OPPORTUNITIES OF GAS DISCHARGE VISUALIZATION TECHNIQUE IN THE ESTIMATION OF FUNCTIONAL STATE OF THE ORGANISM IN PERIOPERATIVE PERIOD

Egor U. STRUKOV

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INTRODUCTION

Overall estimation of functional state and internal environment of the organism is very important for the treatment of patients with serious and especially acute pathogenic processes, apart from the identification of nature and character of the latter. This diagnostic approach determines the scope and effectiveness of the performed intensive therapy (B.S. Uvarov, N.A. Mezheryakov, 1974).

Large possibilities have been opened up recently in this direction, being stipulated by the successful development of clinical biochemistry and perfection of medical technique. Modern laboratory and functional methods of diagnostics allow obtaining extensive information characterizing the state of blood circulation, gaseous exchange, water-electrolytic and acid-base balance, system of hemostasis, function of CNS, endocrine glands, lever, kidneys, and other organs. However, apart from multiple advantages, the mentioned methods have a series of significant limitations. Particularly, a considerable part of modern laboratory and functional methods of diagnostics are not available for all patient care institutions. Furthermore, these methods demonstrate the state of particular organs and systems of the organism, or are based on using strong radiations. Certain methods have invasive character and require considerable investment and maintenance costs. Apart from that, the procedure of research, as well as the decoding of results received by means of the research require much time. Human factor might also be a cause of error on account of unequal informativeness and value of diagnostic means applied by doctors, difference in experience and knowledge.

One of the most perspective electrographic methods for the estimation of functional state of the organism is the Gas Discharge Visualization (GDV). The technique is based on the effect of registration of glow, stimulated by photons and electrons, as well as other particles near the surface of biological objects, placed in high intensity electromagnetic field. It is supposed that the biological emission enables to estimate the entropy of human state (K. Korotkov, 1995, 2000, 2001).

At present this technique is quite actively used in various spheres of medicine – therapy, oncology, obstetrics, gynaecology, and psychophysiology (Gurvitz B.L., et al., 1998; Alexandrova R.A., et al., 1999, 2000, 2001; Azheulov A.U., 2000; Bundzen P.V., et al, 2000; Gimbut V.S., 2000; Bundzen P., Unenstahl L.E., 1999; Kolmakow S. et al., 1999). However, having analyzed literature on the topic, we haven't found data on the application of the technique for the estimation of functional status of patients under critical state, or for the perioperative examination of patients. The attractiveness of this method from the viewpoint of electrophysiology, as well as the full absence of data on the possibility of its application in the interests of anaesthesiology has been the basis for the performance of our research.

Aim. To estimate the informativeness of the GDV technique from the viewpoint of anaesthetist-reanimatologist during functional examination of patient in pre- and postoperative periods.

Tasks.

1. To prove the possibility of using GDV technique for the estimation of state of patients in need of surgical treatment.
2. To assess the value of indices, obtained with the help of GDV technique, distinguishing the most informative ones.

3. To get an idea on the position of the technique in complex preoperative examination of functional state of patients with chronic abdominal surgical pathology.

4. To investigate the possibility of application of the GDV technique for the monitoring of functional state of patient in postoperative period.

Scientific novelty. The assessment of functional state of patients with the application of GDV technique in pre- and postoperative periods.

The difference between the parameters of gas discharge images (GDI) of practically healthy people and patients with chronic abdominal surgical pathology was found.

It was revealed that the GDI indices reliably differ depending on sex, age, and the degree of severity of functional disorders.

It was proved that the GDI change in response to the operative trauma. The limits of deviation of these indices from the preoperative indices depend on the extent and character of surgical operation, as well as on the initial functional status of the organism. Thus, the opportunity of using GDV technique for the estimation of intensity of operative stress was demonstrated for the first time.

The possibility of application of GDV technique for the monitoring of functional state of patients in postoperative period was disclosed. It was found that the dynamics of GDI indices in the closest postoperative period depended on the initial degree of severity of the state of patient.

The example of acute postoperative pancreatitis demonstrated prospects of application of the technique for the prediction of development of complications in early postoperative period.

Practical value. The results of the performed research demonstrate that the GDV technique is a perspective method in the practice of anaesthesiology and reanimatology, which lays the basis to investigate it further. This method might be used with the purpose of evaluation of patient's functional status in perioperative period, as well as for the identification of adequacy of organism's response to the surgical trauma.

The dependence of GDI indices on age revealed in the course of the research indicates that it is necessary to determine the norm range for the parameters of GDV-grams of different age groups, in the course of further development of the method.

Aspects to be defended.

1. There are reliable differences between parameters of GDV-grams of practically healthy people and patients with chronic abdominal surgical pathology.

2. The obtained data indicate that GDI parameters are connected with the functional status of the organism and reflect the severity of the somatic state of patients with abdominal surgical pathology to a certain extent.

3. The most informative parameters obtained with the help of GDV technique are: "integral area of glow" in "GDV Diagram" program, "total" and "normalized area", "total density", "average brightness", as well as "fractality" and "form coefficient" ("GDV Processor" program).

4. The most informative mode of registration of GDV-grams among the two applied modes is the mode "without filter". On the whole, the application of filter keeps the trend of changes, but they are often less pronounced and unreliable.

