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## RETROSPECTIVE ANALYSIS OF THE RESULTS OF SURGICAL TREATMENT OF PATIENTS WITH PRIMARY AND POSTOPERATIVE VENTRAL HERNIATIONS UNDER THE CONDITIONS OF MORBID OBESITY

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### Abstract

48–78 % of patients admitted to surgical hospitals with ventral hernias are obese, which has a significant impact on the course of the disease and the postoperative period, and little is reported in the literature. Obesity, on the one hand, contributes to the formation of hernia, on the other – progresses with its appearance. Despite the large number of surgical procedures to correct the abdominal wall, the results of surgical treatment of primary and postoperative ventral hernias, especially in morbid obesity are unsatisfactory, due to errors in choosing the optimal method of surgery indicated by the high number of complications and high recurrence. Recurrences after surgical treatment of primary and postoperative ventral hernias occur in 10–60 % of cases, which indicates that the problem of surgical restoration of the abdominal wall is still far from being solved.

**Objective.** Conduct a retrospective analysis of the results of surgical treatment of patients with ventral and postoperative ventral hernia to determine the main risk factors for complications in patients with morbid obesity.

**Materials and methods.** The results of surgical treatment of 183 patients operated on for primary and postoperative ventral hernia with concomitant morbid obesity in 2015–2020

were analyzed. Exclusion criteria were constricted hernias of the anterior abdominal wall, comorbidities in the stage of decompensation or exacerbation. 141 women (76.84 %) and 42 men (23.16 %) underwent surgery. The age of patients ranged from 18 to 84 years (mean age –  $53.4 \pm 5.6$  years). The duration of herniation ranged from 2 to 34 years. 45 (24.7 %) underwent surgery for primary ventral hernias. The remaining 138 (75.3 %) patients were operated on with postoperative ventral hernias.

**Results.** Among the examined 183 patients with degree I of obesity there were 76 (41.42 %) patients, with degree II – 58 (31.48 %), and degree III – 49 (27.1 %) examined. In obese patients of degree II heart failure class I was confirmed in 17 (22.37 %), class II in 19 (32.73 %) and class III in 31 (63.27 %) surgically operated. Among patients with degree III of obesity cardiac class II was detected in 3 (5.17 %) and class III in 4 (8.16 %) surgically operated. With respiratory failure (RF) degree I 102 (55.74 %) patients underwent surgery, with RF degree II – 67 (36.61 %) and RF degree III – in 14 (7.65 %), respectively. Varicose veins of the lower extremities were affected 68 (37.18 %) patients. Diabetes was diagnosed in 21 (11.48 %), including 19 (10.38 %) patients with type II diabetes. Undifferentiated connective tissue dysplasia was diagnosed in 36 (19.46 %) patients. Own tissue hernioplasty was performed in 35 (19.13 %) patients. Prosthetic plasty was performed in most of the surgically operated 148 (80.86%), among them onlay in 25 (13.76 %), sublay in 79 (43.17 %), inlay in 26 (14.73 %), laparoscopic hernioplasty in 13 (6.72 %) respectively. Separation hernioplasty (components separation technique) was performed only in 5 (2.91 %) patients. In some patients, as a simultaneous stage of surgical intervention, hernioplasty was performed in combination with dermatolipectomy and liposuction. A total of 46 (25.14 %) were performed. Dermatolipectomies were performed by Kuster, Jolly, Thorek and Castansres-Goethel. Pulmonary artery thromboembolism (PE) was diagnosed in 2 (1.09 %) surgically operated: 1 (1.31 %) patient with degree I of obesity and 1 (1.72%) with degree II respectively. Abdominal compartment syndrome (ACS) was diagnosed in 4 (2.19 %) surgically operated: among them with obesity degree II – in 2 (3.45 %) patients and degree III – in 2 (4.08 %) patients. Significantly higher frequency of wound complications was observed in patients with obesity degree II – 15 (26.17 %) and degree III – 16 (31.41 %). Hernia recurrence occurred in 10 (12.58 %) surgically operated with obesity degree I, in 6 (9.33 %) with degree II, and in 6 (11.82 %) with degree III.

