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Transatlantic Intersociety Consensus II for the Management of Peripheral Arterial Disease (TASC II for PAD) – Microscopical Structure of the Femoral Artery (FA)Wall in Patients with PAD

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The progress in medical science in the late 20th century and early 21st century made it necessary to review some of the basic guidelines of TASC for PAD, and published TASC II for PAD. One of the main ideas underlying is that due to the high individual variability of the lower limb arteries, the selection of patients requiring revascularization should be based on the presence of arterial anatomy, suitable for the intended revascularization. The study was performed on biopsies of FA from 81 patients with PAD of lower limb and on necropsies from 9 died without PAD. In patients with PAD the FA wall was remodeling. In the terminal stage of the disease differences in FA wall remodeling between the patient with revascularization and with amputation are determined much more by changes in the thickness and variability of the media than similar changes in the intima.

Key words: TASC for PAD, lower limb arteries, revascularization.

Introduction

PAD of the lower extremities occurs due to the continuous violation of their blood flow of highway arteries. The syndrome occurs mainly in men as compared to their proportion in women – 9:1 [1]. With age the incidence of the syndrome increases affecting 20% of the population of 70 years or more [9]. At the end of the last century, leading experts from Europe and North America created a TASC for PAD [6, 7, 8]. Significant progress in medical science and technology in the late 20th century and early 21st century made it necessary to review some of the guidelines and objectives of this document and published a new TASC II for PAD [4]. One of the main ideas that lie at the heart of the TASC II for PAD is that due to the high individual variability of the lower limb arteries, the selection of patients requiring revascularization should be based on the availability of anatomy of the lower limb arteries, suitable for the intended revascularization. In all studied patients with PAD, the average thickness of the media at the FA is greater than the average thickness of the intima [2, 3, 5]. In this study, the changes in the structure of the FA wall in patients with PAD of the lower limb were examined.

Materials and Methods

The biopsies of FA from 81 patients with PAD of lower limb were studied. The biopsies were taken in University Clinic of Vascular Surgery, St. Anna Hospital, Varna, from patients with PAD II-III or III-IV degree during the reconstruction of the arterial vascular bed, as well as from patients with PAD III-IV or IV degree during the amputation of the gangrened limbs. In all studied patients with PAD, the average thickness of the media at the FA is greater than the average thickness of the intima. As controls, the necropsies of FA taken from 9 cadavers without evidence of vascular disease in the Departments of Forensic Medicine, Pathology and Anatomy, Histology and Embryology, Prof. Dr. P. Stoyanov Medical University – Varna were used. Histological sections 7 μm thick, colored with Hematoxylin-eozin, Orcein, AZAN and by Van Gieson and Mallory methods, were examined using a microscope OLYMPUS BX50 equipped with a video camera Ikegami. Filming of 10-50 images of each vessel studied at different magnifications are then stored in digital form. The study was conducted by following all requirements and standards for the Ethical Treatment of patients and research biopsy and necropsy material.

Results

Thrombus formation in the FA is a multistep process, that is why along with the newly formed thrombi, old thrombi in different stages of organization are identified and incorporated. As a result it was established partial or full restoration of the lumen. In patients with reconstruction accessible area of the lumen is at least 1/3 of the cross-section, while in patients with amputation it is less than 1/5 of the cross-section. In some cases this process may lead to severe thinning of the wall of the FA and/or inability to distinguish the thrombus of the intima and the individual envelopes therebetween. In the thrombus-free areas the endothelial cells are partially preserved (**Fig. 1**), while in patients with amputation they are significantly reduced. In the thrombus-free areas of the FA intimal smooth muscle cells (SMC) are located mainly close to the media. In

