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Endothelial dysfunction of patients with incisional hernias with concomitant morbid obesity

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Abstract

The analysis of the diagnostic value of endothelial dysfunction index of patients with postoperative ventral hernias because of morbid obesity has proved its informativeness, especially in determining the endothelium level index circulating entohelial cells (CEC) and adhesion molecules of vessel endothelium type 1 (sVCAM-1) which allowed the prediction and the appropriate correction of probable complications in the early postoperative period.

Objective: to study the dynamics of endothelial dysfunction markers of patients with large incisional hernias in the consequence of morbid obesity before and after surgical interventions.

Materials and methods. The investigation was performed from 2016 to 2018 and was based on the study of endothelial dysfunction and early local and general postoperative complications of 164 patients who were treated for post-operative ventral hernia in obesity.

The results of investigation. Tissue hernioplasty was performed for 48 (29.27%) patients. Prosthetic plastic is executed for most operated persons 116 (70.73%), among them “Onlay” for 56 (34.15%), “Inlay” - 11 (6.71%), “Sublay” for 49 (29.87%) patients. The separation technique of hernioplasty was conducted only for patients with giant incision hernias - 5 (3,05%). Dermatolipectomy was performed for 39 (23.78%) operated patients.

Preference was given to dermatolipectomy of Jolly, Thorek 39 (19.5%) and Castansres-Goethel 7 (4.3%). The frequency of postoperative complications was high - 40.85%. Thromboembolism of the pulmonary artery arose in 0.61%, ACS - 3,05%, the recurrence of hernia - 12,20%. The analysis of endothelial dysfunction index shows a significant increase of the CEC level to 10.25 ± 1.6 cells × 104 / l ($p < 0.05$) and sVCAM-1 to 440.4 ± 18.69 ng / ml. in the early postoperative period. The decrease in the concentration of P and E selectines which was below the preoperative levels, both in the early and late postoperative period, is a good prognostic sign, and the correction, which was made in time, reduces postoperative complications significantly.

Conclusions. The markers of endothelial dysfunction CEC and sVCAM-1 can be used as a prognostic criterion of the occurrence of complications and severity of the postoperative period of patients with large inquisitive hernias as a result of morbid obesity.

Key words: postoperative ventral hernia, obesity, complications, markers of endothelial dysfunction.

Introduction. Postoperative ventral hernias make up 22.9% of the total number of abdominal hernias; their frequency, despite the wide usage of surgery in the abdominal cavity of modern noninvasive technologies, does not decrease, which is due to the increase of laparotomies and postoperative complications in recent years [2, 9]. Aloplasty is definitely the main operation in the surgical treatment of hernias over the past decade which improved both direct and long-term postoperative outcomes of treatment greatly. At the same time, the frequency of both general and local wound complications remains high with ventral hernias of large and gigantic proportions characterized by clinical features of the course, in particular, the decrease of external respiration rates by 35-40% from the proper, chronic adhesive obstruction (75-82,3%), increased baseline intraabdominal pressure, obesity II-III degrees (55.6% -56.6%), [1, 7, 10]. Abdominal compartment syndrome is among the common complications (2.8-6.2%), which becomes one of the main causes of postoperative lethality (1,2-3,4%) [6]. This is due to the fact that in postoperative ventral hernias of large and gigantic size, the classic techniques of aleronial plasticization (Rives, Chevrel, Stoppa) often cause a reduction in abdominal cavity and an increase in VHF, leading to intra-abdominal hypertension [5]. The usage of surgical treatment of the anesthetic components of the anterior abdominal wall for the incision hernia, "CST" (components separation technique) for Ramirez in combination with alloplasty "onlay" increases the area of the abdominal wall and the volume of the abdominal cavity, improves the results of treatment, decreases intra-abdominal

hypertension and abdominal compartment syndrome [4, 8]. It is not always possible to create the optimal volume of the abdominal cavity and eliminate intra-abdominal pressure and abdominal compartment syndrome despite of such a combined operation in large and giant postoperative ventral hernias with contracture of the right abdominal muscles. In addition, the high frequency of local complications such as serum (30.8-60.4%), infection (1.5-4.8%), ligature fistulas (1,2-3%), meshoma (0,06-1,6%), with such a technique of combined aloplasty, due to the contact of a large area of the mesh implant with a subcutaneous basis which leads to recurrence (10-15%) [3, 11, 12]. The high frequency of both general and local complications in the surgical treatment of ventral and incisional hernias leads to the development of new methods for predicting and preventing complications after these surgical interventions.

Objective: to study the dynamics of endothelial dysfunction markers of patients with large incisional hernias as a result of morbid obesity before and after surgical interventions.

