

Histological structure of bovine coronary arteries at varying distance from their origins from the aorta (a preliminary study)

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Abstract

Coronary arteries of three bovine hearts, obtained from animals, aged about 2 years, were studied. Both right and left coronary arteries were dissected out, divided into 10 mm long segments, fixed in formalin and embedded in paraffin. Histological sections were cut in a plane perpendicular to the axis of the vessel and stained, using van Gieson's method; additional staining with resorcin-fuchsin.

We observed a distinct thickening of the tunica media, formed by circular layers of smooth muscle cells and by a small amount of elastic fibres, in the ramus interventricularis subsinu- osus and paraconalis. The tunica media thickenings were situated in the middle segments of the coronary arteries at a distance of about 2-3 cm from its origin in the aorta.

Key words: heart, coronary vessels, tunica media, histology.

Introduction

The mechanisms, which regulate blood flow through the inner organs of animals, and the morphological structures of arteries, which are involved in this regulation, remain unsatisfactorily known in spite of numerous physiological and histological descriptions [1-6]. Thickenings of the tunica media in the arteries of muscular type were described in recent years [7-

11] in limbs of several mammal species. We undertook a microscopic study of the walls of bovine coronary arteries in search for similar morphological specializations, presumably participating in blood flow regulation.

Material and methods

Three bovine hearts were obtained immediately post mortem at the slaughterhouse from cows of the black and white breed, about 2 years of age. Both right and left coronary arteries were dissected. The vessels were divided into successive 10 mm long segments, starting from the origin from the aorta, and fixed in 5% formalin. Next the segments were embedded in paraffin; 8 µm thick histological sections were cut in a plane perpendicular to the axis of the vessel and mounted onto microscopic glasses. They were stained, using van Gieson's trichrome method (for the differentiation between muscle cells and connective tissue fibres). Additional staining with resorcin-fuchsin, according to Weigert (for visualization of elastic fibres), was performed on the same sections. It enabled us to differentiate separate components of the arterial walls (smooth muscle cells, collagen fibres, elastic fibres). We also measured the thickness of the three layers of arterial wall: tunica intima, tunica media and tunica adventia. The measurements were made, using the Microscan V 1×30 computer program with accuracy of 0.001 mm.

Results

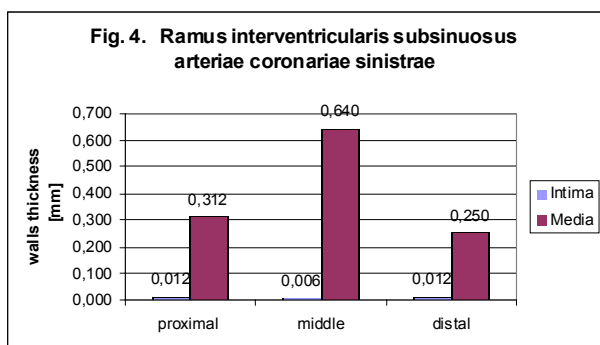
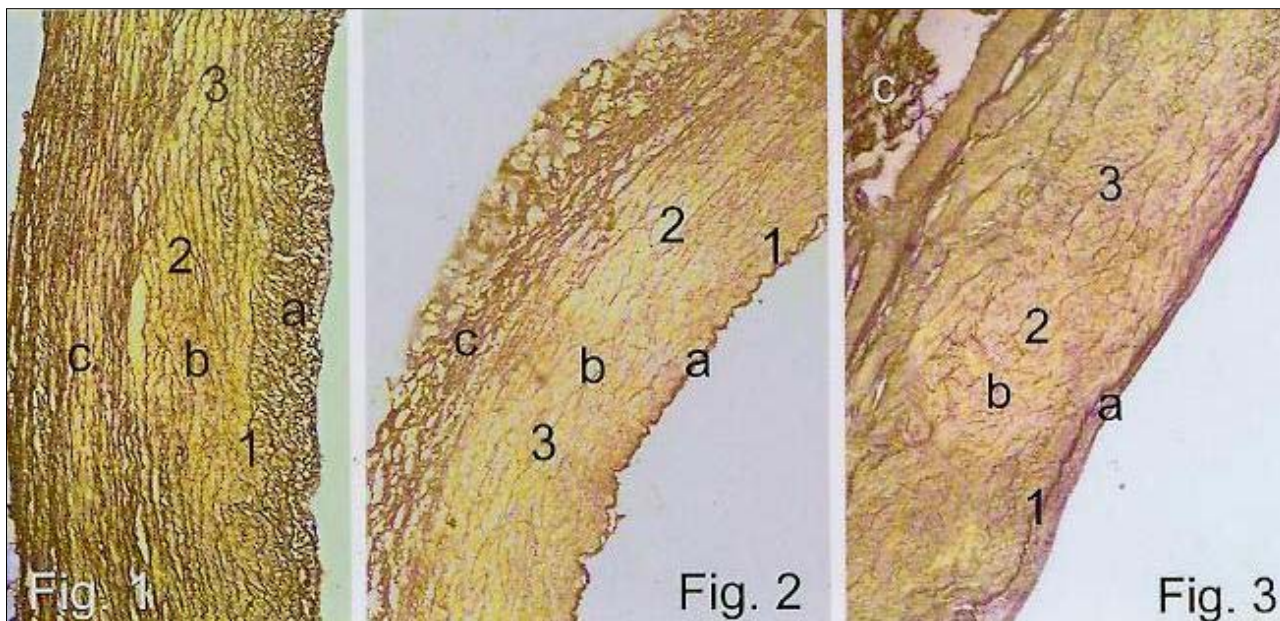
The qualitative morphological characteristics of the coronary arteries, resulting from the specimens, prepared as described above, are given below.

