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Potentialiation of the glutamatergic synaptic input to rat locus coeruleus neurons by P2X7 receptors

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Abstract

Locus coeruleus (LC) neurons in a rat brain slice preparation were superfused with a Mg²⁺-free and bicuculline-containing external medium. Under these conditions, glutamatergic spontaneous excitatory postsynaptic currents (sEPSCs) were recorded by means of the whole-cell patch-clamp method. ATP, as well as its structural analogue 2-methylthio ATP (2-MeSATP), both caused transient inward currents, which were outlasted by an increase in the frequency but not the amplitude of the sEPSCs. PPADS, but not suramin or reactive blue 2 counteracted both effects of 2-MeSATP. By contrast, α,β -methylene ATP (α,β -meATP), UTP and BzATP did not cause an inward current response. Of these latter agonists, only BzATP slightly facilitated the sEPSC amplitude and strongly potentiated its frequency. PPADS and Brilliant Blue G, as well as fluorocitric acid and amino adipic acid prevented the activity of BzATP. Furthermore, BzATP caused a similar facilitation of the miniature (m)EPSC (recorded in the presence of tetrodotoxin) and sEPSC frequencies (recorded in its absence). Eventually, capsaicin augmented the frequency of the sEPSCs in a capsazepine-, but not PPADS-antagonizable, manner. In conclusion, the stimulation of astrocytic P2X7 receptors appears to lead to the outflow of a signalling molecule, which presynaptically increases the spontaneous release of glutamate onto LC neurons from their afferent fibre tracts. It is suggested, that the two algogenic compounds ATP and capsaicin utilise separate receptor systems to potentiate the release of glutamate and in consequence to increase the excitability of LC neurons. © 2010 Springer Science+Business Media B.V.

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Keywords

Adenosine 5'-triphosphate, Locus coeruleus, Miniature excitatory postsynaptic currents, P2X7 receptors, Presynaptic modulation, Spontaneous excitatory postsynaptic currents