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Morphological and electrophysiological characterization of white matter neurons expressing 5-HT3A serotonin receptor

Promotionsfach: Neurologie

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The white matter in the central nervous system consists mainly of axons and glial cells. Nevertheless, a number of anatomical studies have shown that there are also neurons within the white matter.

This work focuses on the poorly analyzed population of white matter neurons. To study these cells, transgenic mice expressing enhanced green fluorescent protein (EGFP) under the control of the 5-HT3A-receptor promoter were used. The white matter of young and adult 5-HT3A-EGFP transgenic mice contains two morphological types of EGFP+ cells. One type comprises immature migrating neuroblasts and the other type comprises mature neurons. This study focused on analysis of the latter group.

Mature 5-HT3A-EGFP+ WM neurons have different morphological and immunochemical phenotypes. They have different degrees of dendritic and axonal arborization. WM neurons send their projections to different brain regions, such as cortex, striatum and hippocampus, but their processes often were constrained to the white matter. Typically, 5-HT3A-EGFP+ WM neurons are either bipolar or multipolar, although some other types were also seen. 5-HT3A-EGFP+ WM Most neurons express calretinin and VIP. Electrophysiological experiments with 5-HT3A-EGFP+ WM neurons showed that they have firing patterns typical for interneurons. 5-HT3A-EGFP+ WM neurons of the mature brain are not non-functional remnants of subplate cells but are functionally integrated into neuronal microcircuits. They receive excitatory and inhibitory inputs from cortex and subcortical structures (e.g. striatum). Paired recordings showed that they target cortical principal neurons evoking GABA-A-receptor mediated currents in the postsynaptic cell. Furthermore, no 5-HT3A-receptor mediated current could be recorded in 5HT3A-EGFP+ WM neurons, suggesting that 5-HT3A receptors are localized extrasynaptically or presynaptically on 5-HT3A-EGFP+ WM neurons.