The character and frequency of postoperative complications are largely determined by the degree of surgical aggressiveness of the operative approach. According to our data, in a series of 423 quite difficult operations in which the median sliding approach was used, complications in the early postoperative period developed in 6 (1.6%) patients undergoing the operation, including hematomas into the wound in 2 (0.5%), suppuration of the wound in 3 (0.7%), and separation of aponeurotic sutures with subcutaneous eventration in 1 (0.2%), and pneumonia in 1 (0.2%). Three of these patients (0.7%) later developed paraumbilical (1) and epigastric (2) hernias. Meanwhile, in a series of 136 operations performed in our clinic for biliary pathology, using oblique and transverse subcostal incisions, three (2.2%) developed pneumonia, five (3.9%) suppuration of the wound, and two (1.5%) eventration, and 17 (12.5%) of these patients developed postoperative hernias.

These experimental and clinical investigations of the use of the median sliding approach in abdominal surgery thus demonstrate its definite advantages over traditional forms of laparotomy, and they enable this approach to be recommended, if suitably indicated, for use in abdominal surgery.

LITERATURE CITED

1. G. A. Bairov, Surgery of the Pancreas in Children [in Russian], Moscow (1978), pp. 38-39.
2. R. I. Venglovskii, Operative Surgery [in Russian], Moscow (1915), pp. 334-338.
3. N. N. Volobuev, Klin. Khir., No. 9, 65 (1981).
4. A. P. Gubaev, Zh. Akush. Zhen. Bol., No. 7-8, 1385 (1910).
5. A. G. Zemlyanoi, Diverticula of the Gastrointestinal Tract [in Russian], Leningrad (1970), pp. 108-110.
6. V. N. Krylov, Akush. Gin., No. 4, 38 (1948).
7. N. A. Telkov, Klin. Khir., No. 3, 16 (1967).
8. A. Yu. Sozon-Yaroshevich, Anatomo-Clinical Bases of Surgical Approaches to the Internal Organs [in Russian], Moscow (1954).

ACCUMULATION OF ABNORMAL GLYCOPOLYMERS IN THE WALL OF THE MAIN LYMPHATICS OF THE HUMAN LIMBS IN CHRONIC LYMPHEDEMA

A. E. Kotyk, D. D. Zerbino, and A. D. Lutsik

UDC 616.132-007.64-007.251-091.8

KEY WORDS: main lymphatics; chronic lymphedema; methods of lectin histochemistry; glycopolymers

The pathogenesis of chronic lymphedema (elephantiasis) and the mechanisms transforming the walls of the main lymphatics (ML), leading to subsequent lymphostasis are still far from being fully understood [1, 2, 7, 11]. To study the etiology, pathogenesis, and morphogenesis of the different forms of pathology of ML in the limbs, biopsy of the vessels during microsurgical operations and lymphography have been used [1, 11, 13]. In lymphostasis marked fibrosis of the wall of ML in the limbs has been found [9, 10, 11, 13]. Despite the fact that some mechanisms of this process have been studied in considerable detail, the histochemical manifestations of injury to the structural components of the wall of ML in lymphostasis have not been completely investigated.

Department of Pathological Anatomy and Department of Histology and Embryology, L'vov Medical Institute.

(Presented by Academician of the Academy of Medical Sciences of the USSR V. V. Kupriyanov.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 111, No. 4, pp. 414-417, April, 1991. Original article submitted February 2, 1990.

0007-4888/91/0004-0534$12.50

TABLE 1. Lectin-Histochemical Characteristics of Main Lymphatics in Normal Individuals and Patients with Chronic Lymphostasis

Lectin	Normal intima	Media	Adventitia	In chronic lymphostasis		
				intima	media	adventitia
LCA	++	+	++	++	+++	++
RCA	+	+	+	+	+	+
PNA	++	+	++	++	+++	++
SBA	++	+—	+	++	+++	+
WGA	++	+	+	++	++	+
LAA	++	+	++	++	++	++

Legend. Intensity of binding of lectins: +—, +, ++, +++ indicate weak, moderate, strong, and very strong interaction.

Research in recent years has shown the use of labeled lectins, to broaden our views on the pathogenetic mechanisms and histochemical manifestations of various nosologic forms in man and animals, to be promising [3, 5, 6, 12, 14]. In particular, it was shown previously that methods of lectin histochemistry can be used to study dystrophic transformation of the wall of the human aorta in Gsell—Erdheim syndrome [3].

