Institute of Experimental Morphology and Anthropology with Museum
Bulgarian Anatomical Society

Acta morphologica et anthropologica, 13
Sofia • 2008

Morphological Changes in the Smooth Muscle Cells of the Valvular Sinus Wall in Essential Varicosis

*M. Minkov, G. Marinov, V. Knyazhev**

Department of Anatomy, Histology and Embryology
* *Clinic of Vascular Surgery, Prof. Paraskev Stoyanov Medical University, Varna*

The investigations cover the operative material taken from 60 patients aged between 18 and 62 years during the surgical interventions. The electron microscopic data demonstrate that in the valves during the initial stage of valvular cusps' reduction the first and most common alterations in the smooth muscle cells (SMCs) of the valvular sinus wall are established in the mitochondria. They present with a congestion of the mitochondrial matrix, disorganization of the crests and loss of the crest-like structure of the mitochondria. In the morphologically inferior valves presenting with advanced valvular cusps' reduction there exist not only alterations in the mitochondrial complex but also changes related to the degeneration and destruction of the cells.

Key words: vein, valves, varicosis, TEM, smooth muscle cells.

Introducton

Valvular dysfunction is a fundamental reason for venous hypertension and stasis in the superficial venous system of the lower extremities. In case of venous hypertension, the blood pressure that is exerted on the valvular cusp during the valve closure is transmitted not only to the little valvular axle but also to the wall of the valvular sinus. It seems logically to assume that the venous hypertension and the hypoxia would induce early changes in the morphology of SMCs of the valvular sinus wall.

The objective of the present work is to study the morphological changes of the SMCs of the valvular sinus wall of the great saphenous vein (VSM) during the development of the essential varicosis by using of the methods of transmission electron microscopy (TEM).

Material and Methods

The investigations of the venous valvular complex during the development of the essential varicosis of the VSM were performed on an operative material taken from

60 patients age between 18 and 62 years during the surgical interventions. The material was put into a fixer such as 3% or 4% solution of glutaraldehyde in 0,1M phosphate buffer at pH 7,4. The selected regions were processed after a routine procedure for TEM examination. After a careful inspection of the semi-thin sections some representative areas were chosen from which ultra-thin sections were prepared. The sections were observed by using JEM 7A and OPTON transmission electron microscopes.

Results

The electron microscopic data show that in the valves during the initial stage of valvular cusps' reduction, the first and most common changes in the SMCs of the valvular sinus wall are established in the mitochondria. They possess the shape typical of them and are surrounded by an internal and an external membrane that lose their contours at certain places as the spaces limited by them fuse with the intracellular matrix (Fig. 1). The inner space limited by the internal membrane is filled-up with a non-homogenous matrix that, at certain places, demonstrates a high electron microscopic density. The crests typical of this space that are formed by their inner membrane strongly decrease. The greater part of the mitochondria loses their crest-like structure as a few disorganized crests can be established in single mitochondria only. Along with the changes in the ultrastructure of the mitochondria in the SMCs of the valvular sinus wall described above some multivesicular bodies as well as events of alteration of the type of myelin degeneration can be found out (Fig. 2).

