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Paraprosthetic Recurrent Ventral Hernias and Their Surgical Correction

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ABSTRACT

Objective: *To conduct a comparative analysis of macro- and microscopic morphological changes in tissues in patients with recurrent ventral hernias and to improve surgical methods for managing these cases.* ***Methods:*** *Patients were divided into two groups based on prior hernioplasty techniques: Group I (n=52) received tension methods, while Group II (n=26) underwent non-tension prosthetic methods. Clinical and instrumental analyses, including CT scans and morphological assessments of tissue around prostheses, were performed to evaluate recurrence patterns and inflammation levels.* ***Results:*** *Findings revealed that complete relapses frequently followed tension hernioplasty, while non-tension methods resulted in partial recurrences along the prosthesis contours. Tension methods showed significant void formation and inflammatory responses around the prostheses, while non-tension techniques led to a mature connective tissue response. The recurrence rate was notably lower (3.8%) in patients treated with improved non-tension methods, such as "onlay" without defect suturing and "onlay + sublay" with duplication.* ***Novelty:*** *This study offers insights into morphological differences in tissue responses based on hernioplasty techniques, supporting improved surgical methods for recurrent hernias. By enhancing tension-free techniques, recurrence rates were reduced from 15% to 3.8%, underscoring the clinical benefit of tailored approaches in recurrent ventral hernia management.*

INTRODUCTION

Over the past 20 years, the improvement of treatment results for patients with primary and postoperative hernias has been associated with the introduction of synthetic prostheses made of various materials. The frequency of ventral hernia recurrence after plastic surgery using autoplastic methods ranges from 20 to 46%, after prosthetic methods it ranges from 8 to 15.3% of patients [1], [2], [3]. Currently, the pathogenesis of recurrent hernias is considered from the point of view of the development of a constantly progressing local inflammatory process in the tissues around the prosthesis, which indicates an increased risk of wound complications during repeated operations [4], [5]. At the same time, methods for preventing complications and relapses of the disease have not been sufficiently developed [6].

The lack of clearly formulated recommendations for choosing a surgical method in patients with recurrent ventral hernias after both autoplastic and prosthetic methods of hernioplasty became the main motivation for conducting this study.

Objective the study is conduct a comparative analysis of macro- and microscopic morphological changes in tissues in patients with recurrent ventral hernias after various

methods of plastic surgery and to improve methods of surgical treatment of recurrent ventral hernias.

RESEARCH METHOD

All 78 patients aged 28 to 75 years (mean age was 57.2±9.02 years) with recurrent postoperative ventral hernias were divided into 2 groups. Group I included 52 patients whose hernia recurrence developed after tension methods of hernioalloplasty. Group II included 26 patients whose disease recurrence occurred after operations with non-tension combined methods using synthetic prostheses. Most often, hernias formed after gynecological operations - 23.2%, other diseases, including abdominal trauma - 22.1%, interventions on the hepatobiliary system 16.2% and herniotomy for umbilical hernia - 15.1%, etc [7].

Distribution of patients by size, localization and frequency of recurrent hernias according to the classification of J.P. Chevrel and A.M. Rath (SWR – classification 2000). In this case, a significant place was occupied by patients with hernias of median localization 87.2%, then - with anterolateral hernias 8.1% and with lateral hernias 4.7%. Recurrent hernias of small sizes (W1) were in 18.6% of patients, medium (W2) - in 34.9%, large (W3) - in 31.4%, huge (W4) - 15.1% [8].

Particular importance was attached to the registration of instrumental research methods: ultrasound, CT in the intervention area before and after surgery. CT in patients with POVG allowed reliable visualization of the defect in the projection of the hernial protrusion, its size, identification of elements of the hernia contents, determination of the thickness of the subcutaneous fat, the state of the muscular-aponeurotic framework of the anterior abdominal wall [9].

Figure 1. View of the Anterior Abdominal Wall and Computed Tomography of Patient P., 56 Years Old, With Recurrent Postoperative Ventral Hernia (M2W3R1).

