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Comparison of stress before and after operation for patients that underwent laparoscopic surgical treatment of hiatal hernia and simultaneous operations

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Abstract
The development of technology in laparoscopic surgery used in patients with combined surgical pathology of the abdominal cavity creates the preconditions for the simultaneous operations. One-staged treatment linked to more effectiveness. The technique of simultaneous treatment of hiatal hernia and gallstone disease have been developed and tested. The parameters used for evaluation of negative impact were heart rate (HR), variation range (∆X) - the difference between the maximum and minimum duration of cardio intervals, mode of the amplitude (AMo) - the percentage of the most common cardio intervals, as well as their duration - mode (Mo). These parameters were used to evaluate the level of IN (by Baevsky method) for estimating stress level and tension of sympathetic nervous system. Parameters were compared in group of simultaneous laparoscopic treatment of hiatal hernia and gallstone disease (group #1 n=126) and control group of just one operation for treatment of hiatal hernia (group #2 n=206). In all cases Toupet fundoplication with crurorаphy was performed. Comparing to the preoperative period in the postoperative period the heart rate was increasing, reaching a maximum after 2 h. (accordingly by 26.8% and 24.6%, p>0.05); the dynamics of the ∆X in the comparison groups was wavy with the first period of decrease after 2 h (accordingly 19.2% and 21.9%, p<0.05) and after 2 days (accordingly 12.8% and 15, 5%, p<0.05); Mo did not differ in both groups (p>0.05); the dynamics of the AMo increased compared with the preoperative level with a maximum after 2 h. (accordingly by 21.9% and 20.9%, p<0.05); the IN rate has been increasing up to 2 hours postoperative compared to the preoperative level: in the control group - accordingly by 92.4%, in the research group - by 92.5% (p<0.05).All indicators were back to normal rates within two days and did not differ statistically significant with preoperative rates in both groups. This fact indicates that the degree of stress linked to both types of surgical interventions has no differencein the level of tension in sympathetic nervous system and the degree of centralization of heart rate regulation. Our developed technique has been shown safe and effective

Key words: *laparoscopy, gallstone disease, hiatal hernia, simultaneous*

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I. Introduction

The development of technology in laparoscopic surgery used in patients with combined surgical pathology of the abdominal cavity creates the preconditions for the simultaneous operations. One-staged treatment accelerates the patient's recovery and reduces its cost because of reducing terms of general hospital stay and general time needed for treatment. The main problem of simultaneous operations is their additional trauma and duration, which influenceson surgical stress and theoretically can increase the frequency of postoperative complications. [1] All this demands implementation additional equipment of operating rooms, skills for the surgeon and using technique that provides reduction of trauma and invasiveness of surgical interventions, adequacy of preoperative preparation of the patient, anesthesiological support and management of patients in the postoperative period. [2] It may be extrapolated for gallstone disease. It affects 15 to 20% of the adult population of Western countries. Among them, up to 12% of patients have comorbid hiatal hernia. [3] This prompted us to develop a technique forlaparoscopic surgery aimed at surgical treatment of hiatal herniaand gallstone disease simultaneously. Under these conditions, because of increasing admeasurement of surgical trauma, one of the important criteria for the effectiveness and safety of simultaneous operations compared to mono-interventions is the severity of operational stress. [4] Under stress, one of the first to note is the adaptive adjustment of the cardiovascular system, which is reflected in the variability of heart rate. [5, 6]

II. Aim Of Work:

to evaluate the intensity of preoperative and postoperative stress in patients with laparoscopic treatment of hiatal hernia and simultaneous laparoscopic treatment of hiatal hernia and gallstone disease on the basis of variability of cardiac rhythm.

III. Materials And Methods:

Survey was performed in the Volynian regional clinical hospital in the laparoscopic surgery unit. Statistic used in survey was formed using data of patients that underwent laparoscopic surgery treatment for the hiatal hernia and patients that underwent simultaneous laparoscopic treatment for the comorbid hiatal hernia and gallstone disease during 2015-2019 period. In every case laparoscopic Toupet fundoplication with crurоraphy was performed. Patients were formed in two groups: group #1 – 126 patients that underwent simultaneous laparoscopic Toupet fundoplication with crurоraphy with laparoscopic cholecystectomy; group #2 – 206 patients that underwent only laparoscopic Toupet fundoplication with crurоraphy. In group #1 in each case our developed technique of simultaneous operations was used. In group #2 in each case technique `baseball diamond` was used.

