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Prenatal Morphogenesis and Remodelling of the Wall of the Main Arteries of the Leg and Foot

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The age-related remodelling of the walls of the main leg and foot arteries during the prenatal ontogenesis is accomplished according to a common plan. In some arterial wall areas there is an anticipating intimal development.

Key words: leg and foot arteries, fetuses, structure, remodelling.

Introduction

The structure of the walls of lower-limb arteries represents an interest because of the variety and severity of their diseases [6]. However, the age-related remodelling of the arterial wall is very difficult to distinguish from pathological alterations of this wall [2, 3, 8, 10]. The objective of the present work is to study the remodelling of the main leg and foot arteries during prenatal ontogenesis.

Material and Methods

The study covers histo-topographical sections of the leg and foot from 20 lower limbs of 135-388-mm-long fetuses and histological sections at the middle of the main leg and foot arteries from 12 lower limbs of mature stillborn fetuses. The sections were stained with hematoxylin-eosin, orcein, Weigert-Mallori and Van Gieson methods. They were examined on Olympus BX 50 microscope and pictures were taken with Ikegami ICD-840P digital camera.

Results

A. tibialis posterior (ATP), a. tibialis anterior (ATA), a. peronea (AP) and *a. dorsalis pedis (ADP)* are built-up according to a common plan. In 130-140-mm-long fetuses the thin intima is composed by endothelium and homogenous internal elastic membrane (IEM). Endothelium looks relatively higher in the nuclear region than in

adult individuals while the cell nuclei are located closer to each other. The thin media is formed by 2-3 loose rows of smooth muscle cells (SMC). Single elastic fibres (EFs) can be observed in the external half of the media. Spindle-shaped fibroblasts, are located in the adventitia.

With fetus' elongation the arterial structure changes, and diameter and the thickness of the wall increase. Short lamellae entering the internal media region break away in single IEM areas in 256-310-mm-long fetuses (Fig. 1). SMC number in the media increases. The media is clearly distinguished from the adventitia because of the changes of SMC appearance such as elongated, light, with corkscrew-like undulated nuclei that are of larger volume than the nuclei in adults (Fig. 2). Some EFs in the outer media layers are grouped into small lamellae. Initial stages of an external longitudinal fibroelastic layer (FEL) can be observed in the inner adventitial layers. The breaking-away of the short IEM-related lamellae as well as the formation of lamellae in the inner media develops most intensively in the distal third of the leg arteries and in *ADP*, as it is less expressed in their proximal and weakest — in their middle third.

In 365-395-mm-long fetuses, IEM thickens and even doubles in some areas, and some intima parts develop more intensively. Media thickness increases on the account of SMC number. The borderline between the media and adventitia is sharper as SMC nuclei are darker, more flattened and more elongated than these of the adventitial cell populations. The EFs in the internal and middle third of the media disappear. The EFs of the FEL thicken and arrange in denser groups (Fig. 3). The priority development of the above described alterations persists in the distal third of the leg arteries and in *ADP* along with their weaker development in their proximal third and the weakest one in their middle third.

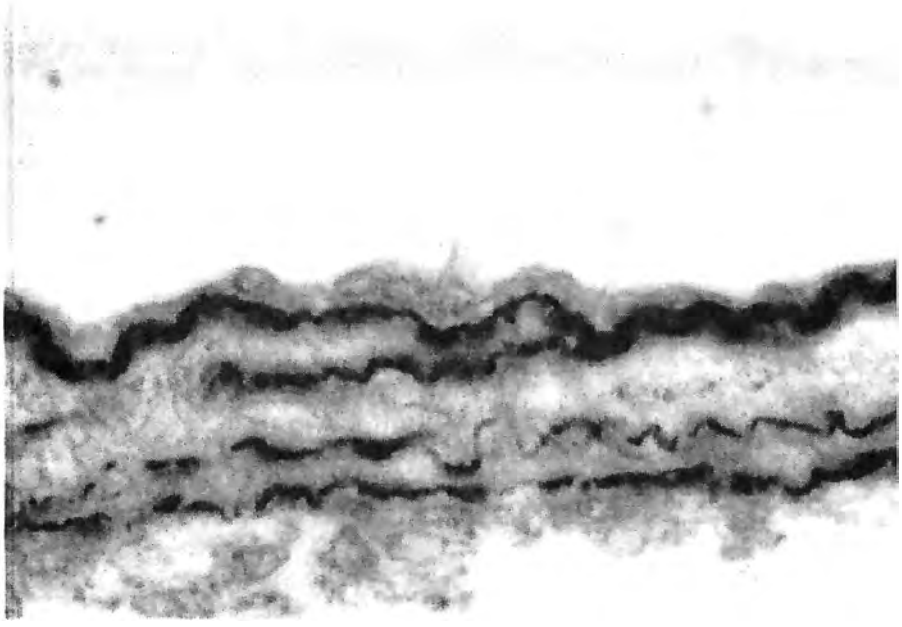

Fig. 1. Transversal section of peroneal artery at the distal third. 257 mm fetus. Orcein. Microphotograph (× 1000)

