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STRUCTURAL PECULIARITIES OF THE VENOUS WALL BEFORE AND AFTER VALVES IN THE FEMORAL VEIN IN BROILER CHICKENS

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Abstract

The veins transport the blood from the capillaries to the heart and to prevent blood reflux, the veins dispose valves. This study aims to describe the microscopic structure of the femoral vein in broiler chickens, before and after the valves. The right femoral vein was collected from a 10-day-old broiler chicken that was histologically processed by embedding in paraffin and the sections were stained by the Verhoeff-trichrom method. In the case of the femoral vein in broiler chickens, before the valves, the tunica media is made up of smooth muscle cells without being compactly arranged, while the tunica adventitia is predominantly fibrous. In the segment after the valves, the tunica media is more compact than in the segment before the valves and the tunica adventitia is fibro-elastic. At the borderline between the media and the adventitia, there are 3-4 elastic lamellae similar to those in the external elastic lamina of the arterial wall. At the level of the agger, the tunica media is twice as thick as in the segment after the valves. These structural differences of the venous wall are directly related to ensuring changes in the hemodynamic parameters in the phases of the valvular cycle (opening phase, equilibrium phase, closing phase and closed phase).

Key words*: femoral vein, microscopic structure, broiler chickens, valves, Verhoeff-trichrome.*

INTRODUCTION

The venous system transports unidirectionally the blood from the capillary network to the heart (Miclăuș et al., 2017). Veins have a wall consisting of 3 tunics: intima, media and adventitia (Bacha and Bacha, 2000).

The approximate proportion between the three tunics is 5 - 15 - 80%. From a structural point of view, the tunica media of the veins can be muscular, fibrous, musculo-fibrous or musculo-elastic. Generally, tunica adventitia is made of irregular dens connective tissue (Rus, 2021).

Blood reflux in the venous system is prevented due to the existence of valves (Renaudin et al., 1999; Lurieet et al., 2003). The venous valvular system is represented by semilunar folds of the tunica intima.

The valves have two faces: luminalis and parietalis. The area below the valve insertion base on the venous wall is called agger (Caggiati, 2013). The valves present a connective axis covered by the endothelium. The lumen of the veins, in the portion after the valves, is more dilated and is called the sinus (Safir and Lev, 1952). Blood circulation at the level of the valves is divided into 4 phases: opening, equilibrium, closing and the closed phase (Lurie et al., 2006).

The detailed knowledge of the structure of the venous wall represents numerous advantages, especially since in human medicine numerous surgeons use fresh chickens as non-living animal models to practice vascular microanastomosis techniques (Galeano and Zarabini, 2001; Couceiro et al., 2013; Kang et al., 2017). Some authors state that the chickens are preferred to other non-living animal models because the chickens have some great advantages such as: easy storage, convenient disposal, low purchase price, less preparation time and absence of ethics issues (Kim et al., 2013; Kang et al., 2017).

This study aim is to describe the microscopic features of the femoral vein in broiler chickens, before and after the valves.

MATERIALS AND METHODS

The right femoral vein was collected from a 10-day-old broiler chicken during the necropsy. It was fixed in 10% formalin for 5 days. Later, the harvested fragment was included in paraffin and 5 µm thick sections were made. The obtained

sections were stained by the Verhoeff-trichrome method to appreciate both the elastic and collagen components of the venous wall structure on the same section. The microscopic slides were examined with an optical microscope (Olympus BX 41) and photographs were taken (Olympus SC 180). The obtained images were processed with Olympus cell Sens software.

The study was approved by the Bioethics Committee of the University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, no. 453, from 29.05.2024.

RESULTS AND DISCUSSIONS

The right femoral vein, in 10-day-old broiler chickens, is a muscular vein, and the approximate proportion between the 3 tunics is similar to that described in specialized literature. Valves were intercepted on the section (Figure 1A). At the level of the tunica intima, no particular aspect was observed, displaying the typical structure, made of endothelium.

The tunica media consists of circularly arranged smooth muscle cells. Into the tunica media, it can be seen that there are small differences in the segment before (Figure 1B) and after (Figure 1C) the valves, in the sense that the muscle cells are somewhat better represented in the segment after the valves and have a more compact arrangement.

At the level of the tunica adventitia, structural differences were also found. Thus, in the segment before the valves, the tunica adventitia is formed by dense irregular connective tissue in which collagen fibres are the majority, but from place to place, rare elastic fibres can be observed (Figure 1B). In the segment after the valves, the amount of elastin is much higher so that we can affirm the fact that the tunica adventitia is fibro-elastic (Figure 1C).

