UDC 611.98:611.13:616-092.9:613.81

MORPHOGENESIS OF THE VASCULAR BED OF THE DURA MATER IN RATS DURING THE PERINATAL PERIOD UNDER PROLONGED ALCOHOL EXPOSURE

Mardanov Jamshid Jaxongirovich -Assistant of the Department of Traumatology and neurosurgery,PhD
Bukhara State Medical Institute named after Abu Ali ibn Sino,
https://orcid.org/0009-0007-7760-6050

Abstract
The present study addresses the morphogenesis of the angioarchitectonics of the cranial dura mater during the prenatal stage of ontogenesis in rat embryos under normal conditions and during prolonged experimental alcohol exposure. The animals were divided into six groups according to the objectives of the study. Four experimental groups were subjected to chronic ethanol consumption for 90 days. The fifth and sixth groups, consisting of five animals each at 4 and 7 months of postnatal development, served as controls.

Keywords:Dura mater architectonics, morphogenesis, ethyl alcohol.

МОРФОГЕНЕЗ СОСУДИСТОГО РУСЛА ТВЕРДОЙ МОЗГОВОЙ ОБОЛОЧКИ У КРЫС В ПЕРИНАТАЛЬНЫЙ ПЕРИОД ПРИ ДЛИТЕЛЬНОМ ВОЗДЕЙСТВИИ АЛКОГОЛЯ

Марданов Джамшид Джахонгирович - ассистент кафедры травматологии и нейрохирургии, PhD
Бухарский государственный медицинский институт имени Абу Али ибн Сино,
https://orcid.org/0009-0007-7760-6050

Аннотация
В настоящем исследовании рассматривается морфогенез ангиоархитектоники твердой мозговой оболочки черепа на пренатальной стадии онтогенеза у эмбрионов крыс в нормальных условиях и при длительном экспериментальном воздействии алкоголя. Животные были разделены на шесть групп в соответствии с целями исследования. Четыре экспериментальные группы подвергали постоянному потреблению этанола в

течение 90 дней. Пятая и шестая группы, состоящие из пяти животных в возрасте 4 и 7 месяцев постнатального развития, служили контрольными.

Ключевые слова:Архитектоника твердой мозговой оболочки, морфогенез, этиловый спирт.

Introduction

At present, due to the advancement of clinical anatomy, neuromorphology, and immunology, there is a growing scientific interest among morphologists in the detailed investigation of pathogenetic mechanisms and clinical manifestations of fetal alcohol syndrome. Prenatal exposure to ethanol leads to impaired development of various components of the nervous system[2,4].

Consequently, the development of correction strategies, as well as the improvement and creation of clinical-diagnostic and morpho-clinical algorithms for the management of traumatic brain injury complicated by alcohol history, is impossible without a comprehensive study of the morphological, functional, and adaptive characteristics of the relevant anatomical structures[1,3,5].

Aim of the Study

To investigate the morphogenesis of the angioarchitectonics of the cranial dura mater during the prenatal period of ontogenesis in rat embryos under physiological conditions and under prolonged experimental alcohol exposure.

Materials and Methods

The duration of the experiment was 90 days and was conducted during April–May–June, as seasonality represents an additional criterion for assessing adaptive phases. A 90% ethanol solution diluted with distilled water was used: a 0.5% ethanol solution (8 g of alcohol per 1.5 L of water) and a 1.0% ethanol solution (15 g of alcohol per 1.5 L of water). Ethanol solutions were available ad libitum in the drinking bottles of experimental male rats throughout the entire experimental period.

The animals were divided into six groups:

Group 1: Five 4-month-old male rats receiving a 0.5% ethanol solution

Group 2: Five 7-month-old male rats receiving a 0.5% ethanol solution

Group 3: Five 4-month-old male rats receiving a 1.0% ethanol solution

Group 4: Five 7-month-old male rats receiving a 1.0% ethanol solution

Groups 5 and 6: Control groups consisting of five animals each at 4 and 7 months of postnatal development, respectively, receiving drinking water only

At the completion of the experiment, control weighing was performed. All animals were euthanized under ether anesthesia. Following dissection, the intact brain with

the dura mater was isolated by anatomical preparation. Fixation was carried out in 10% neutral formalin.

