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Stress before and after surgery in patients with laparoscopic treatment of gallstone disease and inguinal hernia

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Abstract

Background: Laparoscopic surgery for combined surgical pathology demands technique of simultaneous operations. The technique of simultaneous treatment of inguinal hernia (IH) and gallstone disease (GD) has been developed and tested.
Material and methods: Prospected parameters were: heart rate (HR), variation range (ΔX), mode of the amplitude (AMo), and duration mode (Mo). The level of Index of Nervous Tension (INT) was evaluated by Baevsky method for estimating stress level and tension of sympathetic nervous system. Parameters were compared between control group (No1, n=76 one operation for IH) and simultaneous surgery group (No 2, n=58 IH+GD). In all cases laparoscopic transabdominal periperetoneal alohernioplasty was performed.
Results: Heart rate was increasing after surgery, maximum after 2 h (by 26.3% and 23.3%, p>0.05); the ΔX in both groups decreased after 2 h (by 12.4% and 12.1%, p<0.05) and after 2 days (5.3% and 6.8%, p<0.05); Mo did not differ in both groups (p>0.05); the dynamics of the AMo increased with a maximum after 2 h (by 20.2% and 20.6%, p<0.05); the INT rate was increasing up to 2 hours postoperative (by 93.6% and 93.4% (p<0.05)). All indicators were back to normal rates within two days and did not differ in both groups.
Conclusions: No difference in the level of tension in sympathetic nervous system and the degree of centralization of heart rate regulation was registered in both groups. Our developed technique has been shown safe and effective.
Key words: laparoscopy, gallstone disease, inguinal hernia, simultaneous.

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Introduction

Gallstone disease is a common surgical pathology. Each year gallstone disease is diagnosed in 1-2% of adult population in USA and EU [1]. Chronic cholecystitis is well-treated by using laparoscopic surgical treatment. Nowadays laparoscopic cholecystectomy is the main recommended tactic for use [2]. Also, it is shown that early laparoscopic cholecystectomy is the most acceptable approach if complications are considered (mechanic jaundice, choledocholytiasis, gallbladder cancer etc.) [2]. At the same time 27% of males and 3% of females develop a groin hernia at some time of life [3]. Up-to-date fast-track surgery strategic demands minimal hospital stay time. Considering all these factors it is acceptable to perform laparoscopic cholecystectomy simultaneously with other operations if comorbid cholecystitis is diagnosed. One-staged treatment reduces total cost of treatment because of reducing terms of general hospital stay. The main problem of simultaneous operations may become their additional trauma and duration, which theoretically may influence the surgical stress and rate of postoperative complications [4]. These factors demand additional equipment of operating rooms and skills for the surgeon. It is necessary to use technique that provides minimum trauma and invasiveness of surgical interventions, anesthesiological support and management of patients in the postoperative period [5]. This prompted us to develop a new laparoscopic technique for simultaneous surgical treatment of inguinal hernia gallstone disease (GD). 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 [6]. Adaptive adjustment of the cardiovascular system is one of the first to note while talking about stress. Stress can be valued through the variability of heart rate [6, 7].

Aim of the work: Using the variability of cardiac rhythm to evaluate the intensity of postoperative stress in patients that underwent transabdominal preperitoneal patch technique (TAPP) and simultaneous laparoscopic cholecystectomy. To compare their result with the one in patients that underwent only TAPP.

Material and methods

Sample includes patients that underwent TAPP (control group No 1, n=76) and patients that underwent TAPP (as one of recommended procedure for inguinal hernia (IH) repair [8, 9]) and simultaneous cholecystectomy (research group No 2, n=58). Patients underwent surgical treatment during 2015-2019 year time period. Survey and all the operations were performed in the Volynian regional clinical hospital in the laparoscopic surgery unit. In every case laparoscopic transabdominal preperitoneal alogernioplastic was performed. In group No 1 in each case standard technique was used. In group No 2 in each case our developed technique of simultaneous operations was used. Selection into groups was performed exclusively on the principles of surgical comorbidity. All patients underwent routine conservative treatment before and after surgery. The average length of stay of the patient in the hospital before surgery was 1 hospital day.