The left coronary artery (arteria coronaria sinistra) has a relatively short trunk which divides into 2 big branches: (a) ramus interventricularis paraconalis, which runs to the heart's tip, and

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Figures 1, 2 and 3. Microphotographs of the histological preparations of the coronary arteries (ramus interventricularis paraconalis of arteria coronaria sinistra), stained by van Gieson's trichrome method and with resorcin?fuchsin. Proximal segment (Fig. 1), middle segment (Fig. 2 and 3). Labels: a-tunica intima, b- tunica media, c- tunica adventitia; 1- elastic tunica intima, 2- circular layers of smooth muscle cells, 3- elastic fibres.



(b) ramus circumflexus, running along the coronary groove; this vessel in cattle passes into ramus interventricularis subsinuus.

The ramus interventricularis paraconalis varies in its structure in different segments. The proximal segment is short and has a thin tunica media, composed of smooth muscle (Fig. 1-b) and of elastic fibres (Fig. 1-3). The middle segment (Fig. 2, 3-b) is situated 2 cm away from the aorta, it is 2-3 cm long and its tunica media gradually increases in thickness (to 0.437 mm); it contains considerably smaller amount of elastic fibres, as compared to the proximal segment. The distal segment of the vessel begins 5 cm away from the beginning of the artery; it is characterized by a gradually decreasing thickness of tunica media (0.375 mm), which is composed of smooth muscle cells and of a subtle network of elastic fibres. Tunica intima is comparatively thick in the proximal segment of the artery, farther on, it undergoes a definite thinning (Fig. 1; 3-a). Tunica adventitia (an external coat) becomes thinner along with the farther run of the artery. The ramus circumflexus has a similar structure of tunica media and its distinct thickening can be observed in the middle segment, between the 2nd and the 5th cm away from the origin of the vessel. The ramus interventricularis subsinuus (a distal branch) in cattle is a continuation of the ramus circumflexus of

the arteria coronaria sinistra. This distal branch has a thin tunica media (0.312 mm) but, at the point of transition into the ramus interventricularis subsinuus, it grows definitely thicker (0.640 mm) and, along its farther course, it gradually becomes again distinctly thinner (0.25 mm) (Fig. 4).

In the right coronary artery (arteria coronaria dextra), the tunica media of the proximal segment is comparatively thin (0.344 mm). In the middle segment, it becomes thicker (0.562 mm) and, in the distal segment, it again becomes thinner.

Discussion The walls of the coronary arteries, as described here, are characterized by thickening of the tunica media in the middle segments. These thickenings are formed by several layers of circular smooth muscle cells and by a network system of elastic fibres. A similar thickening has been described in the arteries of limbs in a number of mammalian species [7-11]. In conditions of psychological stress, a complete closure of these arteries has been observed, what proves the view that "muscle rings" may stop the blood supply to body parts [11]. Our results, reported here, are preliminary ones. It is necessary to study larger material before any final conclusions may be drawn. The preliminary results indicate that "muscle rings" [7-11] are also present in the coronary arteries of cattle. They presumably participate in the regulation of blood supply to myocardium.

Acknowledgments

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