Features of the Skin and Fascia Structure in Patients with Ventral Hernias

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ABSTRACT

Nowadays ventral hernias still remain the actual problem of abdominal surgery. The disorders of collagen formation and collagen types ratio in the connective tissue play the major role in the pathogenesis of ventral hernias. The peculiarities of collagen structure in the skin and aponeurosis were investigated in 95 patients with and without ventral hernias. All patents were divided in two groups.

The first group included 46 patients, suffering from the anterior abdominal wall hernias, the patients of the second group presented no signs of hernia disease or signs of connective tissue dysplasia.

The specimens of the skin and aponeurosis were taken during planned surgical operations. They were used for the investigation of the quality contents of the connective tissue collagen fibers. The specimens were stained with Sirius Red dye, and investigated with the usage of polarization microscope Altami Polar 2, magnification ×250 и ×400, in ordinary and polarization regimes. Photos of microspecimens were made with digital ocular camera Altami 3 Mpx., there were taken 10 fields of view in each magnification. Analysis of the results was fulfilled with MS Excel program.

The investigation of collagen fibers presented the heterogeneity of their structure. In each bunch of fibers there were found longitudinal fibrillation. The comparison of the results of aponeurosis architecture investigation in patients with anterior abdominal wall pathology revealed that in the control group (patients with ventral hernias) collagen fibers are localized in different directions and plans in 42% of all cases, in 53% the collagen fibers were branching in separate thin fibers, in 63% of the main group patients interfiber spaces are significantly more in sizes in comparison with the aponeurosis architecture in patients of the control group (without ventral hernias). The patients with the hernias of the anterior abdominal wall possess lower index of collagen fibers density and interfiber spaces in the skin in comparison with patients without this pathology.

The collagen fibers of aponeurosis in patients with ventral hernias possess more porous structure. This causes weakness of the anterior abdominal wall and leads to hernia defects formation.

Keywords: ventral hernia, polarization microscopy, collagen.

INTRODUCTION

Surgical treatment of ventral hernias (VH) still remains the actual problem of the modern abdominal surgery. During the last years one can observe the tendency towards the increase in the rate of hernias in general structure of surgical pathology. Technical mistakes can lead to relapse of the disease in 14 – 54% of all cases. Up to 25% of the operations, performed in surgical departments are hernioplastics. Among them 22% are the operations in case of VH, about 35% of them are fulfilled in emergency due to infringement. VH of the anterior abdominal wall is a comparatively frequent pathology, complicating laparotomy in 10-13% [3,4,8,11].

In aging the rate of the middle VH increases, and contributes from 57 to 83% of all post operation anterior abdominal wall hernias. Nowadays the results of VH treatment are not satisfactory, despite using of the new surgical technologies.

It was pointed the considerable role of collagen metabolism in the mature connective tissue formation and in the possible further VH development. The disorders can influence upon the characteristics of the connective tissue, contributing to reparative processes in the focus of hernioplastics, in the postoperation scar formation, and thus to the development and relapse of hernias [5,6,10].

Nowadays there are no exact, approved with scientific research indications for different types of plastics, accounting the grade of the connective tissue dysplasia. Thus it is still actual a choice of the method of different localization hernias treatment.

In surgical treatment of the patients with VH the methods including using of synthetic materials are the most effective. However, despite the results of VH treatment have been improved in case of plastics without intention and with using of synthetic materials, there are certain problems of the synthetic endoprothesis and the method of surgical treatment choice [1,2,7,9].

The purpose of investigation: to reveal the differences of collagen fibers structure in skin and aponeurosis of patients with VH and without VH.

MATERIALS AND METHODS

The research is based on the investigation of the skin and aponeurosis structure in 95 patients, examined and treated from 2010 till 2012 years in clinics of surgical diseases № 1 of Kursk State Medical University based in Kursk Regional hospital.

There were examined 30 males (31,6%) and 65 females (68,4%). The control group (group № 1) presented 46 patients with VH, (group № 2) group of investigation or main group consisted

of 49 patients without VH. The patients of the second group were operated on due to complications of cholelithiasis.

For microscopic examination the pieces of the skin and aponeurosis were taken in planned operations. In the specimens there was examined quality content of the connective tissue collagen fibers. The specimens were stained with Sirius Red and examined by the ordinary light and by the light of polarization with the help of polarization microscope Altami Polar 2, of ×250 and × 400 magnifications.