Exclusion criteria: patients with progressive coronary heart disease in combination with severe heart failure and severe chronic kidney disease, isolated obliterating atherosclerosis of the vessels of the lower extremities, chronic pulmonary diseases in the acute stage, cancer of various localization.

To measure the operative stress by a variation of pulsogram, was used cardiocomplex "CardioLab +" (designed and manufactured by HAI-MEDICA, Kharkiv/Ukraine) for all patients in the control group and the 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 [10-12].

Recorded data was 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, index of nervous tension (INT) was calculated by R.M. Baevsky, which reflects the degree of centralization of heart rate control: INT = AMo / (2 ´ Mo ´ DX).

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

Results and discussion

Data analysis was performed. According to the results of the research there was no statistically significant difference in heart rate between groups.

Records of heart rate are shown in tab. 1 and fig. 1.

Heart rate was increasing and reached its maximum in 2 hours after surgery in both groups (26.3% in group 1 and 23.3% in group 2, p>0.05). Subsequently, in both comparison groups, the indicator decreased and, starting from the 12 hours of postoperative period, did not differ statistically significantly from the value of the indicator before surgery (p>0.05). The same reactions on pain and trauma were registered in other researches [13, 14]. Also common reaction was shown in patients after cholecystectomy [15]. It is noteworthy that the value of heart rate in all periods of the postoperative period in the group of patients that underwent TAPP with laparoscopic simultaneous cholecystectomy and patients that underwent only TAPP did not differ significantly (p>0.05).

Table 1

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

Period of measurement	Control group (No 1)	Research group (No 2)	p
Day before surgery	72.2 (64; 75)	71.7 (66; 75)	>0.05
Postoperative period			
1 hour	85.8 (81; 90)	83.6 (78; 87)	>0.05
2 hours	91.2 (83; 96)	88.4 (82; 92)	>0.05
6 hours	83.6 (77; 89)	84.2 (77; 88)	>0.05
12 hours	75.9 (71; 81)	76.1 (68; 78)	>0.05
1 day	74.8 (68; 77)	75.5 (67; 78)	>0.05
2 days	72.2 (66; 76)	72.8 (67; 77)	>0.05
3 days	70.8 (65; 75)	71.4 (66; 75)	>0.05

Note: here and further *p* – possibility of difference for rate in the control group from the research group

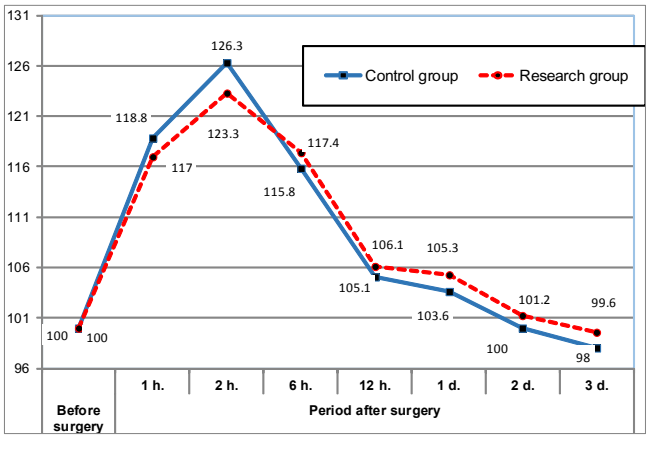

Fig. 1. Heart rate dynamics (in percent to the control level)

(Note: here and further * – differences for the terms before operation are statistically possible p<0.05).

Analysis of the variation scale (ΔX) (tab. 2, fig. 2) had shown that before the operation the indicator did not differ significantly between the control and the main groups (p>0.05). Worth to notice that intraoperative and postoperative (up to 2 hours) heart rate and its variations in both groups were similar between groups as well as from other studies [16]. HR levels shown in this study are widespread during IH operations [17].

