

AGE-RELATED MORPHOMETRIC CHANGES IN THE UTERUS FOLLOWING EXPERIMENTAL LIVER INJURY

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ABSTRACT

The aim of this study was to investigate age-related morphometric changes in the uterus of female albino rats following experimental liver injury. The study included 3- and 9-month-old animals. Hepatic injury was induced by a single subcutaneous administration of heliotrine at a dose of 25 mg/100 g body weight. Uterine tissues were examined histologically, and morphometric parameters were evaluated using QuPath 0.5.1 software. In intact animals, most uterine parameters increased with age. Total uterine wall thickness was 950 ± 18 μm in 3-month-old rats and 1045 ± 20 μm in 9-month-old rats. After liver injury, these values decreased to 875 ± 17 and 925 ± 19 μm , respectively. Endometrial thickness decreased from 181 ± 4 to 158 ± 4 μm in younger animals and from 202 ± 5 to 171 ± 4 μm in older animals. Uterine gland diameter decreased from 27.4 ± 0.7 to 23.8 ± 0.6 μm and from 30.4 ± 0.8 to 25.7 ± 0.7 μm , respectively. Gland density decreased from 21.3 ± 0.8 to 17.6 ± 0.7 glands/ mm^2 in 3-month-old rats and from 19.8 ± 0.7 to 15.2 ± 0.6 glands/ mm^2 in 9-month-old rats. In contrast, vascular diameter increased from 40.6 ± 1.1 to 46.8 ± 1.2 μm and from 45.3 ± 1.2 to 53.6 ± 1.4 μm , respectively. The observed alterations were more pronounced in 9-month-old animals, indicating an age-dependent response of uterine tissues to experimental liver injury.

Keywords: uterus, liver injury, morphometry, female albino rats, endometrium, uterine glands, blood vessels, age-related changes, heliotrine.

**ВОЗРАСТНЫЕ МОРФОМЕТРИЧЕСКИЕ ИЗМЕНЕНИЯ МАТКИ
ПОСЛЕ ЭКСПЕРИМЕНТАЛЬНОГО ПОВРЕЖДЕНИЯ ПЕЧЕНИ**

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АБСТРАКТ

Целью настоящего исследования явилось изучение возрастных морфометрических изменений матки у самок белых крыс после экспериментального повреждения печени. В исследование были включены животные в возрасте 3 и 9 месяцев. Повреждение печени моделировали однократным подкожным введением гелиотрина в дозе 25 мг/100 г массы тела. Ткани матки исследовали гистологически, а морфометрические показатели оценивали с использованием программы QuPath 0.5.1. У интактных животных большинство морфометрических параметров матки увеличивалось с возрастом. Толщина стенки матки у 3-месячных крыс составляла 950 ± 18 мкм, а у 9-месячных — 1045 ± 20 мкм. После повреждения печени данный показатель снижался соответственно до 875 ± 17 и 925 ± 19 мкм. Толщина эндометрия уменьшалась с 181 ± 4 до 158 ± 4 мкм у молодых животных и с 202 ± 5 до 171 ± 4 мкм у 9-месячных крыс. Диаметр маточных желез снижался с $27,4 \pm 0,7$ до $23,8 \pm 0,6$ мкм и с $30,4 \pm 0,8$ до $25,7 \pm 0,7$ мкм соответственно. Плотность желез уменьшалась с $21,3 \pm 0,8$ до $17,6 \pm 0,7$ желез/мм² у 3-месячных животных и с $19,8 \pm 0,7$ до $15,2 \pm 0,6$ желез/мм² у 9-месячных. Одновременно отмечалось увеличение диаметра сосудов с $40,6 \pm 1,1$ до $46,8 \pm 1,2$ мкм и с $45,3 \pm 1,2$ до $53,6 \pm 1,4$ мкм соответственно. Выявленные изменения были более выражены у 9-месячных животных, что свидетельствует о возрастной зависимости реакции тканей матки на экспериментальное повреждение печени.

Ключевые слова: матка, повреждение печени, морфометрия, белые крысы, эндометрий, маточные железы, кровеносные сосуды, возрастные изменения, гелиотрин.

**EKSPERIMENTAL JIGAR SHIKASTLANISHIDAN KEYIN
BACHADONNING YOSHGA BOG‘LIQ MORFOMETRIK
O‘ZGARISHLARI**

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ANNOTATSIYA

Tadqiqotning maqsadi eksperimental jigar shikastlanishidan keyin urg‘ochi oq kalamushlar bachadonida yoshga bog‘liq morfometrik o‘zgarishlarni o‘rganishdan iborat bo‘ldi. Tadqiqotga 3 va 9 oylik hayvonlar jalb qilindi. Jigar shikastlanishi 25 mg/100 g tana vazniga miqdorda geliotrinni bir martalik teri ostiga yuborish orqali modellastirildi. Bachadon to‘qimalari gistologik usulda tekshirildi, morfometrik ko‘rsatkichlar esa QuPath 0.5.1 dasturi yordamida baholandi. Intakt hayvonlarda bachadonning aksariyat morfometrik ko‘rsatkichlari yosh ortishi bilan oshib bordi. Bachadon devorining umumiy qalinligi 3 oylik kalamushlarda 950 ± 18 mkm, 9 oylik hayvonlarda esa 1045 ± 20 mkm ni tashkil etdi. Jigar shikastlanishidan keyin ushbu ko‘rsatkich mos ravishda 875 ± 17 va 925 ± 19 mkm gacha kamaydi. Endometriy qalinligi yosh hayvonlarda 181 ± 4 mkm dan 158 ± 4 mkm gacha, katta yoshdagi hayvonlarda esa 202 ± 5 mkm dan 171 ± 4 mkm gacha pasaydi. Bachadon bezlari diametri mos ravishda $27,4 \pm 0,7$ dan $23,8 \pm 0,6$ mkm gacha va $30,4 \pm 0,8$ dan $25,7 \pm 0,7$ mkm gacha kamaydi. Bezlar zichligi 3 oylik kalamushlarda $21,3 \pm 0,8$ dan $17,6 \pm 0,7$ bez/mm² gacha, 9 oylik hayvonlarda esa $19,8 \pm 0,7$ dan $15,2 \pm 0,6$ bez/mm² gacha kamaydi. Aksincha, qon tomirlari diametri $40,6 \pm 1,1$ dan $46,8 \pm 1,2$ mkm gacha va $45,3 \pm 1,2$ dan $53,6 \pm 1,4$ mkm gacha oshdi. Aniqlangan o‘zgarishlar 9 oylik hayvonlarda yaqqolroq namoyon bo‘lib, bachadon to‘qimalarining eksperimental jigar shikastlanishiga javobi yoshga bog‘liqligini ko‘rsatdi.