The comparison of the histological structures was performed with microscope × 400 magnifications, as it helps to visualize all structures the best way. The photos of microspecimens were taken with ocular camera Altami 3 Mpx., there were taken 10 fields of view with microscope different magnification. The statistics of the results was performed with the help of Microsoft Excel-2003 supplements and Statistica 6.0 program.

There were determined quantity index (M), the standard error of mean (m), and standard deviation (σ). The significance of mean differences was estimated with Student index. Correlation analysis was performed with using of ranging correlation Spirman's index. Critical level of significance (p) was 0,05.

RESULTS AND DISCUSSION

The examination of histological specimens of control group patients (without VH), stained with Sirius Red in polarization light (pic. 1, a,b), revealed that bunches of collagen fibers are arranged in several layers, and wavy bunches are parallel to each other. The collagen fibers of bunches go from one layer to another, connecting them.

Architecture of the skin and aponeurosis in patients with VH possesses certain peculiarities (pic. 2, a, b). There is a lot of not properly arranged collagen fibers of different directions and are localized in different planes.

In examination of the collagen fibers and interfiber spaces density in the skin specimens with the help of ImageJ2x program, there were got the following results: in patients of the 1 group the collagen fibers density is 259,4±48,3 pixel/inch; and interfiber spaces density is 178,2±30,4 pixel/inch; In patients of the 2 group (without VH) the collagen fibers density is 362,8±39,7 pixel/inch; and interfiber spaces density is 266,8±51,3 pixel/inch; (table) in equal optic magnification.

In patients with VH the interfiber spaces density is 178,2±30,4, and in patients without VH it is significantly higher - 266,8±51,3 ($p \leq 0,05$) (pic. 3,a).

At the same time in comparison of the collagen fibers density it is revealed that in patients with VH their density is 259,4±48,3, and in patients without VH it is 362,8±39,7. Thus, in patients without VH the collagen fibers density is significantly higher ($p \leq 0,05$) (pic. 3,b).

In investigation of aponeurosis specimens stained with Sirius Red by the light of polarization collagen fibers are of 1 to 2 micrometers in patients of main group (without VH) (pic. 4, a). In patients of the group with VH microscopic examination presents thinning of collagen fibers and widening of interfiber spaces (pic. 4, b).

CONCLUSION

Analysis of the results of the aponeurosis architecture examination in patients with the anterior abdominal wall pathology revealed that in the group of patients with VH in 42% of specimens collagen fibers are of different directions and are localized in different planes. In 53% of specimens collagen fibers are branching into thing fibers of 1-2 micrometers. In 67% of the control group cases the specimens demonstrate wider interfiber spaces in comparison with the architecture of the aponeurosis in the main group (patients without VH). Patients with VH possess less index of collagen fibers density in the skin than the patients without this pathology.

The results of investigation present the significant differences in the architecture of the connective tissue structural elements of the anterior abdominal wall in patients with VH in comparison with patients without VH. These differences are important for understanding of the disorders of the aponeurosis, which provides structural and functional characteristics of the anterior abdominal wall. Thus, it is causative to use preoperation diagnostics with the help of polarization microscopy.

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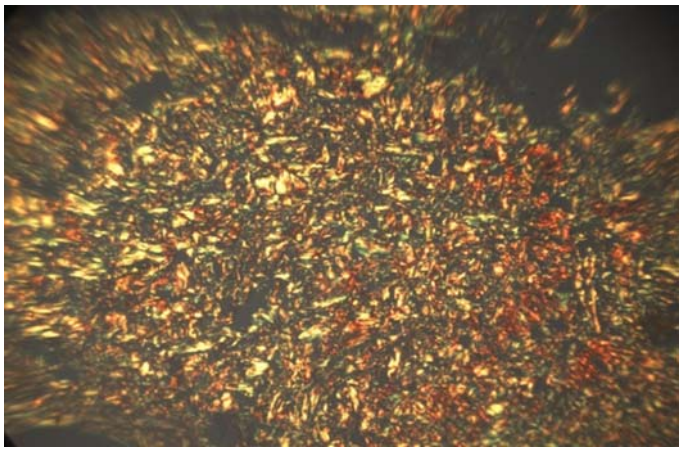


Fig. 1a. Microscopic picture of skin specimen (patient without VH). Sirius Red staining. X 400.