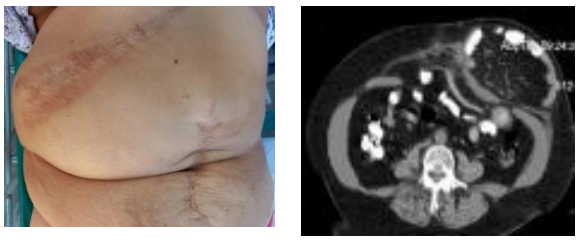

Figure 2. View of the Anterior Abdominal Wall And Computed Tomography of Patient G., 54 Years Old, With Recurrent Postoperative Ventral Hernia (L1W3R2)

For morphological examination of patients with recurrent hernias, fragments of a previously implanted prosthesis, tissues from the hernial orifice area directly at the site of hernia recurrence and at a distance of 5-15 cm from them (determined from the size of the primary hernia), walls of fluid formations and fistulas, if any, were obtained during interventions. In patients with recurrent hernias after prosthetic methods, tissues surrounding the plastic area, as well as at the prosthesis-tissue border, obtained during repeated operations, were studied. Histological sections were studied at the Histology Department of Samarkand State Medical University using a visualization system based on an Olympus BX 41 microscope. Morphometry of structures was performed after obtaining images using the Morphology 5.2 program [10].

To determine the causes of hernia recurrence in patients after plastic closure of defects in the abdominal wall with local tissues and strengthening them with a synthetic prosthesis, a retrospective analysis of operations in treated patients was conducted. In patients with recurrent hernias, a complete relapse of the disease occurred after plastic surgery with local tissues. Intraoperatively, ligatures were found along the line of divergence of the edges of previously sutured tissues with the integrity of the thread and knot preserved, which indicates tissue cutting, and not a rupture of the thread. After plastic surgery with local tissues, a relationship was noted between hernia recurrence and the size of the protrusion, which, in turn, correlated with increased intra-abdominal pressure after surgery. This indicates the inadequacy of the applied method of plastic surgery for large hernias, which contribute to an increase in intra-abdominal pressure [11].

In patients of this group, microscopic examination of tissues after local tissue plasty showed that the recurrence zone, represented by a scar, changed the anatomy of the anterior abdominal wall during the formation of hernia elements, creating technical difficulties during the operation. In case of recurrence within 2 to 6 months, the basis of the scar was mature connective tissue without signs of fibrous transformation . Collagen fibers were mainly collected in bundles, but the thickness and density of the fibers in them were not the same. In areas with low density, there were signs of inflammation with tissue edema and diffuse focal lymphocytic infiltration (Figure 2) [12]. Such changes were observed over a large distance from the recurrence zone, and at the site of hernia recurrence, against the background of existing inflammation, there were small foci of immature granulation tissue.

In patients with recurrent hernias after tension prosthetic methods of plastic surgery, the following changes were detected macroscopically. The main differences depending on the time of relapse occurrence were observed directly in the area of the implant location, which were expressed in the insufficiency and unevenness of the formation of the connective tissue capsule around the synthetic prosthesis [13]. Within 6 months after plastic surgery, with the synthetic material in the "on lay" position, pathological integration of the prosthesis was detected with an almost complete absence of a circular capsule around it. Its basis was granulation tissue intensively infiltrated by

inflammatory cells, most of which are lymphocytes, as well as multiple degranulated mast cells, which forms significant "voids" between the tissues and fibers of the synthetic material (Figure 3b). Collagen fibers forming the circular capsule of the prosthesis had signs of fibrous transformation. Thus, from a morphological point of view, a sign of existing tissue tension in the case of closure of the hernial orifice by local tissues or prosthetic tension methods is chronic aseptic inflammation, which causes the processes of scar remodeling, the formation of "voids" between the fibers of the prosthesis and tissues, reducing the strength of its fixation to the tissues.

