

STATE OF CELLULAR AND HUMORAL IMMUNITY IN EXAMINED PATIENTS WITH POSTOPERATIVE VENTRAL HERNIA

Zuparov K. F., Alimxanov O. O.

Tashkent Pediatric Medical Institute, Uzbekistan, Tashkent, Yunusabad district

Abstract:

It is well known that the majority of synthetic materials currently in use, by virtue of being foreign bodies, tend to sustain an inflammatory response at the surgical site. This is largely attributed to their inadequate biological inertness or suboptimal structural properties, which may further exacerbate tissue reactivity.

The implantation of mesh endoprotheses has been linked to a heightened risk of postoperative purulent-inflammatory wound complications, posing a significant challenge in surgical practice. The prevention and management of both localized and systemic postoperative complications remain complex issues, with reported incidence rates reaching as high as 35%.

Keywords: postoperative ventral hernia, purulent-inflammatory complications, immunogram.

Introduction

Relevance. As a result of surgeries on abdominal organs performed due to various diseases and injuries, postoperative ventral hernia may develop. At the same time, the total number of postoperative ventral hernias is steadily increasing, accounting for 26% of all of hernia carriers [3].

With the increasing number of surgeries for postoperative ventral hernias, these operations are increasingly performed under conditions of pre - existing tissue infection caused by wound complications from previous surgeries, further complicates treatment [1,2].

Despite the high biocompatibility and inertness of modern mesh implants, the rising number of implant-based repairs is paralleled by an increasing incidence of implant-associated complications. This necessitates a deeper investigation into the underlying mechanisms contributing to these adverse outcomes [6,7].

Dysregulation of the immune response may promote chronic inflammation and subsequent tissue damage, which can further exacerbate the course of the disease [5].

From an immunological perspective, the cellular immune response plays a pivotal role in the pathogenesis of postoperative ventral hernia, particularly in the context of infectious complications [4].

A comprehensive understanding of immune system activation mechanisms, including the role of cellular immunity components, is essential for the development of novel diagnostic strategies and optimized therapeutic approaches [3].

Objective: Based on the study of the clinical and immunological characteristics of allohernioplasty in postoperative ventral hernias, to substantiate the significance of immune parameters in the pathogenesis of the disease in order to optimize therapeutic strategies.

Materials and Methods. This study is based on the analysis of clinical and immunological data obtained from the surgical treatment of 137 patients diagnosed with postoperative ventral hernia. All patients underwent inpatient treatment at the clinics affiliated with the Department of Surgical Diseases of the Tashkent Pediatric Medical Institute between 2020 and 2022. To assess the impact of different prosthetic materials on immune response parameters, the patients were stratified into two groups.

Control group (n = 64): Patients in this group underwent hernioplasty using a conventional polypropylene prosthesis (Esfil-Heavy), characterized by its high material density and substantial mechanical strength.

Main group (n = 73): Patients in this group were implanted with a lightweight polypropylene prosthesis (Esfil-Light), designed to reduce foreign body reaction and improve biocompatibility.

To evaluate immune status, a comprehensive analysis of standard immunogram parameters in peripheral blood was conducted, assessing both cellular and humoral immunity components.

For humoral immunity assessment, an enzyme-linked immunosorbent assay (ELISA) was utilized to quantify serum levels of immunoglobulins A (IgA), G (IgG), and M (IgM). This approach allowed for a precise evaluation of immune response variations associated with different prosthetic materials.

The results of this study and their discussion.

To evaluate the intensity of the inflammatory response triggered by the polypropylene implant in the immediate postoperative period, we conducted a cytological analysis of wound exudate collected between postoperative days 3 and 7. The study focused on monitoring the early postoperative course in patients who required drainage tube placement for a duration of 1 to 7 days due to the accumulation of wound exudate, which included serous effusion (seroma), lymphatic leakage (lymphorrhea), and hemorrhagic discharge (Fig. 1). This approach allowed for a detailed assessment of local inflammatory processes associated with different types of polypropylene implants.



Fig.1. View of the surgical area after allogenioplasty: drainage tubes are connected to the system.

The results of cytological examination of wound exudate in dynamic observation are shown in Table 1.

