

Surgical Aspects of the Treatment of Giant Ventral Hernias

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Abstract The article is devoted to the review of modern views and approaches to the surgical treatment of giant ventral hernias. The results of various plastic surgery options, the specifics of their implementation are considered and the frequency and structure of various specific and common complications are analyzed in detail. Modern approaches to laparoscopic allogenioplasty options, the advantages of these techniques and the results are described in detail.

Keywords Giant ventral hernias, Surgical aspects, Synthetic implants, Methods of allogenioplasty

1. Introduction

In recent years, alloplasty methods using synthetic mesh prostheses have become the most widespread in the surgical treatment of ventral hernias. The main advantage of the above methods is to reduce the number of relapses. However, despite the undoubted successes achieved in the treatment of hernias of the anterior abdominal wall using synthetic implants (endoprotheses), this disease is accompanied by both fatal outcomes and large labor losses associated with human disability. The most difficult category is patients with giant postoperative ventral hernias. Questions regarding the optimization of approaches to their treatment are still relevant in modern herniology.

Ermolov A.S., with co-authors (2019) [1] optimized surgical tactics in patients with large and giant postoperative ventral hernias by analyzing the immediate and long-term results of modern hernioplasty methods. 680 patients with postoperative ventral hernias (445 (65.4%) women, 235 (34.6%) men) were operated on at the Scientific Research Institute of Ambulance and Medical Unit of the Ministry of Internal Affairs named after Sklifosovsky over a 15-year period. The average age of the patients was 63.2 ± 14.2 years. The study was dominated by patients of middle-aged and elderly (able-bodied) age (45-74 years) (n=510, 75%). Sublay herniation was performed in 490 (72%) patients without severe concomitant pathology and a relative volume of hernial protrusion of up to 18%. The submuscular insertion technique was used in 95 (14%)

patients with severe concomitant pathology and persons over 50 years of age or with a relative volume of hernial protrusion of more than 18%. Over the past 3 years, we have applied a modified repair technique in 5 (0.75%) patients with giant postoperative ventral hernia and anterior abdominal tissue deficiency (partial or complete absence of some anatomical formations, for example, rectus abdominis). The hybrid technology was used in 12 patients with severe concomitant diseases, European-qualified W2 hernias or recurrent hernias, significant adhesions in the abdominal cavity or hernial sac. As a result, early postoperative wound complications occurred in 27 (5.5%) patients in the form of hematoma (n=12, 2.5%), infiltration (n=7, 1.4%), wound suppuration (n=8, 1.6%). Other complications were observed in 6 (1.2%) patients: pneumonia, pulmonary embolism, intestinal obstruction. There were no deaths. Relapses in the long-term period were detected in 18 (3.7%) patients. The axillary-insertion herniation technique was accompanied by early postoperative wound complications in 5 (5.1%) patients, including hematoma (n=3, 3.2%), infiltration (n=1, 1%), wound suppuration (n=1, 1%). There was no mortality. No other early postoperative complications were observed. Relapses were detected in 5 (5.2%) patients. Preoperative intra-abdominal pressure was 7-10 mmHg in all patients with tissue deficiency. This value did not exceed 12 mmHg after surgery due to the creation of a "preset diastasis". There were no deaths. There were no early or long-term relapses or wound complications. An analysis of the early and long-term results of the modified hybrid anterior abdominal wall plastic surgery revealed no relapses, local and systemic complications. Persistent minor diastasis between the rectus muscles reinforced with a mesh implant was observed in 3 (25%) of 12 patients. Thus, an optimized and personalized approach to patients with large and giant postoperative ventral

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hernias takes into account all intra- and postoperative risk factors [2,3].

