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## SURGICAL TREATMENT OF ANTERIOR ABDOMINAL WALL HERNIA IN PATIENTS WITH PENDULOUS ABDOMEN

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### ABSTRACT

**Introduction.** The research presents an analysis and results discussion of surgical treatment of postoperative ventral hernia accompanied with pendulous abdomen in patients with obesity. **The aim of the research** is to evaluate results of hernioplasty on the background of expansion of the surgery volume for correction of the abdomen ptosis, as well as to evaluate frequency of postoperative complications at the expense of additional abdominal plasty in the groups of patients with a combination of ventral hernia, pendulous abdomen and adiposity of various severity level. **Materials and methods.** Differentiated approach in the treatment of 174 patients with postoperative ventral hernias against the background of obesity substantially reduced the incidence of short-term and long-term complications. **Results and discussion.** Suggested method of assessment of volume of cellulocutaneous flap resection allowed to optimize the choice of combined tactics of (various methods of hernioplasty and abdominoplasty) surgical treatment of patients with VH and pendulous abdomen considering the localization and size of the defect, as well as degrees of abdominal ptosis. Modified type of classical abdominoplasty with the use of additional cross-section contributes to manipulate broadly in anticardium, reliable fix the explant and excess considerable volume of adipose tissue, thereby eliminating formation of the postoperative cellulocutaneous fold. The combination of formed neonaivel with the suggested method allowed to improve aesthetic result of the surgical treatment. **Conclusion.** Abdominoplasty is not merely an aesthetic or cosmetic method of therapy, but also a technical surgical technique that contributes improving of hernioplasty results. Hernioplasty combined with abdominoplasty in patients with postoperative ventral hernia of abdominal wall associated with obesity which is performed after careful preoperative preparation, eliminates aesthetic inconvenience, contributing to

the psychological and social rehabilitation, improving quality of life and giving satisfactorily cosmetic effect.

**Key words:** obesity, postoperative ventral hernia, abdominoplasty, hernioplasty, surgical treatment, short-term and long-term results.

### Introduction

Basing on the data of World Health Organization it is established that morbidity of ventral hernia (VH) makes in average 4-7 %, whereas in the structure of all surgical interventions in the abdomen the rate of hernioplasty grows constantly reaching up to 20-30 % [4,7]. It is explained by increasing number of complex, traumatic and time-consuming interventions concerning the organs of abdominal cavity. Frequency of VH development after the planned laparotomy reaches rates from 4,0 to 18,1 % in accordance with data from various authors, whilst after urgent surgeries this number reaches 58,7 % [1,13]. Despite all progress in medicine, surgical treatment of ventral hernia still remains one of the most acute problems of abdominal surgery [1, 4, 7]. Ventral hernia (VH) rank is high in structure of emergency and planned operative measures [5, 8, and 14]. In 3-10 % of cases laparotomy might be complicated by postoperative hernia (suppuration of a postoperative wound, technical defects, broncho-pulmonary complications, and etc.) which have recurrence in 18,1-34,3 % of cases [3,15]. A significant cause of hernia is abdominal adiposity [8, 12]. Science literature provides 600 methods of surgical measures that confirms the fact that there is no unified approach to this problem and dissatisfied with results of surgical treatment [3, 10]. Frequency of hernia recurrence reaches 3-29 %, and principal causes are the expressed tension of tissues of the anterior abdominal wall, acute rise of intra-abdominal pressure at hernioplasty, and purulent postoperative complications [2, 11]. This issue has the most significant value for the group of patients with the maximum risk of operative treatment that is associated with accompanying diseases, particularly, abdominal adiposity and a pendulous abdomen.

VH hernioplasty combined with abdominoplasty is one of the most widespread surgical interventions in surgery among patients with the expressed skin fold thickness [6,9,11]. Broad mobilization of the cellulocutaneous flap allows to estimate not only a condition of tissues round defect of aponeurosis, but also to reveal additional hernial ring and weak areas [6,10,13]. Excision of a significant volume of adipose tissue in the abdominal area is a preventive measure for short-term and long-term postoperative complications and hernia recurrence [9,12]. In the process of recovery of aponeurosis, improvements of a figure silhouette and relative comfort without elimination of a principal cause of adiposity [2,8] is created. Though many authors agree that adiposity is the prevailing factor in development of postoperative hernia, only a few number of surgeons note about necessity of excision in case of a ventral hernia of skin fold thickness [6, 9].

Such individual approach in prosthetic plastics on the anterior abdominal wall in patients with pendulous abdomen defines necessity of working out of various methods of abdominalplasty based on hernia localization.

