.33-76.87

after op.6 h	75	77	73	77	60	72.40	75	7.127	2.550	69.85-74.95
after op.12 h	95	78	75	90	78	83.20	78	8.757	3.133	80.07-86.33
after op.24 h	69	78	80	74	90	78.20	78	7.823	2.799	75.4-81.0

Table 5. Statistical data and results for patient diastolic blood pressure during and after operation in gr. R

Diastolic pressure /mmHg	**Patient 1**	**Patient 2**	**Patient 3**	**Patient 4**	**Patient 5**	**mean**	**median**	**St. Dev**	**margin of error**	**95% CI**
15 min.	109	75	74	79	68	81.00	75	16.140	5.775	75.22-86.78
30 min.	108	74	84	97	91	90.80	91	12.872	4.606	86.19-95.41
45 min.	100	72	84	81	79	83.20	81	10.377	3.713	79.49-86.91
1 h	95	55	84	82	66	76.40	82	15.820	5.661	70.74-82.06
1.5 h	95	55	85	81	67	76.60	81	15.709	5.621	70.98-82.22
after op.6 h	92	70	80	82	81	81.99	81	7.810	2.794	78.21-83.79
after op.12 h	77	80	79	68	75	75.80	77	4.764	1.704	74.1-77.5
after op.24 h	79	73	84	78	63	75.40	78	7.956	2.847	72.77-78.25

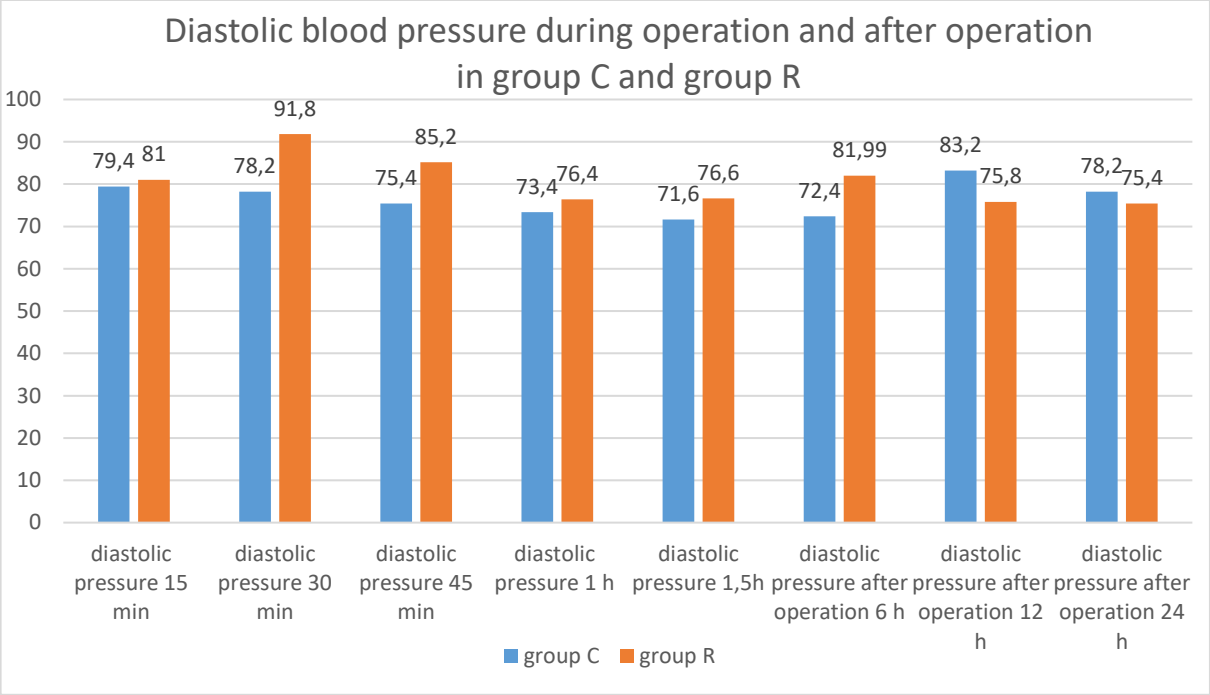

Chart 3. Statistical data and results for patient diastolic blood pressure during and after operation in group C and group R