Materials and methods. Surveys and surgical treatment of 164 patients with large and giant ventral hernias were performed in the period from 2016 to 2018. The age of patients was from 30 to 75 years (average age 64.7 ± 3.3). There were 106 women (64.6%) and 58 men (35.4%), without significant difference in separate age groups (χ 2 = 0.3; π = 0.84). According to the classification of the European Association of Surgeons-Herniologists (EHS classification, Ghent, Belgium, 2008) [8], postoperative ventral hernias of large and gigantic size are devided into: the middle localization of the hernia defect (M) which was diagnosed in 110 (67.4%) patients, lateral (L) - in 12 (7,3%), combined (ML) - in 42 (25,3%). Regular incisional hernias were observed in 69 (42.4%) patients, inaccurate in 95 (57.6%). A recurrent invasive hernia was marked of 44 (26.9%) patients. The contract for direct abdominal muscles was diagnosed in 19 (11.6%) patients. 4 (2.7%) patients had maceration, skin ulcers had 2 (1.4%) people, chronic laryngeal fistulae was observed in 5 (3.2%) patients. Among the concomitant diseases ischemic heart disease, hypertonic illness II-III. were observed in 120 (73.1%) patients, chronic abdominal adhesion of the abdominal organs was in 41 (24.7%) patients, varicose disease of the lower limbs occurred in 51 (31.1%), chronic obstructive bronchitis in 32 (19.8%), diabetes mellitus in 21 (12,9%), obesity of I-III degrees in 119 (72.4%) patients.

Endothelial dysfunction was evaluated by determining the level of its markers: R-selectin, E-selectin, tissue plasminogen activator, endothelin-1, sVCAM-1-soluble vascular cellular molecule, adhesion molecule of circulating endothelial cell. CEC was determined by the method of J. Hladovec in the interpretation of NN Petrishcheva et al. (2001).

Concentrations of P-selectin, E-selectin, tissue plasminogen activator, adhesion molecule of vascular endotheliumor of the 1st type (sVCAM-1-soluble vascular cellular molecule) were determined by using the "Bender MedSystems" (Austria) kit for immune enzyme analysis (ELISA) according to the instructions. Concentration of endothelin-1 was established by using Biomedica (Canada) sets for immunoassay analysis (IFA) according to the instructions. The reaction was evaluated by a SUNRISE (Tecan, Austria) semi-automatic photometric photometer with the help of a Hydroflex washing station (Tecan, Austria) which allowed standardizing these methods. The control was made on 30 healthy people, which were compared by age and gender with patients who were examined. Endothelial dysfunction markers were also detected in the early (10 days after surgery) and late postoperative period (60 days after surgery).

Statistics processing of digital data was carried out by the method of variation statistics. The certainty of the differences between the average amount and their errors were estimated according to the Student-Fisher criteria. The calculation of digital data was carried out by using the Student method in the Exel programme on a computer. The accuracy of the error was considered to be less than 5% ($p \leq 0.05$). For each investigated subject, the arithmetic average number (M) is calculated by the formula: $M = (\Sigma V \times P) / n$, where P - the number of cases of observation of this trait; V - option.

The results of investigation. Tissue hernioplasty was performed for 48 (29.27%) patients (Table 1). Prosthetic plastic is executed in most operated 116 (70.73%), among them “Onlay” is 56 (34.15%), “Inlay” - 11 (6.71%), “Sublay” in 49 (29.87%) patients.

Table 1.

	tissue hernia-plastic	«Onlay»	«Inlay»	«Sublay»	«CST» (components separation technique)	Dermatolipectomy	A light net	A hard net
Amount	48	56	11	44	5	39	48	68
%	29,27%	34,15%	6,71%	26,83%	3,05%	23,78%	29,27%	41,46%

The separation technique of hernioplasty was performed only in patients with giant incision hernias-5 (3,05%) patients, with no primary hernia in this group of patients. Dermatolipectomy is performed in patients with obesity of the 2nd-3rd centuries, especially in the presence of a "hanging abdomen". Such patients were 39 (23.78%). Preference was given to dermatolipectomy for Jolly, Thorek 39 (19.5%) and Castansres-Goethel 7 (4.3%). The

choice of the mesh implant depended on the type of plastic: during tensile methods, "heavy" polypropylene nets (68 patients) were used; "light" polypropylene nets (48 patients) were used in non-tensile herniopastiques.

The frequency of postoperative complications of postoperative ventral herniasbecause of morbid obesity among operated patients remains high enough - 40.85%. Pulmonary artery thromboembolism was diagnosed in 1 (0.61%) patient who had been tensed hernioplasty with the onlay method (Table 2).

Table 2.

	frequency of postoperative complications	PE	ACS	hernia recurrence	wound complications				
					lymphorrhea	postoperative wound infiltration	postoperative wound suppuration	cysts in the mesh area	mesh rejection
Amount	67	1	5	20	48	54	16	9	3
%	40,85%	0,61%	3,05%	12,20%	29,27%	32,93%	9,76%	5,49%	1,83%

ACS is diagnosed in 5 operated persons. Tensile hernioplasty is performed in all of these cases ("actually tissue" -3, the method "onlay" -2). According to the practice, the development of this complication is not only the choice of the method of surgical correction of the anterior abdominal wall, but also changes (edema) of adipose tissue of the abdominal cavity and retroperitoneal space, paresis of the intestine in the early postoperative period. In some cases, this requires an increase in the surgical intervention as an additional implementation of omenectomy, and in rare cases right-sided hemiclectomy.