Feleshtynsky YP, et al. (2023) [4] also tried to increase the effectiveness of treatment of postoperative ventral hernias of gigantic size due to a differentiated approach to the choice of posterior dissection technique of anatomical components of the anterior abdominal wall in combination with alloplasty. They analyzed the surgical treatment of 312 patients with giant postoperative ventral hernias (PVH). The main group consisted of 232 patients who underwent a differentiated approach to the choice of component separation in combination with alloplasty, taking into account intra-abdominal pressure (IAP) when modeling hernioplasty during surgery. In the second control group (80 patients), surgical treatment of giant PVH was performed only with the posterior Carbonell technique. As a result, in 78 patients of the 1st subgroup, the IAP was 9.1 ± 1.2 mmHg. The posterior method of separation of anatomical components by Carbonell in combination with sublay alloplasty was performed. In 80 patients of subgroup II with IAP from 11.1 to 14.1 ± 1.2 mmHg, the TARR technique with sublay alloplasty was performed. In 74 patients of subgroup III with IAP from 16 to 20.1 ± 1.2 mmHg, we improved the TAPP technique in combination with intraperitoneal alloplasty. An increase in the effectiveness of surgical treatment was achieved in patients of subgroup I, a decrease in the probability of intra-abdominal hypertension to 5.1% versus 11.2%, in patients of subgroup II to 5% versus 11.2%, and in patients of subgroup III to 1.4% versus 11.2% in the control group.

2. Materials and Methods

The use of various modifications of plastic surgery of ventral hernias. The component separation technique (CST) has become popular in recent years for postoperative hernia repair [5]. The following two main CST are currently in use: separation of the front components [6] and separation of the rear components [7]. In both methods, mesh is added to strengthen the closure of the abdominal wall and ensure long-term stability [8], and the methods of separation of the anterior components and separation of the posterior components have proven effective [9,10]. Moreover, in some cases, they represent the last chance to achieve a good quality of life for patients who are forced to change their lifestyle due to a hernia [11,12].

However, most of the data on the use of both CST is obtained from single experiments or hospitals with a large volume of patients [10,13,14,15,16]. There is no data on a multicenter cohort of patients. Real data (etc. registers) can provide information from different institutions about the routine practice of component separation technique in unselected patients and can answer questions that are more difficult to analyze in other studies (etc. randomized trials). The Postoperative Hernia Surgery Registry (EVEREG) [17] was launched in 2012 and promoted by the Abdominal Wall

Department of the Spanish Association of Surgeons (AEC), and it represents one of the few registries of these characteristics present in Europe and the world, the rest of the globe.

Pauli EM, et al. (2013) describe their current surgical technique for open ventral hernia repair using component separation [18]. Although methods of separation of the anterior component have been described, in their current practice, the authors mainly use separation of the posterior component with the release of the transverse abdominal muscle to ensure dissection outside the retro-rectal space. This method adheres to the principles supported by the literature of closing the fascia along the midline without tension with a wide overlap of the mesh located in the sublayer position. The authors' experience with this method confirms a low recurrence rate and a decrease in the incidence of wounds. Majumder A, et al. (2018) evaluated myofascial medialization after separation of the posterior component due to the release of the transverse abdominal muscle in a cadaveric model [19]. Separation of the posterior component using the transverse abdominal release (TAR) procedure continues to gain popularity. However, neither the physiological basis nor the degree of myofascial medialization after transabdominal preperitoneal have been established. We aimed to evaluate the medialization of the anterior and posterior fascia of the rectus abdominis (AF and PF) after each stage of the TAR procedure. Ten fresh corpses underwent separation of the rear component through TAR. The stages included median laparotomy, retrorectal dissection, dissection of the posterior vagina of the rectus abdominis muscle, dissection of the transverse abdominal muscle and retromuscular dissection. Medial advancement of AF and PF was measured after application of 2.5, 5.0 pounds and maximum fascial edge tension. The values are presented as the average advance over the median line in centimeters. Median laparotomy allowed to advance 2.5, 3.7 and 4.9 cm. Retro-rectal dissection provides advancement of 4.1, 5.9 and 7.6 cm for AF and 4.4, 6.2 and 7.5 cm for PF. Dissection of the posterior vagina of the rectus abdominis muscle provides an advance of 4.2, 6.1 and 8.0 cm for AF and 4.6, 6.6 and 8.3 cm for PF. Dissection of the transverse abdominal muscle provided an advance of 4.5, 6.6 and 8.6 cm for AF and 5.3, 7.5 and 9.5 cm for PF. Retromuscular dissection provided an advance of 5.5, 7.9 and 9.9 cm for AF and 6.9, 9.6 and 11.2 cm for PF. Overall, the complete TAR procedure provided a 102% improvement in the physiological position and a 129% improvement in PF compared to the baseline level. The TAR procedure provides significant medial advancement of both the anterior and posterior myofascial components of the abdominal wall. Retromuscular dissection deep to the intersected transverse abdominal muscle appears to be a key step in the procedure, which makes it possible to effectively reconstruct very wide (≈ 20 cm) defects.