**Material and methods.** The work provides experience of treatment of 174 patients with VH accompanied with pendulous abdomen. The primary aim of the research was the evaluation of results of hernioplasty on the background of expansion of the surgery volume for correction of the abdomen ptosis, as well as evaluation of postoperative complications frequency at the expense of additional abdominalplasty in the most difficult group of patients with a combination of ventral hernia, pendulous abdomen and adiposity of various severity level.

All patients were divided into two groups. The core group included 84 patients with the specified diagnosis and performance of combined surgery on VH correction and pendulous abdomen, the control group involved 90 patients who underwent merely hernioplasty. The age of patients ranged from 19 to 82 years. In the control group 81 patients (90 %) were women, and 9 (10 %) men, the average age of patients of the control group was  $49 \pm 9,5$  years. In the core group there were 76 women (90,5 %) and 8 men (9,5 %), the average age was  $48 \pm 7,5$  years.

Excessive body weight in the core group was identified in 15 (17,9 %) patients, the 1<sup>st</sup> degree of obesity - in 30 (35,7 %), the 2<sup>nd</sup> degree - in 27 (32,1 %), the 3<sup>rd</sup> degree - in 5 (6 %) and 7 (8,3 %) patients had a morbid adiposity. In the control group those indicators were as following - 22 (24,4 %), 31 (34,4 %), 20 (22,2 %), 11 (12,2 %) and 6 (6,7 %) respectively. 46 (26,4 %) patients had the 1<sup>st</sup> degree of ptosis, 65 (37,4 %) – the 2<sup>nd</sup> degree, 46 (26,4 %) – the 3<sup>rd</sup> degree and 17 (9,8 %) - 4<sup>th</sup> degree of ptosis.

In the core group the combined method of aponeurosis annulorrhaphy and prosthesis insert under aponeurosis (sublay) was performed in 33 (39,3 %) patients. The combined method with partial annulorrhaphy and prosthesis fixing (inlay) was performed in 35 patients (41,7 %). Abdominal wall reconstruction by Ramirez ( prosthesis - sublay) is performed in 12 (14,3 %), and the combined multilayer method of plasty ( prosthesis - sublay) in 4 (4,8 %) patients. In the control group the combined method with annulorrhaphy and prosthesis insert under aponeurosis (sublay) was performed in 28 (31,1 %) patients, the combined method with partial annulorrhaphy and prosthesis bracing (prosthesis - inlay) was performed in 33 (36,7 %) and aponeurosis annulorrhaphy (prosthesis - onlay) in 29 (32,2 %) patients.

**Evaluation of condition and reserve possibilities of the respiratory system.** While studying efficiency of standard preoperative preparation the following peculiarity had been noticed. Only in 51,2 % of patients of the core group at admission the function of external breathing remained within normal range. In 34 cases there was reduction of compensatory possibilities of the respiratory system. 7 patients demonstrated respiratory distress. So appropriate treatment was demanded for the maintenance of sufficient ventilation and gas exchange processes. External breath function was examined once again by 7-14 days after the treatment for the presence of mentioned conditions. Though the

treatment provided sufficient change of the latter indicators, average value of all parameters anyway remained below of recognized norm rates - 62,2 %.

Being guided by indicators of lungs vital capacity, which should not be below 70 % when measuring by a spirograph, only 70,2 % of patients by the time of the treatment cessation had normal values of external breath function. The revealed changes after correcting therapies in 23 patients demanded prolonged treatment for surgery preparation. If on the background of the standard preoperative preparation lungs vital capacity made 49,8 % to 62,2 %, after the prolonged preparation in combination with dosed banding and respiratory gymnastics which continued up to 1-1,5 months, the indicator increased to 72,6 %.

Monitoring of intra-abdominal pressure (IAP) of patients with VH of W3-4 also proved benefits of prolonged preparation to adaptation to the abdominal compression. Compression (bandage applying) has led to elevated IAP from  $10 \pm 1,2$  mm w\column to  $20 \pm 2,1$  mm w\column ( $P < 0,05$ ) at W4 hernia and from  $4 \pm 0,5$  mm w\column to  $12 \pm 1,6$  mm w\column at W3 hernia ( $P < 0,05$ ). At application of the dosed compression to the 7<sup>th</sup> day there was a gradual depression of IAP to  $17 \pm 1,7$  and  $10 \pm 1,1$  w\column respectively, whereas genuine depression of this indicator has been received in later terms of banding - 2-6 weeks to  $13 \pm 1,5$  and  $8 \pm 0,9$  mm w\column ( $P < 0,05$ ).