Table 1. Percentage of the main cellular elements in Candtology of wound exudate

Cellular elements	Esfil-heavy (n=64)			Esfil-easy (n=73)		
	2 days	3-4 days	5-7 days	2 days	3-4 days	5-6 days
Granulocytes	55,0±1,8,8	43,0±1,5	39,0±1,3	53,0±1,7	40,0±1,4	35,0±1,2*
Lymphocytes	26,0±0,86	29,0±0,97	27,0±0,89	25,0±0,82	28,0±0,92	26,0±0,85
Macrophages	12,0±0,39	18,0±0,60	20,0±0,66	19,0±0,63***	19,0±0,64	23,0±0,76**
Fibroblasts	3,0±0,10	8,0±0,26	14,0±0,47	9,0±0,30***	9,0±0,29*	16,0±0,52*

Note: * - significantly compared to the control group (*-P<0.05; ** -P<0.01; *** -P<0.001).

A notable finding was that by postoperative day 5, patients in the main group exhibited a less pronounced inflammatory response, as evidenced by a lower granulocyte count in wound exudate. In contrast, the fibroplastic response was significantly more pronounced in this group, with a higher concentration of macrophages and fibroblasts, compared to patients in the control group ($p < 0.05$). This suggests a shift from an acute inflammatory phase to a reparative process at an earlier stage in patients receiving the lightweight prosthetic mesh.

Ultrasound imaging of the wound healing process in both study groups revealed that by postoperative day 3, the inflammatory infiltrate surrounding the prosthetic material was more prominent in patients who received the Esfil-Heavy mesh compared to those implanted with the Esfil-Light mesh. By postoperative day 6, a progressive reduction in inflammatory infiltrate was observed in the main group, whereas in the control group, the inflammatory reaction persisted, indicating prolonged tissue response to the heavier implant.

The postoperative wound complications associated with alloplastic repair included the development of seroma, inflammatory infiltrate, surgical site infection (SSI), hematoma, marginal necrosis of the skin and subcutaneous tissue, and lymphorrhea.

Seroma formation within the residual cavity was diagnosed in 3 patients (4.1%) in the Esfil-Light group and in 8 patients (12.5%) in the Esfil-Heavy group. This complication is predominantly observed following allohernioplasty for giant ventral hernias performed using the onlay technique, where extensive subcutaneous dissection creates a large potential dead space conducive to seroma formation.

Table 2 provides a detailed breakdown of the incidence and structure of local postoperative complications in patients undergoing surgical repair for postoperative ventral hernia.

Table 2. The nature of local complications in patients with ADH in the comparison groups

Type of complication	Main group (n=73)		Control group (n=64)		p
	Abs.	%	Abs	%	
Seroma	3	4,1±2,3,3	8	12,5±4,2	>0,05
Infiltrate	5	6,8±3,0	2	3,1±2,2	>0,05
Postoperative wound suppuration	1	1,4±1,4	2	3,1±2,2	>0,05
Hematoma	1	1,4±1,4	1	1,6±1,6	>0,05
Wound edge necrosis	1	1,4±1,4	-	-	-
Lymphorrhea	--	-	1	1,6±1,6	-
Total patients with complications	7	9,6±3,5	11	17,22±4,8	>0,05
Total patients without complications	62	84,9±4,2	50	78,11±5,2	>0,05

Analysis of relative indicators of cellular immunity revealed a significant decrease in the total number of T cells and their subpopulations. As can be seen from Figure 2, a pronounced deficit was observed in patients with postoperative ventral hernia compared to the control group (42.5±1.2% vs. 56.4±1.9% in the control group, $P<0.01$). A low level of T-lymphocytes is an unfavorable prognostic sign, indicating a decrease in the effector function of T-cells.