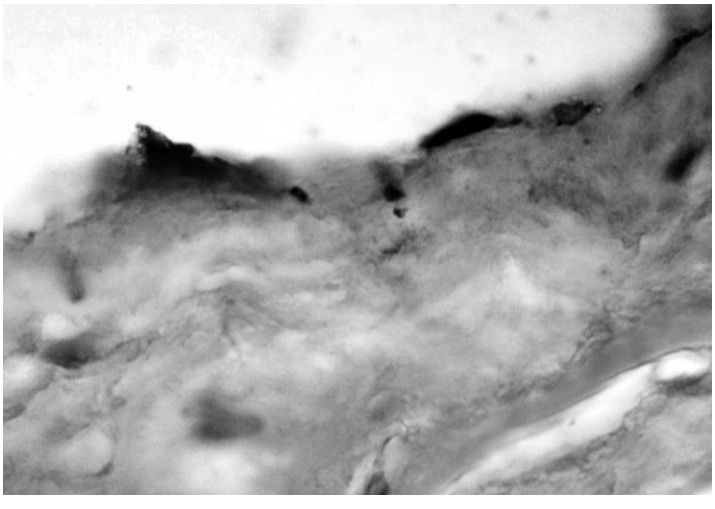


Fig. 1. Microphotographs of the wall of the Femoral artery (FA): luminal surface of FA in PAD preserved Commission. HE × 1000

all studied patients with PAD, the average thickness of the media at the FA is greater than the average thickness of the intima with longitudinal orientation. In patients with amputation their amount is reduced, they are placed more irregularly and can change their longitudinal orientation.

Intimal elastic fibers (EF) of FA in PAD are grouped subendothelially and at the border with the media form Internal elastic lamina (IEL). In thrombotic masses EF are missing. Therefore splitting between IEL establishes zones in which EF are missing. Perhaps these alternating zones are places of thrombi incorporation. Such flakings in IEL of FA in the control group are missing. Collagen fibers (CF) dimensional network formed through the thickness of the intima of the FA.

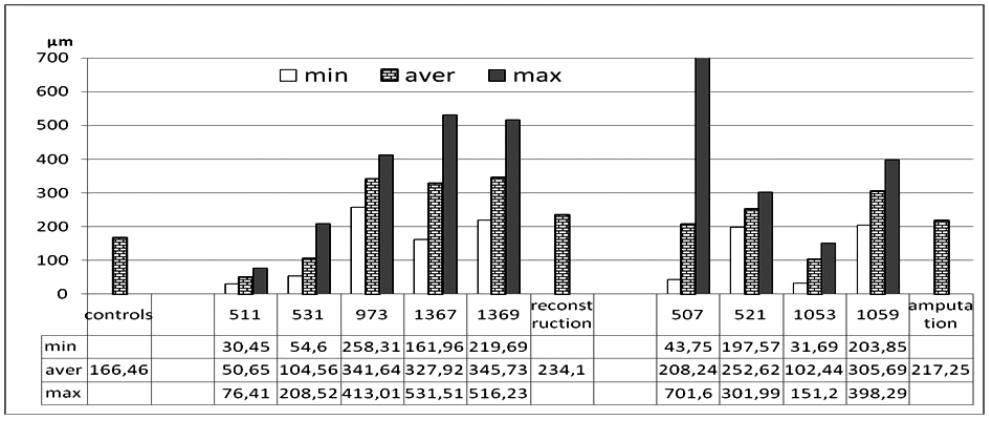
Media showed a significant resistance to the processes of remodeling. It is built mainly from transversally orientated to the longitudinal axis of the vessel SMC. They form a well-developed circular muscle layer, which is not significantly different from that in controls. The extracellular matrix between smooth muscle cells of the media is scarce. EF in uncommitted with organized thrombus wall sections are scarce and are single or rarely grouped in bundles. They do not differ from EF in the media of control arteries. At the boundary between media and adventitia the amount of fiber-like connective tissue structures increases significantly and forms pronounced fibroelastic layer. This layer passes without sharp boundary in the adventitia.

SMC in the adventitia of FA in PAD are not found. EF in this layer are thick, the amount varies, as in the inner tangential to the media areas dominated by longitudinally oriented EF. Adventitia is rich in thick CF organized in large bundles of different diameter (**Fig. 2**).

In PAD sections of the FA are with significant deformation of the wall, so that its thickness was measured only in the areas in which this shell was sufficiently well preserved structure. The points of attachment of blood clots were excluded, as in these sections organizing thrombus deleted boundary between it and the underlying part of the wall, and in some cases, the boundaries between shells. FA intimal increases its