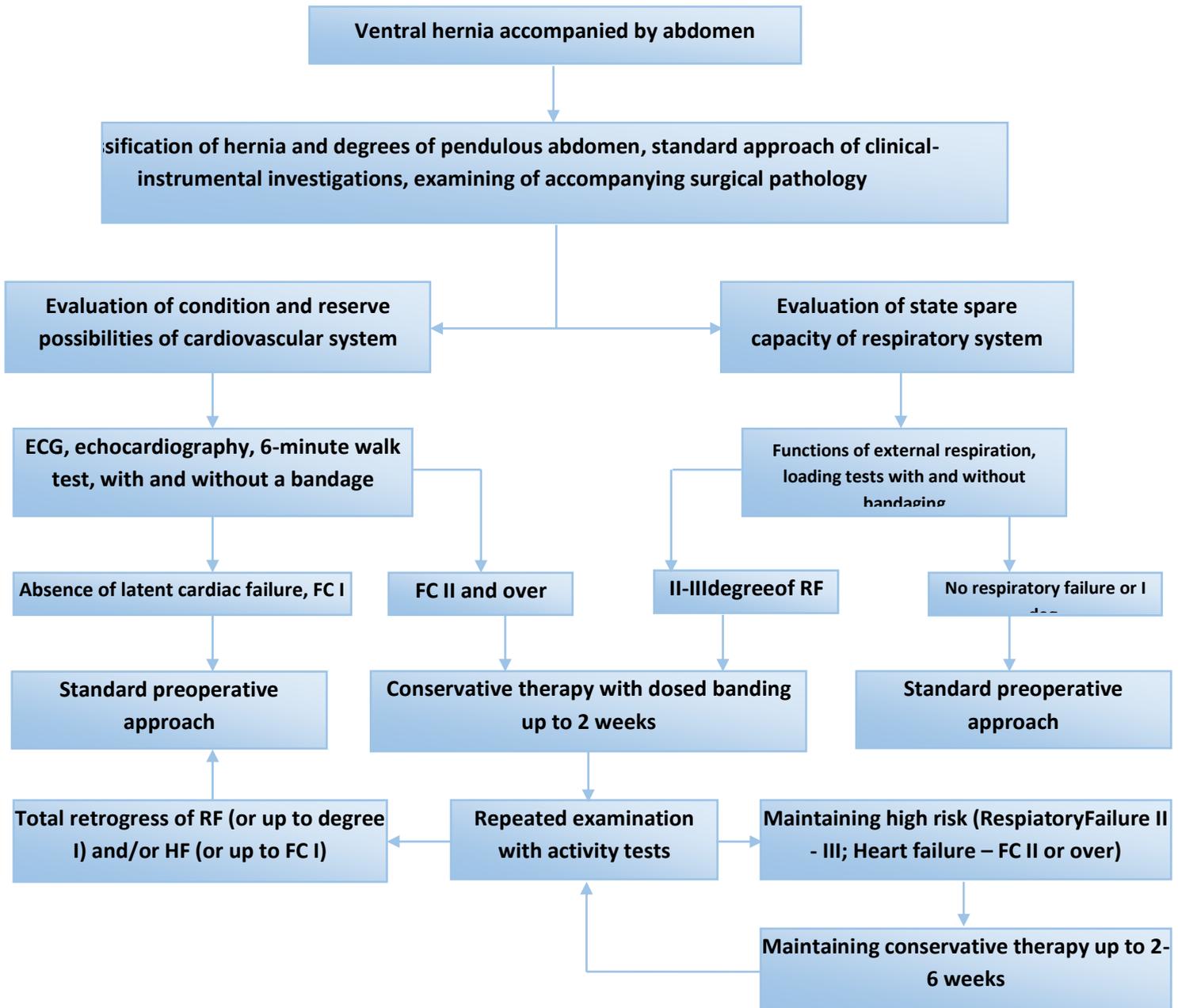
**The measuring method of cardiovascular system reserve possibilities in patients with VH against the background of adiposity.** Distinctive feature of a coined method is the estimation of reserve possibilities to decrease frequency of postoperative complications in the group of patients with a high operational risk.

The indicators of cardiovascular system activity measured in rest, weakly correlate with functional abilities of cardiovascular system during activity and has no need in defining reserve and adaptive possibilities of cardiovascular system. So nowadays there are various physical exercises to test these indicators, particularly an easy and convenient way of testing of a functional class (FC) for each patient - a six-minute walking test (SMWT).