**Conclusions.** Performance of laparoscopic and non-tension implantation methods of hernioplasty should be a priority, especially in groups of patients with pre-existing morbid obesity degree II–III. In obese patients with degree III there is a significantly higher incidence

of abdominal compartment syndrome, and the simultaneous dermatolipectomy or liposuction significantly reduces the incidence of local complications and recurrences.

**Key words: primary ventral hernia; postoperative ventral hernia; morbid obesity; complications.**

### **Introduction**

Most patients with ventral and postoperative ventral hernias suffer from concomitant morbid obesity and are a special risk group for the frequency of complications after surgery [6, 12, 14]. In Ukraine, 28.5% of patients are obese, and 48 % are overweight [9, 15]. The attitude of most surgeons is restrained regarding the treatment of this category of patients. Lack of individualized approach to each individual patient without taking into account the probable factors of hernia, comorbid pathology, lack of sufficient experience and skills to choose the optimal method of surgery, leads to unsatisfactory treatment results [13].

Despite the significant number of surgical methods of abdominal wall correction, the results of surgical treatment of ventral and postoperative ventral hernias are unsatisfactory, as indicated by the large number of complications and high recurrence rate (4.5–42 %) [3, 5, 17, 18]. The question of performing combined surgical interventions, such as dermatolipectomy and liposuction is debatable [1, 14, 20, 22]. Carrying out a detailed analysis of the results of surgical treatment of patients with ventral and postoperative ventral hernia to determine the main predictors of complications in the group of patients with morbid obesity determined the purpose and objectives of our study.

### **Objective**

Carry out a detailed retrospective analysis of the results of surgical treatment of patients with ventral and postoperative ventral hernia to determine the main risk factors for complications in patients with morbid obesity.

### **Materials and methods**

A retrospective analysis of the results of surgical treatment of 183 patients operated on for primary and postoperative ventral hernia with concomitant morbid obesity in 2015–2020 was conducted at the Ternopil City Clinical Hospital No. 2. Exclusion criteria were constricted hernias of the anterior abdominal wall, comorbidities in the stage of decompensation or exacerbation. There were 141 women (76.84 %) and 42 men (23.16 %). Age of patients was from 18 to 84 years (mean age –  $53.4 \pm 5.6$  years). The duration of herniation ranged from 2 to 34 years. Primary ventral hernias were observed in 45 (24.7 %). The remaining 138 (75.3%) patients had postoperative ventral hernias.

To determine the location, size and length of the hernial protrusion of the anterior abdominal wall there was used the classification of primary and postoperative ventral hernias (2008), recommended by the European Association of Surgeons-Herniologists (EHS-classification, 2008) [2]. Among primary ventral hernias, M1 defects were detected in – 3 (6.67%); M1-3 – 31 (68.89 %); M3 – 9 (20.00 %). There were no M4-5 defects among primary hernias. L4 defects were observed in 2 (4.44 %) patients. Defects of other localizations (L1-L3) were not noted.

Patients with postoperative ventral hernia were diagnosed with the following localization and spread of anterior abdominal wall defects: M1-3 – 78 (56.52 %), M4-5 – 21 (15.22 %), and variant M1-5 in this group in 17 (12.32 %) patients. Defects L1, L2, L4 – 9 (6.52 %). Combined ML defects in this group – in 13 (9.42%) patients.

Among patients with primary ventral hernia, more than half of the cases were diagnosed with a predominance of W2 size – 54 (29.80 %), mostly due to white line hernias and rectal diastase. In patients with postoperative ventral hernia, the size of the defect of the anterior abdominal wall was significantly higher in patients with large and giant postoperative ventral hernias W3 and > - 99 (54.26 %).

## **Results**

Among the examined 183 patients with degree I of obesity there were 76 (41.42 %) patients, with degree II 58 (31.48 %), and degree III – 49 (27.1%) patients. Class I heart failure was diagnosed in 59 (77.63 %) patients with degree I of obesity, class II – in 36 (62.10 %) and class III – in 14 (28.57%) patients, respectively. In obese patients degree II, heart failure class I was confirmed in 17 (22.37 %), class II in 19 (32.73 %) and class III in 31 (63.27 %) of surgically operated. Among patients with degree III of obesity heart failure class I was not observed in any patient, class II was detected in 3 (5.17 %) and class III in 4 (8.16 %) patients (Table 1).