Kalit soʻzlar: bachadon, jigar shikastlanishi, morfometriya, urgʻochi oq kalamushlar, endometriy, bachadon bezlari, qon tomirlari, yoshga bogʻliq oʻzgarishlar, geliotrin.

Introduction

The liver performs important metabolic, detoxification, endocrine, immune, and hemodynamic functions. Therefore, hepatic injury may affect the structural and functional state of organs located outside the primary site of damage. The uterus is particularly sensitive to systemic metabolic and hormonal changes, as well as alterations in tissue microcirculation. Age may additionally influence the degree of morphological response of uterine tissues to pathological factors. The comparative assessment of uterine morphometry at different ages may therefore provide important information about age-dependent tissue responses to liver injury.

Aim

The aim of the study was to determine age-related morphometric changes in the uterus of 3- and 9-month-old female albino rats following experimental liver injury.

Materials and Methods

The study was performed on female albino rats aged 3 and 9 months. Experimental liver injury was induced by a single subcutaneous administration of heliotrine at a dose of 25 mg/100 g body weight. Age-matched intact animals were used as controls. After the experiment, uterine tissues were fixed in 10% neutral formalin and processed according to standard histological procedures. Paraffin sections with a thickness of 4–5 μm were prepared and stained with hematoxylin and eosin. Morphometric assessment was performed on digital microphotographs using QuPath 0.5.1 software. The total uterine wall thickness, endometrial and myometrial thickness, epithelial height, stromal thickness, diameter and density of uterine glands, diameter of myometrial muscle fibers, and vascular diameter were evaluated.

Results

In intact animals, most morphometric parameters demonstrated an age-related increase. Total uterine wall thickness was $950 \pm 18 \mu\text{m}$ in 3-month-old rats and $1045 \pm 20 \mu\text{m}$ in 9-month-old rats. Endometrial thickness increased from 181 ± 4 to $202 \pm 5 \mu\text{m}$, while stromal thickness increased from 156 ± 3 to $170 \pm 4 \mu\text{m}$. The diameter of uterine glands increased from 27.4 ± 0.7 to $30.4 \pm 0.8 \mu\text{m}$, and myometrial thickness increased from 738 ± 12 to $798 \pm 14 \mu\text{m}$.

Following experimental liver injury, a decrease in most uterine morphometric parameters was observed. In 3-month-old animals, uterine wall thickness decreased to $875 \pm 17 \mu\text{m}$, endometrial thickness to $158 \pm 4 \mu\text{m}$, epithelial height to $17.8 \pm 0.3 \mu\text{m}$ ($p < 0.001$), and stromal thickness to $138 \pm 3 \mu\text{m}$. Uterine gland diameter decreased to $23.8 \pm 0.6 \mu\text{m}$ ($p < 0.001$), while gland density decreased from 21.3 ± 0.8 to 17.6 ± 0.7 glands/ mm^2 ($p < 0.01$). Myometrial thickness decreased to $690 \pm 11 \mu\text{m}$ and muscle fiber diameter to $12.8 \pm 0.3 \mu\text{m}$. In contrast, vascular diameter increased from 40.6 ± 1.1 to $46.8 \pm 1.2 \mu\text{m}$ ($p < 0.01$).

The changes were more pronounced in 9-month-old animals. Uterine wall thickness decreased to $925 \pm 19 \mu\text{m}$, endometrial thickness to $171 \pm 4 \mu\text{m}$, epithelial height to $18.2 \pm 0.3 \mu\text{m}$ ($p < 0.001$), and stromal thickness to $148 \pm 3 \mu\text{m}$. Gland diameter decreased to $25.7 \pm 0.7 \mu\text{m}$ ($p < 0.001$), while gland density decreased to 15.2 ± 0.6 glands/ mm^2 ($p < 0.001$). Myometrial thickness and muscle fiber diameter decreased to 731 ± 13 and $13.7 \pm 0.3 \mu\text{m}$, respectively. Vascular diameter increased to $53.6 \pm 1.4 \mu\text{m}$ ($p < 0.001$).

Conclusion

Experimental liver injury is associated with pronounced morphometric alterations in the uterus of female albino rats. The main changes include reductions in uterine wall, endometrial and myometrial thickness, epithelial height, stromal thickness, uterine gland diameter and density, accompanied by an increase in vascular diameter. The magnitude of these changes was greater

in 9-month-old animals than in 3-month-old animals, demonstrating an age-dependent pattern of uterine response to experimental liver injury.

Keywords: uterus, experimental liver injury, age-related changes, morphometry, endometrium, myometrium, uterine glands, blood vessels, female albino rats, heliotrine.

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