5. The revealed variability of GDV-gram parameters depending on the sex and age of patients indicates that it is necessary to determine their individual norms.

6. The dependence of perioperative dynamics of a number of indices of GDV-grams on the severity of the somatic state of patient, patient's age and duration of surgical procedure enables using the technique for the functional monitoring in postoperative period, as well as for the evaluation of operative stress.

Materials and methods of research

The investigation of possibilities of application of the GDV technique for the assessment of functional state of patients in pre- and postoperative periods represents the first experience of application of the technique in anaesthesiology and reanimatology. The work was performed step by step in order to achieve the tasks set. All the research had prospective character. 10 fingers of healthy people and patients were the object of research.

GDI were registered with the help of "GDV Camera" complex under the direction of Prof. K. Korotkov (SPIFMO (Technical University), St. Petersburg). The complex was certified by the Ministry of Health of Russia as a medical device. Conformance certificate N РОСС RU.АЯ27.НО2777. Statement of the Ministry of Health of Russia dating December 3, 1999. (АТНЛО.009.1764).

GDV-grams were registered using both modes: "without filter" and "with filter". The filter is a thin polymer film, placed between the screen of the "GDV Camera" and the finger of the tested person.

The obtained images were processed by means of the specialized software package "GDV Diagram" and "GDV Processor" (Kirlionics Technologies International). "GDV Diagram" program performs sector diagnostics, constructing diagnostic table, demonstrating analysis and comparison of characteristics of glow of separate zones of fingers with the functional state of organs and systems of the organism. The program enables to receive 56 numeric parameters for every series of measurements, i.e. for 10 fingers of patient on the whole. Parametric analysis of GDV-grams of every finger was carried out in "GDV Processor" program. This program enables to transform geometrical, brightness, structural, and fractal characteristics of GDI in numerical data and store the latter on the hard drive of a PC in the form of text files.

At the first stage, when it was first of all necessary to make sure if the GDV technique could be used for clinical purposes, the two groups were gathered: the control group, including 35 people (practically healthy people – students of the I year at the faculties of training of doctors at the Military-Medical academy and staff nurses at a number of clinics), and the main group, consisting of 96 people (patients with chronic surgical pathologies of organs of the abdominal cavity, who had been treated in the period from 2000 to 2002 in anaesthesiology, reanimation, and intensive therapy clinics, as well as in the clinic of abdominal surgery of S.P.Fedorov of the Military-Medicine academy). The difference in the parameters for healthy people and patients received with the help of GDV technique was found, and the influence of various factors (sex, age, main pathology) on the parameters was assessed. The informational significance of GDV-gram indices, processed in GDV software, was disclosed.

Having obtained our own idea about the opportunities of the method, we passed to studying its effectiveness in the estimation of functional state of the organism. In order to solve the main tasks of this stage of research, all patients were divided into three groups according to the degree of heaviness of their state, accepted in military-medical institutions of the armed forces of Russian Federation.

I group was made up by patients, having the 1st degree of severity of the somatic state. **II group** consisted of patients with the 2nd degree of severity. **III group** was made up by patients with the 3rd-4th degree of severity.

General characteristics of patients are given in table 1.

Table 1

General characteristics of patients

Parameters	Groups		
	I	II	III

Number of patients	22	46	28
Male	9	13	14
Female	13	33	14
Somatic state of patient, degree	1	2	3-4
Middle age, years	32.1±2.6**. ***	53.2±1.4*. ***	62.9±2.4*. **
Body weight, kg	76.5±3.5	77.5±2.2	74.5±2.4
Height, cm	167.5±2.4	165.7±1.2	165.9±1.2

Note: * – $p<0,05$ in comparison with group I, ** – $p<0,05$ in comparison with group II, *** – $p<0,05$ in comparison with group III.

The GDV-gram parameters were compared with the data received in the course of physical and instrumental (integral rheography of the body, spirography) examination of patients. Multifactor regression and correlation analyses were used in order to reveal the dependence between these parameters.

The patients were examined by the following stages:

I – the day before the planned operative intervention, with the purpose of detecting initial GDV-gram parameters;

II – in the closest postoperative period (during the first hour after the operation);

III-V – in early postoperative period from the 1st day to the 3rd inclusive;

VI – on the 5th day of postoperative period.

The possibility of using GDV technique for the monitoring of state of patients in postoperative period, including the evaluation of postoperative stress, was studied at the next stage of research.

In order to solve the tasks of this stage, all patients were divided into four groups depending on the anatomical area where the surgery was performed, taking into account the technique of operation.

1st group. Surgical operations in gall-bladder and bile-excreting tracts by means of laparoscopic approach (laparoscopic cholecystectomy). 47 patients (30 women and 17 men).

2nd group. Surgical operations in gall-bladder and bile-excreting tracts by means of laparoscopic approach. 14 patients (8 women and 6 men).

3rd group. Surgical operations in abdominal area and duodenum. 18 patients (5 women and 13 men).

4th group. Surgical operations in different parts of the large intestine (mainly resection of the large intestine and rectum, hemicolectomy regarding cancer of colo-rectal localization). 12 patients (9 women and 3 men).

The Subgroups depending on the severity of the somatic state in preoperative period were distinguished in each group of patients. It's worth mentioning that only the 1st group (laparoscopic surgeries) enabled to distinguish the subgroup of patients initially having the 1st degree of severity of the somatic state (1st subgroup). The severity of the somatic state of all patients in other groups was assessed as the 2nd and 3rd-4th degree (II and III subgroups, respectively).

