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Research Article

Morphological Characteristics of The Large-Cell Layer of The Retrosplenal Cortex

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Abstract

The retrosplenial cortex is located on the medial surface of the rat's cerebral hemispheres. It consists of seven layers: molecular, granular, pyramidal, polymorphic, and a weakly expressed fourth layer. The presented results on the morphological characteristics of the rat retrosplenial cortex will serve as a fundamental basis for further studies of this cortical region in both normal and pathological conditions.

Keywords: brain; rats; neurons; retrosplenal cortex

Introduction

The retrosplenial cortex is located on the medial surface of the rat's cerebral hemispheres. It consists of seven layers: molecular, granular, pyramidal, polymorphic, and a weakly expressed fourth layer[1] (Table 1).

Neurontype	Corticallayers	Mainneurotransmitters
Horizontalneurons	molecular, polymorphic	GABA
Starneurons	stellate, polymorphic	calretinin
Pyramidalneurons	medium pyramidal, large pyramidal, and polymorphic	aspartate,glutamate calretinin, calbindin
Basketneurons	stellate, medium pyramidal, large pyramidal, and polymorphic	GABA, parvalbumin
Chandeliercells	stellate, medium pyramidal, large pyramidal, and polymorphic	GABA, parvalbumin
Granular neurons	granular	glutamate, dynorphin
Bipolarneurons	small-celled, polymorphic	calretinin, calbindin, somatostatin, substance P
Polymorphicneurons	stellate, medium pyramidal, large pyramidal, and polymorphic	calretinin, calbindin, somatostatin, substance P
Fusiformneurons	medium pyramidal, large pyramidal, and polymorphic	GABA, parvalbumin
Star pyramidalneurons	stellate, medium pyramidal, and polymorphic	aspartate,glutamate calretinin

Table 1: Neural and transmitter organization of the retrosplenial cortex

The rat retrosplenial cortex is divided into granular and agranular regions. The granular region of the retrosplenial cortex is distinguished by its layers II-III, which consist of larger neurons.[2] The following fields are classified as granular retrosplenial cortex: 29a, 29b, and 29c. [3]. This classification is based on cytoarchitectural features, primarily the medium pyramidal and large pyramidal layers. In field 29a, layers II, III, and VII are thin, and the medium pyramidal layer is barely noticeable.[4] In contrast, field 29b has a well-developed layer II, formed by densely packed bodies of stellate neurons, while the granular and medium pyramidal layers are less pronounced, and the neuronal cell bodies are more dispersed. "Layer VI contains the bodies of large typical pyramidal neurons. The multiform layer, although thin, is clearly defined. In field 29c, the granular layer is most

pronounced, and, in general, the neurons of other layers are smaller 1 compared to fields 29a and 29b. The predominant types of neurons are fusiform neurons and a transitional type of neuron - stellate pyramids. [5] The apical dendrites of these neurons form bundles that reach the molecular layer. Stellate pyramidal neurons of old rats form significantly fewer branches than those of young animals.[6]"The medium pyramidal and large pyramidal layers are well developed, and their organization is similar to the organization of the pyramidal layer of the frontal cortex of the isocortex. [7]The agranular region of the retrosplenial cortex is represented by field 30. Microscopic examination of this region reveals a narrow granular layer. For this reason, field 30 cannot be called completely agranular. The retrosplenial cortex forms connections with the thalamic nuclei, raphe nuclei, medial geniculate body nuclei, and motor cortex. It is involved in visual memory processes and the regulation of behavior to predict and prevent situations that lead to painful sensations.[8].

Materials and Methods

For morphological studies, the brain was quickly extracted after decapitation of the animal. Pieces of the frontal cortex were fixed in Carnoy's solution.Serial paraffin sections were stained with 0.1% toluidine blue using Nissl's method.Histological preparations were examined, microphotographed, and subjected to morphometric and densitometric analysis of the chromogen precipitate using an Axioscop 2 plus microscope (Zeiss, Germany) and a digital video camera.(Leica DFC 320 cameraGermany) and ImageWarp image analysis software (Bitflow, USA). "In histological studies, the size and shape of neuronal cell bodies in the rat brain are determined.[9] The changes in size and shape of neuronal cell bodies were assessed by measuring their area, form factor ($4\pi S/P^2$, an indicator of sphericity and folding), and elongation factor (Dmax/Dmin, an indicator of sphericity) using ImageWarp image analysis software (Bitflow, USA).[10]

Results

The sizes and shapes of the neuronal cell bodies in the large-celled layer of the retrosplenial cortex are presented in Table 2.