At the beginning, patients in group R, with applied bilateral US-guided RSB and standard general anesthesia, had mean diastolic pressure of 81 mmHg (75.22-86.78), and during the hysterectomy had a mean diastolic pressure of 83.20 mmHg (79.49-86.91). Those were equal or higher values compared to control group C, with mean diastolic pressure of 79.40 mmHg (75-83.8), who had a calm hemodynamic initial course. In the postoperative period, the measurements in group R stabilized and showed a slight increase in the values of the hemodynamic parameters, with mean diastolic pressure of 81 mmHg (78.21-83.79), compared to patients in group C, with mean diastolic pressure of 75 mmHg (69.85-74.95). The last postoperative parameters show a tendency of lowering of the parameters in group R, with mean diastolic pressure of 75.40 mmHg (72.77-78.25) compared to group C, with mean diastolic pressure of 78.20 mmHg (75.4-81).

Table 6. Statistical data and results for Mean arterial Blood pressure (MAP) of the patents during and after operation in group C

MAP/mmHg	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	mean	median	St. Dev	margin of error	95% CI
15 min.	79	87	98	101	94	91.80	94	8.871	3.174	88.63-94.97
30 min.	79	72	115	123	65	90.60	79	26.613	9.523	81.08-100.12
45 min.	74	76	102	112	65	85.80	76	20.104	7.194	78.61-92.99
1 h	74	76	102	112	65	84.40	77	14.258	5.102	79.3-89.5
1.5 h	76	84	85	103	75	84.60	84	11.238	4.021	80.58-88.62
after op.6 h	75	77	73	77	60	72.40	75	7.127	2.550	69.85-74.95
after op.12 h	95	78	75	90	78	83.20	78	8.757	3.133	80.07
after op.24 h	69	78	80	74	90	78.20	78	7.823	2.799	75.4-81

Table 7. Statistical data and results for Mean arterial Blood pressure (MAP) of the patents during and after operation in group R

MAP/mmHg	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	mean	median	St.Dev	margin of error	95% CI
15 min.	142	138	113	99	80	58.40	80	54.582	19.531	38.87-77.93
30 min.	140	84	104	110	104	108.40	104	20.218	7.235	101.16-115.64
45 min.	124	92	97	97	94	100.80	97	13.141	4.702	96.1-105.5
1 h	112	84	99	97	79	94.20	97	13.065	4.675	89.52-98.88
1.5 h	112	84	88	122	79	97.00	88	18.867	6.751	90.25-103.75
after op.6 h	101	91	96	94	93	95.00	94	3.807	1.362	93.64-96.36
after op.12 h	115	100	95	84	91	97.00	95	11.640	4.165	92.83-101.17
after op.24 h	103	91	98	91	77	92.00	91	9.797	3.506	88.49-95.51