The conducted researches revealed that 21 (25,0 %) patients had a cardiac failure of I FC, 11 (13,1 %) - II FC, 3 (3,6 %) - III FC and only one (1,19 %) patient had FC IV. In general, 36 (42,9 %) patients were diagnosed a latent cardiac failure, and only 48 (57,1 %) patients did not have this complication before the surgery. After the recommended treatment in average within 10-14 days a repeated examination of patients was carried out with exertion evaluation and beginning of the dosed banding. Reduction of reserve possibilities remained in 20,2 % cases, whilst on standard investigation methods (an electrocardiogram, echocardiography) the obtained data corresponded to the normal value. Considering this fact, we recommended to continue the treatment in combination with subsequent dynamic estimation of patient's condition against the background of activity tests and dosed banding for adaptation to forthcoming plastics. Enlarging of a share of patients with absence of signs of cardiac failure was demanded with activity tests to 91,7 % (at 77 of 84). And only 6 patients (7,1 %) remained with I FC and 1 patient (1,2 %) with II FC. New diagnostic algorithm

was worked out for tactical approach for estimation of possible surgical treatment, allowing to define a condition of reserve possibilities of respiratory and cardiovascular system according to suggested measures (Fig. 1).

**Figure 1. Diagnostic algorithm of evaluation of condition and capacity of respiratory and cardiovascular systems in patients with VH and pendulous abdomen associated with obesity**



Criterion for choice of optimal methods for hernioplasty combined with abdominoplasty in patients with pendulous abdomen was consideration of ptosis degree, sizes of hernial ring and general condition.

**A method of calculation of the excised subcutaneous fat volume of anterior abdominal wall.** Based on distribution of adipose tissue on anterior

abdominal wall there are 2 types of obesity: so-called female type (the pear-shaped) and android (male type, the apple-shaped). In this connection for definition of the anterior abdominal wall area, it was divided into two geometrical figures, while calculating its area in accordance with formulas given below:

$$S = \frac{a+b}{2} h; \quad S = \pi r^2$$

Excessive subcutaneous fat of anterior abdominal wall which demanded excising with hernia covers was calculated by the formula:

$$T (\text{thickness}) = X \text{ cm} - 3 \text{ cm}$$

where: X – is a thickness of subcutaneous fat of anterior abdominal wall according to ultrasound investigation,

T - excessive subcutaneous fat of anterior abdominal wall.

The excessive volume of subcutaneous fat of anterior abdominal wall is defined by formula:

$$V = S \times T \text{ (cm}^3\text{)}$$

The excited mass of subcutaneous fat of anterior abdominal wall is defined by formula:  $m = \text{mass}$

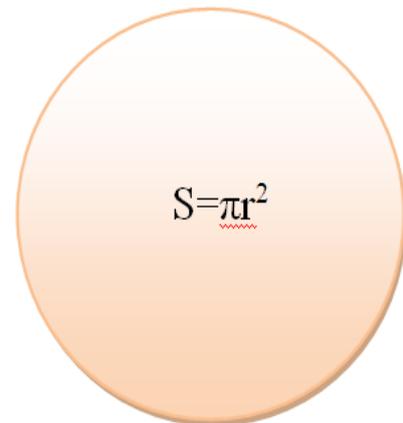
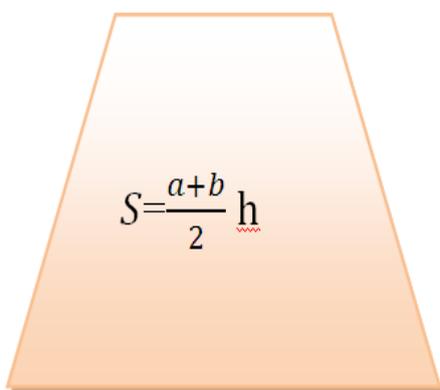
$$m = V \times k = S \times T \times k$$

( $k = 1,1 \text{ cm}^3 = \text{of adipose tissue is equal to } 1 \text{ g}$ )

m-mass should be removed, or X-  $\text{cm}^3$ , which are equal, as  $1 \text{ cm}^3$  of adipose tissue is equal to 1g of mass.