Indicator	Large-celledlayer
S, mkm^2	114 (112; 115)
FF, units.	0,83 (0,82; 0,83)
FE, units.	1,67 (1,66;1,70)

The large-celled layer is predominantly composed of pyramidal neurons (Figures 1, 2, 3), among which normochromatic and hyperchromatic, non-shriveled neurons are predominant.[11]

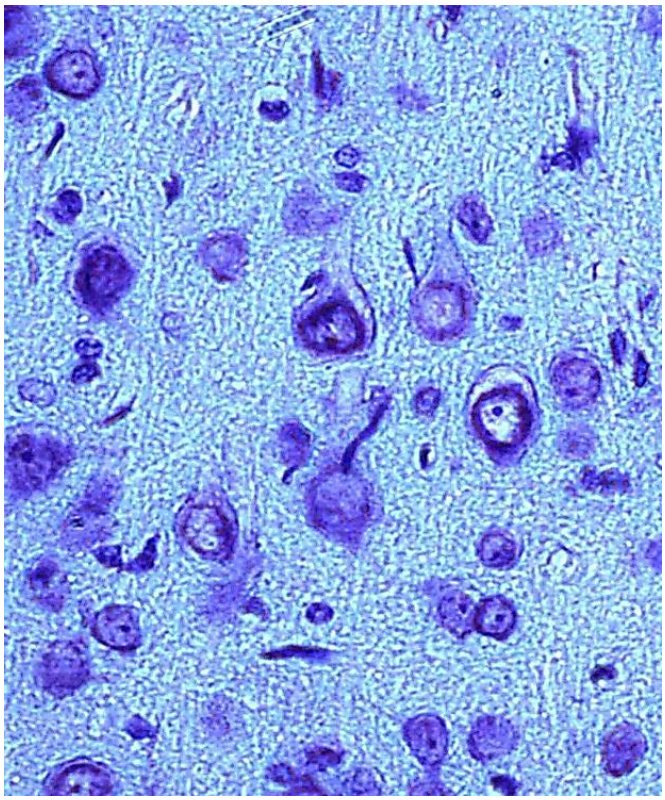

Figure 1: Neurons of the large-celled layer of the retrosplenial cortex. Nisslstain. Digital micrograph. Magnification: 40x.

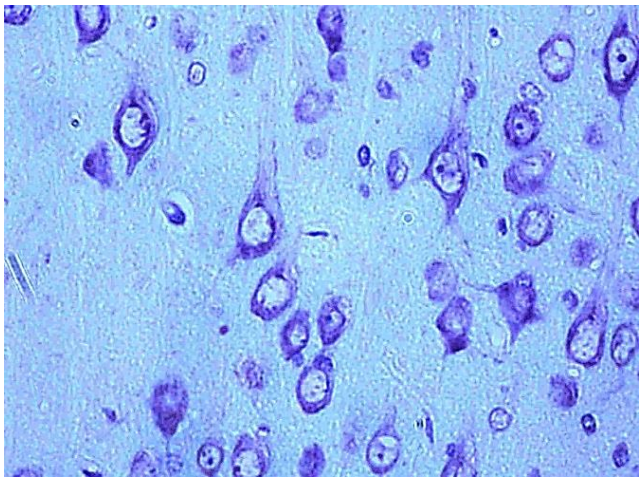

Figure 2: Neurons of the large-celled layer of the retrosplenial cortex. Nisslstain. Digital micrograph. Magnification: 40x.

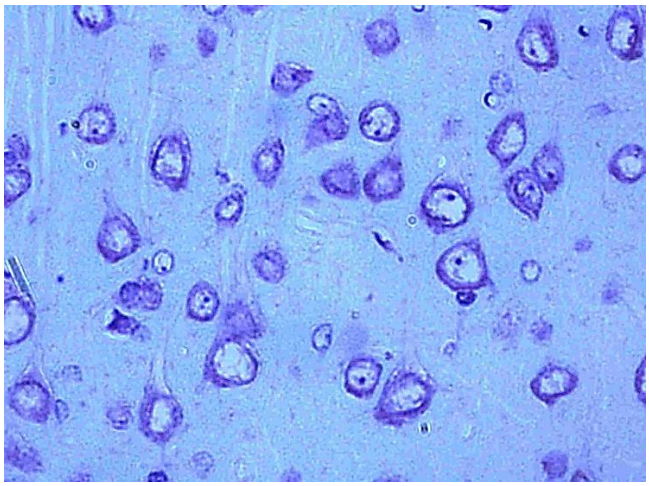

Figure 3: Neurons of the large-celled layer of the retrosplenial cortex. Nissl stain. Digital micrograph. Magnification: 40x.

The presented results on the morphological characteristics of the rat retrosplenial cortex will serve as a fundamental basis for further studies of this cortical region in both normal and pathological conditions.

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