CHRONIC ALCOHOL INTOXICATION AND ITS IMPACT ON CEREBELLAR HISTOLOGY: AN EXPERIMENTAL RAT MODEL STUDY

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Abstract. This study examines the histological effects of chronic alcohol intoxication on the cerebellar cortex.
Key words: Cerebellum, Cerebellar Cortex, Chronic Ethanol Intoxication, Rat Model, Histopathology.
Introduction. Despite extensive research, the mechanisms by which alcohol affects the central nervous system (CNS) remain incompletely understood. This study focuses on chronic ethanol intoxication (CEI) and its impact on the cerebellum, particularly during prenatal and early postnatal periods. Alcohol consumption disrupts brain function, impairing attention and memory. The cerebellum, critical for movement coordination and cognitive processing, is highly susceptible to alcohol's toxic effects. Recent findings suggest that changes in gamma-aminobutyric acid (GABA) receptor neurotransmission may underlie ethanol-induced cerebellar dysfunction [1, 2].
We **aimed to investigate** the extent of histological changes in the cerebellum of rats subjected to chronic alcohol exposure.
Methods. We utilized a well-established model of chronic alcohol intoxication. Adult Wistar rats (n=55) and their offspring (n=240) were studied. Rats received 40% ethanol intragastrically at a dose of 2 ml per 100 g body weight daily for three months. Observations were recorded at postnatal days 30, 60, 90. Rats were divided into control and experimental groups, including males, non-pregnant females (Group I), pregnant females (Group II), and lactating females (Group III). Histological analysis was performed on cerebellar tissues, with staining conducted using hematoxylin and eosin. Postpartum assessments included live births, litter size, and neonatal mortality rates within the initial 30-day period. The study adhered to ethical guidelines for animal research [3, 4].
Results. Chronic ethanol exposure resulted in significant histological changes in the cerebellum. Pathological alterations included neuron structural changes, atypical cell migration, and pericellular and perivascular edema. The molecular layer exhibited cell migration to other layers, with affected cells showing abnormal morphology. The granular layer showed evidence of macrophage infiltration, indicating necrotic islands. Vascular dilation and increased edema were also observed in the cerebellar cortex (**Fig. 1**) [5, 6].

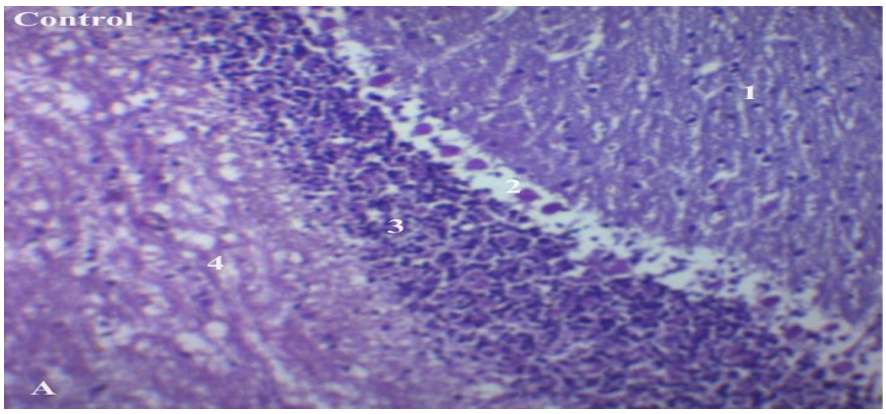

Fig. 1. Section of the cerebellum of a control group rat's brain. Stained with hematoxylin and eosin. Magnification: A – x400, B – x200, C – x200. 1. Molecular layer. 2. Purkinje cell layer. 3. Granular layer. 4. White matter

Histological analysis revealed significant alterations in neuronal morphology within the cerebellar cortex. Abnormal cell migration was observed in the molecular layer, resulting in atypical neuron localization. Pathological cell migration during embryogenesis leads to tissue heterotopy and loss of differentiation in neuroblasts, culminating in disorganized cortical cytoarchitecture (**Fig. 2**).