The excited mass surface is calculated by the formula:

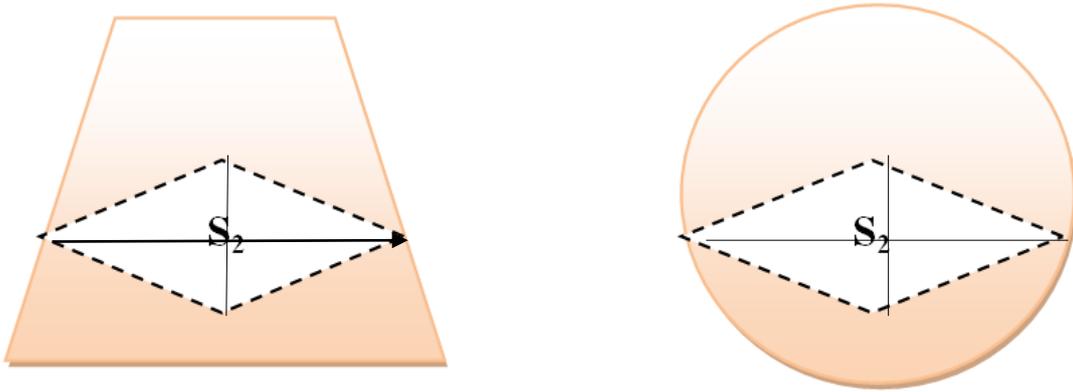
$$\frac{m}{X} = S_2$$



**Figure 2. Anterior abdominal wall in the shape of a trapezium and a circle**  
Classic and mini-abdominoplasty were calculated via formula: (Fig. 3):

$$S_2 = a^2 \sin \alpha = \frac{d_1 \cdot d_2}{2}$$

$d_{1,2}$  – diagonals,  $a$  - sides

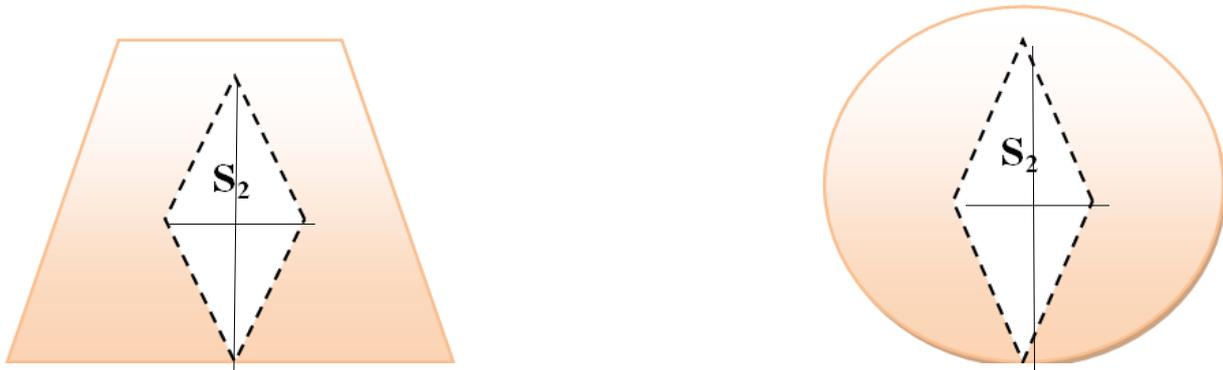


**Fig.3 Scheme of mini-abdominoplasty**

Vertical abdominoplasty is determined by formula: (Fig. 4):

$$S_2 = a^2 \sin \alpha = \frac{d_1 \cdot d_2}{2}$$

where  $d_{1,2}$  – are diagonals



**Fig.4 Scheme of vertical abdominoplasty**

In order to determine area of complex shapes (combined abdominoplasty) they were divided into two figures – a rhombus and a triangle (Fig. 5).



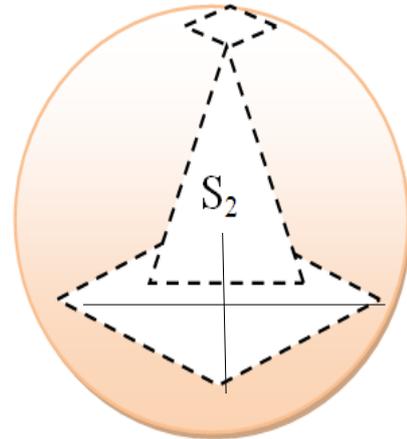
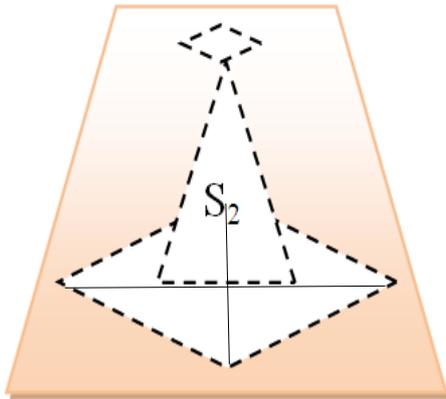
**Fig . 5. Scheme of combined abdominoplasty**