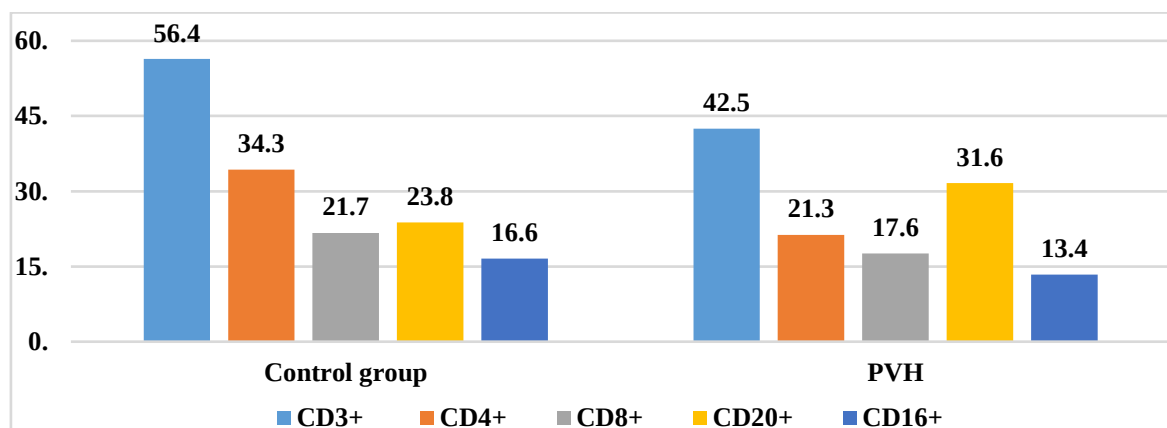


Figure 2. Relative values of T and B immune system parameters in the examined patients.

The humoral link of immunity is represented by the content of CD20+ lymphocytes, as well as the immunoglobulins A, M, and G synthesized by them.

As a control group for immunological studies, we used data obtained during the examination of the health status of residents of Tashkent, Mirzo Ulugbek district, as part of a standard in-depth medical examination (medical examination) in the family polyclinic No. 5. The level of serum immunoglobulins was determined in the blood serum of 20 healthy people of the appropriate age and gender (control group).

The results of the analysis of the blood content of serum immunoglobulins in patients showed an increased IgG synthesis by 1.44 times compared to the control group, a tendency to increase IgA and IdM synthesis (Fig.3).

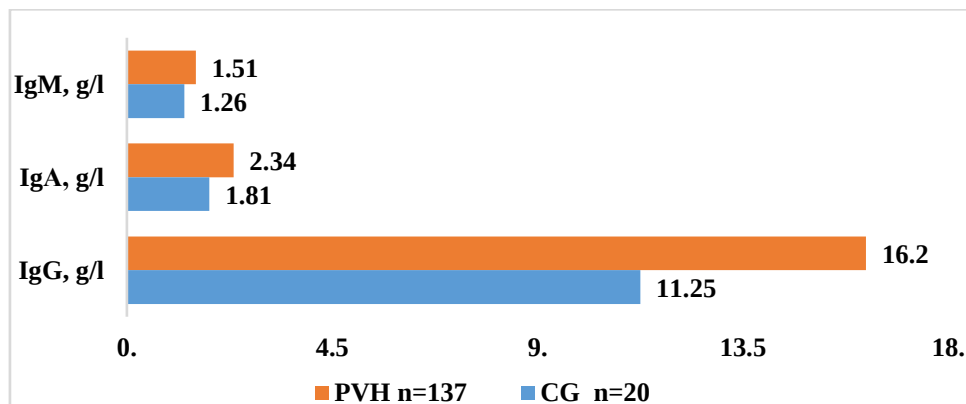


Figure 3. The level of immunoglobulins in the examined patients

Immunological studies have demonstrated that in patients with postoperative ventral hernia, suppression of the T-cell component of the immune system is accompanied by a profound imbalance in the humoral immune response.

For the purpose of comparative immunological analysis, a control group was established using data obtained from a standardized in-depth medical examination (preventive screening) of residents from the Mirzo-Ulugbek district of Tashkent, conducted at Family Polyclinic No. 5. The serum immunoglobulin profile was assessed in a cohort of 20 healthy individuals, carefully matched for age and sex (control group).

The quantitative analysis of serum immunoglobulins in patients diagnosed with postoperative ventral hernia (PVH) demonstrated a 1.44-fold increase in IgG synthesis compared to the control group. Additionally, a trend toward elevated IgA and IgM production was observed, suggesting a systemic immunological shift in response to the underlying pathological process (Fig. 3).

up to 12.6% (p 0.01), and the incidence of surgical site infections (SSIs) increased from 1.5% to 3.2% (p 0.01), indicating the superior biocompatibility of the Esfil-Light polypropylene implant compared to Esfil-Heavy.

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