Du X, et al. (2023) [20] suggest that the hernia parameters measured by computed tomography can predict the separation of components. Currently, there are no reliable preoperative methods for predicting component separation (CS) in

postoperative hernia repair. By quantifying preoperative computed tomography, we sought to assess the importance of hernial defect size, abdominal wall muscle quality, and hernia volume in predicting CS. The data of 102 patients who underwent open Rives-Stoppa retromuscular mesh surgery for median postoperative hernia between January 2019 and March 2022 were retrospectively analyzed. The patients were divided into two groups: patients of the "CS group" who needed CS to attempt fascia closure, and patients of the "non-CS" group who needed only Reeves-Stop retromuscular relaxation to achieve fascia closure. Computed tomography images measured the width of the hernial defect, the angle of the hernial defect, the width of the rectus abdominis muscles, the area of the abdominal wall muscles and computed tomography - attenuation, the volume of the hernia and the volume of the abdominal cavity. The ratio of rectal width to defect width (RDR), HV/ACV and HV/peritoneal volume (PV, etc. HV + ACV) was calculated. The differences between the indicators of the two groups were compared. Logistic regression models were applied to analyze the relationships between the above computed tomography and CS parameters. Receiver operator performance curves were created to assess the potential usefulness of computed tomography parameters for CS prediction. Of the 102 patients, 69 were in the non-CS group and 33 in the CS group. Compared with the group without CS, the width of the hernial defect ($P<0.001$), the angle of the hernial defect ($P<0.001$) and the volume of the hernia ($P<0.001$) were larger in the CS group, whereas the RDR ($P<0.001$) was smaller. The area of abdominal wall muscles in the CS group was slightly larger than in the non-CS group ($P=0.046$), and there was no significant difference in computed tomography-attenuation of abdominal wall muscles between the two groups ($P=0.089$). Multifactorial logistic regression revealed the width of the hernial defect (OR 1.815, 95% CI 1.428-2.308, $p<0.001$), RDR (OR 0.018, 95% CI 0.003-0.106, $p<0.001$), the angle of the hernial defect (OR 1.077, 95% CI 1.042-1.114, $p<0.001$), volume hernias (OR 1,002. 95% CI 1,001-1,003, $p<0.001$), and weakening of abdominal wall muscles on computed tomography (OR 0.962. 95% CI 0.927-0.998, $P=0.037$) as independent predictors of CS. The width of the hernial defect was the best predictor of CS with a cut-off point of 9.2 cm and an area under the curve (AUC) of 0.890. AUC RDR, angle of hernial defect, volume of hernia and weakening of abdominal wall muscles during computed tomography were 0.843, 0.812, 0.747 and 0.572, respectively. Quantitative computed tomography measurements are of great importance for the preoperative prediction of CS. The size of the hernial defect, the volume of the hernia and the weakening of the abdominal wall muscles on computed tomography are preoperative prognostic indicators of CS.

Sazhin A.V. (2018) [21] also used endoscopic retromuscular alloplasty for primary and postoperative ventral hernias, only in 1 case a seroma was noted above the mesh implant, which was removed under ultrasound control.

3. Results and Discussions

Laparoscopic plastic surgery of a ventral hernia.

Alexander AM, et al. (2013) [22] believe that laparoscopic ventral hernia repair (LVHR) has established itself as a generally accepted method of hernia treatment. Clear advantages have been established regarding the superiority of LVHR in terms of fewer wound infections compared to open surgeries. Careful technique and proper patient selection are crucial to achieve the stated results.