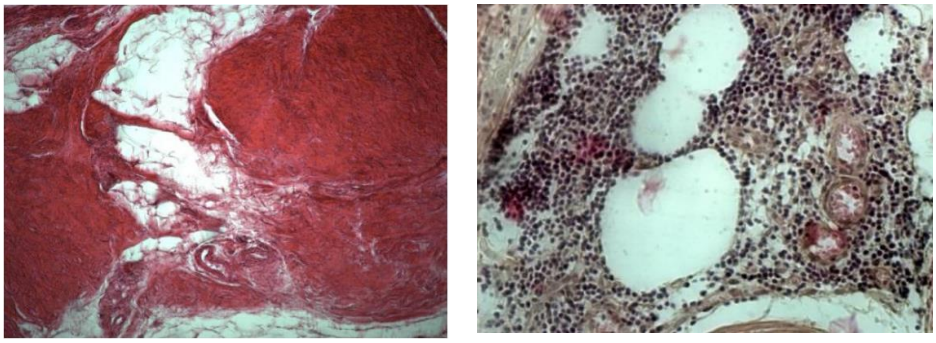

Figure 3. Microscopic Changes in the Tissues of the Relapse Zone In Patients of Groups Ia (A), Ib (B). Hematoxylin And Eosin Staining: A - Lipomatosis of the Scar at the Site of Plastic Surgery With Signs of Edema And Inflammation (Magnification 100); B - Signs of Severe Inflammation Around the Fibers of the Synthetic Polypropylene Prosthesis (Magnification 400).

When performing surgery on patients with recurrent hernias after tension-free prosthetic combined plastic surgery and when dissecting the skin in the subcutaneous tissue, a prosthesis integrated into the tissue was clearly defined, forming the anterior walls of the sheaths of the rectus abdominis muscles in case of median hernias. Regardless of the location (epi-, meso-, hypogastric, as well as anterolateral, lateral), recurrent hernias were localized in 20 patients along the lower, in 4 - along the lower lateral, in 2 - along the upper contour of plastic surgery. Therefore, the hernial orifice along the upper or lower contour was represented by a prosthesis, along the lower and upper - by the aponeurosis of the rectus abdominis muscles, respectively, and the hernial sac was formed by overstretched peritoneum and hypertrophied transverse fascia. In none of the 26 observations was there a prosthesis installed in the hernial sac during the previous surgery. It was not possible to find suture material in the hernial orifice at the site of prosthesis fixation, since absorbable suture material (vicryl or polyglycolide) was used in patients during operations.

The size of the hernia depended on the time of its onset. The longer the period, the larger the size of the hernia, increasing both due to the hernial orifice and the hernial sac. Moreover, the hernial orifice expanded along the lower contour due to stretching and rupture of tissues, from which the prosthesis slipped. This is evidenced by a dense fibrous ring along its lower and lateral contours. Along the upper contour, the hernial ring was represented by the edge of the prosthesis without fibrous tissue growing into it. Clinical observations showed that in patients of group II, relapses developed within 6 months to

1.5 years. Intraoperatively, it was confirmed that all recurrent hernias were incomplete and developed most often along the lower contour of fixation of the prosthesis. Morphological studies of the relapse zones showed that there was a thick capsule of mature connective tissue with fibrous transformation and diffuse focal lipomatosis around the prosthesis. The first "line of interaction" with the fibers of the material were giant cells of foreign bodies with a number of nuclei from 18 to 38 and only in one plane of the histological section. Signs of granulomatous inflammation were present in all observations, but were most pronounced in the areas of fiber interweaving, which caused the presence of a gap of 263+44.5 μm. The relapse zone itself was represented by full-blooded granulation tissue, moderately infiltrated with lymphocytes (Figure 4, 5).

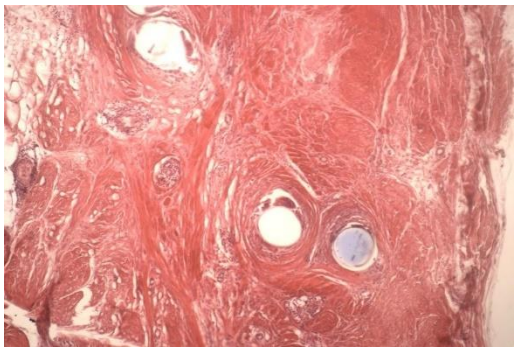

Figure 4. Microphotogram. Tissue Condition in Case Of Recurrent Hernia in the Area of the Synthetic Prosthesis. Patient K. Diagnosis: Postoperative Ventral Hernia MW4R2. Hematoxylin and Eosin Staining. Magnification 100.