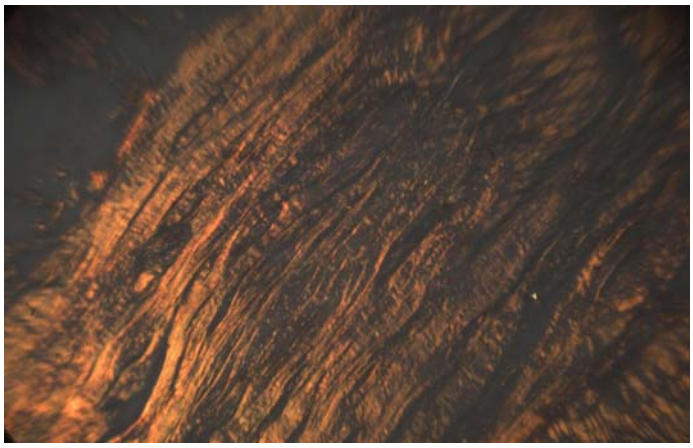


Fig. 1б. Microscopic picture of aponeurosis specimen (patient without VH). Sirius Red staining. X 400.

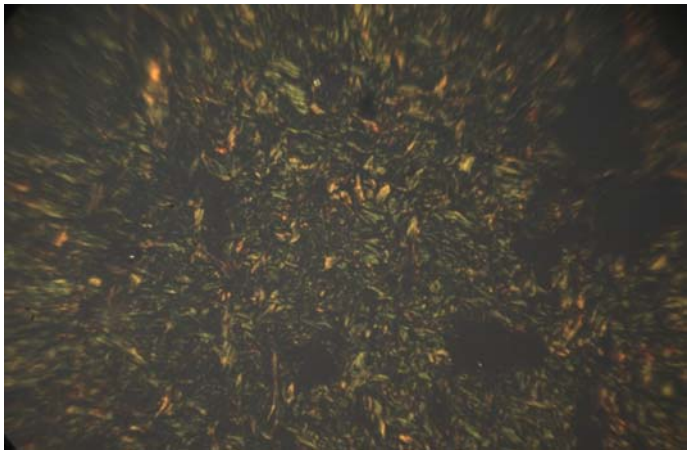


Fig. 2а. Microscopic picture of skin specimen (patient with VH). Sirius Red staining. X 400.

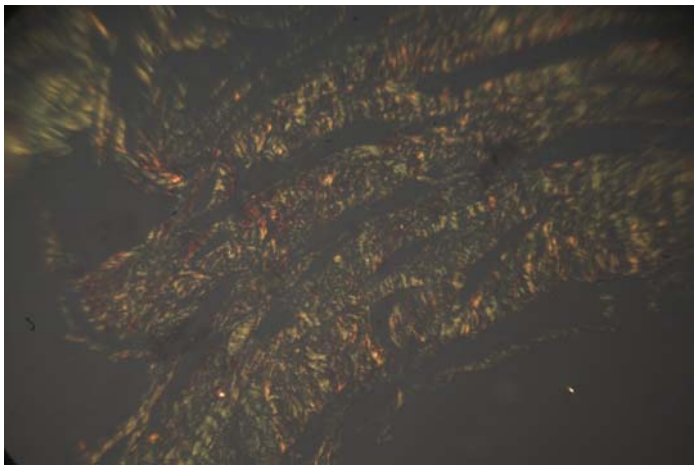


Fig. 2б. Microscopic picture of aponeurosis specimen (patient with VH). Sirius Red staining. X 400.

Table1.

The density of the collagen fibers and interfiber spaces in the skin of patients

Group of patients	density of the collagen fibers (pixel/inch)	density of interfiber spaces (pixel/inch)
1- Patients with VH N = 46	259,4±48,3*	178,2±30,4*
2 – patients without VH N = 49	362,8±39,7*	266,8±51,3*

Note: «*» - the differences are significant, p<0,05.