Table 2

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

Period of measure-ment	Control group (No 1)	Research group (No 2)	p
Day before surgery	0.152 (0.144; 0.151)	0.148 (0.139; 0.151)	>0.05
Postoperative period			
1 hour	0.142 (0.134; 0.154)	0.134 (0.127; 0.139)	>0.05
2 hours	0.118 (0.109; 0.134)	0.114 (0.110; 0.124)	>0.05
6 hours	0.144 (0.137; 0.155)	0.139 (0.128; 0.147)	>0.05
12 hours	0.150 (0.139; 0.158)	0.142 (0.131; 0.151)	>0.05
1 day	0.153 (0.140; 0.164)	0.142 (0.137; 0.144)	>0.05
2 days	0.144 (0.136; 0.151)	0.138 (0.131; 0.152)	>0.05
3 days	0.175 (0.167; 0.189)	0.171 (0.151; 0.177)	>0.05

The dynamics of the ΔX in the postoperative period groups was wavy in both groups with the first period of decrease after 2 hours (12.4% in group 1 and 12.1% in group 2, p<0.05) and after 2 days (5.3% in group 1 and 6.8% in group 2, p<0.05). After 3 days, the rate in both groups increased and in the control group became significantly higher than before surgery (15.1%, p<0.05) as well as in the research group (15.5%, p<0.05) which was expectable for normal adaptation process [18]. It is remarkable that common data was shown for cholecystectomy performed laparoscopically without TAPP [15, 19].

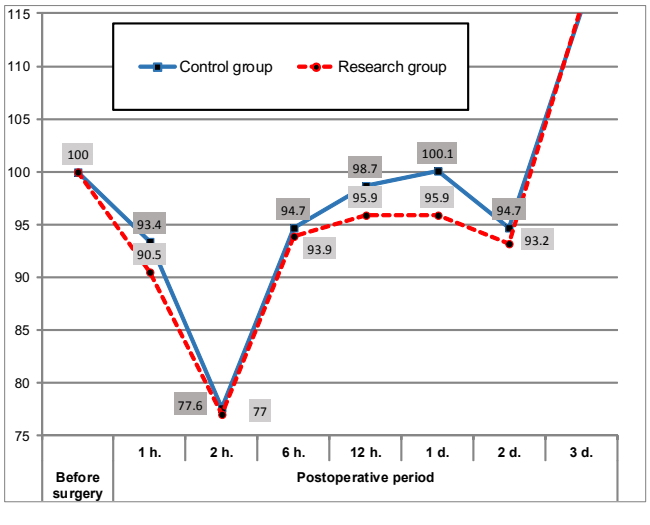

Fig. 2. ΔX (in percent to the control level)

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

Furthermore, the dynamics of the *Mo* was similar to the value of heart rate (tab. 3, fig. 3). The 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 hours of the postoperative period compared with the preoperative level (20.2% in group 1 and 20.6%, p<0.05). This is characteristical for traumatic events [18]. Subsequently, the rate increased and starting from 12 hours of the postoperative period. It did not differ statistically significant from the preoperative level (p>0.05).

Table 3

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

Period of measure-ment	Control group (No 1)	Research group (No 2)	p
Day before surgery	0.851 (0.811; 0.904)	0.857 (0.793; 0.908)	>0.05
Postoperative period			
1 hour	0.711 (0.647; 0.756)	0.720 (0.674; 0.791)	>0.05
2 hours	0.679 (0.627; 0.717)	0.681 (0.625; 0.733)	>0.05
6 hours	0.727 (0.666; 0.771)	0.724 (0.651; 0.769)	>0.05
12 hours	0.796 (0.731; 0.825)	0.833 (0.768; 0.899)	>0.05
1 day	0.827 (0.755; 0.879)	0.822 (0.744; 0.867)	>0.05
2 days	0.849 (0.777; 0.885)	0.841 (0.767; 0.891)	>0.05
3 days	0.868 (0.807; 0.941)	0.857 (0.812; 0.910)	>0.05