With respiratory failure (RF) degree I 102 (55.74 %) patients underwent surgery, with RF degree II – 67 (36.61 %) and RF degree III – 14 (7.65 %) patients, respectively. It should be noted that all patients with RF degree III surgically operated at the request of patients, despite the explanation of the significantly high risks of surgery.

Varicose veins of the lower extremities with insufficiency of the valvular apparatus of the tibial veins were affected 68 (37.18 %) patients, with obese patients degree II this concomitant pathology was the largest 36 (62.07 %). Diabetes mellitus was diagnosed in 21 (11.48 %), including 2 (1.09 %) with type I, and 19 (10.38 %) patients with type II. Undifferentiated connective tissue dysplasia UCTD (presence of 5 or more phenotypic signs)

was diagnosed in 36 (19.46 %) patients, with obese patients degree I it was reliably the highest 19 (25.00 %). There was a higher frequency of HF class II, RF II and diabetes mellitus in patients with degree III of obesity compared with patients with degree I of obesity (Table 1).

**Table 1. Comorbidities of obese patients with ventral hernia**

|  | Cardiac failure<br>NYHA |              |            | Respiratory failure |              |             | Diabetes mellitus |              | Varicose<br>vein<br>disease | UCTD         |
|--|-------------------------|--------------|------------|---------------------|--------------|-------------|-------------------|--------------|-----------------------------|--------------|
|  | Class I                 | Class II     | Class III  | Type I              | Type II      | Type III    | Type 1            | Type 2       |                             |              |
| Obesity<br>degree I<br>(76 patients)   | 59<br>77.63%            | 17<br>22.37% | -<br>0.00% | 42<br>55.27%        | 29<br>38.16% | 5<br>6.57%  | -                 | 3<br>3.95%   | 18<br>23.68%                | 19<br>25.00% |
| Obesity<br>degree II<br>(58 patients)  | 36<br>62.10%            | 19<br>32.73% | 3<br>5.17% | 39<br>67.24%        | 17<br>29.31% | 2<br>3.45%  | -                 | 5<br>8.62%   | 36<br>62.07%                | 11<br>18.97% |
| Obesity<br>degree III<br>(49 patients) | 14<br>28.57%            | 31<br>63.27% | 4<br>8.16% | 21<br>42.86%        | 21<br>42.86% | 7<br>14.29% | 2<br>4.08%        | 11<br>22.45% | 14<br>28.57%                | 6<br>12.24%  |
| Total                                  | 109<br>59.56%           | 67<br>36.61% | 7<br>3.82% | 102<br>55.74%       | 67<br>36.61% | 14<br>7.65% | 2<br>1.09%        | 19<br>10.38% | 68<br>37.16%                | 36<br>19.67% |

Own tissue hernioplasty was performed in 35 (19.13 %) patients, and in most cases 18 (23.68 %) this type of surgery was performed in patients with degree I of obesity. In our opinion, this is due to the greater number of hernioplasties performed in primary abdominal hernias and small hernias. Prosthetic plasty was performed in most of the surgically operated 148 (80.86 %), among them onlay in 25 (13.76 %), sublay in 79 (43.17 %), inlay 26 (14.73 %), laparoscopic hernioplasty in 13 (6.72%) patients, respectively. Component separation hernioplasty technique was performed only in patients with giant postoperative hernias 5 (2.91 %), and with recurrence of R3-4, there were no primary hernias in this group of patients (Table 2).

In some operated patients, as a simultaneous stage of surgery, we performed surgical treatment of primary and postoperative ventral hernias with dermatolipectomy and liposuction. A total of 46 (25.14 %) were performed.

In patients with abdominal obesity (degree I–II), diabetes mellitus, increased risk of purulent-septic complications, comorbidity index (4 and more), small defects of the middle localization (M1-2) and to minimize surgical trauma and, as a result, the duration of surgery 21 (11.47 %) patients underwent liposuction, which preceded the hernioplasty. Standard

mechanical wet liposuction was used. Klein's solution with a sufficient concentration of anesthetic solution, previously prepared in a ratio of 1 to 1 (solution – fat) was used for infiltration of subcutaneous fat.