Anesthetic management of surgeries in gall-bladder and bile-excreting tracts (1st and 2nd group) was performed in accordance with the standard method (general combined anesthesia with intubation of trachea and artificial pulmonary ventilation). The epidural anesthesia and general combined anesthesia with intubation of trachea and ALV was used for the majority of abdominal surgeries (3rd group) and surgeries in different parts of large intestine (4th group).

The reaction of organism to the trauma was investigated, basing on the dynamics of the main GDV-gram indices, apart from changes of the clinical picture, hemodynamics, and biochemical indices of blood (glucose, aminotransferases, etc.).

The possibility of application of the GDV technique for the prognosis of unfavorable flow of the early postoperative period was assessed at the conclusive stage of the research. In

order to solve this task, patients with acute postoperative pancreatitis (OPP) were distinguished from the main group. Then the GDV-gram parameters of the latter and of patients with usual postoperative processes were compared.

Results of research

1. Assessment of individual characteristics of GDV-gram parameters

The comparative analysis of data, received in the course of examination of patients of the main and control groups with the GDV technique, enabled to reveal reliable differences between GDV-gram parameters processed both in "GDV Diagram" and "GDV Processor" programs. These differences concerned the main GDI characteristics: "area", "brightness", "density of glow", as well as "irregularity of outer contour" of GDV-gram. Both "GDV Diagram" and "GDV Processor" programs demonstrated reliable rise of GDI parameters for patients in comparison with practically healthy people.

Apart from the present pathology, other factors such as age and sex of patients influenced GDI parameters. The analysis of GDV-gram parameters processed in "GDV Diagram" program demonstrated that all the parameters increased with age. The highest values of these parameters belonged to patients older than 60.

Analyzing the whole totality of the parameters of "GDV Diagram" program (56 parameters on the whole), it was found that only "$S_{integer}$" parameter changed reliably in all the age categories (fig. 1). Reliable age changes of GDV-gram parameters, received in the course of processing in "GDV Diagram" program in the mode "with filter", were absent regardless of the rising tendency.

Age differences of parameters, reflecting their geometrical, brightness, structural, and fractal characteristics, were also received in the course of processing of GDV-grams accumulated in "GDV Processor" program. When image filtration was used, the age differences were smoothed and in most cases became unreliable.

The obtained differences indicate that it is necessary to determine the age norm of GDV-gram parameters.

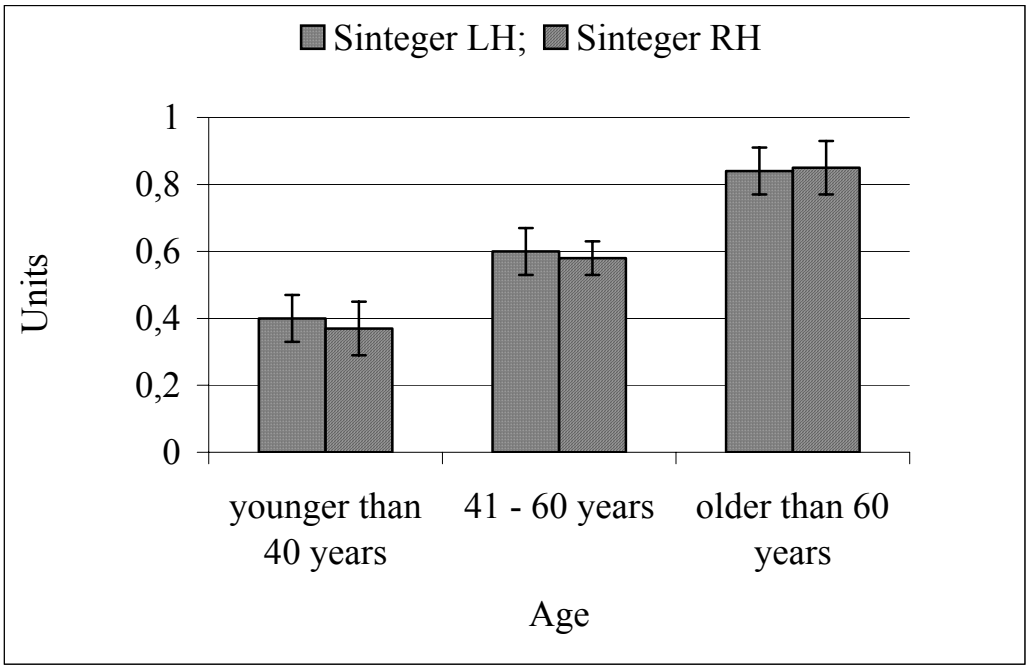

Fig. 1. Distribution of "$S_{integer}$" parameter for the left (LH) and right (RH) hands in different age categories (processing mode "no filter")

The examination of women demonstrated that their GDV-grams differ from men's GDV-grams in a series of parameters and are characterized by reliably high values. The processing of

the data accumulated in “GDV Diagram” program showed reliable differences only in the registration mode “without filter”. A significant amount of reliable differences were found for the GDV-grams registered in both modes: “without filter” and “with filter”, when processed in “GDV Processor” program. Larger amount of reliable differences was found for the registration “without filter”.