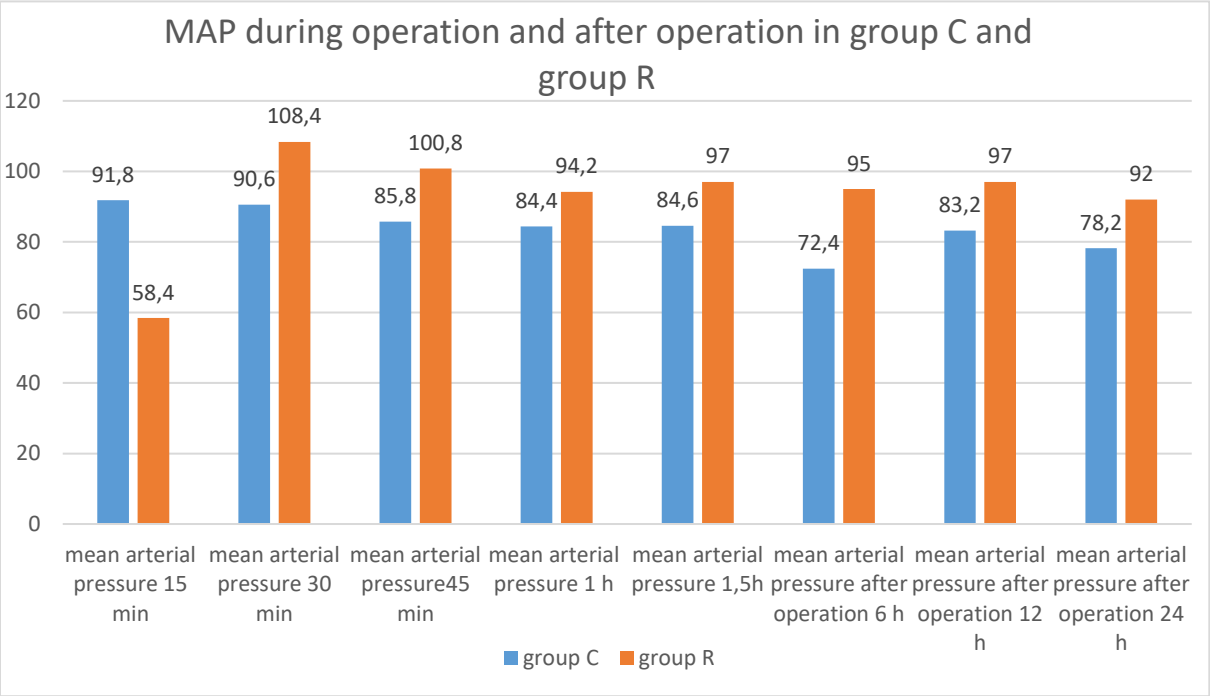

Chart 4. Statistical data and results for Mean arterial Blood pressure (MAP) of the patents during and after operation in group C and group R

At the beginning, patients in group R (with applied bilateral US-guided RSB and standard general anesthesia) had mean arterial blood pressure-MAP of 58.40 mmHg (38.87-77.93) which was lower than group C with MAP of 91.8 (88.63-94.97). During the hysterectomy, group R had MAP of 100.80 mmHg (96.1-105.5), which was higher than the control group C, with had MAP of 76 mmHg (78.61-92.99). In the postoperative period, values showed stable parameters and slight increase in the values of the hemodynamic parameters in group R with MAP of 95 mmHg (93.64-96.36) compared to the patients in group C, with MAP 75 mmHg (69.85-74.95). The last postoperative parameters show slightly higher values of MAP, of 92 mmHg (88.49-95.51) in group R, compared to MAP of 78.20 mmHg (75.4-81) in group C.

Table 8. Statistical data and results for heart rate of the patents during and after operation in group C

Heart rate /bpm	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	mean	median	St.Dev	margin of error	95% CI
15 min.	92	94	93	78	92	89.80	92	6.648	2.379	87.42-92.18
30 min.	64	65	101	68	82	76.00	68	15.732	5.629	70.37-81.63
45 min.	73	68	97	87	79	80.80	79	11.497	4.114	76.69-84.91
1 h	73	68	83	92	78	78.80	78	9.257	3.312	75.49-82.11
1.5 h	72	77	85	80	80	78.80	80	4.764	1.704	77.1-80.5
after op.6 h	84	88	74	90	72	81.60	84	8.173	2.924	78.68-84.52
after op.12 h	99	80	75	79	83	83.20	80	9.284	3.322	79.88-86.52
after op.24 h	85	88	82	72	89	83.20	85	6.833	2.445	80.75-85.65

Table 9. Statistical data and results for heart rate of the patents during and after operation in group R

Heart rate /bpm	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	mean	median	St.Dev	margin of error	95% CI
15 min.	104	95	66	76	56	79.40	76	19.919	7.128	72.27-86.53
30 min.	96	84	104	82	104	94.00	96	10.583	3.787	90.21-97.79
45 min.	95	74	66	74	94	80.60	74	13.107	4.690	75.91-85.29
1 h	95	75	65	64	56	71.00	65	15.016	5.373	95.63-76.37
1.5 h	94	74	65	66	60	71.80	66	13.386	4.790	67.01-76.59
after op.6 h	92	76	96	67	60	78.20	76	15.562	5.568	72.63-83.77
after op.12 h	99	100	82	69	68	83.60	82	15.533	5.558	78.04-89.16
after op.24 h	82	77	80	74	60	74.60	77	8.706	3.115	71.48-77.72