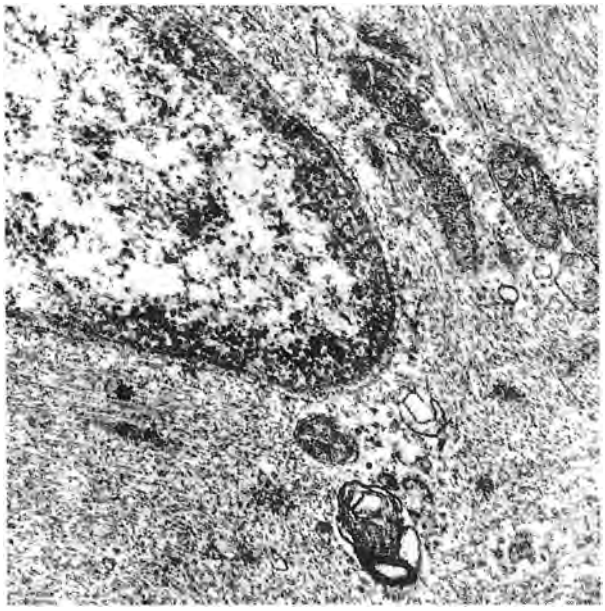

Fig. 1. Valvular sinus wall of a morphologically inferior valve. TEM, × 30 000

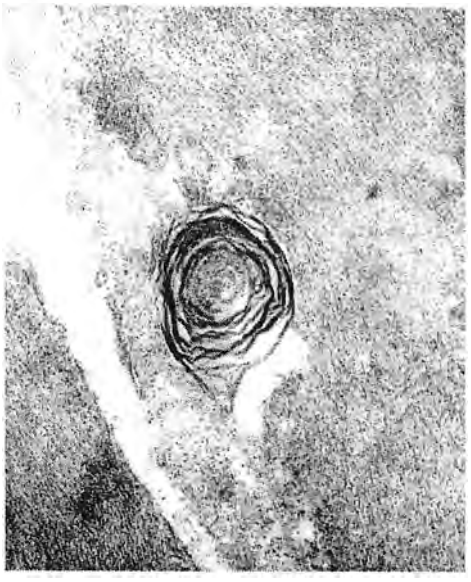

Fig. 2. SMC in the sinus wall of a morphologically inferior valve. TEM, × 30 000

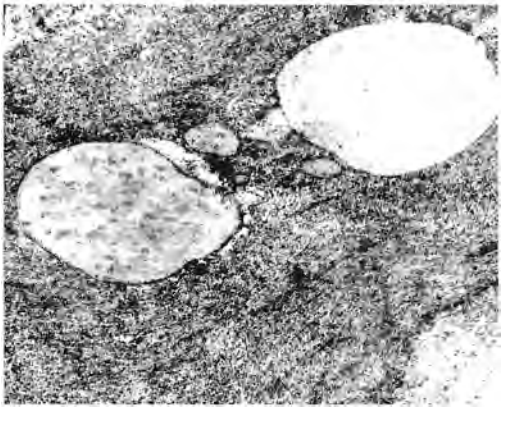

Fig. 3. Morphologically inferior valve presenting with advanced valvular cusps' reduction. Valvular sinus wall. TEM, × 30 000. SMC and vacuoles of different size and content

Along with the progression of the varicose process in the morphologically inferior valves presenting with advanced reduction of the valvular cusps, the SMCs appear to be predominantly alone among an abundant fibrous mass and are united in bundles in rare cases only. In them, one can establish not only alterations in the mitochondrial complex but also changes related to the degeneration and destruction of the cells. One observes vacuoles of different size and content (Fig. 3) as well as sequestration of the regions of SMC destruction.

Discussion

The changes established in the mitochondria of the SMCs of the valvuar sinus wall resemble the analogous findings in the extravalvular regions of the varicose veins already reported by Marinov and Vankov [1]. That is why we accept that the mechanisms of origin of the morphological changes in the SMCs of the valvular sinus wall are, in principle, similar to those that cause varicose changes in the extravalvular areas. In the mitochondria, the metabolism of a series of amino acids, fatty acids and other substances is accomplished in addition to the oxidative phosphorization [7]. The variety of the functional opportunities makes the mitochondria sensitive to the hypoxia of the venous wall.

The enhancement of the tissue compression on the intramural vessels in the venous wall with the valves in advanced stage of valvular cusps' reduction will block the blood circulation in them that, on its part, will increase the hypoxia and the manifestations of degeneration and destruction related to it. Michels et al. [2, 3, 4, 5] and Michels [6] argue that the influence of venotropic drugs on the mitochondrial respiratory chain provides a rational explanation of the therapeutic effects of the drugs of this class. They are capable of increasing the vascular tone and to reduce the capillary permeability. In fact, their targets are the complexes of the mitochondrial respiratory chain, and they preserve the production of ATP during hypoxia.

References

1. Marinov, G., V. Vancov. Early changes of the smooth muscle cells (SMC) and extracellular matrix in the wall of varicose veins. — Verh. Anat. Ges. Anat. Anz., **84**, 1991, Suppl. 168, 99-100.
2. Michiels, C., T. Arnould, D. Janssens, K. Bajou, I. Geron, J. Remacle. Interactions entre les cellules endothéliales et les cellules musculaires lisses apres activation par l'hipoxie. Une étiologie possible de la maladie veineuse. — Phlébologie, **48**, 1995, 141-149.
3. Michiels, C., T. Arnould, D. Janssens, J. Remacle. Importance des cellules endothéliales et de l'hypoxie dans le développement des veines variqueuses: effect de ginkor fort. — Phlébologie, **48**, 1995, 150-154.
4. Michiels, C., J. Remacle, N. Bonaziz. Endothelium and venotropic drugs in chronic venous insufficiency: a review. — Phlebology, **17**, 2002, 145-150.
5. Michiels, C., N. Bonaziz, J. Remacle. Role of the endothelium and blood stasis in the appearance of varicose veins. — Int. Angiol., **21**, 2002, 1-8.
6. Michiels, C. Role of the respiratory activity of vascular endothelial mitochondria in the pathophysiology of CVI. — Phlebolymphology, **39**, 2003, 105-112.
7. Кръстев, Л., И. Вълков, Р. Райчев, Х. Прокопанов. Основи на ултраструктурната патология. София, Медицина и физкултура, 1982. 231 с.