

Do the femoral veins of female Wistar rats have valves?

Existem válvulas na veia femoral em ratas Wistar?

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Abstract

The femoral veins of 30 female rats of the Wistar lineage were studied using histological methods with the objective of determining whether they have valves. Histological analysis did not detect any endothelial projections or valve recesses that would suggest the presence of venous valves in this species of animal.

Keywords: rats; femoral vein; valves.

Resumo

As veias femorais de 30 ratas da linhagem Wistar foram estudadas por método histológico com objetivo de investigar a presença de válvulas. Na análise histológica não foram identificadas projeções do endotélio ou recessos valvares que poderiam sugerir a presença de válvulas venosas nessa espécie de animal.

Palavras-chave: ratos; veia femoral; válvulas.

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The study was carried out at the Laboratory of Experimental Surgery, Universidade do Estado do Pará (UEPA), Belém, PA, Brazil.

INTRODUCTION

Hieronymous Fabricius Ab Acquapendente discovered the existence of venous valves in 1603^{1,2} and since then these important structures have been studied in the context of blood circulation, in particular with relation to their role in the physiology of venous return, impeding reflux of blood,^{1,3} with particular importance in the large caliber veins of the lower limbs.^{1,2,4} From a histological point of view, valves are paired invaginations of the tunica intima of the veins, creating saliencies into the interior of the vessel.⁵

Venous grafts are widely used in surgical practice to reestablish blood flow in many different specialties and care must be taken to ensure that the graft is implanted in the correct direction, so that the venous valves do not impede blood flow.^{5,6} Nowadays, veins are also grafted to reestablish the continuity of peripheral nerves, in cases of nerve tissue loss, as though they were conduits within which nerve regeneration can proceed.^{7,8} They also play a role in the pathophysiology of diseases such as chronic venous insufficiency^{3,5} and, because of this, experimental animal models employing the femoral vein, the saphenous vein and others are widely employed.^{7,9}

Even in small animals such as rats, primarily of the Wistar lineage, the morphofunctional role played by venous valves in the venous drainage system is recognized. However, it can be observed that reports in the literature on the presence¹⁰⁻¹² or absence of valves^{7,13,14} or providing anatomic details of the valves in the deep and peripheral system veins of female rats are rare and of debatable merit. In smaller quadruped animals, in which the pelvic veins of the limbs are of microscopic diameters, absence of vein valves may be a common occurrence.¹⁵ This study was therefore conducted with the objective of identifying the presence or absence of venous valves in the femoral veins of Wistar female rats.

METHODS

This study was approved by the Animal Research Ethics Committee at the Universidade do Estado do Pará (UEPA), Belém, PA, Brazil. Thirty female rats (*Rattus norvegicus*) of the Wistar lineage weighing 200-240 grams were acquired from the animal house at the university's Experimental Surgery Laboratory. They were housed in temperature humidity controlled conditions and provided with food and water ad libitum throughout the study.

The animals were anesthetized with an intraperitoneal injection of ketamine (70 mg/kg) and xylazine (10 mg/kg). Once adequate anesthesia had been

confirmed, the right inguinal region was dissected and the femoral vein was identified. The vein was carefully dissected and isolated cranially and caudally before being sectioned between single nylon 10-0 monofilament ligatures, maintaining the blood content inside. At this point, analysis of the presence/absence of valves in the femoral vein was conducted with a surgical microscope.

The femoral vein was immediately fixed in 10% buffered formaldehyde, set in paraffin, cleaved with 4 µm longitudinal slices and stained with Hematoxylin and Eosin. A histological analysis with an optical microscope was then conducted to attempt to identify valves along the length of the femoral vein.

The animals were maintained alive for use in microsurgery training by interns at the UEPA Experimental Surgery Laboratory. They were then euthanized with an overdose of intraperitoneal xylazine.

RESULTS

The femoral veins of all of the animals studied were patent and contained large quantities of red blood cells. No endothelial projections or valve recesses compatible with venous valves were identified under the surgical microscope or the optical microscope (Figure 1).

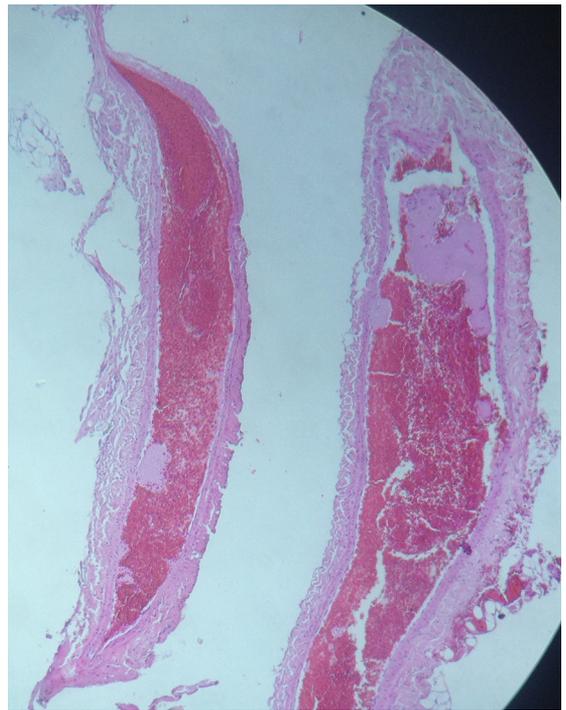


Figure 1. Photomicrograph showing a segment of femoral vein from a female Wistar rat in which no valves or valve recesses were identified.

■ DISCUSSION

Anatomic knowledge is extremely important for reproducing clinical situations in animals for validation of experimental models of diseases and surgical conditions. In humans, the anatomical and physiological notion of venous valves is vital,^{3,5} primarily in cardiac and vascular procedures, given that the flow direction of veins should be carefully respected when fragments of veins are connected into the circulation.^{1,4,8}

The fact that the femoral veins of female Wistar rats do not contain valves could compromise many microsurgery research streams, since experimental models do not reproduce the situation found human beings: the constant presence of valves. Notwithstanding, this should not necessarily affect training in the microsurgical skills of anastomosis and interposition of vein grafts and neurotubes.

A review of the literature did not locate any studies that had analyzed whether venous valves exist in the femoral vein, but several studies suggested that they do exist in Wistar rats, by analogy with the human system.⁷⁻¹⁰ It is speculated that the absence of valves is because of the small dimensions of the animal, since Caggiati et al.¹⁵ state that vessels smaller than 2 mm do not have valves, but it is also possible that there are microvalves that could not be detected using histological methods, and that other methods such as electron microscopy are necessary.

The rat femoral vein is the most commonly used venous graft in microsurgery,⁷⁻⁹ because of its caliber and ease of access and because when removed it does not compromise the limb, since there is a rich system of collateral drainage from the foot. Studies that are designed to analyze the effects of venous valves should therefore seek other models, because this one does not reproduce human anatomy and physiology. Further studies are needed to determine whether other veins in these animals' bodies have valves, including studies employing electron microscopy.

In summary, on the basis of the methodology used in this study, the authors conclude that no valves were found in segments of femoral veins from female Wistar rats.

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