In the inner third of the tunica adventitia, the amount of elastin is greater than that of collagen. Thus, at the limit between the tunica media and the tunica adventitia, there are 3-4 elastic lamellas similar to those described in the external elastic lamina in the arterial wall. In the middle and outer third of the tunica adventitia, the amount of elastic fibres is slightly higher than in the segment before the valves, but the collagen fibres are the majority.

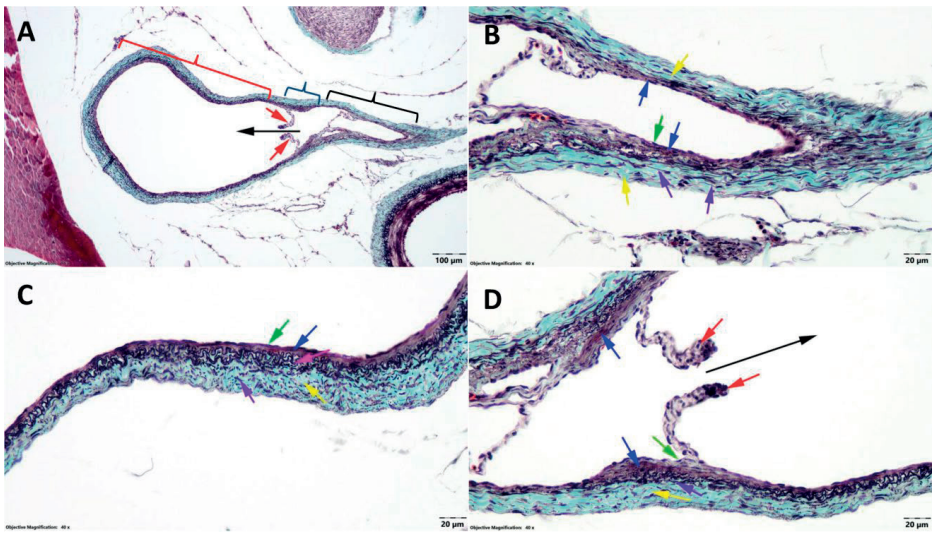

Figure 1. The microscopical appearance of the right femoral vein in 10 days broiler chicken, Verhoeff-trichrome stain; A - general features of the venous wall, black brace - the segment before the valves; blue brace - the agger area; red brace - the segment after the valves; B - details of the venous wall before the valves; C - details of the venous wall after the valves; D - details of the venous wall at the agger area; A, B, C, D - black arrow - the direction of blood flow; red arrow - valves; green arrow - endothelium; blue arrow - tunica media; pink arrow - elastic lamella; yellow arrow - collagen fibres into the tunica adventitia; purple arrow - elastic fibres into the tunica adventitia

In the area of insertion of the valves on the venous wall, which is called agger, the tunica media is significantly thicker (Figure 1D), being almost twice as thick as in the segment after the valves. Due to the fact that in the agger area tunica media it is much thicker, this has the role of preventing the opening of the vein in this region during the closed phase of the valves cycle. The same aspects are also described by Caggiati in humans (2013).

These structural differences of the venous wall before and after the valves seem to be related to the hemodynamic parameters in the 2 segments. Thus, in the segment before the valves, the predominantly fibrous wall prevents the excessive dilation of the veins, so that the occurrence of valvular insufficiency is prevented, respectively the blood reflux during the closed phase of the valves.

Renaudin et al. (1999) claim that valvular deficiency and blood reflux is a consequence of vascular wall distension. Instead, in the segment after the valves, the much more elastic structure of the venous wall allows dilation of the vein at the level of the sinus during the opening and equilibrium phase.

The differences regarding the media in the two segments would be explained by the fact that in the segment after the valves, where the tunica media is more compact and more developed, it would participate in the good functioning of the closing phase, where the contraction of the smooth muscle cells of the tunica media would increase the blood pressure on the mural side of the valves, and valve closure is facilitated. The increase in blood pressure in the mural part of the valves that exceeds the one in the luminal part leads to their closure is also reported by other authors (Lurie et al., 2006).

CONCLUSIONS

In the case of the femoral vein in broiler chickens, before the valves, the tunica media is made up of smooth muscle cells without being compactly arranged, while the tunica adventitia is predominantly fibrous. In the segment after the valves, the tunica media is more compact than in the segment before the valves and the tunica adventitia is fibro-elastic. At the borderline between the tunica media and the tunica adventitia, there are 3-4 elastic lamellae similar to those described into the external elastic lamina of the arterial wall. At the level of the agger, the tunica media it is twice as thick as in the segment after the valves.

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