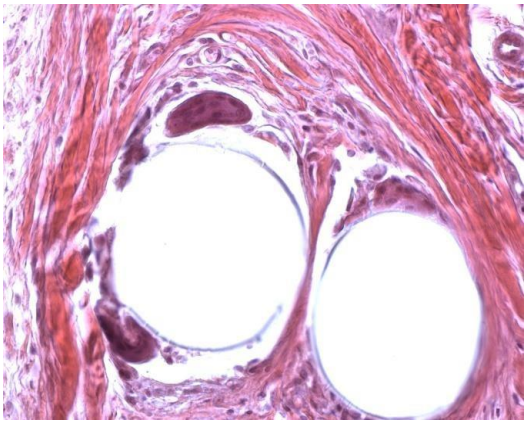

Figure 5. Microphotogram. Fibers of a Polypropylene Prosthesis and Surrounding Granulation Tissue With Giant Cells of Foreign Bodies as Part of a Circular Capsule. Patient L. Diagnosis: Postoperative Ventral Hernia MW3R1. Hematoxylin and Eosin Staining. Magnification: 400.

In areas distant from the recurrence site, the first "cells of interaction" with the fibers of the prosthetic material were numerous giant cells of foreign bodies containing from 16 to 28 nuclei in one plane of the histological section, and the main content of the circular capsules was granulation tissue consisting of numerous newly formed vessels infiltrated with single lymphocytes and macrophages. The thickness of the granulation tissue around the fibers of the prosthesis reached 263+44.5 μm. In histological preparations

obtained from the zone of hernia recurrence, the number of giant cells of foreign bodies was the same as in distant areas, however, the number of nuclei visualized in one plane of the section varied from 20 to 42. Granulation tissue around the fibers of the prosthetic material had signs of pronounced chronic inflammation, the vessels in it were dilated and full-blooded with erythrocyte stasis in them. The thickness of the granulation tissue around the fibers reached 488+38.5 μm.

Granulation tissue around the fibers of the prosthetic material, traumatizing the surrounding tissues, in combination with the reaction on the surface of the implanted material led to the development of voids, the size of which was equal to the thickness of the granulation tissue. In the relapse zone, a violation of the integrity of the general connective tissue capsule around the prosthesis was also determined. In all observations, the resulting defect was filled with granulation tissue with dilated full-blooded vessels and infiltrated with chronic inflammatory cells.

The above changes in the tissues are prerequisites for the prosthesis to slip along the line of its fixation edge to edge in places of greatest tension in the abdominal wall.

RESULTS AND DISCUSSION

Among patients of the first group, prosthetic tension plastic surgery was repeated in 4 patients, after which the disease relapsed in 1 patient (25%). Prosthetic non-tension plastic surgery using improved methods was performed in 48 patients with a relapse in 2 patients (3.8%). In this case, hernioalloplasty "onlay" without suturing the defect with implantation of the endoprosthesis with U-shaped sutures was performed in 30 patients (relapse - 1), hernioalloplasty "onlay + sublay" without suturing the defect by creating a duplicate in 18 patients (relapse - 1).

Table 1. Results in Patients With Recurrent POVH (Group Ib) Depending on the Localization of the Hernia and the Type of Reoperation.

Localization of recurrent hernia	Option for reoperation			
	Prosthetic tension plastic surgery n=4	**Prosthetic non-tension plastic surgery n=52**		
	Hernioalloplasty "onlay" with preliminary suturing of the defect	**Hernioalloplasty "onlay" without suturing the defect with implantation of an endoprosthesis using П-shaped sutures**	**Hernioalloplasty "onlay+sublay" without suturing the defect by creating a duplicate**	**Total**
M	4/1	14	4	18
M1	-	2	-	2
M2	-	4	6/1	10/1
M3	-	6/1	4	10/1
M4	-	4	-	4
ML	-	-	2	2
L	-	-	2	2

Итого	4/1	30/1	18/1	48/2

Note: the denominator indicates the number of hernia recurrences

Table 2. Results in Patients With Recurrent POVH (group Ib) Depending on the Size of the Hernia and the Type of Reoperation.