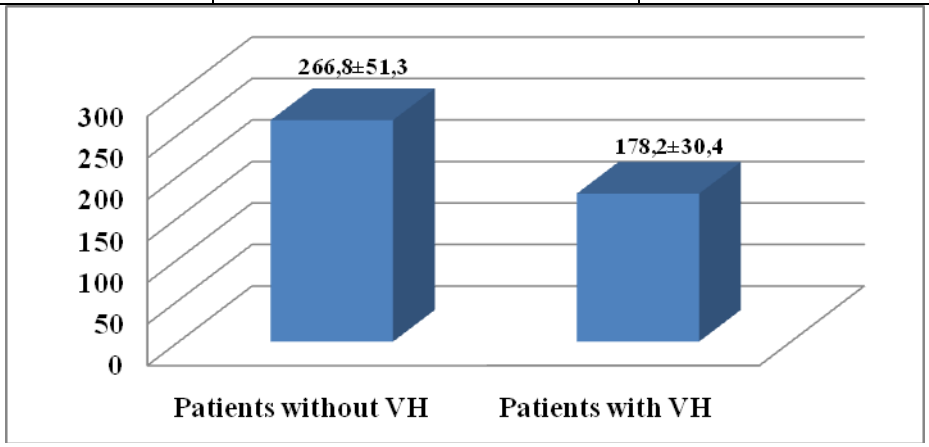


Fig. 3. Density of interfiber spaces in the skin of patients with VH and without VH (pixel / inch).

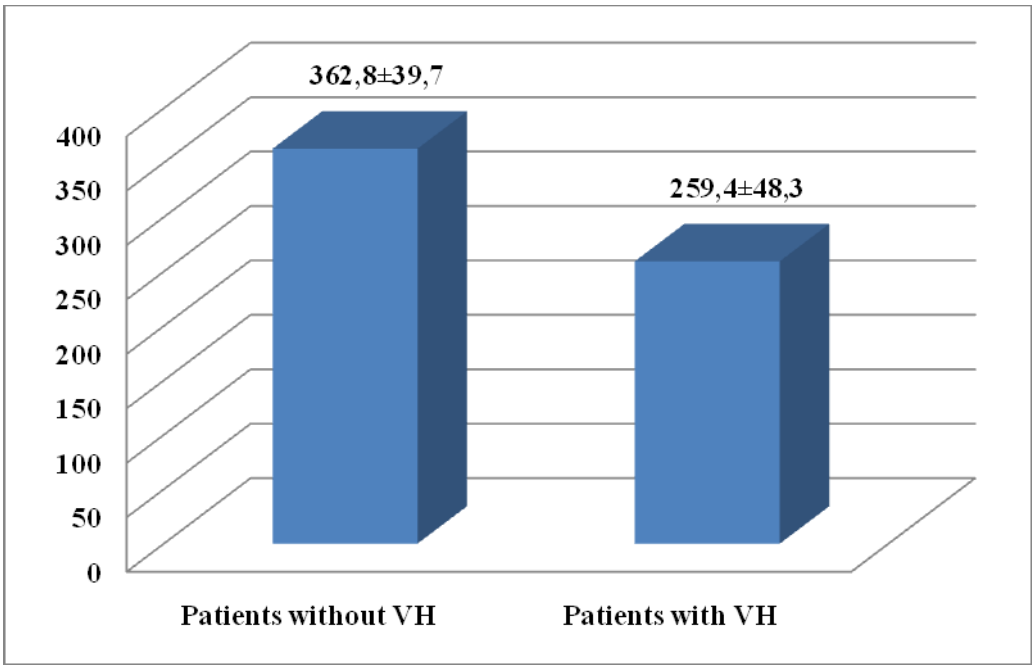
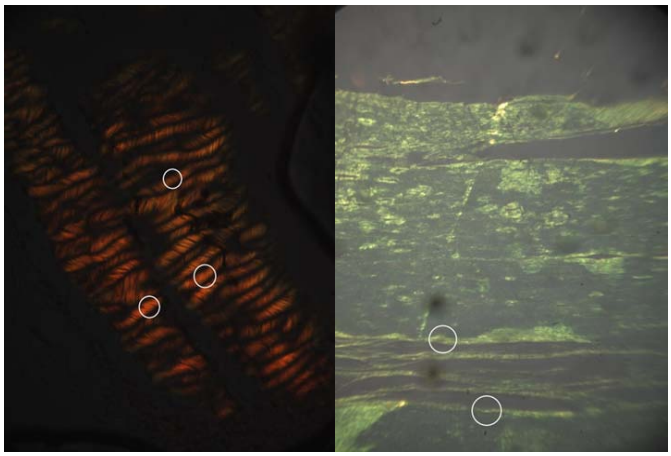


Fig. 4. The density of collagen fibers in the skin of patients with VH and without VH (pixel / inch).



а) б)

Fig. 5. Microscopic picture of aponeurosis specimen. Sirius Red staining. X 400.

а) - main group (patients without VH)

б) - control group (patients with VH)