Combined abdominoplasty was calculated in accordance with the formula:

$$S = \sqrt{p(p-a)(p-b)(p-c)}; \quad a, b, c - \text{side} \quad , p = \frac{a+b+c}{2}$$

Modified abdominoplasty is defined with the formula:

$$S_2 = (a^2 \sin \alpha = \frac{d_1 d_2}{2}) + (\sqrt{p(p-a)(p-b)(p-c)} + (a^2 \sin \alpha = \frac{d_1 d_2}{2}))$$



Dermal zone in suprapubic area was grasped in "apron" with forefingers, calculating cellulocutaneous flap which should be removed, and lines were marked on a prospective cutting point so that at the process of suturing there would be no excessive tension of tissues.

1. In order to avoid necrosis of the wound, location of feeding vessels was taken into account during hernioplasty combined with abdominoplasty. Minimum mobilization of cellulocutaneous flap with conservation of peripheral vessels was performed if considered necessary, by dissecting subcutaneous fat accurately from aponeurosis, while peripheral vessels were not bandaged.

2. The further step involved extracting of the hernial sac.

3. Next step was dissection of the sac (herniolaparotomy), with simultaneous surgery on abdominal cavity organs if necessary, and enterolysis was performed in case of commissures.

4. After performing enterolysis, a small intestine was deprived of serous layer and was sutured with an absorbing material.

5. The further step included intraoperative observation of change IAP, BP, HR, oxygen saturation. Before aponeurosis suturing, IAP was determined, and only after it the choice of hernioplasty performance method was identified.

6. After bracing of polypropylene prosthesis a drainage by Redon was fixed by layer-by-layer wound suturing.

7. The next step involved preliminary contracture of dermal edges of the wound, with continuous observation of intra-abdominal pressure.

8. 8. To relieve the load from the skin seams, the Thompson fascia was sutured with nodal seams.

Duration of hernioplasty combined with abdominoplasty made  $176 \pm 12$  minutes. Minimum time spent for surgery was 40 minutes, maximum - 230 minutes.

For evaluation of a psychological load degree of the patient with adiposity and pendulous abdomen, an additional examination had been spent before performing of operative treatment. Major importance was given to the attitude of patients to expansion of surgery volume. All 84 patients in the core group have chosen a single-step treatment of VH and abdomen ptosis with the medical or aesthetic purpose. The aesthetic effect at the expense of neonaev formation was pursued by patients with 1<sup>st</sup> - 2<sup>nd</sup> degrees of ptosis - 86,8 %, and in general by 69 % in the whole group.

**Results and discussion.** When planning abdominoplasty, there is a basic question: what volume of subcutaneous fat of anterior abdominal wall should be excised? In this regard, in order to evaluate the area, anterior abdominal wall was divided into two geometrical figures: a trapezium and a circle. By the help of the offered formulas it is possible to define the excising mass of subcutaneous fat for classical, vertical and combined abdominoplasty. Cutting lines were performed in such way so that sutures would not cause excessive tension of tissues. In order to avoid regional necrosis of the wound, the location of feeding vessels was considered, by dissecting subcutaneous fat from aponeurosis without binding of peripheral vessels.

Another technical aspect was modification of classical abdominoplasty. Despite simplicity of performance of "anchor" type of incisions, junction of vertical incisions of prosthetic materials bracing could cause technical difficulties due to insufficient excision of adipose tissue and limited access, and after excising of the formed excessive dermal flaps at restoration on angles cellulocutaneous folds could be formed. In this regard an additional cross-section in the top angle of the wound was applied which allowed to manipulate widely in an anticardium, to excise appreciable volume of adipose tissue, to reliable fix an explant and to eliminate by this way the formation of postoperative cellulocutaneous fold.

In order to improve aesthetic results the technique of neonaev formation was suggested. At performing of the vertical dermal incision in the place of navel formation a dermal flap was cut out in the semilunar shape, on the opposite edge – a recess was made of the corresponding size. The dermal flap was isolated from adipose tissue, and then was sewn to adjacent aponeurosis by purse-string sutures with kapron threads. The edges of flap were sewn to the wound edge.