The aim of the present investigation was, by using a set of lectins, to describe the comparative histochemical characteristics of the wall of ML in the limbs of normal subjects and patients with chronic lymphostasis, differing in carbohydrate specificity.

EXPERIMENTAL METHOD

Biopsy material was obtained from ML of the human limbs during lymphography and operations of lymphovenous anastomosis in the Department of Microsurgery, All-Union Research Center for Surgery, Academy of Medical Sciences of the USSR, by the method in [2], from patients with primary lymphedema (six cases) aged 15-36 years and patients with secondary lymphedema (five cases), aged 42-71 years. Pieces of unchanged ML obtained at forensic medical investigation of the cadavers of three persons dying suddenly as a result of accidents, served as the control. The material was fixed for 12 h in a 4% solution of neutral formalin and embedded in paraffin wax. Serial sections 7 μ thick were placed on slides and dried in a thermostat at 42°C for 23-48 h. The sections were treated with the following lectins: lentil (LCA, specific for D-mannose), castor oil (RCA) and peanut oil (PNA, both specific for D-galactose), soy (SBA, specific for N-acetyl-D-galactosamine), wheat germ (WGA, specific for N-acetyl-D-glucosamine) and laburnum (LAA, specific for L-fucose). The lectins were purified and conjugated with horseradish peroxidase in the A. V. Palladin Institute of Biochemistry, Academy of Sciences of the Ukrainian SSR. The lectin receptors were visualized by means of a system of diaminobenzidine tetrahydrochloride — hydrogen peroxide, as described previously [4]. The morphology of the wall of ML was studied in preparations stained with hematoxylin and eosin and with Heidenhain's azan.

EXPERIMENTAL RESULTS

The results are summarized in Table 1 and Figs 1 and 2. In chronic lymphedema the histotopography of the receptors of all the lectins used, in the composition of the inner and outer membranes of ML did not differ from that in normal lymphatics. For instance, lentil, peanut, wheat germ, and laburnum lectins exhibited marked affinity for endotheliocytes; all lectins of the set used interacted with glycopolymers in the composition of the subendothelial layer and the collagen fibers of the adventitia (Table 1; Fig. 1a, c; Fig. 2a, c). In the composition of the media of ML, which normally binds the lectins used moderately homogeneously, in primary lymphostasis accumulation of receptors of lentil, soy, peanut, and laburnum lectins was observed around the smooth muscle cells (Fig. 1b, d, e; Fig. 2b, d, e). More marked changes affected the apices of the muscle layers, projecting like ridges into the lumen of the vessel. In particular, when histologic sections were treated with peanut lectin a characteristic wide-looped network was seen in the composition of the media of ML (Fig. 1d, e). Incidentally, accumulation of abnormal glycopolymers in the composition of the media of ML was more marked in the case of primary than of secondary chronic lymphedema.