Selection into groups was performed exclusively on the principles of surgical comorbidity. All patients underwent routine surgical treatment. The average length of stay of the patient in the hospital before surgery was 1 hospital day.

Exclusion criteria were: patients with progressive coronary heart disease incombination with severe heart failure and severe chronic kidney disease, isolated obliteratingatherosclerosis of the vessels of the lower extremities, chronic pulmonary diseases in theacute stage, cancer of various localization.

To measure the operative stress by a variation of pulsogram, we used cardiocomplex "CardioLab +" (designed and manufactured by HAI-MEDICA, Kharkiv/ Ukraine) for all patients in the control group and main group the day before surgery and 1, 2, 3, 6, 12 hours and 1, 2 and 3 days postoperatively. The recording was performed in the patient's ward in a supine position not earlier than after 7-10 minutes of adaptation to this position. At least 100 cardio intervals were recorded with subsequent determination of the main statistical characteristics according to the method of R.M. Baevsky [7, 8].

The obtained records were used to determine heart rate (HR), variation range (ΔX) - the difference between the maximum and minimum duration of cardio intervals, mode of the amplitude (AMo) - the percentage of the most common cardio intervals, as well as their duration - mode (Mo).

According to the obtained data, the voltage index of regulatory systems was calculated (by Baevsky (IN)), which reflects the degree of centralization of heart rate control: IN = AMo / (2×Mo×ΔX).

Estimation of the probability of differences between the control and main groups was performed using the nonparametric Mann-Whitney test.

IV. Results And Discussion:

The result of data analysis after research showed that there were no statistically significant difference in heart rate between groups. The measurements of heart rate filed in table 1 and diagram 1.

Period of measurement	Control group (#2)	Research group (#1)	p
Day before surgery	71,0(66,0; 75,0)	72,0(67,0; 75,0)	>0,05
Postoperative period			
1 hour	87,0(80,8; 91,9)	82,8(77,1; 86,3)	>0,05
2 hours	90,0(83,7; 95,1)	89,7(83,5; 93,5)	>0,05
6 hours	84,0(78,1; 88,7)	84,6(79,1; 88,1)	>0,05
12 hours	78,0(72,5; 82,4)	73,4(68,3; 76,5)	>0,05
1day	74,0(68,8; 78,2)	76,6(71,3; 79,8)	>0,05
2 days	73,0(67,8; 77,1)	74,6(69,4; 77,7)	>0,05
3 days	70,0(65,1; 74,0)	71,9(66,9; 74,9)	>0,05
Note: here and further*p* – possibility of difference for rate in control group from research group			

Table 1 Heart rate (bpm) of patients in both groups (Me (LQ; Uq) – median and upper and lower rate)

Comparing to the preoperative period in the postoperative period the heart rate was increasing, reaching a maximum after 2 h. (accordingly by 26.8% and 24.6%, p>0.05). Subsequently, in both comparison groups, the indicator decreased and, starting from the 12 h. of postoperative period, have not differ statistically significantly from the value of the indicator before surgery (p>0.05). It is noteworthy that the value of heart rate in all periods of the postoperative period between the group of patients that underwent Toupet fundoplication with crurоraphy with laparoscopic simultaneous cholecystectomy and patients that underwent only Toupet fundoplication with crurоraphy did not differ significantly (p>0.05).