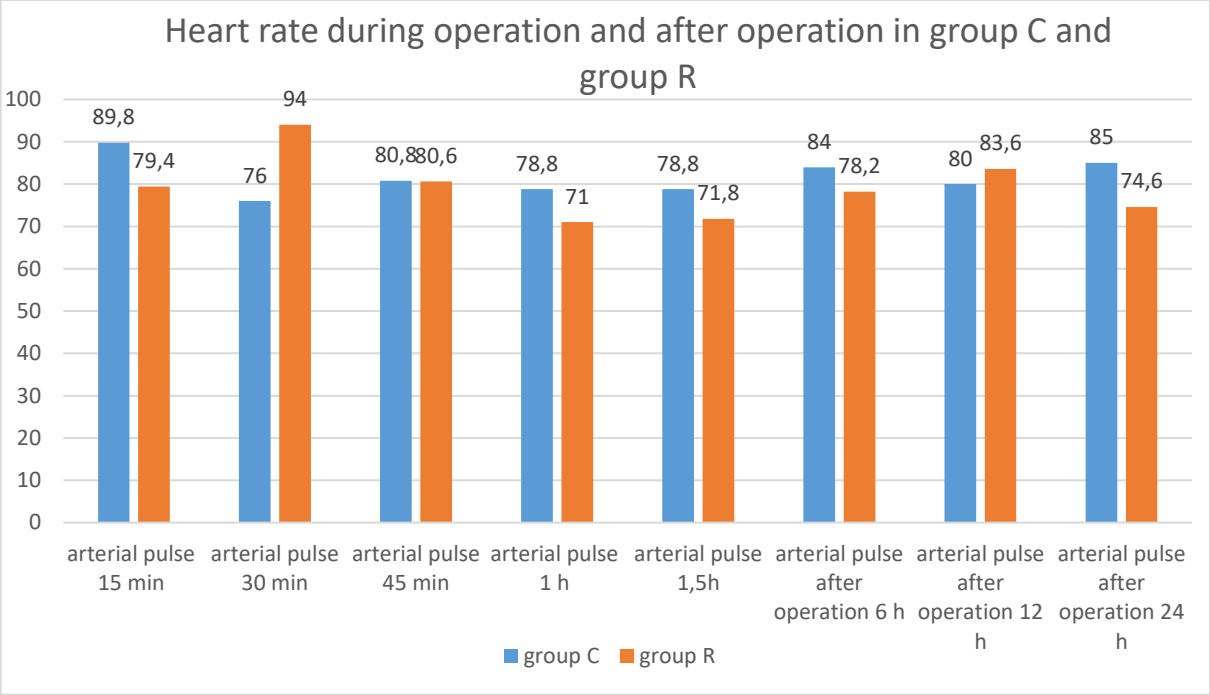

Chart 5. Statistical data and results for heart rate of the patents during operation and after operation in group C and group R.

At the beginning, patients in group R had a lower heart rate (HR) 79.40 bpm (72.27-86.53) compared to patients in group C, with HR of 89.80 bpm (87.42-92.18), which continued during the hysterectomy, with HR values in group R of 80.60 bpm (75.91-85.29), compared to group C, with HR of 80.80 bpm (76.69-84.91). In the postoperative period, HR values stabilized and showed a slight decrease in group R of 76 bpm (72.63-83.77) compared to patients in group C, with HR of 81.60 bpm (78.68-84.52). The last postoperative parameters lowered in group R, with HR of 74.60 bpm (71.48-77.72) compared to group C with HR of 83.20 bpm (80.75-85.65).

Discussion

The results obtained in this study confirmed the research goals. Rectus sheath block technique is used to block the terminal branches of the 9th, 10th, and 11 the intercostal nerves which run in between the internal oblique and transverses abdominis muscles to penetrate the posterior wall of the rectus abdominis muscle and end in an anterior cutaneous branch supplying the overlying skin of the umbilical area.

Local anesthetic deposition within the posterior rectus sheath bilaterally provides dense and predictable analgesia over the middle of anterior wall from the xiphoid process to the symphysis pubis [8].

Ultrasound guidance has various advantages because it provides optimal needle positioning and monitors the distribution of local anesthetic. In recent years, ultrasound has been widely used in regional anesthesia. This technique allows non-invasive real time imaging, higher success rate of block, shorter block onset time, lower local anesthetic dose and reduced complications [3-12].

In gynecological surgery, IV opioids, nonsteroidal anti-inflammatory drugs, local anesthetic infiltration to the surgical area and peripheral nerve blockades may be preferred for postoperative pain management. Rectus sheath block can be combined with other blocks to achieve a wider blockade for transverse incisions below the umbilicus [12]. In this study, we combined the rectus sheath block with postoperative analgesia for gynecological surgery with Pfannenstiel incision as a part of multimodal anesthesia.