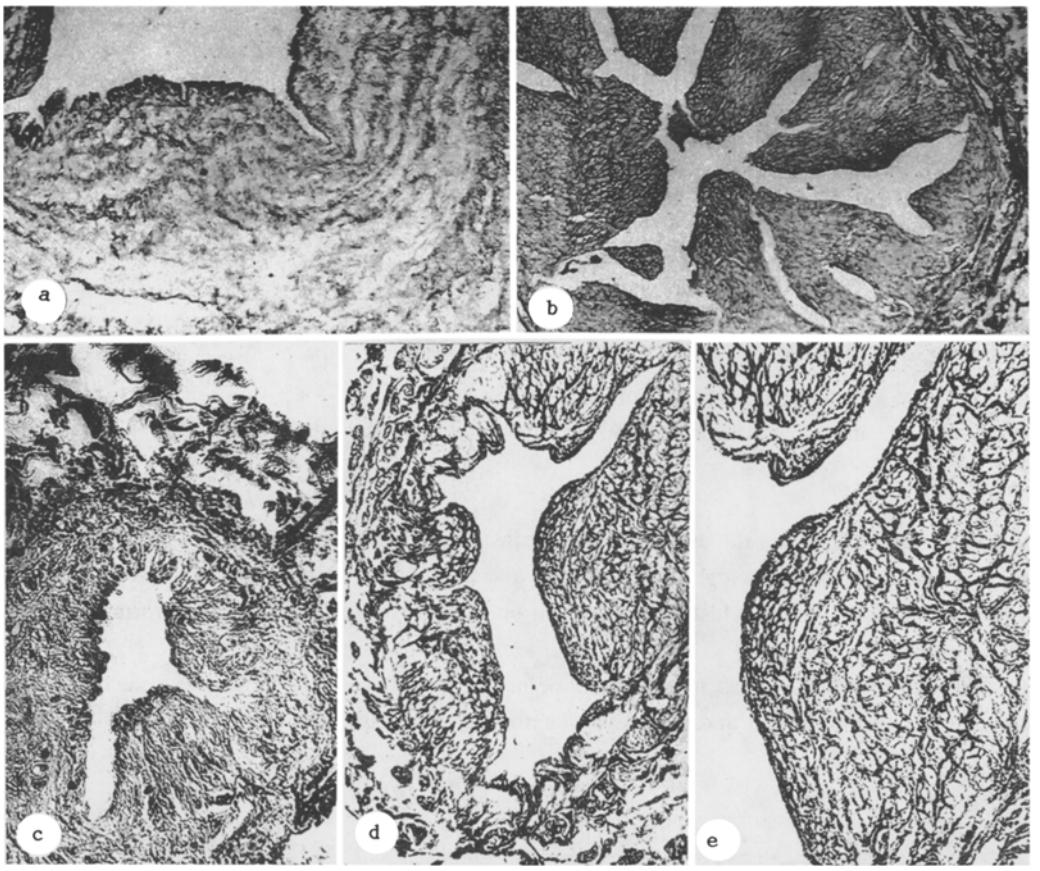

Fig. 1. Receptors of lentil (a, b) and peanut (c, d, e) lectins in composition of wall of ML of human limbs. a) Control. Against the background of are active structures of the lymphatic wall intensive binding of lentil lectin with endotheliocytes can be seen. 63×; b) primary lymphostasis of lower limbs due to hyperplasia of vessels and ganglia, edema more than 10 years in duration. Accumulation of LCA-reactive glycopolymers in media of lymphatics at apices of smooth-muscle bundles, projecting into lumen of vessel. 63×; c) control. Against the background of weak reactivity of the lymphatic wall, endotheliocytes, intensively binding peanut lectins, and collagen fibers of the outer membrane can be seen. 63×; d) primary lymphostasis of lower limbs, edema for more than 20 years. PNA-reactive deposits of abnormal glycopolymers around smooth muscle cells forming a large-looped network. 63×; e) detail of Fig. 1d. 112×.

On the basis of these results we can put forward certain suggestions regarding the pathogenetic mechanisms of development of the changes in ML in chronic lymphostasis. In the opinion of Potashov and co-workers [7], for instance, insufficiency of the lymphatic system in lymphedema is based on structural lesions and functional disorders of the contractile system of the lymphatics — the main factor in lymph drainage. In our view, accumulation of abnormal glycoconjugates in the composition of the media of ML reflects degenerative changes in the smooth muscle cells. This view is in good agreement with data of Potashov and co-workers [7], who found that hypoxia of the smooth muscle cells of the lymphangion in lymphostasis gives rise to considerable changes in their carbohydrate metabolism, manifested as the accumulation of glycogen-containing granules in the cytoplasm. On the other hand, in a study of the morphogenesis of fibrosis of the wall of ML in the limbs in chronic lymphostasis, this process was found to be based on transformation of the smooth muscle cells into fibroblast-like, collagen-synthesizing cells [9, 10, 13]. Smooth muscle cells participate in the transformation of elastic fibers, their strength being due to peripheral filamentous structures of glycoprotein nature [8]. Taking the above facts into consideration, the appearance of receptors of lentil and laburnum lectins around the smooth muscle cells and, in particular, deposition of PNA- and SBA-reactive glycopolymers (considered to be markers of functionally immature cells [5, 6]) can be interpreted as the initial dystrophic changes in the metabolic pool of smooth muscle cells. Another interesting fact is that the accumulation of peanut and soy lectin receptors in the composition of the media of ML correlated with dystrophic changes established by staining with azan.