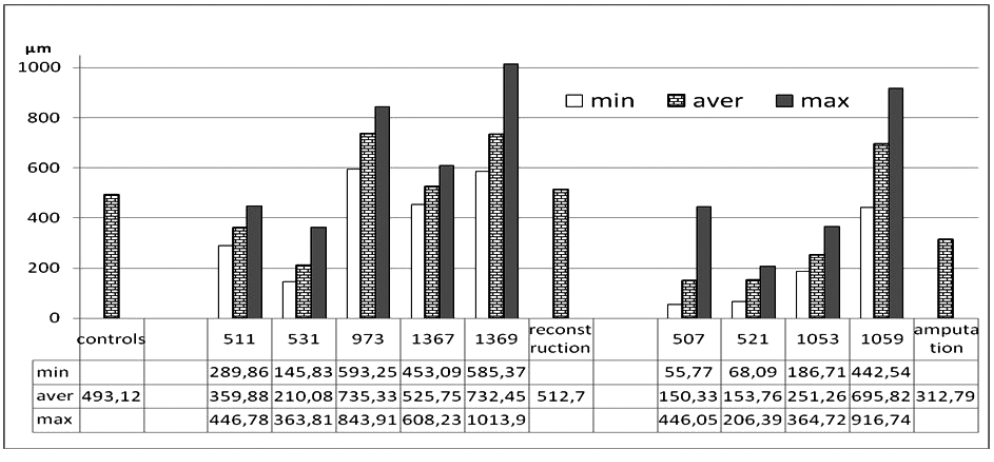
Fig. 2. Microphotographs of the wall of the Femoral artery (FA): EF in the media and adventitia of FA in PAD. Orcein × 400

thickness. Its average thickness in patients with reconstruction exceeds that of the control and is 141% and in those with amputation is 131% against it (**Fig. 3**). FA media initially retains its thickness, but with the progress of PAD it significantly reduces. In patients with reconstruction it is 104% against it. In patients with amputation media is significantly less – 63% against it (**Fig. 4**). The intima/media (I/M) thickness is: reconstruction – 0.44, amputation – 0.97, controls – 0.34.



	controls		511	531	973	1367	1369	reconstruction		507	521	1053	1059	amputation
min			30,45	54,6	258,31	161,96	219,69			43,75	197,57	31,69	203,85	
aver	166,46		50,65	104,56	341,64	327,92	345,73	234,1		208,24	252,62	102,44	305,69	217,25
max			76,41	208,52	413,01	531,51	516,23			701,6	301,99	151,2	398,29	

Fig. 3. Intima thickness in µm



	controls		511	531	973	1367	1369	reconstruction		507	521	1053	1059	amputation
min			289,86	145,83	593,25	453,09	585,37			55,77	68,09	186,71	442,54	
aver	493,12		359,88	210,08	735,33	525,75	732,45	512,7		150,33	153,76	251,26	695,82	312,79
max			446,78	363,81	843,91	608,23	1013,9			446,05	206,39	364,72	916,74	

Fig. 4. Media thickness in µm

Discussion

In patients undergoing surgical treatment for PAD of lower limb, the wall of FA was remodeling. The process progresses with the development of the disease. The results obtained showed that in patients undergoing surgical treatment for PAD of lower limb this process has specific characteristics in terms of both location and specificity, as well as their degree of expression in the various coatings on the wall. Generally, the thickness

of the intima of FA increases with disease progression, while the media back decreases. However, in all studied patients with PAD, the average thickness of the media at the FA is greater than the average thickness of the intima The average thickness of intima in patients with reconstruction exceeds that of control – 141%. In patients with amputation intima less exceeds that of the control – 131%. Media of FA initially retains its thickness, but with the progress of PAD it significantly reduces. In patients with reconstruction it is close to that of the control - 104% against it. In patients with amputation media is significantly less – 63% against it.

In medico-biological and clinical studies evaluating of only absolute terms increases the risk of "distortion" or errors due to age, gender, racial, and other individual characteristics of the patients studied. Technological features associated with the technique and the conditions of taking material, which are also not subject to 100% uniformity and can lead to possible differences in metric reporting. For these reasons, evaluation of metric (quantitative) changes we introduced index expressing the thickness divided by intima/media (I/M) thickness. Index value I/M in patients with major amputation is twice larger than those in patients with reconstruction. In the terminal stage of the disease differences in arterial wall remodeling of FA in PAD between the two patient groups are determined much more by changes in the thickness and variability of the media than similar changes in the intima. Conducted researchs on the microscopic anatomy of the FA in patients with PAD of the lower limb showed significant variability in structural changes in the wall of this artery that must be considered when planning and performing reconstructive surgery in this area.

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