Mini-abdominoplasty was performed generally at a median location and size of herniac defect  $W_1$  with 1<sup>st</sup> - 2<sup>nd</sup> degrees of ptosis; classical method was applied

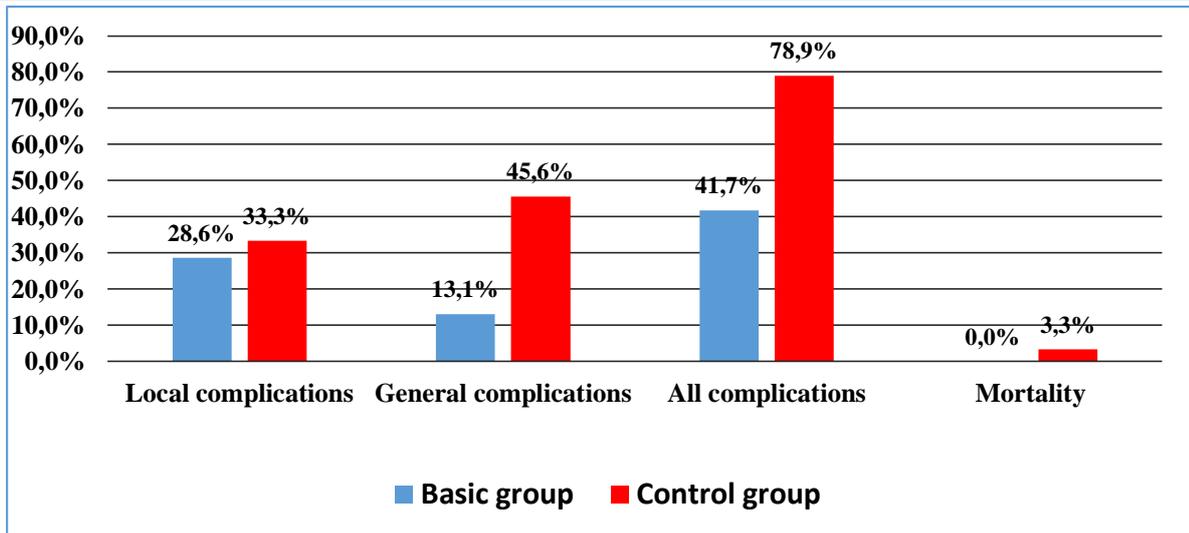
at 3<sup>rd</sup> - 4<sup>th</sup> degrees of ptosis. At hernia W<sub>3</sub> with 1<sup>st</sup> - 2<sup>nd</sup> degrees of ptosis - vertical abdominoplasty was performed, and in case of 3<sup>rd</sup> and 4<sup>th</sup> degrees of ptosis a combined method was used. At the size of hernial defect W<sub>3</sub> with 1<sup>st</sup> - 2<sup>nd</sup> degrees of ptosis, classical method was applied, and at 3<sup>rd</sup> and 4<sup>th</sup> degrees of ptosis - combined abdominoplasty.

Indicators of IAP at the moment of surgery were 10,1±1,1 against 13,4±1,0 sm w\column (P<0,05). 2 and 8 hours after the operation those indicators remained genuinely lower in the core group, and in a day made at 11,3±0,7 and 13,6±0,8 sm w\column (P<0,05).

Local complications were noted in 24 (28,6 %) patients of the core group and 30 (33,3 %) in the control group. Seroma formation was observed in 10 patients of the core group, so the repeated puncture was performed under ultrasound scan. The prolonged exudation from the wound was noted in 5 (6,0 %) patients, suppuration of postoperative wound in 1 (1,2 %) patient, whereas the necrosis of dermal flap edge developed in 4 (4,8 %) patients. The control group had no mentioned above complications. A fistula between skin and graft developed in 1 (1,2%) patient. 6 (6,7%) patients of the control group (6,7 %) had prolonged exudation from the wound, 11 (12,2 %) patients had seroma formation, and in 8 (8,9 %) patients there was a wound infiltration, whereas suppuration of wounds was observed in 3 patients (3,3 %), and fistulas between skin and graft were found in 2 patients (2,2 %).

General complications were noted in 11 patients from the core group (13,1%), that 3,5 times was rarer, than in the control group - 45,6 % (41 patients) (Fig. 3).

### **Figure 3. Comparative frequency of postoperative complications and mortality rate**



Thromboembolism of fine branches of pulmonary artery developed in one patient (1,2 %) from the core group by the third day after the surgery. That complication was eliminated after a conservative treatment. Bronchial-pulmonary complications were observed in 4 (4,7 %) patients, clinic of cardiovascular failures in 3 (3,6 %), intra-abdominal hypertension in 3 (3,6 %) patients. Mortality cases were not observed. In the control group complications in cardiovascular system were observed in 16 (17,8 %) patients. The manifestations of intra-abdominal hypertension were determined in 11 (12,2 %) patients (the average value of IAP made  $18 \pm 1,5$  sm of w\column). The mortality in the control group was observed in 3 (3,3 %) cases against the background of a myocardial infarction, TEPA and bronchial pneumonia.