We acknowledged the following parameters of GDV-grams to be the most informative at the present stage: “$S_{integer}$” in “GDV Diagram” program, parameters of “area” (total, and, to a greater extent, normalized area), “total density” and “average brightness” of glow, as well as irregularity of the GDV-gram outer contour (fractality and, to a greater extent, form coefficient) in the “GDV Processor” program. To our mind, the individuality and variability of GDV-gram parameters indicates that it is necessary to study the differences of these parameters in equivalent groups, i.e. taking into account a quantity of incoming factors, each raising the specificity of the method. In this case, studying the GDI of people, with the purpose to discover some kind of pathology of functional systems, could hardly be considered correct without taking into account various circumstantial factors.

Considering the abovementioned fact, we compared parameters of GDV-grams of practically healthy women and women with chronic abdominal pathology in one age category from 20 to 40 years. The results of analysis allowed distinguishing certain reliable differences between these groups. The amount of differences turned out to be lower than when the age and sex characteristics had not been taken into account. The comparison of women in one age category (older than 60 years), with and without an oncology as the main pathology, allowed revealing reliable differences between GDI parameters. The results of this analysis demonstrated that, on average, the value of GDV-gram parameters for women with oncological pathology as the main pathology was lower than for patients of the same age category who had never had cancer diseases.

Thus, as a result of the work performed at the given stage we can conclude that the GDV-gram parameters of patients are manifested in a different way, as compared to healthy people. However, the GDI are very individual and depend not only on the pathological changes in the organism, but also on sex, age, as well as, most probably, on other factors. All that, at the present stage of development of the method, enables to consider it suitable not for the comparative research or diagnostics of diseases, but for the dynamic control of change of the patient’s bioenergy status.

2. Investigation of informativeness of the GDV technique for the examination of functional state of patients in preoperative period

The comparative analysis of parameters of GDV-grams, processed both in “GDV Diagram” and “GDV Processor” program depending on the degree of severity of the somatic state demonstrated that there are reliable differences between them. On average, patients of the III group were characterized by lower GDV-gram parameters. It is worth mentioning that “$S_{integer}$” index reliably differed only when the GDV-grams were registered “without filter” (fig. 2).

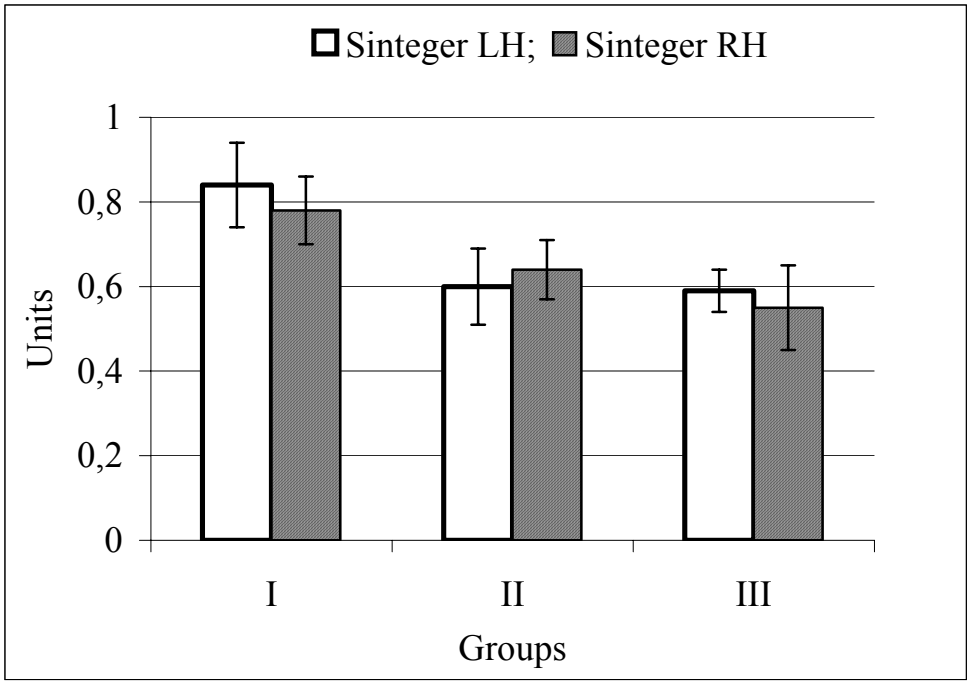

Fig. 2. The differences of "$S_{integer}$" parameter in the groups depending on the severity of functional state (LH – left hand, RH – right hand) (mode of registration: «without filter»)

Important data were received from the estimation of correlations between the degree of severity of state of patient and GDV-gram parameters. It turned out that there were convincing correlations of many GDI parameters, processed both in "GDV Diagram" program and in "GDV Processor" program, with the severity of the somatic state of the patient. Moreover, the GDV-grams of patients who had high value of the severity of somatic state were characterized by smaller area and brightness of GDI glow, as well as smoothness of its outer contour (direct correlation with fractality).

Thus, we can assume from the bioenergy point of view that the decrease of the above-mentioned parameters of GDV-grams of patients with a larger degree of severity of the somatic state is stipulated by low functional reserves of the organism.

The obtained data enable to conclude that, to a certain extent, the GDV-gram parameters reflect the severity of the somatic state of patients with abdominal surgical pathology.