With respect to hemodynamic changes, patients in group R, with applied bilateral US-guided RSB and standard general anesthesia, had at the start mean systolic pressure of 140 mmHg (123.75-156.25), and during the hysterectomy had higher values of mean systolic pressure compared to the control group C, which had mean systolic pressure of 116.40 mmHg (111.64-121.16) and a calm hemodynamic initial course. The postoperative measured values showed slight decrease in values of the hemodynamic parameters in the control group R, with mean systolic pressure of 125.80 mmHg (124.1-127.5), as compared to the patients in group C, showing mean systolic pressure of 127.80 mmHg (124.1-127.5).

The last postoperative parameters show a tendency of approximation and equalization of the parameters between the two groups, with values of the mean systolic pressure of 129.20 mmHg (126.99-131.41).

This pattern continued with mean diastolic pressure of 81 mmHg (75.22-86.78) during the hysterectomy, with mean diastolic pressure of 83.20 mmHg (79.49-86.91) and showed equal or higher values of mean diastolic pressure, compared to the control group C, with mean diastolic pressure of 79.40 mmHg (75-83.8). The postoperative measured values were stable and showed slight increase in the hemodynamic parameters in group R with mean diastolic pressure of 81 mmHg (78.21-83.79), compared to the patients in group C, with mean diastolic pressure of 75 mmHg (69.85-74.95). The last postoperative parameters show a tendency of lowering of the parameters in group R, with values of mean diastolic pressure of 75.40 mmHg (72.77-78.25) compared to the group C, with mean diastolic pressure of 78.20 mmHg (75.4-81).

The mean systolic and diastolic pressure as well as the MAP are higher at the beginning of the open gynecological surgery, as a result of the existence of a moderate or severe form of arterial hypertension in the patients in group R who are on chronic combined antihypertensive therapy. After the start of the operation and the introduction of general anesthesia, RSB is applied and sedation is continued with propofol 25 ml/h without opioids [14, 15].

On the other hand, in the control group C the patients have reference initial values of mean systolic and diastolic pressure as well as MAP. After the start of general anesthesia, and continuous maintenance, with propofol 20 μg/kg/h and remifentanil 25 μg/kg/h, yields a stabile hemodynamic condition of the patients in group C [16].

At the beginning of the operation in group R, MAP value of 58.40 mmHg (38.87-77.93) are lower compared to group C, with MAP of 91.8 (88.63-94.97). During the hysterectomy, group R MAP value is 100.80 mmHg (96.1-105.5), higher than control group C, with MAP of 76 mmHg (78.61-92.99). In the postoperative period, measured values are stable and show slight increase in the control group R with MAP of 95 mmHg (93.64-96.36), compare to group C, with MAP 75 mmHg (69.85-74.95). The last postoperative

parameters show slightly higher values of MAP of 92 mmHg (88.49-95.51) in group R, compared to the MAP of 78.20 mmHg (75.4-81) in group C.

Patients in group R had from the start lower HR values of 79.40 bpm (72.27-86.53) compared to group C, with HR of 89.80 bpm (87.42-92.18), which continued during the hysterectomy, with HR of 80.60 bpm (75.91-85.29), compared to group C, with HR of 80.80 bpm (76.69-84.91). In the postoperative, measured values were stable and showed a slight decrease in HR values in group R of 76 bpm (72.63-83.77) compared to group C, with HR of 81.60 bpm (78.68-84.52).

The last postoperative parameters show a tendency of continuity in group R, with HR of 74.60 bpm (71.48-77.72), compared to group C with HR of 83.20 bpm (80.75-85.65). Regarding HR in group R, the hemodynamic bradycardic effect of the local anesthetic, in our case ropivacaine, on the heart rate is visible, hence, the HR of group R is lower compared to the HR of group C [17, 18, 19].

Conclusion

Our results show that patients in group R, with bilateral US-guided RSB and standard general anesthesia, had at the start and during the hysterectomy higher values of systolic and diastolic pressure and slightly higher mean arterial blood pressure and equal heart rate, compared to the control group, C, which had a calm hemodynamic initial course. The postoperative measured values showed stable parameters and a certain decrease in the values of the hemodynamic parameters of systolic pressure and MAP, and showed an approximately equal or lower values for the diastolic pressure and heart rate in the group R compared to patients in group C.

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