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

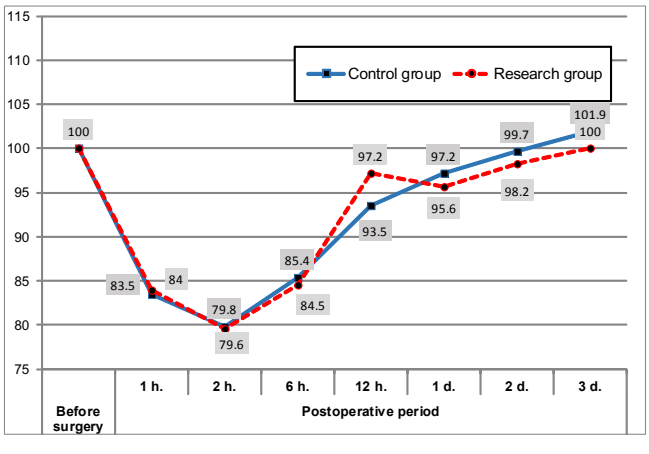

Fig. 3. *Mo* (in percent to the control level)

Table 4

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

Period of mea-surement	Control group (No 1)	Research group (No 2)	p
Day before surgery	36.1 (32.2; 37.9)	38.5 (34.7; 38.9)	>0.05
Postoperative period			
1 hour	42.8 (38.8; 43.6)	44.4 (40.7; 44.9)	>0.05
2 hours	44.8 (40.0; 47.6)	46.1 (42.7; 47.3)	>0.05
6 hours	41.8 (37.0; 44.6)	43.2 (40.2; 46.4)	>0.05
12 hours	39.6 (35.5; 42.8)	41.0 (37.7; 41.9)	>0.05
1 day	38.2 (34.8; 41.6)	38.5 (35.1; 41.1)	>0.05
2 days	36.0 (34.7; 38.2)	36.2 (35.0; 41.0)	>0.05
3 days	35.1 (31.8; 37.4)	35.9 (34.4; 40.1)	>0.05

The value of A*Mo* also did not differ significantly (tab. 4, fig. 4) in the preoperative and late postoperative period between the control and experimental groups (p>0.05).

The dynamics of the studied indicator increased in postoperative period compared to the preoperative period level with a maximum after 2 hours (24.1% in group 1 and 19.7% in group 2, p<0.05). Subsequently, the indicator decreased and, starting from 12 hours 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). The recovery time in both groups is comparable to recovery after operation of laparoscopic inguinal hernia repair [20-22] but slightly longer than recovery after open hernia repair with spinal and paravertebral anesthesia [23].

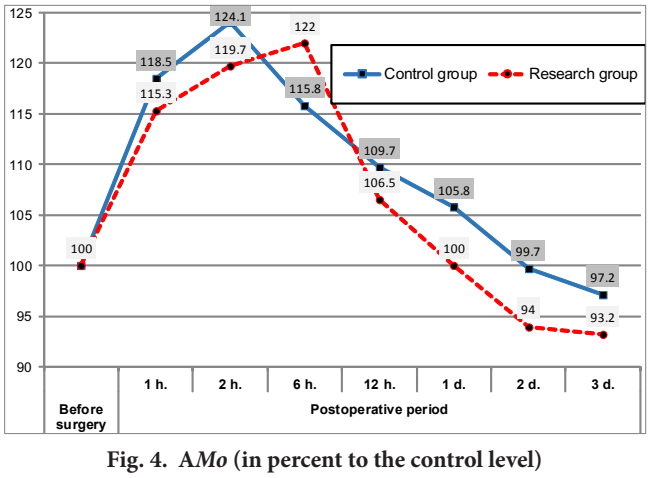

Fig. 4. A*Mo* (in percent to the control level)

An integral measure of the tension of adaptation mechanisms is the value of INT.

Surveys showed that the value of INT in the preoperative period (tab. 5, fig. 5) between the control and main groups did not differ significantly (p>0.05).