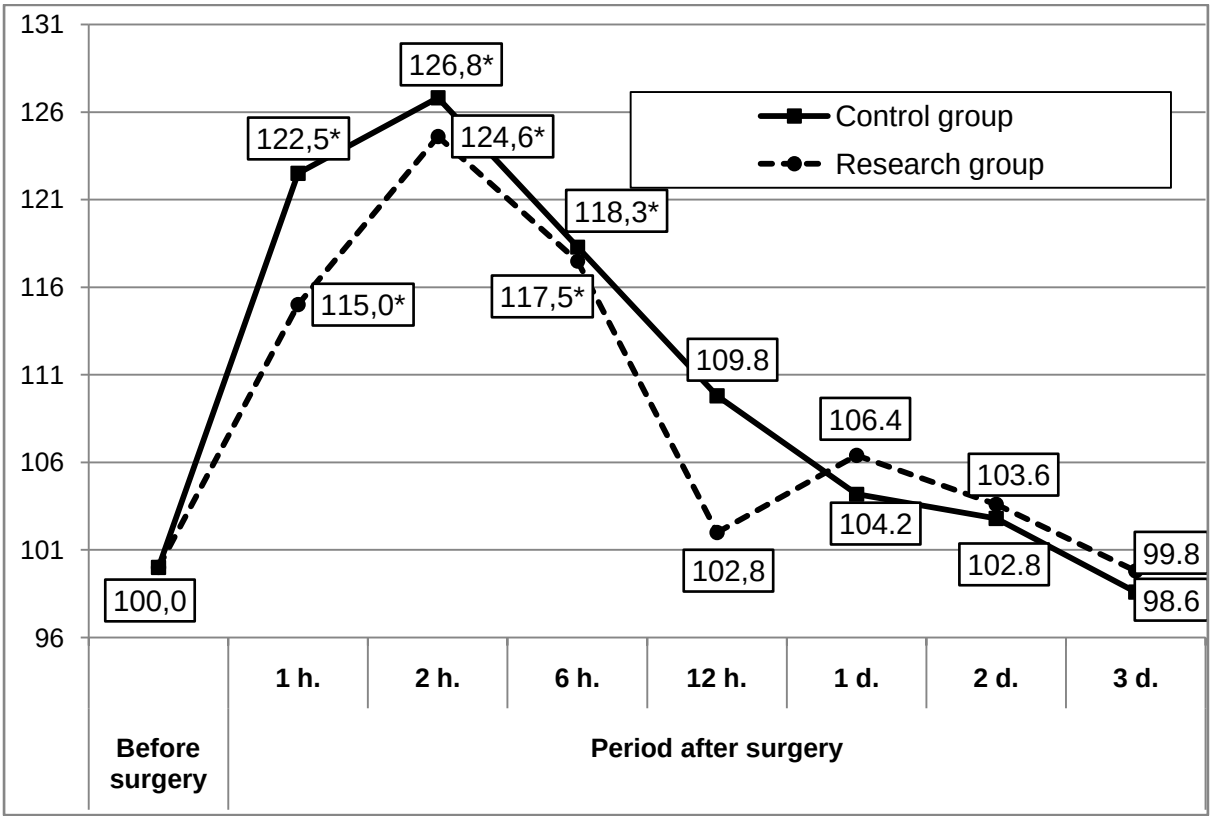

Diagram 1 Heart rate dynamics (in percent to control level) **(Note: here and further * - differences for the terms before operation is statistically possiblep<0,05).**

Analyzing the value of the variation scale (ΔX) (Table 2, Diagram 2), it was found that before the operation the indicator did not differ significantly between the control and the main groups (p>0.05).

Period of measurement	Control group (#2)	Research group (#1)	p
Day before surgery	0,156(0,148; 0,153)	0,142(0,137; 0,153)	>0,05
Postoperative period			
1 hour	0,144(0,136; 0,156)	0,130(0,125; 0,141)	>0,05
2 hours	0,126(0,118; 0,138)	0,112(0,107; 0,123)	>0,05
6 hours	0,148(0,140; 0,160)	0,134(0,130; 0,143)	>0,05
12 hours	0,149(0,141; 0,161)	0,133(0,124; 0,144)	>0,05
1 day	0,151(0,143; 0,163)	0,139(0,131; 0,146)	>0,05
2 days	0,136(0,125; 0,140)	0,121(0,125; 0,145)	>0,05
3 days	0,176(0,168; 0,188)	0,162(0,157; 0,173)	>0,05

Table2ΔX rates of patients in both groups (Me (LQ; Uq) – median and upper and lower rate)

In the postoperative period, the dynamics of the ΔX in the comparison groups was wavy with the first period of decrease after 2 h (accordingly 19.2% and 21.9%, p<0.05) and after 2 days (accordingly 12.8% and 15, 5%, p<0.05). After 3 days, the rate in both groups increased and in the main group became significantly higher than before surgery (by 14.1%, p<0.05).