3. Estimation of possibility of application of GDV technique for the monitoring of functional state of patients in postoperative period

At this stage of research the dynamics of GDV-gram parameters in postoperative period after various planned surgical operations was analyzed. It was found that the most pronounced changes of GDV-gram parameters, processed both in "GDV Diagram" and "GDV Processor" programs took place during the first day after the surgery. It was found that most of the parameters received from the processing in "GDV Diagram" program reliably increased, as compared to the initial parameters registered within the first hour after the surgery. That particularly concerned the main parameters of the glow area. Index "$S_{integer}$" in "GDV Diagram" program increased (fig. 3). However, reliable changes were determined only for the mode of registration "without filter", which confirmed the value of the technique again. When the mode "with filter" was used, no parameter of "GDV Diagram" program reliably changed in the closest postoperative period.

The parameters of "normalized" and "total area" in "GDV Processor" program were changing in a similar way.

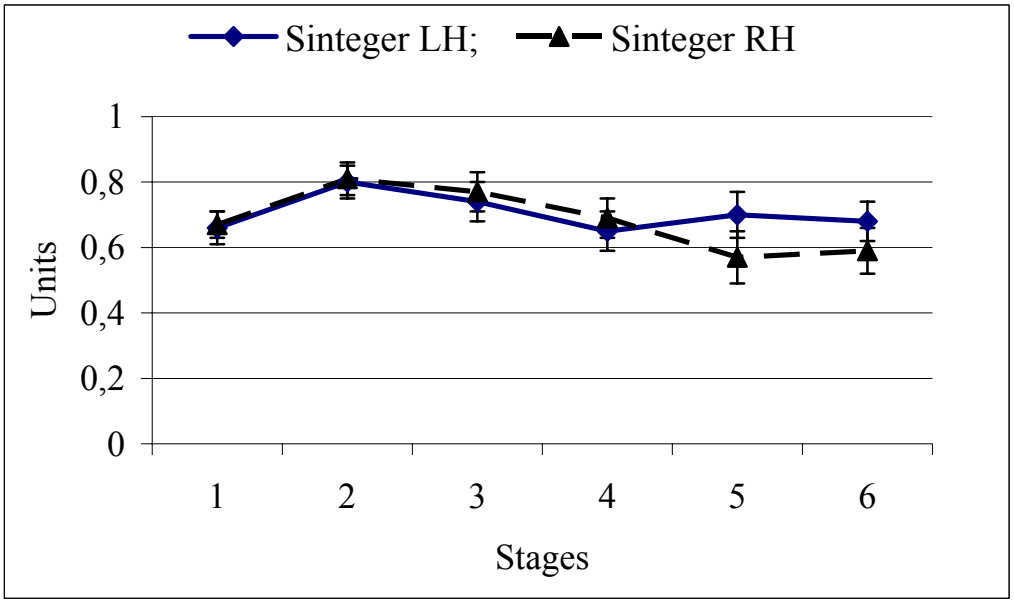

Fig. 3. Trend of "$S_{integer}$" index of GDV-grams in early postoperative period (LH – left hand, RH – right hand) (registration mode: "without filter")

The character of outer contour of GDV-gram also changed in response to the operative trauma, which manifested in the increase of "fractality" and decrease of "form coefficient". When the image filtration was used, reliable differences were registered only for the "form coefficient" index. Reliable changes of the "brightness of glow" were not fixed.

We suppose that such a dynamics of parameters of GDV-grams is connected with the strain of functioning of all the systems and organs in response to the operative trauma, i.e. with the operative stress.

The dynamics of GDV-gram parameters, received during the first hour after different surgical interventions, was analyzed with the purpose of studying the possibility of using the GDV technique for the estimation of operative stress. The dynamics of GDV-gram area parameters in response to surgeries differing in volume and character was determined for the patients of II group (2 degree of severity state according to ASA), taking into account that the GDV-gram parameters depend on patient's age and severity of state. The most informative indices – area of glow "$S_{integer}$" and "normalized area" were used (fig. 4, 5).

The analysis of data given in the figures demonstrated that the most significant shifts took place after surgical interventions by laparotomy method. Moreover, the most significant changes were found after the gall-bladder, bile-excreting tracts, and abdominal surgeries. That was connected with the fact that the biggest amount of extended and simultaneous surgeries was performed in these groups. As a result of that, surgical interventions in the upper part of the abdominal cavity were the longest and most traumatic. The changes of parameters of GDV-gram area after large intestine surgeries came out to be less expressed. The changes of these parameters after laparoscopic surgeries were even smaller.