Table 5

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

Period of measurement	Control group (No 1)	Research group (No 2)	p
Postoperative period			
1 hour	212.1 (171.4; 251.4)	218.2 (187.4; 207.4)	>0.05
2 hours	251.9 (211.4; 307.6)	281.1 (231.7; 340.4)	>0.05
6 hours	195.7 (157.4; 231.2)	201.4 (174.3; 258.1)	>0.05
12 hours	172.1 (141.7; 201.4)	185.4 (152.8; 221.9)	>0.05
1 day	152.2 (131.4; 179.2)	165.9 (152.9; 211.3)	>0.05
2 days	174.8 (132.7; 209.4)	192.1 (152.4; 224.8)	>0.05
3 days	116.4 (96.2; 127.4)	125.3 (108.2; 142.7)	>0.05

The IN rate was increasing up to 2 hours in the postoperative period compared to the preoperative level: in the control group – by 93.6%, in the research group – by 93.1% (p<0.05). After 6 hours INT decreased in both groups and did not differ significantly from the preoperative level (p>0.05). There was a repeated increase in the value of INT after 2 days in both experimental groups. However, the obtained result compared to the preoperative level was statistically unlikely (p>0.05).

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

It has been shown that optimal recovery time for laparoscopic hernia repair is about 3 days [24-26]. It means that IN decreasing to preoperative levels in both groups in 3 days does not get beyond normal recovery for IH repair even with simultaneous cholecystectomy [27]. Both groups had normal recovery process [28].

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.

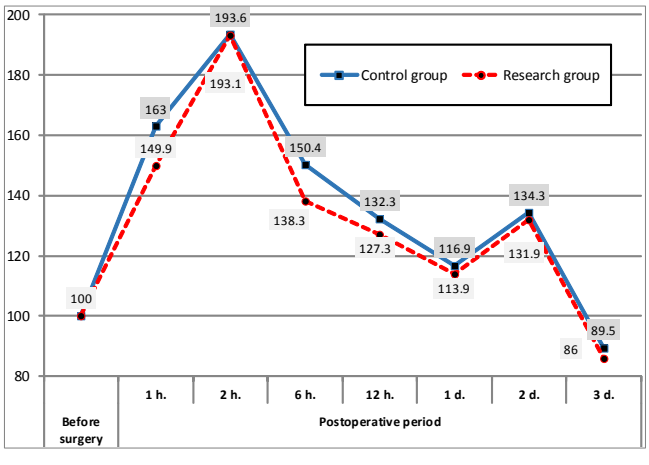

Fig. 5. INT (in percent to the control level)

In the postoperative period up to 2 hours after surgery the indicators values of Mo, ΔX decreased and AMo and INT increased. This indicates an increasing of the activity of the sympathetic nervous system and increasing of the centralization of heart rate control, which indicates an increasing of the stressor effects of surgery. Obviously, this fact is associated with a decrease in the effect of drugs used for anesthesia.

By the 12 hour in the postoperative period, the deviations reached the preoperative level in both groups. Noteworthy is the moderate statistically significant decrease in the value of ΔX and the tendency to increase the INT 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 surgeries, all applied statistical indicators of mathematical analysis of heart rate reached the preoperative level. There is common information about rehabilitation during simultaneous treatment of gallstone disease [29] where 2.55+0.89 days of hospital stay are shown. Length of stay also didn't differ between groups and data from studies in which only TAPP [30] and only laparoscopic cholecystectomy were per-

formed [31]. Analysing from anesthesiologycal approach it is completely clear that intraoperative heart dynamics during simultaneous operation was in normal zone comparing to the control group and data from other studies [32].

However, despite the types of surgical interventions performed, both laparoscopic transabdominal periperitoneal alohernioplasty and simultaneous cholecystectomy and only TAPP 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. Considering recommendations of Hernia Group that inguinal hernia should be repaired as fast as possible [30] as well as cholecystitis [33] because of their complications and risks [34, 35] possibility of simultaneous treatment without negative recovery outcomes is remarkable.

Conclusions

1. Mono-intervention for inguinal hernia and simultaneous operations for inguinal 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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MH and IM conceptualized the project and drafted the first manuscript. AP interpreted the data. ID critically revised the manuscript. All authors revised and approved the final version of the manuscript.

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Conflict of Interests
No competing interests were disclosed.