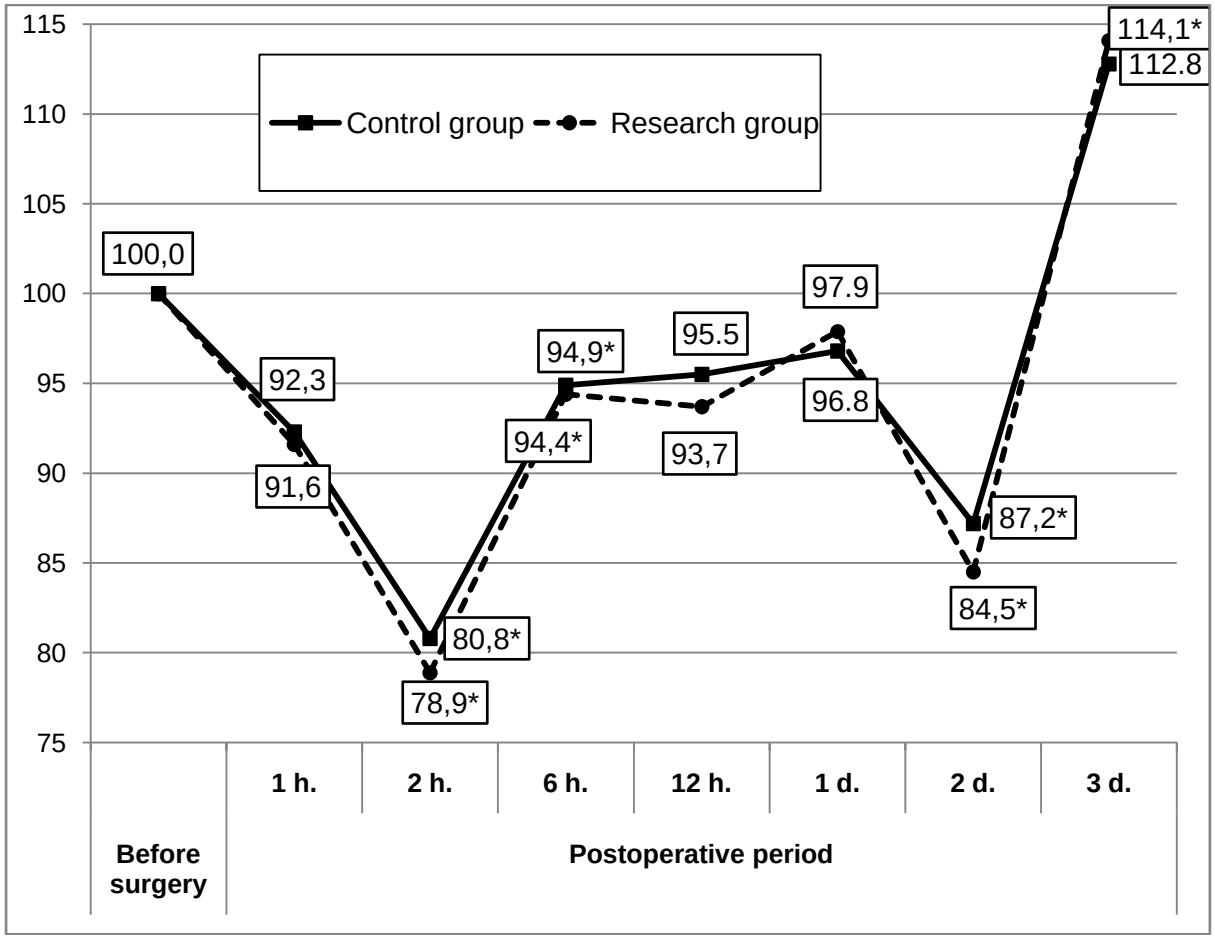

Diagram2ΔX (in percent to control level)

Also, during the postoperative period, no significant differences between the comparison groups were observed (p>0.05).

Furthermore, the dynamics of the *Mo* was similar to the value of heart rate (Table 3, Diagram 3). Te day before the operation, the value of *Mo* between the control and main groups did not differ significantly (p>0.05).