Localization of recurrent hernia	Option for reoperation			
	Prosthetic tension plastic surgery n=1	Prosthetic non-tension plastic surgery n=24		
	Hernioalloplasty "onlay" with preliminary suturing of the defect	Hernioalloplasty "onlay" without suturing the defect with implantation of an endoprosthesis using П-shaped sutures	Hernioalloplasty "onlay+sublay" without suturing the defect using a combined method	Total
W1	2	2	-	2
W2	2/1	10/1	4	14/1
W3	-	14	8	22
W4	-	4	6/1	10/1
Итого	4/1	30/1	18/1	48/2

Note: the denominator indicates the number of hernia recurrences

Tables 3 and 4 present information on the methods and number of operations performed on patients with recurrent hernias after tension-free prosthetic improved methods of plastic surgery.

Table 3. Results of Treatment of Patients With Recurrent Ventral Hernias (Group II) After Prosthetic Combined Methods of Plastic Surgery Depending on Their Localization.

Method of plastic surgery	Localization of hernia						
	M	M1	M2	M3	ML	L	Total
Hernioalloplasty "onlay" without suturing the defect with implantation of an endoprosthesis using П-shaped sutures	2	6	2	8/1			18/1
Hernioalloplasty "onlay+sublay" without suturing the defect with the creation of a duplicate	2			2	2	2	8
Total	4	6	2	10/1	2	2	26/1

Table 4. Results of Treatment of Patients With Recurrent Ventral Hernias (Group 2) After Prosthetic Combined Methods of Plastic Surgery Depending on Their Size.

Method of plastic surgery	Hernia size				Total
	W1	W2	W3	W4	
Hernioalloplasty "onlay" without suturing the defect with implantation of an endoprosthesis using П-shaped sutures	8	4	6/1	-	18/1
Hernioalloplasty "onlay+sublay" without suturing the defect with the creation of a	2	3	1	2	8

duplicate					
Total	10	7	7/1	2	26/1

Prosthetic tension-free plastic surgery using improved methods was performed in all 26 patients with a relapse in 1 (3.8%) patient. In this case, hernioalloplasty "onlay" without suturing the defect with implantation of an endoprosthesis with U-shaped sutures was performed in 18 patients (relapse - 1), hernioalloplasty "onlay + sublay" without suturing the defect by creating a duplicate in 8 patients.

Analysis of the data in Tables 3 and 4 shows that all patients in Group II with a relapse of hernia underwent repeated tension-free plastic surgery using improved methods according to options 1 and 2. There were no complications in the patients during the operations. Exceptions were patients with recurrent anterolateral hernias suffering from grade 4 obesity.

Clinical and statistical analysis of the results showed that the use of tension-free improved methods of plastic surgery in patients with recurrent ventral hernias after operations, prosthetic tension-free plastic surgery significantly reduces the risk of recurrent relapse of the disease to 3.8%. The results of the study allow us to conclude that in the surgical treatment of postoperative ventral hernias, it is recommended to use improved methods of hernioalloplasty - "on lay" without suturing the defect with implantation of an endoprosthesis with U-shaped sutures (for W1-W2) or "on lay + sub lay" with the creation of a duplicate prosthesis (for W3-W4), which was performed in 56.9% and 19.8% of patients, respectively.

The proposed improved methods of tension-free prosthetic plastic surgery in patients with recurrent ventral hernias made it possible to significantly improve treatment results by reducing the recurrence of the disease from 15% to 3.8%.

CONCLUSION

Fundamental Finding : This study identified that the clinical outcomes of patients with recurrent ventral hernias vary significantly based on the technique used in prior hernioplasties. Complete relapse is more frequent after prosthetic tension hernioplasty, whereas partial relapses are more typical with non-tension prosthetic techniques, manifesting around the edges of the prosthesis fixation and occasionally through damaged areas of the prosthesis. **Implication :** These findings suggest that improved surgical techniques, particularly tension-free approaches, may reduce recurrence rates. Specifically, "on lay" and "on lay + sub lay" methods for different severity levels (W1-W4) show promise in enhancing surgical success by strengthening the prosthetic integration and limiting void formation around synthetic materials. **Limitation :** One limitation of this study is that it focuses on specific hernia repair techniques without extensive long-term follow-up to fully assess recurrence over extended periods. Additionally, variations in patient physiology and previous surgical histories may influence the generalizability of the results. **Future Research :** Future studies should investigate longer-term outcomes and compare these improved methods with emerging minimally invasive techniques.

Research into patient-specific factors that impact hernia recurrence, such as connective tissue integrity and abdominal pressure variations, could also provide valuable insights for personalized surgical interventions.

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