Histopathological examination identified pericellular and perivascular lucencies, indicative of tissue edema. The cerebellar molecular layer displayed vascular dilation. Extensive pericellular edema was noted, accompanied by neuronal wrinkling and hyperchromasia in edematous regions. Macrophagic infiltration within the granular layers was indicative of necrotic foci (**Fig. 3**).

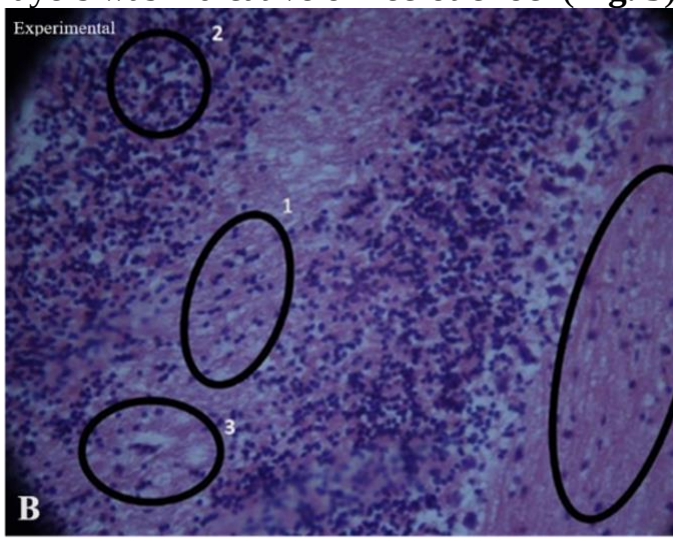

Fig. 2. Section of the cerebellum of a rat's brain from the experimental group. Stained with hematoxylin and eosin. Magnification: A – x400, B – x200, C – x200. 1. Migrating cells. 2. Necrotic islands. 3. Pericellular edema

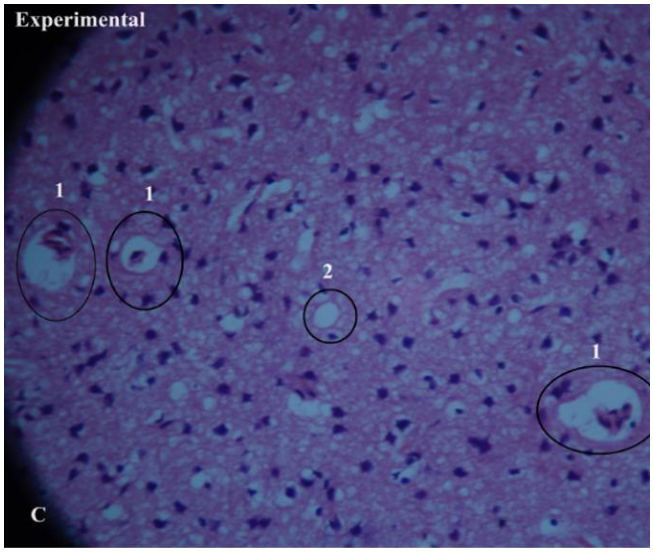

Fig. 3. Section of the cerebellum of a rat's brain from the experimental group. Stained with hematoxylin and eosin. Magnification: A – x400, B – x200, C – x200.

Discussion. Our findings align with previous research, demonstrating that chronic alcohol intoxication induces substantial histopathological changes in the cerebellum. These changes include reduced Purkinje cell populations, neuron dystrophy, and increased cell death. The cerebellum's role in movement and cognitive processing underscores the importance of understanding alcohol's impact on this brain region. Chronic alcohol consumption is associated with cerebellar ataxia, impaired motor coordination, and cognitive deficits. These effects may be due to altered GABA receptor neurotransmission and increased GABA release in cerebellar neurons [7, 8].

Conclusions. Chronic alcohol intoxication leads to significant histological changes in the cerebellum, affecting neuron structure and function. These alterations contribute to motor and cognitive impairments observed in chronic alcohol users. Further research is needed to explore the precise mechanisms underlying these changes and potential therapeutic interventions.

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