In the dynamics, the value of *Mo* decreased in both groups up to 2 h. of the postoperative period compared with the preoperative level (accordingly by 21.1% and 19.7%, p<0.05). Subsequently, the rate increased and starting from 12 h. of the postoperative period, did not differ statistically significant from the preoperative level (p>0.05).

Period of measurement	Control group (#2)	Research group (#1)	p
Day before surgery	0,865(0,800; 0,918)	0,855(0,788; 0,918)	>0,05
Postoperative period			
1 hour	0,706(0,653; 0,750)	0,743(0,686; 0,798)	>0,05
2 hours	0,682(0,631; 0,724)	0,686(0,633; 0,736)	>0,05
6 hours	0,731(0,676; 0,776)	0,726(0,669; 0,777)	>0,05
12 hours	0,788(0,729; 0,836)	0,838(0,773; 0,900)	>0,05
1 day	0,830(0,768; 0,881)	0,803(0,741; 0,862)	>0,05
2 days	0,841(0,778; 0,893)	0,825(0,761; 0,886)	>0,05
3 days	0,877(0,811; 0,932)	0,857(0,790; 0,919)	>0,05

Table3*Mo* rates of patients in both groups (Me (LQ; Uq) – median and upper and lower rate)

Comparison of control and main groups in the postoperative period did not reveal significant differences in the value of Mo (p>0.05).

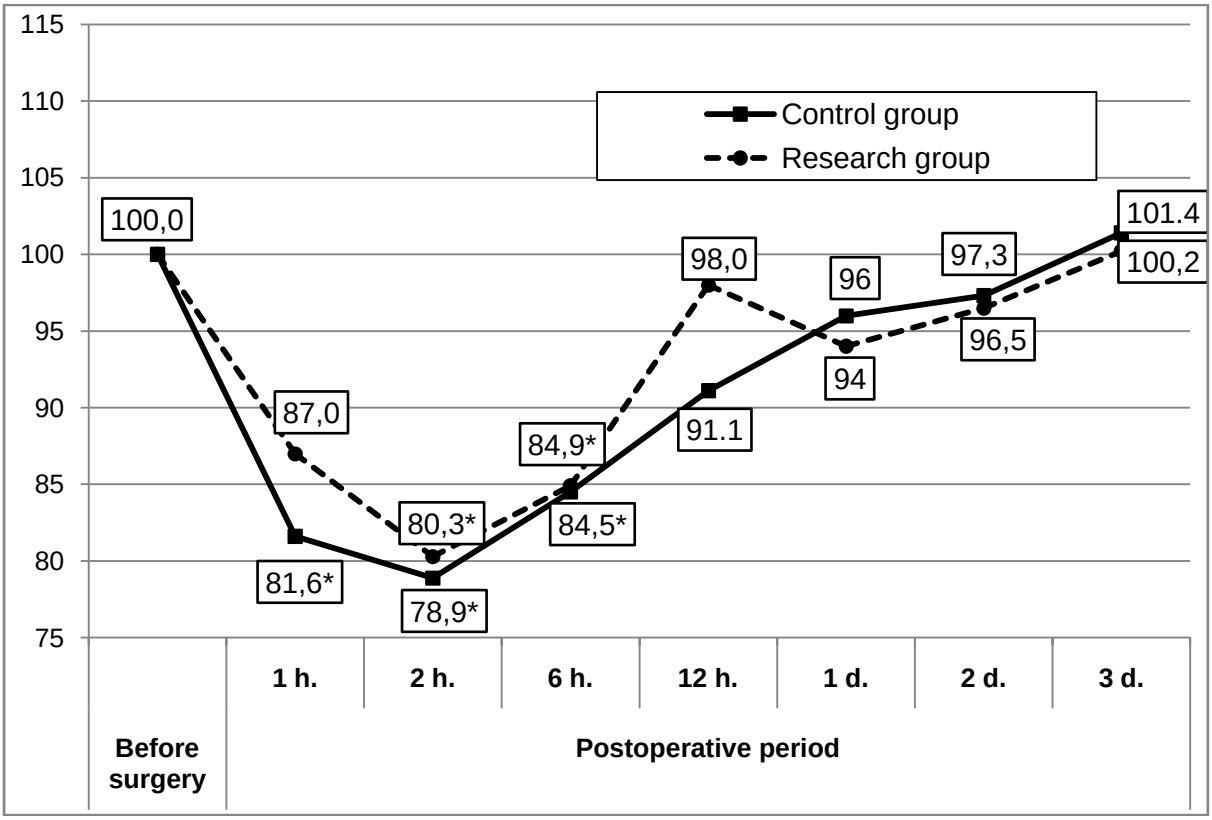

Diagram3*Mo* (in percent to control level)