130 patients had wound complications. Among them, there were infiltrate p/o wounds which appeared in most cases - 54 patients (32.93%), prolonged lymphorrhage - 48 (29.27%). 9 patients marked the formation of cysts in the area of the net and 3 patients had the rejection of the reticular implant. These complications were after the alogernioplastics "Onlay".

Hernia recurrence was noted in 20 patients, which made up 12.20%.

The analysis of biochemical markers of endothelial dysfunction (Table 3) indicates the presence of obvious signs of endothelial dysfunction of patients with incisional hernias. Thus, the number of circulating endothelial cells in the blood of patients with incisional hernias was significantly higher in comparison with venous blood taken from the elbow in healthy patients. This indicates the location of pathological processes and proves the high significance of this marker of endothelial dysfunction in this pathology.

Table 3.

Index	Control (n=30)	Patients with incisional hernias (n = 164)
CEC, cells, $\times 10^4$/l	3,67±1,47	7,13±1,72*
sVCAM-1,ng/ml	248,53±1,96	356,76±11,78*
P-selectin, ng/ml	158,47±1,61	188,73±8,89*
E- selectin, ng/ml	40,5±1,1	47,47±4,93*
t-PA, ng/ml	3,4±1,07	3,7±0,6
Endothelin-1, pmol/l	2,24±0,015	1,85±0,4
* - p<0,05 in comparison with control		

Also, it was found the difference in the sVCAM-1 index which indicates a contravention of the interaction of endothelial cells with peripheral blood cells. Thus, the increased expression of the adhesion molecule sVCAM-1 in the vein wall is a sign of the migration of leukocytes through the endothelium and maintaining the inflammatory process in it. The above proves that one of the key roles in the development of postoperative complications and the possible development of relapse of postoperative ventral hernias is inflammation as a result of a functionally altered and activated endothelium.

The analysis of the results (Table 4) shows a significant increase in the level of CEC to 10,25 ± 1,6 cells × 104 / l (p <0,05) in the early postoperative period. A similar situation is observed with the indicator sVCAM-1. So, we have noted an increase in this figure to 440.4 ± 18.69 ng / ml. This phenomenon can be explained by damage to vascular endothelium during operative intervention and increased inflammatory reaction in the area of surgical intervention. In the late postoperative period, the above indexes are significantly reduced, but do not return to control.

Table 4.

Index	10 days after operation	60 days after operation
CEC, cells $\times 10^4$/l	10,25 ± 1,6*	5,41 ± 1,09
VCAM-1, ng/ml	440,4 ± 18,69*	274,51 ± 24,13
P-selectin, ng/ml	178,7 ± 4,54*	159,51 ± 7,35
E- selectin, ng/ml	33,4 ± 4,0*	26,23 ± 3,0*
t-PA, ng/ml	3,6 ± 1,04	3,8 ± 1,4
Endothelin-1, pmol/l	2,78 ± 0,28	2,46 ± 0,23

At the same time, there is a tendency to decrease the concentration of P and E selectines below the preoperative levels, both in the early and late postoperative period, which in our opinion is a good prognostic sign. The difference in concentrations of endothelin-1 and tissue plasmanogen (t-PA) in the pre- and postoperative periods was insignificant.

Based on the data obtained, the most reliable indicators for prognostication and correction of endothelial dysfunction in patients with incision hernias under morbid obesity are endothelial load (CEC) and adhesion molecules of vessel type 1 endothelium (sVCAM-1).

Discussion of results: As we can observe, the surgical treatment of patients with large incision hernias because of morbid obesity is a complicated and unresolved problem of surgery. Performing an operation with this category of patients, the emergence of a great number of complications in the early postoperative period leads to the development of a syndrome of local and general inflammatory response which can follow to endothelial dysfunction (ED). Further study of the features of the course of endothelial dysfunction and the development of methods for its correction will improve the results of this category of patients.

Conclusions.

1. It is observed a statistically significant deterioration of endothelial dysfunction before surgery and in the early postoperative period of patients with large incisional hernias. Non-corrected endothelial dysfunction may be one of the factors of the development of both local and general complications.

2. Correction of endothelial dysfunction of patients with large incision hernias as a result of morbid obesity will reduce the number of postoperative complications, improve the functional state of the endothelium, leveling the manifestations of endothelial dysfunction.

3. Markers of endothelial dysfunction CEC and sVCAM-1 can be used as a prognostic criterion for the occurrence of complications and severity of the postoperative period.

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