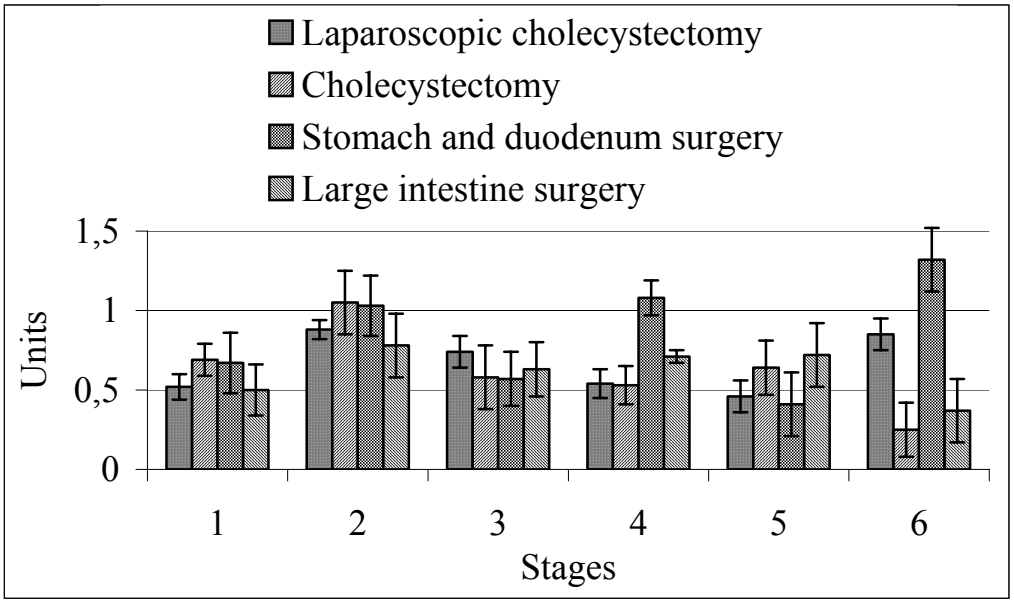

Fig. 4. The dynamics of "$S_{integer}$" index for the right hand in postoperative period after different surgeries for patients of II group (registration mode: "without filter")

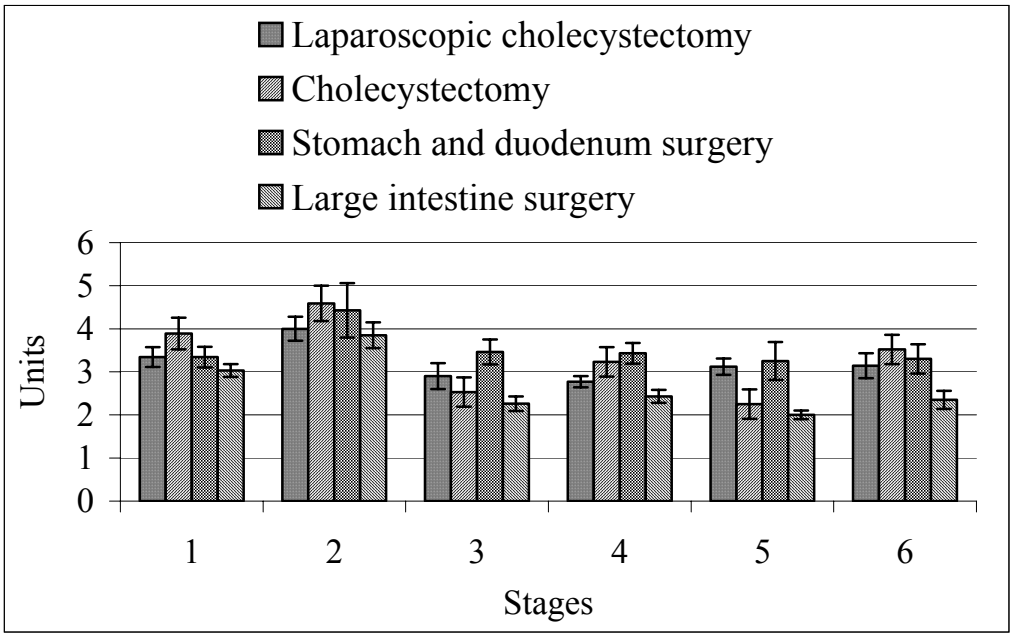

Fig. 5. The dynamics of "normalized area" parameter for the right hand in postoperative period after different surgeries for patients of II group (registration mode: "without filter")

Thus, we can conclude that the GDV technique can be used for the evaluation of the degree of operative stress.

The analysis of dynamics of GDV-gram parameters in early postoperative period after similar surgeries in different subgroups demonstrated that stronger changes were expressed for patients with the 1st degree of severity of state (I subgroup). That was specially registered after the surgeries by laparoscopic method (I group), representing all the three subgroups (fig. 6). The dynamics of GDV-gram parameters was similar to that after laparoscopic surgeries in the groups of patients who bore traditional (laparotomic) cholecystectomies (II group). A less expressed reaction of GDI "area" parameters in response to surgery was registered for patients with high degree of severity of state (III subgroup). The presented dynamics of GDV-gram parameters for the patients, who initially had high degree of somatic state, reflects the decrease of compensatory possibilities of reaction of the organism and its reactivity. In addition, the changes of parameters

of GDV-gram area turned out to be even opposite after larger and longer surgeries (abdominal and large intestine surgeries, 3rd and 4th groups, respectively) (fig. 7, 8).