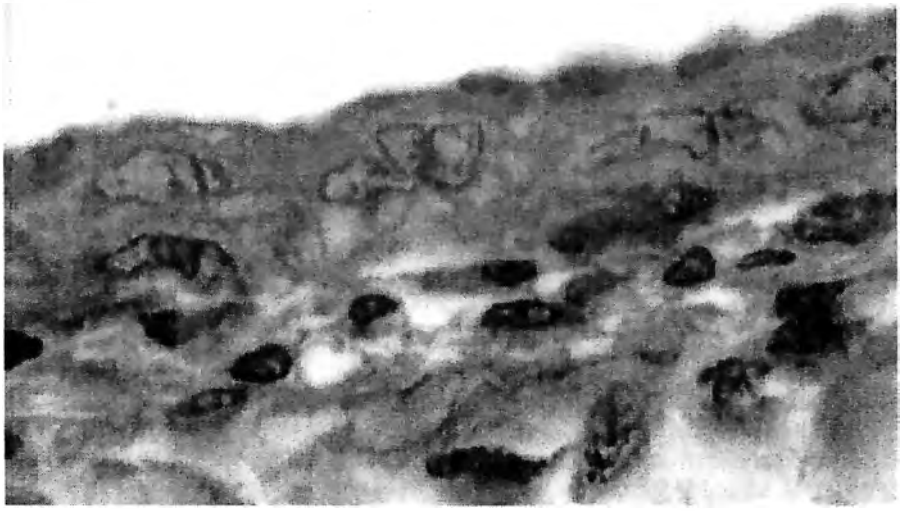

Fig. 2. Transversal section of peroneal artery at the distal third. 257 mm fetus. Hematoixilin-Eosin stain. Microphotograph (× 1000)

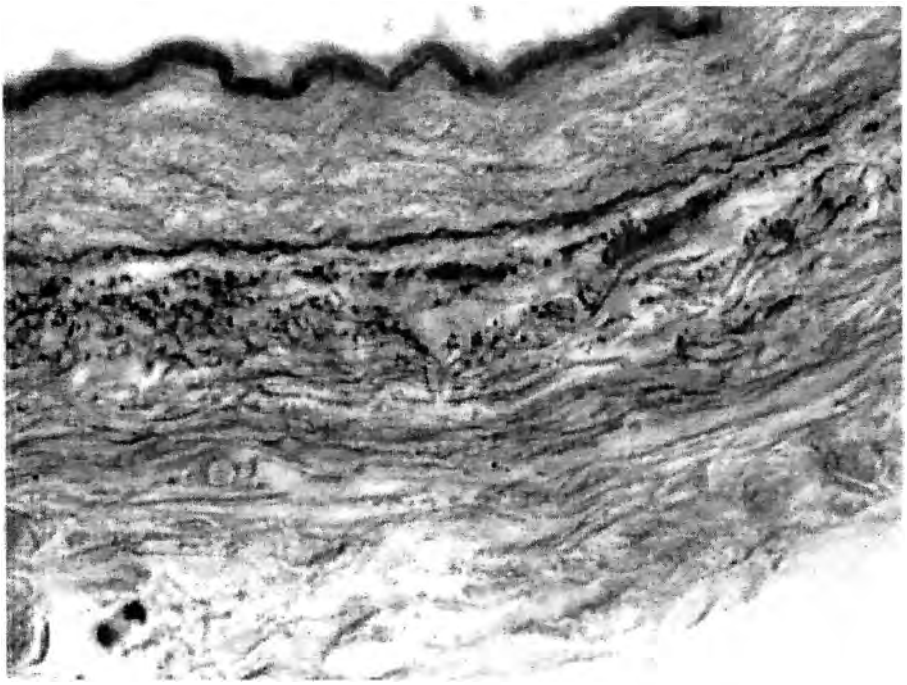

Fig. 3. Transversal section of posterior tibial artery at the middle third. 388 mm fetus. Orcein. Microphotograph (×1000)

In stillborn, IEM is homogenous, dense and thickened. The media muscular layer is thicker and compact. Single circularly oriented EFs are located in its outer half. In the adventitia are clearly differentiated an inner FEL and an outer connective tissue layer rich in collagen fibres. In some areas a continuing anticipating intimal development was established. In certain areas IEM doubles within a small region and a connective tissue layer between both sheets is formed. In these regions intimal thickness reaches up to 8 μm and their extent on the vascular circumference reaches up to 70 μm. In other regions there is incomplete IEM reduplication as from it some lamellae break away and direct themselves either to the endothelium, or to the media.

Discussion

The most essential element of the established in some arterial parts anticipating wall development is the development of a thin subendothelial layer and IEM duplication only in single small fields of the intima. These forms of development can be related to the mechanism of intimal development through migration of cellular elements from the media that has been described in the literature [7]. This process is most intensive in the distal third of the leg arteries and of *ADP*, less expressed in their proximal third and weakest in their middle third. The structural peculiarities of the distal parts of the leg arteries and of *ADP* can be related to the dynamic change of the geometry of these vessels caused by the movements in the knee and leg joints which are, in principle, one of the basic factors for vascular bed remodelling [4]. The possible role of these regions for the earlier started pathogenesis of the atherosclerotic process remains a task of further purposeful research [1, 5, 9].

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