**Table 2. Types of surgical interventions conducted for ventral hernias in the patients with obesity**

|                                  | Native tissue hernioplasty | Onlay         | Inlay         | Sublay        | CST         | Laparoscopic hernioplasty | Dermatolipectomy + hernioplasty | Liposuction + hernioplasty |
|----------------------------------|----------------------------|---------------|---------------|---------------|-------------|---------------------------|---------------------------------|----------------------------|
| Obesity degree I (76 patients)   | 18<br>23.68 %              | 14<br>18.42 % | 3<br>3.95 %   | 34<br>44.74 % | 1<br>1.32 % | 6<br>7.89 %               | 2<br>2.63 %                     | 5<br>6.58 %                |
| Obesity degree II (58 patients)  | 9<br>15.52 %               | 6<br>10.34 %  | 10<br>17.24 % | 25<br>43.10 % | 3<br>5.17 % | 5<br>8.62 %               | 7<br>12.06 %                    | 13<br>22.41 %              |
| Obesity degree III (49 patients) | 8<br>16.33 %               | 5<br>10.20 %  | 13<br>26.53 % | 20<br>40.82 % | 1<br>2.04 % | 2<br>4.08 %               | 16<br>32.65 %                   | 3<br>6.12 %                |
| Total                            | 35<br>19.13 %              | 25<br>13.66 % | 26<br>14.21 % | 79<br>43.17 % | 5<br>2.73 % | 13<br>7.10 %              | 25<br>13.66 %                   | 21<br>11.48 %              |

Since in all cases the application of this technique preceded the stage of hernioplasty, its implementation was performed from the hernia sac to the periphery. On average, up to 3–6 liters of fat were removed. The surgery was completed by suturing postoperative wounds and the use of compression underwear with a fixed hernia. The main stage of hernioplasty was performed within 2–3 weeks after liposuction. The main method was the sublay technique.

Choosing surgical access to dermatolipectomy was guided primarily by the choice of hernioplasty. There are mainly three types of these surgeries. Thus, performing abdominoplasty by the method of Kuster vertical excision of the skin and subcutaneous tissue with preservation of the navel was performed. Indication for its use, we considered the localization (M1-4) of small primary and/or postoperative ventral hernias, moderate subcutaneous tissue (obesity degree I–II). This type of surgery was performed in 4 (2.19 %) patients.

Dermatolipectomy according to Jolly, Thorek horizontal incision was performed with the localization of the defect in the hypogastric and suprapubic regions (M4-5) or in the lower lateral parts of the abdomen and excessive subcutaneous fat (obesity II–III). This type of surgery was performed in 11 (6.01 %) cases. After allogeneic plasty, the wound was sutured in the transverse direction. If necessary, this access was supplemented with a V-shaped incision 5–6 cm along the midline upwards, removing the altered navel.

In patients with severe abdominal obesity (degree III) with apron belly, localization of the defect (M1-5) and L3 dermatolipectomy was used by Castansres-Goethel, which provided "anchor" excision of excess overstretched skin, subcutaneous tissue after removal scar of the meso-hypogastric area. This method was performed in 10 (5.46 %) patients.

Pulmonary artery thromboembolism (PE) was diagnosed in 2 (1.09 %) surgically operated: 1 (1.31 %) patient with degree I of obesity and 1 (1.72 %) with degree II, respectively. In all cases of development of this complication, tension types of hernioplasty were performed: own tissue hernioplasty and allohernioplasty by onlay method.

Abdominal compartment syndrome (ACS) was diagnosed in 4 (2.19 %) patients: of them with obesity degree II – 2 (3.45 %) patients and degree III – 2 (4.08 %) patients, respectively, and after performing tension allohernioplasty on the type of onlay. Significantly higher frequency of ACS in obese patients degree II–III indicates that in the development of this complication is the choice of method of surgical correction of the anterior abdominal wall, taking into account changes (swelling) of adipose tissue of the abdominal cavity, retroperitoneal space, intestinal paresis in the early postoperative period.