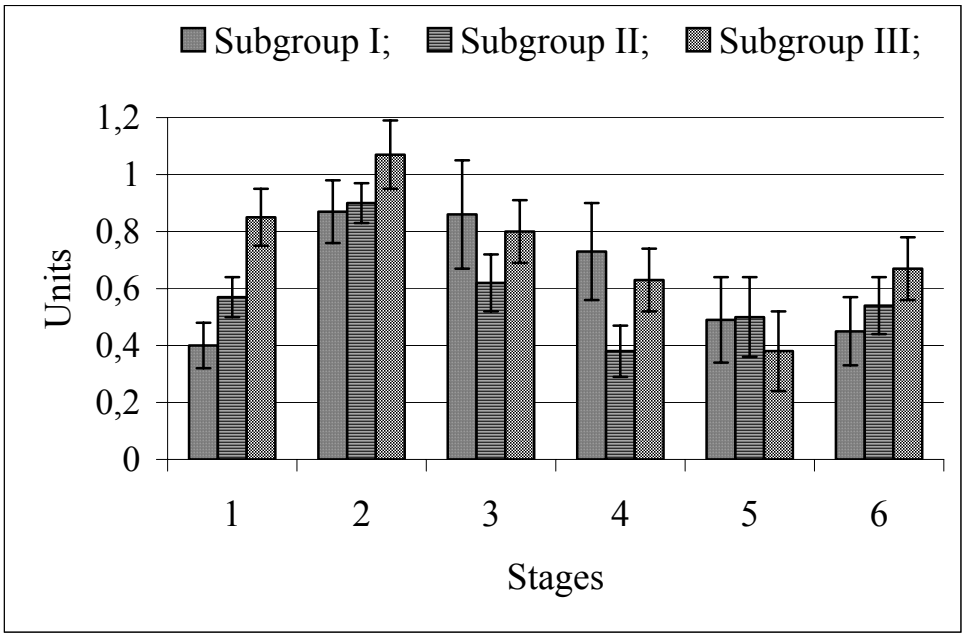

Fig. 6. The dynamics of "$S_{integer}$" index for the right hand after laparoscopic cholecystectomies (registration mode: "without filter").

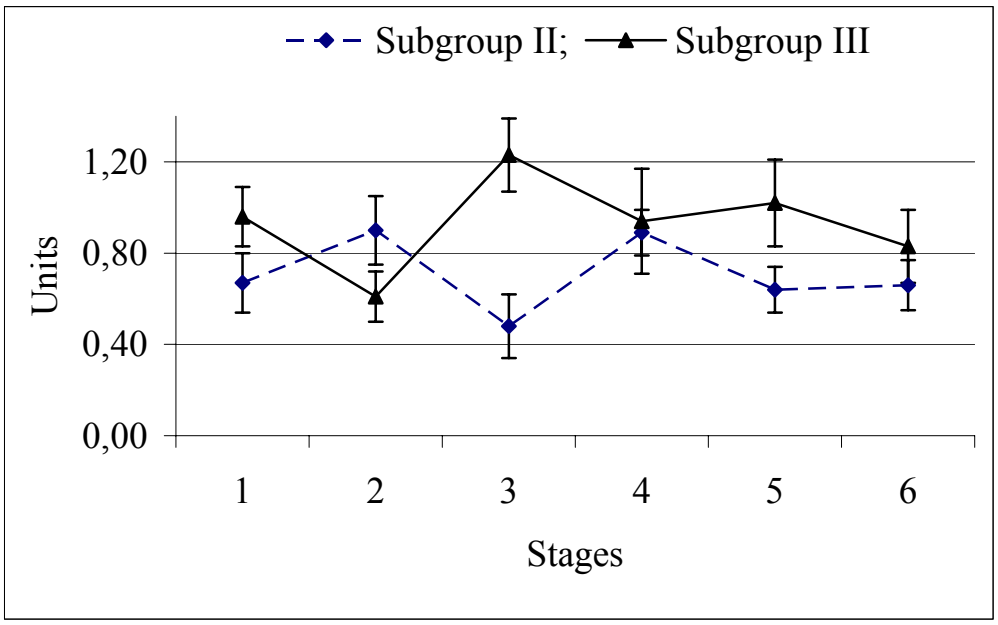

Fig. 7. The dynamics of "$S_{integer}$" for the right hand for patients after abdominal surgeries (registration mode: "without filter")

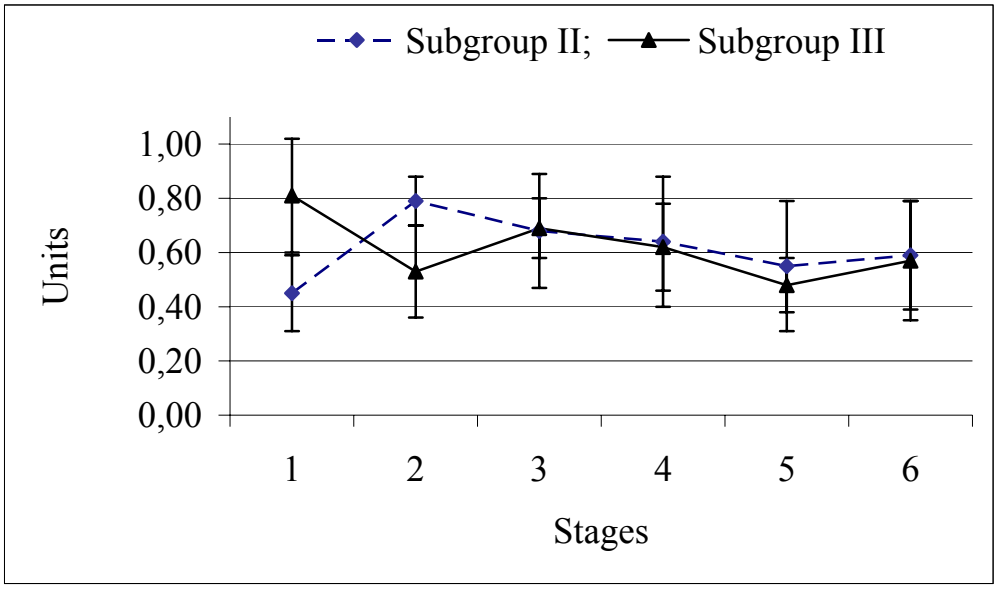

Fig. 8. The dynamics of "$S_{integer}$" index for the right hand after large intestine surgeries (registration mode: "without filter")

