

So Called - D-Neuron

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Definition of “D-Neuron”

The D-neuron in the rat central nervous system (CNS) was described by Jaeger et al. in 1983. Initially, they defined as “the non-monoaminergic aromatic L-amino acid decarboxylase (AADC)-containing cell”, and called the “D-cell”. AADC is an equivalent enzyme to dopa decarboxylase (DDC). The D-cell contains AADC but not dopaminergic nor serotonergic. Then, it is natural that the D-cell is thought to produce the trace amine (TA), such as β -phenylethylamine (PEA), tyramine, tryptamine and octopamine. AADC is the rate-limiting enzyme for TA synthesis. However, it is confusing that these TAs are also “monoamines”, as each TA has one amino residue. D-cells which Jaeger et al. reported were proved to be neurons by electro-microscopic observation, and they are also called D-neurons. The latter is much more accurate nomenclature.

Since 2001, when the trace amine receptor was cloned, D-neurons have been come to be recognized as ligand-producing neurons of the trace amine-associated receptor (TAAR) [1].

Anatomy and Species Differences

The localizations of D-neurons were specified into 14 groups, from D1 (the spinal cord) to D14 (the bed nucleus of stria terminalis) in caudo-rostral orders of the rat central nervous system using AADC immunohistochemistry. In this usage, the classification term “D” means decarboxylation. In rodents, a small number of D-neurons in the striatum were rostrally described. The author reported in 1997, “dopa-decarboxylating neurons specific to the human striatum”, that is, “D-neurons” in the human striatum (classified to be D15)

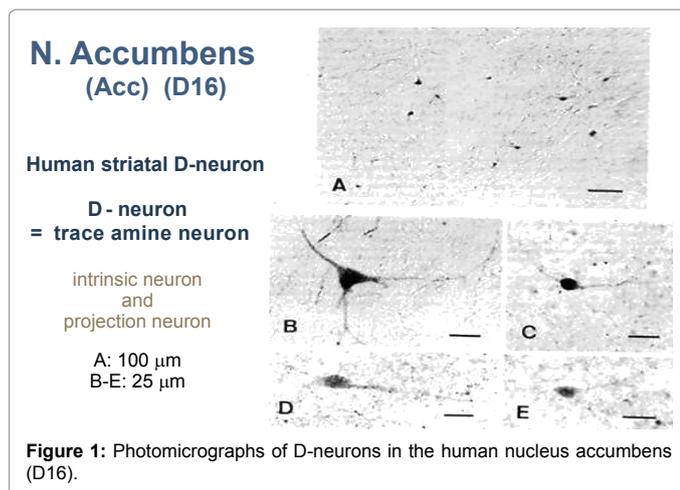
and the nucleus accumbens (Acc, D16) (Figure 1), though monkey striatum did not contain D-neurons in these areas. By using human post-mortem brain materials, D-neurons have been also described in the basal forebrain (D17) and the cerebral cortex (D18). In humans, D-neuron system is far developed in the forebrain. Corresponding to anatomical nomenclature of amine neurons, that is, A group for catecholamine neurons (A1-A16), B group for serotonergic neurons (B1-B14), and C group for epinephrine (adrenergic) neurons (C1-C3), D group is used as the classification term for TA neurons (D1-D18) [2].

Lack of D-Neurons in Striatum (D15) and Nucleus Accumbens (D16) of Schizophrenia Brain, and D-cell (D-neuron) hypothesis

In 2003, by using pathological and legal autopsy brains of patients with schizophrenia, reduction of D-neurons in the striatum (D15) and Acc (D16) of patients with schizophrenia was also shown. This finding lead to establish D-cell hypothesis of schizophrenia, that links dopamine hypothesis to neural stem cell (NSC) dysfunction hypothesis, explaining molecular mechanisms of mesolimbic dopamine hyperactivity (Figure 1).

References

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