Significantly higher frequency of wound complications was observed in patients with obesity degree II – 15 (26.17 %) and degree III – 16 (31.41 %). (Table 3).

Hernia recurrence occurred in 10 (12.58 %) surgically operated with obesity degree I, in 6 (9.33 %) degree II, and in 6 (11.82 %) patients with degree III.

It should be noted that in patients with abdominal obesity who underwent simultaneous dermatolipectomy or liposuction 46 (25.14 %), the percentage of wound complications and recurrences was significantly lower 2 (3.4 %) compared with the group of patients, whom this stage of surgery was not performed.

**Table 3. Complications of surgical treatment of ventral hernias in patients with obesity**

|                                  | PE         | ACS        | Postoperative pneumonia | Wound complications           |                                   |                             |                              |                          | Hernia recurrence |
|----------------------------------|------------|------------|-------------------------|-------------------------------|-----------------------------------|-----------------------------|------------------------------|--------------------------|-------------------|
|                                  |            |            |                         | Prolonged lymphorrhoea Seroma | Infiltrate of postoperative wound | Postoperative wound abscess | Hematoma postoperative wound | Cysts of the mesh region |                   |
| Obesity degree I (76 patients)   | 1<br>1.31% | -          | -                       | 9<br>11.84 %                  | 1<br>1.31 %                       | 1<br>1.31 %                 | 1<br>1.31 %                  | -                        | 10<br>13.16 %     |
| Obesity degree II (58 patients)  | 1<br>1.72% | 2<br>3.45% | 2<br>3.45 %             | 6<br>10.34 %                  | 3<br>5.17 %                       | 1<br>1.72 %                 | 1<br>1.72 %                  | 1<br>1.72%               | 6<br>10.34 %      |
| Obesity degree III (49 patients) | -          | 2<br>4.08% | 2<br>4.08%              | 4<br>8.16 %                   | 2<br>4.08 %                       | 5<br>10.20 %                | 2<br>4.08 %                  | -                        | 6<br>12.24 %      |
| Total                            | 2<br>1,09% | 4<br>2.19% | 4<br>2.19 %             | 18<br>9.83 %                  | 6<br>3.27 %                       | 7<br>3.82 %                 | 4<br>2.18 %                  | 1<br>0.54%               | 22<br>26.51 %     |

### Discussion

The reason for unsatisfactory results of abdominal wall plastic surgery in most cases are: recurrence of hernia, heart and lung failure (pathogenetically associated with the lack of effective methods of preoperative preparation, adaptation of patients to high intra-abdominal pressure, methods of its regulation), suppuration of postoperative wounds and marginal necrosis, suture line disruption, pulmonary embolism, phlebitis of the veins of the lower extremities, lymphorrhea. Unsatisfactory results in abdominoplasty can also lead to a decrease in quality of life [4, 10, 11].

Patients with ventral and postoperative ventral hernia under conditions of morbid obesity degree II-III very often, surgical treatment is denied due to the high surgical risk, which leads to their permanent disability. This necessitates an individual approach to the choice of patients, special preoperative preparation and the optimal method of surgery [8, 21].

The unresolved and controversial issues of surgical treatment of patients with primary and postoperative ventral hernias in obesity indicate the relevance of the topic and the need for further research on this issue [19].



## Conclusions

Laparoscopic and non-tensioning methods of hernioplasty should be a priority, especially in groups of patients with pre-existing morbid obesity degree II–III and pronounced comorbidity, which can significantly reduce the number of early postoperative complications.

In obese patients of degree III there is a significantly higher incidence of abdominal compartment syndrome, which requires an increase in the scope of surgery - omentectomy, and in rare cases, right hemicolectomy.

Simultaneous dermatolipectomy or liposuction significantly reduces the incidence of wound complications and recurrences in patients with primary and postoperative ventral hernia in morbid obesity.