While the changes of GDV-gram parameters in response to the considered surgeries in I and II subgroups were characterized by the increase of "area of glow", a reliable decrease of this index was registered for patients of III subgroup in 3rd and 4th groups when examined in the first hour after the surgery.

We assume that such a decrease of "area of glow" after large surgery interventions characterizes the state of distress and reflects low functional reserves. The consequence of that was probably a longer period spent in intensive care and therapy units (ICTU) and, generally, in a hospital, as well as a large frequency of development of complications and lethal outcomes in early postoperative period (table 2).

Thus, basing on the obtained data, we can conclude that the GDV technique enables to perform the monitoring of functional state of patients in postoperative period.

Table 2

Frequency of development of complications and lethal outcome in early postoperative period for patients of various groups

Parameters	Subgroups of patients		
	I	II	III
Number of patients	22	46	28
Extent and character of surgery, degree	2.08±0.08	2.51±0.12	2.71±0.14
Age, years	32.12±2.57	53.22±1.45	62.89±2.39
Days in bed in ICTU	0.83±0.21	2.49±0.35	4.21±1.21
Total amount of days in bed	6.62±1.42	21.35±4.64	27.35±5.23
Frequency of development of complications, absolute number	-	9	14
Lethal outcome, absolute number	-	-	2

4.
5. Assessment of possibility of application of the GDV technique for the prognosis of unfavorable flow of the early postoperative period

The ***"unfavorable prognosis"*** diagnosis was made on the basis of the clinical picture, data of laboratory and instrumental diagnostics for 12 patients. It was confirmed by the calculation of the diagnostic index according to the method, acknowledged in the clinic of anaesthesiol-

ogy, reanimation, and intensive therapy of the Military-Medical Academy (Suhovetsky A.V., 2001).

The GDI parameters of these patients were compared with the data, received for patients with usual flow of postoperative period. Reliably high values of the parameters "area of glow", "density", and "fractality" of GDV-grams were characteristic of the ***"unfavorable prognosis"*** patients. The "average brightness" parameter was reliably lower for the ***"unfavorable prognosis"*** patients. It's worth mentioning that these differences were yet registered in preoperative period, and had the most pronounced character in the first day after the surgery, when there were no reasons to make the ***"unfavorable prognosis"*** diagnosis from the results of the clinicolaboratory research. These data are now the evidence of the fact the GDV technique is quite a sensitive method, enabling to identify possible unadequate reaction of the organism to the damage. However, further research is needed for a complete interpretation of the obtained results.

Thus, the results of our research, on the whole, allow maintaining that the GDV technique is a perspective method to be applied in anaesthesiology and reanimatology for the functional examination of patients and monitoring of their state in perioperative period.

CONCLUSIONS

1. The parameters of GDV-grams reliably differ for practically healthy people and patients with chronic abdominal surgical pathology.
2. The parameters of GDV-grams are connected with the functional status of the organism and, to a certain extent, reflect the severity of the somatic state of patients with abdominal surgical pathology.
3. The most informative parameters of the GDV technique are: "integral area of glow" in "GDV Diagram" program, "total" and "normalized area", "total density", "average brightness", as well as irregularity of the outer contour of the GDI ("fractality" and "form coefficient") in "GDV Processor" program.
4. The mode "without filter" shall be considered a more efficient mode of registration of GDV-grams. The mode "with filter" generally keeps the trend of changes, but makes them less pronounced and often unreliable, which reduces the sensitivity of the method.
5. The parameters of GDV-grams are individual and depend on the sex and age of patients, which indicates that it is necessary to determine their norm range.
6. The parameters of GDV-grams reliably change in response to the operative trauma, and their dynamics depends on the severity of the somatic state of patient, which allows using the technique for functional monitoring of patients in postoperative period, as well as for the assessment of the operative stress.

PRACTICAL RECOMMENDATIONS

1. The Gas Discharge Visualization technique is mostly advisable for the dynamic assessment of the functional state of patient in perioperative period. Not all the fingers shall be used, at that, but only one finger of each hand. For example, the fourth finger, where the GDI changes are the most significant.
2. The perfection of the hardware and, first of all, the decrease of the size of the sensor for the GDI registration and development of the means of its fixation on patient's finger are needed in order to further practically apply the GDV technique in anaesthesiology and reanimatology.
3. It is enough to use the most informative parameters of GDV-grams for the application of the GDV technique in practice: "integral area of glow", "total" and "normalized area", "average brightness of spectrum", "total density", as well as "fractality" and form coefficient".
4. It is advised that the GDV-grams are registered in the mode "without filter".