The value of A*Mo* (Table 4, Diagram 4) in the preoperative period between the control and experimental groups also did not differ (p>0.05).

Period of measurement	Control group (#2)	Research group (#1)	p
Day before surgery	36,5(33,9; 38,5)	38,3(35,6; 39,8)	>0,05
Postoperative period			
1 hour	42,5(39,9; 44,5)	44,3(41,6; 45,8)	>0,05
2 hours	44,5(41,9; 46,5)	46,3(43,6; 48,1)	>0,05
6 hours	41,5(38,9; 43,5)	43,3(41,1; 45,3)	>0,05
12 hours	39,5(36,9; 41,5)	41,3(38,6; 42,8)	>0,05
1 day	38,5(35,9; 40,5)	38,0(36,0; 40,3)	>0,05
2 days	36,5(33,9; 39,1)	38,8(36,0; 41,0)	>0,05
3 days	35,5(32,9; 38,5)	37,3(34,7; 40,3)	>0,05

Table4A*Mo* rates of patients in both groups (Me (LQ; Uq) – median and upper and lower rate)

During postoperative period, the dynamics of the studied indicator increased compared with the preoperative level with a maximum after 2 h. (accordingly by 21.9% and 20.9%, p<0.05). Subsequently, the indicator decreased and, starting from 12 h. of the postoperative period, in both comparison groups reached the level of the preoperative period (p>0.05).

Comparison of the A*Mo* in the postoperative period did not reveal statistically significant differences between the control and main groups (p>0.05).