Tsuruta A, (2014) [23] conducted a retrospective study to determine the medium-term recurrence and complication rate in patients after LVHR using DualMesh, an expanded polytetrafluoroethylene (ePTFE) mesh. Additionally, in the postoperative period, a study of the rate of mesh contraction was conducted. The author compared the open plastic mesh of ventral and postoperative hernias (OR) and LVHR. The shrinkage rate of a mesh made of foamed polytetrafluoroethylene was also analyzed. The study included 45 patients (21 OR, 24 LVHR) who underwent mesh surgery for primary ventral and postoperative hernias between January 2008 and December 2012. The characteristics of the patients did not differ significantly between the two groups. The average surgery time was 152.7 minutes in the OR group and 143.1 minutes in the LVHR group ($P=0.25$). The average postoperative hospital stay was 13.4 days for the OR group and 6.8 days for the LVHR group ($P=0.01$). The incidence of postoperative complications was 28.6% in the OR group and 12.5% in the LVHR group ($P=0.03$). Among patients with OR, the causes of morbidity were diverse: two relapses, one infection in the surgical area, one relapse, one case of enteritis and one case of heart failure. Among LVHR patients, there was one infection in the surgical area and two cases of seroma. None of the patients in the LVHR group had a relapse, while 14.3% of patients with OR had a relapse. In the LVHR group, the average reduction rate of the ePTFE mesh was 10.6%. Thus, LVHR has advantages over OR, and the reduction rate of the mesh from to ePTFE after administration was 10.6%.

Liang MK, et al. (2013) [24] also compared the results of laparoscopic and open plastic surgery of primary ventral hernias. More and more primary ventral hernias are being treated using the technique of laparoscopic plastic surgery of ventral hernias. There are several studies comparing LVHR results with the results of open ventral hernia repair (OVHR) for PVH. We suggest that LVHR in PVH is associated with fewer infections in the surgical area, but with more recurrence of hernia and more clinical cases of protrusion (protrusion not associated with recurrence or seroma). A retrospective study of 532 consecutive patients who underwent elective PVH plastic surgery in one facility from 2000 to 2010. The results of 2 procedures were compared using 2 statistical methods. Multivariate logistic regression was used to assess the relationship between the results and several independent factors adjusted for treatment propensity, and the results in 2 groups of patients were compared using paired single-factor analysis: 79 patients who

underwent LVHR and 79 patients who underwent OVHR. The main outcomes of interest were surgical site infections, hernia recurrence, and protrusion. The two groups of patients were comparable in terms of hernia size, class of the American Society of Anesthesiologists, age and body mass index. 91 patients underwent LVHR and 167 patients underwent OVHR with mesh, with an average follow-up period of 56 months (range 1-156 months). Seventy-nine LVHR patients were compared with 79 OVHR patients. There were no significant differences in demographic data or mixed factors between the two groups. Compared with OVHR, LVHR was significantly associated with fewer surgical site infections (7.6% vs. 34.1%; $P<0.01$), but with more clinical cases of protrusion (21.5% vs. 1.3%; $P<0.01$) and port hernia (2.5% vs. 0.01%). There were no differences in the recurrence rate at the site of hernia repair (11.4% vs. 11.4%; $P=0.99$). Multivariate analysis with a comparison of predisposition indicators confirmed that LVHR is associated with a large number of clinical cases of protrusion, but with fewer infections of the surgical area. Compared with open plastic surgery of ventral hernias in primary ventral hernias, laparoscopic plastic surgery of ventral hernias in primary ventral hernias is associated with fewer infections of the surgical area, but more clinical cases of protrusion and with the risk of developing a hernia port site. Further research is needed to clarify the role of LVHR in PVH and reduce it.

4. Conclusions

Thus, prosthetic repair of ventral hernias continues to gain popularity, but surgeons are likely to meet with a large number of patients with complications associated with the use of mesh, since no technique or material for hernia repair has demonstrated immunity to these complications. Unfortunately, despite the introduction of numerous new methods and methods of allogernioplasty, there is no "ideal" that meets all the requirements of surgery. Almost every method has disadvantages. However, it has been clearly demonstrated that the use of mesh to enhance recovery is associated with a much lower risk of recurrence compared to local tissue grafting. Therefore, research on the development of new various approaches and methods remains an urgent task of modern surgery, while taking into account not only the size of the initial hernial defect, the type of plastic, the exact anatomical location of the mesh, the technique of fixing the mesh, but also the improvement of the mesh material, which would contribute to reducing the incidence of various wound and abdominal complications. In light of the above, the improvement of technologies in the treatment and prevention of postoperative ventral hernias is particularly relevant and has great practical importance for clinical medicine.

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