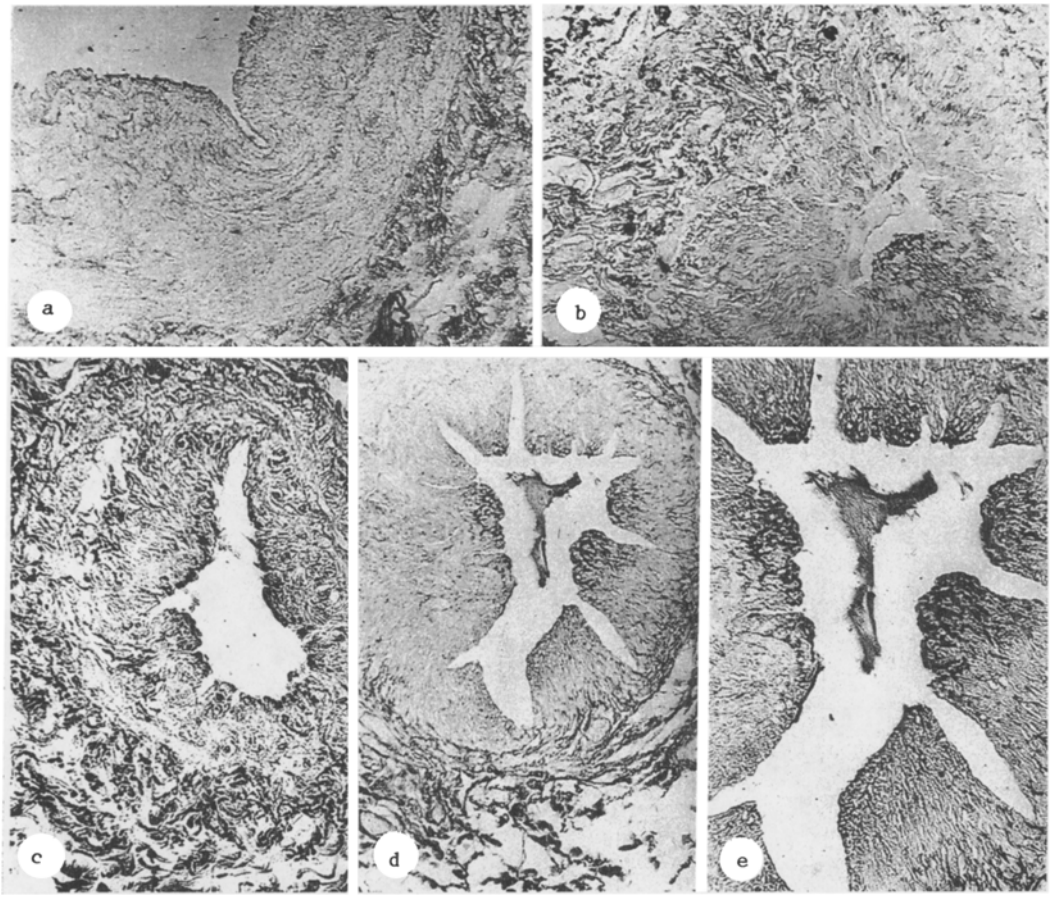

Fig. 2. Histotopography of receptors of soy (a, b) and laburnum (c, d, e) lectins in wall of human lymphatics. a) Control. Intensive binding of soy lectin by endotheliocytes against a background of are activity of surrounding tissue structures. 63×; b) primary lymphostasis of lower limbs, edema about 20 years. Deposition of SBH-reactive glycopolymers in vessel wall. 63×; c) control. Intensive reaction of endotheliocytes, fibrillar structures of media and outer membrane with laburnum lectin. 112×; d) primary lymphostasis of lower limbs due to vascular hyperplasia, and edema for over 10 years. Accumulation of laburnum receptors at apices of smooth-muscle bundles in vessel wall. 63×; e) detail of Fig. 2d. 112×.

We found similar accumulation of PNA-reactive glycopolymers around smooth muscle cells of the media of the aorta in a previous study of the morphogenesis of a dissecting aortic aneurysm in Gsell—Erdheim syndrome [3]. Accumulation of abnormal glycoconjugates, binding peanut, soy, and furze (UEA_1) lectins, was found in pathologically changed tissues in various forms of pathology; most investigators, moreover, associate this phenomenon with defects of carbohydrate biosynthesis (with absence or disturbance of the processes of final glycosylation) in the composition of cell populations involved by the pathological process [5, 6, 12, 14].

Our data show that the redistribution of lectin receptors in the media of ML was more marked in primary than in secondary lymphedema. In our view, despite the different factors playing the role of triggering mechanisms in the development of primary lymphatic insufficiency in the limbs, there is also a kind of genetic predisposition, associated with the possibility of appearance of a defective clone of smooth muscle cells with disturbed synthetic activity. It will be noted, incidentally, that compensatory and adaptive changes take place even if the duration of lymphedema is 10 years or more.