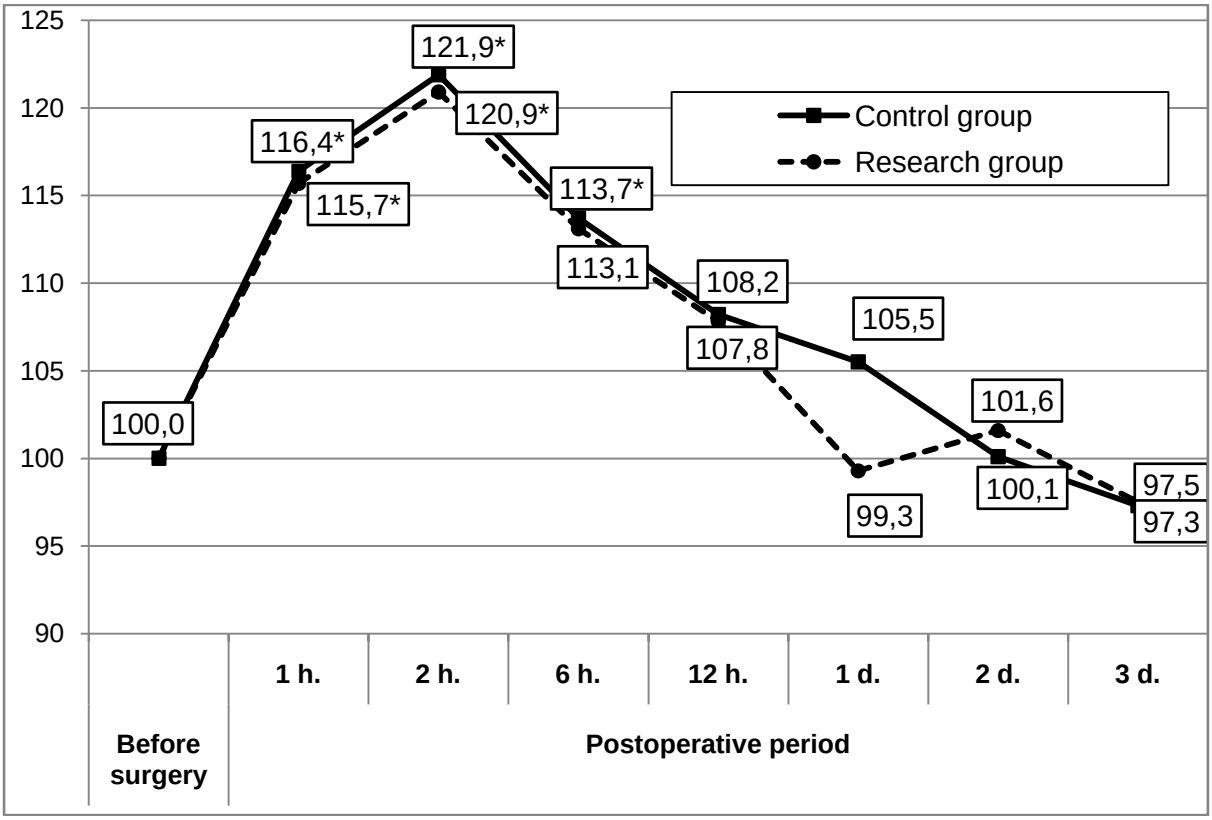

Diagram4A*Mo* (in percent to control level)

An integral measure of the tension of adaptation mechanisms is the value of IN.
Surveys showed that the value of IN in the preoperative period (Table 5, Diagram 5) between the control and main groups did not differ significantly (p>0.05).

Period of measurement	Control group (#2)	Research group (#1)	p
Postoperative period			
1 hour	211,5(169,5; 249,8)	225,4(190,5; 210,0)	>0,05
2 hours	262,0(208,1; 311,8)	298,6(246,5; 356,8)	>0,05
6 hours	194,9(155,6; 229,1)	218,3(184,2; 262,2)	>0,05
12 hours	170,3(136,1; 201,5)	180,1(151,4; 217,3)	>0,05
1 day	155,4(124,1; 184,0)	172,8(143,7; 203,6)	>0,05
2 days	173,8(137,6; 210,7)	205,1(164,4; 245,2)	>0,05
3 days	117,2(94,1; 139,6)	134,0(110,1; 166,1)	>0,05

Table5 IN rates of patients in both groups (Me (LQ; Uq) – median and upper and lower rate)

In the postoperative dynamics the IN rate has been increasing up to 2 hours postoperative compared to the preoperative level: in the control group - accordingly by 92.4%, in the research group - by 92.5% (p<0.05). The indicator decreased after 6 h. in both groups and the IN rates did not differ significantly from the preoperative level (p>0.05). There was a repeated increase in the value of IN after 2 days in both experimental groups. However, the obtained result compared to the preoperative level was statistically unlikely (p>0.05).

Comparison of control and main groups in the dynamics of the postoperative period did not reveal statistically significant differences (p>0.05).

Thus, the analysis of statistical indicators of the variation pulsogram in the preoperative period did not reveal significant differences between the control and research groups, which indicates the representativeness of the observation groups.