A total of 30 anatomical specimens were examined, from which 200 histological sections of the brain with the dura mater were obtained, each 5 μm thick. Sections were prepared using standard histological techniques and stained with hematoxylin–eosin and Mallory's method. Microscopic analysis was conducted using a high-resolution universal light microscope.

The experiment was initiated on April 20, 2023, and completed on June 20, 2023.

Results

The study demonstrated that the spatial and quantitative distribution of vascular primordia within the dura mater exhibits distinct regional characteristics. In the lateral regions of the anterior cranial fossa, a low density of both arterial and venous vessels with dichotomous branching was observed. In contrast, the centro-cranial and centro-caudal regions displayed a high concentration of vascular structures.

The highest vascular density was identified in the lateral regions of the middle cranial fossa, with a relative predominance of the venous component. Increased densities of both arterial and venous vessels were also noted in areas corresponding to dural sinuses and major venous collectors.

Approximately two-thirds of vascular primordia demonstrated a parallel course, while one-third exhibited a ventrolateral orientation relative to the venous component of the dura mater. Statistically significant differences were confirmed ($p < 0.05$).

Conclusions

The tentorium cerebelli is formed as a duplication of the outer layer of the dura mater. In all cases, the central portion of the tentorial primordium demonstrated close topographic and anatomical relationships with the falx cerebri.

Several critical periods in the prenatal development of the dura mater were identified, which are of significant clinical relevance. Alterations during these stages may lead to developmental anomalies:

First critical period (38–39 days post-fertilization, embryonic stage 16): A key phase in the formation of dural angioarchitectonics, with morphometric variability ranging from 0.07 ± 0.02 to 37.3 ± 2.7 μm.

Second critical period (40–41 days, stage 17): Fusion of dural cavities in 87% of cases.

Third critical period (43–44 days, stage 18): Relative closure of the meningeal system, with morphometric values ranging from 43.6 ± 3.1 to 108.7 ± 7.2 μm.

Fourth critical period (52–53 days, stage 21): Final formation of the subarachnoid space, with cavity fusion occurring in the frontal (76%), temporal (97%), parietal (93%), and occipital (82%) regions.

References

1. Loshkarev IA. Morphological characteristics of the hemocirculatory network of the falx cerebri of the dura mater during prenatal human ontogenesis. Russian Morphological Bulletin. 2014;(1–2):61.
2. Lubensky EG, Zotov YuV. Open cranial and cerebral trauma. In: Ugryumov VM, editor. Surgery of the Central Nervous System. Leningrad; 2004. Vol. 1. p. 674–688.
3. Meshcheryakov LV, Mandel AI, Galaktionov OK. Selected socio-psychological factors contributing to the development of alcoholism among oil industry workers in Siberia. In: Problems of Alcoholism and Substance Abuse (Clinical and Organizational Aspects). Khabarovsk; 2017. p. 115–117.
4. Prokhorova MI, editor. Methods in biochemical research. Leningrad: Leningrad University Press; 2012. 272 p.
5. Milovanov AP, Savelyev SV. Human intrauterine development: a clinical guide for physicians. Moscow; 2006. 383 p.

Литература

1. Лошкарев И.А. Морфологическая характеристика гемоциркуляторной сети большого мозга твердой мозговой оболочки в пренатальном онтогенезе человека. Российский морфологический вестник. 2014;(1-2):61.
2. Лубенский Е.Г., Зотов Ю.В. Открытая черепно-мозговая травма. Под ред. Угрюмова В.М. Хирургия центральной нервной системы. Ленинград, 2004. Том 1. с. 674-688.
3. Мещеряков Л.В., Мандель А.И., Галактионов О.К. Отдельные социально-психологические факторы, способствующие развитию алкоголизма среди работников нефтяной промышленности Сибири. В кн.: Проблемы алкоголизма и токсикомании (клинические и организационные аспекты). Хабаровск; 2017. с. 115-117.
4. Прохорова М.И., редактор. Методы в биохимических исследованиях. Ленинград: Издательство Ленинградского университета; 2012. 272 с.

5. Милованов А.П., Савельев С.В. Внутриутробное развитие человека: клиническое руководство для врачей. Москва; 2006. 383 с.