## References

1. Chan DL, Talbot ML. Synchronous ventral hernia repair in bariatric patients. *Obes Surg* 2014;24:944.
2. Classification of primary and incisional abdominal wall hernias / F. E. Muysoms et al. *Hernia*. 2009. Vol. 13, № 4. P. 407–414.
3. Desai KA, Razavi SA, Hart AM, et al. The Effect of BMI on outcomes following complex abdominal wall reconstructions. *Ann Plast Surg* 2016;76:S295-7.
4. Doyle SL, Lysaght J, Reynolds JV. Obesity and post-operative complications in patients undergoing non-bariatric surgery. *Obes Rev* 2010;11:875-86.
5. Fekkes JF, Velanovich V. Amelioration of the effects of obesity on short-term postoperative complications of laparoscopic and open ventral hernia repair. *Surg Laparosc Endosc Percutan Tech* 2015;25:151-7.
6. Halm JA, Heisterkamp J, Veen HF, et al. Long-term follow-up umbilical hernia repair: are there risk factors for recurrence after simple and mesh repair. *Hernia* 2005;9:334-7.
7. Kaoutzannis C, Leichtle SW, Mouawad NJ, et al. Risk factors for postoperative wound infections and prolonged hospitalization after ventral/incisional hernia repair. *Hernia* 2015;19:113-23.
8. Krpata DM, Blatnik JA, Novitsky YW, et al. Evaluation of high-risk, comorbid patients undergoing open ventral hernia repair with synthetic mesh. *Surgery* 2013;153:120-5.
9. Lavryk AS, Tivonchuk OS, Lavryk OA. Surgical treatment of obesity. *Zdorovia Ukrainy* 2013;1:10–11 [in Ukrainian].

10. Manilich E, Vogel JD, Kiran RP, et al. Key factors associated with postoperative complications in patients undergoing colorectal surgery. *Dis Colon Rectum* 2013;56:64-71.
11. Mavros MN, Athanasiou S, Alexiou VG, et al. Risk factors for mesh-related infections after hernia repair surgery: a meta-analysis of cohort studies. *World J Surg* 2011;35:2389-98.
12. Menzo EL, Hinojosa M, Carbonell A, et al. American Society for Metabolic and Bariatric Surgery and American Hernia Society consensus guideline on bariatric surgery and hernia surgery. *Surg Obes Relat Dis* 2018;14:1221-32.
13. Moore M., Bax T, MacFarlane M, et al. Outcomes of the fascial component separation technique with synthetic mesh reinforcement for repair of complex ventral incisional hernias in the morbidly obese. *Am J Surg* 2008;195:575-9.
14. Moreno-Egea A, Campillo-Soto A, Morales-Cuenca G. Does abdominoplasty add morbidity to incisional hernia repair? A randomized controlled trial. *Surg Innov* 2016;23:474-80.
15. Piatnochka VI. Outcomes of surgical treatment of obese patients with ventral and incisional hernias. *Archives of the Balkan Medical Union* 54 (1), 104-109.
16. Poulouse BK, Shelton J, Phillips S, et al. Epidemiology and cost of ventral hernia repair: making the case for hernia research. *Hernia* 2012;16:179-83.
17. Raftopoulos I, Courcoulas AP. Outcome of laparoscopic ventral hernia repair in morbidly obese patients with a body mass index exceeding 35 kg/m<sup>2</sup>. *Surg Endosc* 2007;21:2293-7.
18. Rosen MJ, Aydogdu K, Grafmiller K, et al. A multidisciplinary approach to medical weight loss prior to complex abdominal wall reconstruction: Is it Feasible? *J Gastrointest Surg* 2015;19:1399-406.
19. Sharma G, Boules M, Punchai S, et al. Outcomes of concomitant ventral hernia repair performed during bariatric surgery. *Surg Endosc* 2017;31:1573-82.
20. Spaniolas K, Kasten KR, Mozer AB, et al. Synchronous ventral hernia repair in patients undergoing bariatric surgery. *Obes Surg* 2015;25:1864-8.
21. Sugarman HJ, Kellum JM Jr, Reines HD, et al. Greater risk of incisional hernia with morbidly obese than steroid-dependent patients and low recurrence with prefascial polypropylene mesh. *Am J Surg* 1996;171:80-4.
22. Warren JA, Epps M, Debrux C, et al. Surgical site occurrences of simultaneous panniculectomy and incisional hernia repair. *Am Surg* 2015;81:764-9.