The results demonstrate new histochemical properties of the wall of ML in the limbs in chronic lymphedema and they can be used to study repair processes in the course of combined treatment of lymphedema.

LITERATURE CITED

1. D. D. Zerbino, Khirurgiya, No. 10, 102 (1984).

2. D. D. Zerbino, A. D. Lutsik, A. E. Kotyk, et al., Arkh. Patol., No. 3, 20 (1987).
3. K. Benda, A. F. Cyb, L. Barinka, et al., Lymphedema of the Limbs [in Russian], Prague (1987).
4. A. D. Lutsik, A. M. Yashchenko, E. S. Detyuk, and M. D. Lutsik, Arkh. Anat., No. 8, 27 (1986).
5. A. D. Lutsik, E. S. Detyuk, and M. D. Lutsik, Lectins in Histochemistry [in Russian], L'vov (1989).
6. A. D. Lutsik and D. D. Zerbino, Arkh. Patol., No. 3, 77 (1988).
7. L. V. Potashov, R. S. Orlov, A. V. Borisov, et al., Kardiologiya, No. 3, 63 (1989).
8. V. V. Serov and A. B. Shekhter, Connective Tissue: Functional Morphology and General Pathology [in Russian], Moscow (1981).
9. J. Altorfer and L. Clodius, Ergebn. Angiol., **13**, 51 (1976).
10. J. Altorfer, C. Hedinger, and L. Clodius, Folia Angiol., **25**, 141 (1977).
11. P. Balas, S. Mauromatis, A. Theodosin, et al., Progress In Lymphology, New York (1977), pp. 125-131.
12. N. C. Langkilde, N. Harving, P. Nordgaard, et al., Lectins: Biology, Biochemistry, Clinical Biochemistry, Ed. by D. L. J. Freed and T. C. Bog-Hansen, Vol. 6, St. Louis (1988), pp. 619-623.
13. I. O. Rada and N. Tudose, Lymphology, **19**, 88 (1986).
14. A. Raedler and E. Raedler, J. Cancer Res. Clin. Oncol., **109**, 245 (1985).

CHANGES IN ULTRASTRUCTURE AND ACTOMYOSIN COMPLEX OF CARDIOMYOCYTES IN EXPERIMENTAL HYPERGRAVITATION

M. O. Nikogosova, M. A. Kaifadzhyan, S. B. Barinyan, and A. A. Akopyan

UDC 612.172.014.2+612.173:612.744.17].014.477.063

KEY WORDS: actomyosin complex; ultrastructure; cardiomyocyte; contractile function; hypergravitation

Centripetal acceleration acting on the living organism during ordinary flights and during exploitation of space gives rise to a number of changes in cardiac activity [5]. Morphological and physicochemical changes arising under these circumstances in cardiomyocytes have not been adequately studied [4, 7]. Accordingly, the aim of the investigation described below was to compare the ultrastructure of cardiomyocytes (CMC) with some parameters of contractile function, physicochemical properties, and protein composition of the actomyosin complex of the heart muscle after gravitational overloading and subsequent rest.

EXPERIMENTAL METHOD

Experiments were carried out on noninbred albino rats, male and female, weighing 180-200 g. Hypergravitation was produced by the method described previously [8]. The animals were subjected to acceleration of +5*g* for 15 days, for 25-30 min each day. The rats were killed by decapitation under ether anesthesia next day (Group 1) and 30 days (Group 2) after the last spin. The control consisted of 25 intact animals (Group 3). Pieces of ventricular myocardium for electron-microscopic study were taken from the ventricles of three animals of Group 1 and four animals of Group 2, fixed in buffered OsO_4 solution, dehydrated, and embedded in a mixture of Epon and Araldite. Ultrathin sections, after double staining, were studied in the BS-500 electron microscope. Parameters of contraction of an isolated strip of myocardium (ISM) of the left ventricle of 20 rats from each group were studied as in [3]. Components of the actomyosin complex were identified by electrophoresis in 10% PAG-SDS [12]. To

Laboratory of Pathomorphology, L. A. Oganesyan Institute of Cardiology, Ministry of Health of the Armenian SSR, Erevan. Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 111, No. 4, pp. 417-420, April, 1991. Original article submitted June 22, 1990.

 0007-4888/91/0004-0538$12.50