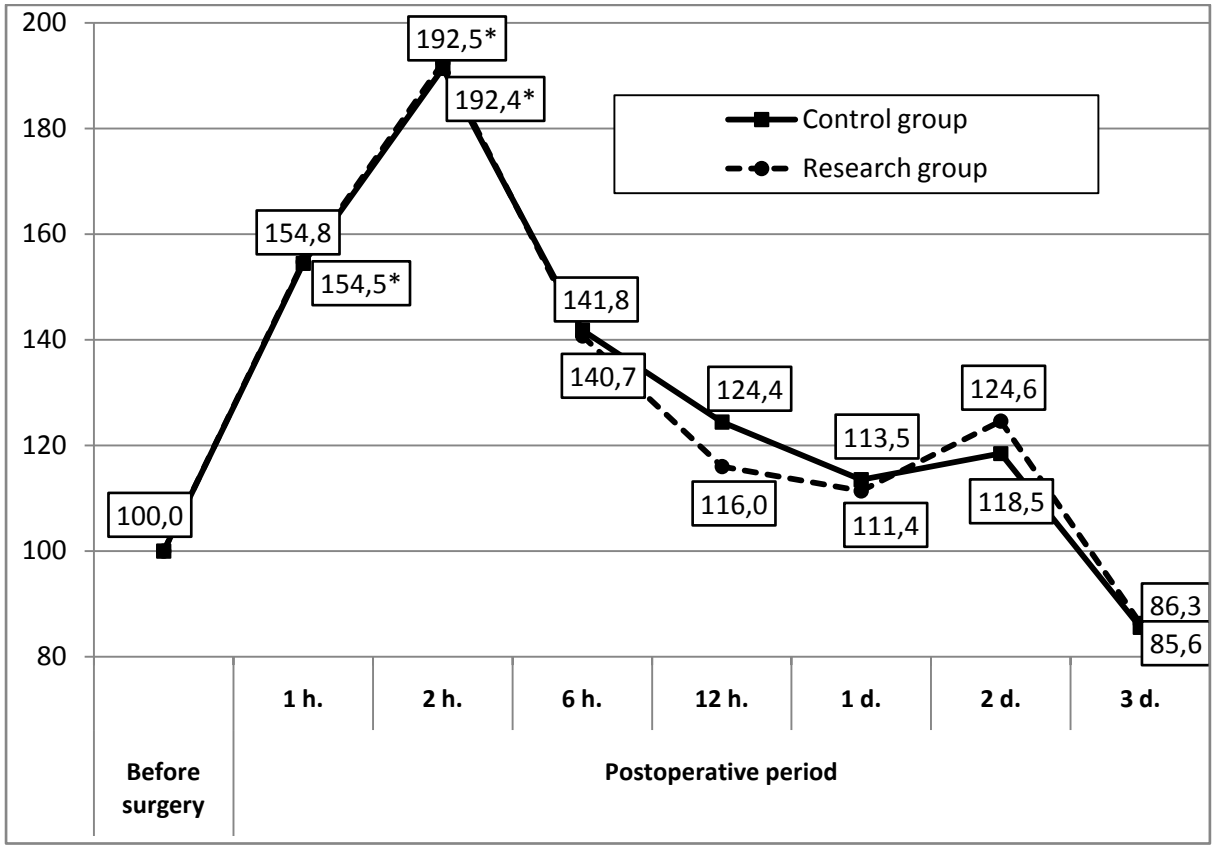

Diagram 5 IN (in percent to control level)

Up to 2 h. after surgery in the dynamics of the postoperative period, the values of *Mo*, ΔX decrease and AMo and IN increased. This indicates an increasing of the activity of the sympathetic nervous system and increasing of centralization of heart rate control, which indicates an increasingof the stressor effects of surgery. Obviously, this increase is associated with a decrease in the effect of drugs used for anesthesia.

By 12 h.in the postoperative period, the deviations reached the preoperative level in both comparison groups. Noteworthy is the moderate statistically significant decrease in the value of ΔX and the tendency to increase the IN after 2 days in the postoperative period, which is the evidence of a delayed response of the body to surgical trauma. By the day 3 after surgery, all applied statistical indicators of mathematical analysis of heart rate reached the preoperative level.

However, despite the types of surgical interventions performed, both laparoscopic Toupet fundoplication with crurography and simultaneous cholecystectomy and only laparoscopic Toupet fundoplication with crurography in the postoperative period at all times caused almost the same deviations of the studied parameters, which were not statistically significant between groups of patients. This fact indicates that the degree of stress for both types of surgical interventions is almost the same for the level of tension in sympathetic nervous system and the degree of centralization of heart rate regulation, regardless of the volume and duration of interventions and indicates the safety and viability of simultaneous operations for treatment of hiatal hernia and gallstone disease.

V. Conclusion

1. Mono-intervention for hiatal hernia and simultaneous operations for hiatal hernia and gallstone disease using our developed technique of simultaneous laparoscopic operations are accompanied by almost identical deviations of statistical indicators of variability of the network rhythm in the postoperative period in all terms of observation.
2. The absence of statistically significant differences in the dynamics of the postoperative period between the groups of patients with mono- and simultaneous interventions on the level of tension in sympathetic nervous system and the degree of centralization of heart rate regulation indicates the same level of postoperative stress and indicates the safety and viability of simultaneous technique.

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