The long-term results were noted in 64 patients of the core group and 72 in the control group. Observation period concluded from 3 months to 5 years. In the control group 7 (9,7 %) patients had relapse of hernia. In all cases the hernial relapse was localized on the edges of the implanted mesh. In the majority of patients (in 6 patients of 7) the relapse was combined with abdominal ptosis of III-IV degree. Besides relapse was noted in 3 (4,7 %) patients from 64 of the core group who underwent herniotomy combined with abdominoplasty. Accordingly, at the sizes of hernia  $W_{1-2}$  in the core group no relapses were determined, at  $W_{3-4}$  in 3 of 43 cases (7,0 %), in the control group - relapses were observed in 5,7 % and 13,5 % of cases. The relapse of abdomen ptosis of I-II degree in the control group was determined in only one case, and at ptosis of III-IV degree in 6 (20,7 %) patients, in the core group 2,7 % and 7,4 % respectively.

For full-scale assessment of medical-aesthetic effect of the performed operations the life quality of patients was analyzed. A special questionnaire was applied - «SF-36 Health Status Survey». Life quality of healthy patients was

analyzed divided by gender and age. The life quality improved in both groups of patients – core and control. Thus, physical activity increased 1,5-4 times. The same positive dynamics was noted in a psychological component of health with elevated indicators in 1,5-3,5 times. 62 % and 79 % of patients indicated the maintenance of social functioning and vital activity. In comparison with received data on the results of life quality evaluation, the best response was received in the core group. The minimum value in the core group - 70 % was received on the scale of pain intensity evaluation, and in the control group - 48,1 % on the scale of mental health. The maximum value - 82 % in the core group was received on the scale of the general state of health, and in the control group - 67,3 % - the role functioning caused by physical condition. The total number of points in relation to control of physical component of health was 78,5 % in the core group and 63,7 % in the control group, and in a cognitive component 79,4 % and 52,2 % respectively.

### Conclusions.

1. Suggested scheme of preoperative preparation with evaluation of the respiratory system reserve capacity allows to observe the most potential risk group of surgical intervention and contributes to retrogress of pulmonary ventilation dysfunctions after the prolonged complex preparation from 60,2 %, if standard approaches are used, up to 90,5 % ( $P < 0,05$ ) with authentic depression of intra-abdominal pressure with dosed abdominal compression.
2. A high frequency of accompanying latent cardiac failure was revealed in patients with ventral hernia associated with pendulous abdomen due to obesity 42,9 %, while standard approach to diagnostics of this condition does not considers reserve capacity.
3. Improved adaptation of cardiovascular system to a forthcoming surgical intervention on the background of prolonged conservative therapy together with dosed banding and dynamic analysis of standard investigations and physical activities, facilitate to improve reserve functional condition and reduce the group with potentially high risk of operative treatment by this criterion from initial 42,9 % to 8,3 %.
4. Suggested method for assessment of cellulocutaneous flap resection volume allows to optimize the choice of combined tactics of (various methods of hernioplasty and abdominoplasty) surgical treatment of patients with VH and pendulous abdomen considering the localization and size of the defect, as well as the degrees of abdominal ptosis.
5. Modified type of classical abdominoplasty with the use of additional cross-section contributes to manipulate broadly in anticardium, reliable

- fix the explant and excise considerable volume of adipose tissue, thereby eliminating formation of the postoperative cellulocutaneous fold. The combination of formed neonaevus with the suggested method allowed to improve aesthetic result of the surgical treatment.
6. In patients with VH and pendulous abdomen associated with obesity the recommended actions of preoperative preparation, assessment of reserve capacities and their potential improvement, expansion of surgical volume (hernioplasty) by performance of abdominoplasty, allowed to decrease the frequency of local complications (33,3 % - in control group and 28,6 % in the core group) and reduce frequency of general cardiogenic or bronchopulmonary complications from 45,6 % to 13,1 %.
  7. Best results were obtained in the core group when evaluating the life quality of patients after the surgery in comparison to healthy people - 78,5 % by physical component of health and 79,4 % by cognitive component, whereas in the control group those values corresponded to 63,7 % and 52,2 % respectively.

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