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MORPHOMETRIC ANALYSIS OF HEPATIC MICROCIRCULATORY STRUCTURES IN 3- AND 9-MONTH-OLD ALBINO RATS

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ABSTRACT. This study presents a detailed morphometric analysis of hepatic microcirculation and parenchymal structures in 3-month-old and 9-month-old albino rats. The study focused on the size, shape, and distribution of hepatocytes, nuclei, sinusoidal capillaries, and major blood vessels within the liver. The results provide insights into the normal morphology and architecture of hepatic structures, contributing to the understanding of liver physiology in this animal model. The findings also highlight age-related differences in the hepatic microcirculation and structural integrity of the liver.

Keywords: Hepatocytes, Sinusoidal Capillaries, Liver Artery, Portal Vein, Central Vein, Microcirculation, Morphometry, Albino Rats.

МОРФОМЕТРИЧЕСКИЙ АНАЛИЗ МИКРОЦИРКУЛЯТОРНЫХ СТРУКТУР ПЕЧЕНИ У 3-Х И 9-ЛЕТНИХ АЛЬБИНОСОВ

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АННОТАЦИЯ. Данное исследование представляет собой детальный морфометрический анализ микроциркуляции и паренхиматозных структур печени у 3-месячных и 9-месячных альбиносов. В работе особое внимание уделено размерам, форме и распределению гепатоцитов, ядер, синусоидальных капилляров и основных кровеносных сосудов печени. Результаты предоставляют представление о нормальной морфологии и архитектуре печеночных структур, способствуя лучшему пониманию физиологии печени в этой животной модели. Также, в работе подчеркиваются возрастные различия в микроциркуляции печени и ее структурной целостности.

Ключевые слова: Гепатоциты, синусоидальные капилляры, печеночная артерия, порталенная вена, центральная вена, микроциркуляция, морфометрия, альбиносы.

Introduction. The liver is a vital organ responsible for multiple functions, including detoxification, metabolism, and synthesis of essential proteins. Understanding the microcirculatory structures within the liver is crucial for investigating hepatic function, especially in animal models. The architecture of the hepatic lobule is formed by a network of sinusoids, central veins, and arterial and venous vessels that facilitate efficient blood circulation and exchange of metabolic products.

In this study, we aimed to examine the morphometric characteristics of hepatocytes, nuclei, sinusoidal capillaries, and major blood vessels in the liver of 3-month-old and 9-month-old albino rats. We utilized a combination of histological analysis and morphometric techniques to quantify and compare the dimensions and distribution of these structures in two distinct age groups.

Materials and Methods. Animals:

A total of 20 albino rats were used in this study. The rats were divided into two age groups: 10 rats aged 3 months (young) and 10 rats aged 9 months (adult).

Tissue Preparation: Liver samples were collected from each animal under general anesthesia. The samples were fixed in 10% formalin and embedded in paraffin. Serial sections (5 µm thick) were prepared and stained using Hematoxylin and Eosin (H&E) for general histological examination.

Morphometric Measurements: The following parameters were measured using a light microscope (×1000 magnification) and image analysis software:

* Hepatocyte count per square millimeter (mm^2).
* Nucleus count per square millimeter (mm^2).
* Diameter of hepatic artery, portal vein, central vein, and capillaries.
* Diameter of sinusoidal capillaries.

Statistical Analysis:

All data were expressed as mean ± standard deviation (M±m). Statistical differences between the two age groups were analyzed using Student's t-test. A p-value of <0.05 was considered statistically significant.

Results. Hepatocyte and Nucleus Morphology: The average number of hepatocytes in 1 mm^2 of liver tissue was 5.33 ± 2.13 for both age groups. Hepatocytes exhibited a cuboidal or polygonal shape, with centrally located nuclei. Nuclei were either mononuclear or binucleate. The average number of nuclei per square millimeter was found to be 5.13 ± 2.44 in both the 3-month and 9-month-old rats.

Diameter of Hepatic Vessels: The diameter of the hepatic artery was measured at 101.42 ± 28.1 µm, and the portal vein had a diameter of 198.73 ± 8.4 µm. The bile duct capillaries exhibited a diameter of 19.0 ± 4.50 µm. The central vein, located at the center of the hepatic lobule, had an average diameter of 54.0 ± 0.86 µm.

Sinusoidal Capillaries: The sinusoidal capillaries, which play a crucial role in blood flow and nutrient exchange, exhibited an average diameter of 10.2 ± 2.25 µm. These capillaries maintained their normal morphology in both young and adult rats, ensuring proper blood circulation within the liver parenchyma.

Age-Related Differences: No significant differences were observed between the 3-month-old and 9-month-old groups in terms of the size or shape of the hepatocytes, nuclei, or blood vessels. However, a tendency towards slight variation in the diameter of the sinusoidal capillaries and portal vein was noted, possibly indicating subtle changes in the microcirculation associated with aging.

Discussion. This study provides valuable data on the normal morphological characteristics of the liver microcirculation in albino rats. Hepatocytes and

sinusoidal capillaries exhibited normal shape and distribution, which is consistent with the liver's role in maintaining effective metabolic processes and blood filtration.

The measurements of the hepatic arteries, portal veins, and bile duct capillaries offer insights into the structural integrity of these vessels and their role in nutrient and waste exchange. Despite the natural aging process, the liver's microcirculatory system remains functional in both the 3-month and 9-month-old rats, with only minor variations observed in the blood vessel diameters, which could be attributed to normal physiological aging.

Interestingly, the study highlights the well-maintained morphological features of hepatocytes and liver architecture in the albino rat model, supporting the utility of this species in liver research.

Conclusion. The hepatic microcirculatory structures, including hepatocytes, nuclei, and blood vessels, display consistent morphological characteristics in both 3-month-old and 9-month-old albino rats. The data presented here serve as a valuable reference for future studies investigating liver function and pathology in rodent models, particularly in aging and disease-related research.

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