Nicotinic acetylcholine receptor

Nicotinic acetylcholine receptors, or nAChRs, are receptor proteins that respond to the neurotransmitter acetylcholine. Nicotinic receptors also respond to drugs, including the nicotinic receptor agonist nicotine. They are found in the central and peripheral nervous system, muscle, and many other tissues of many organisms, including humans. At the neuromuscular junction they are the primary receptor in muscle for motor nerve-muscle communication that controls muscle contraction. In the peripheral nervous system: (1) they transmit outgoing signals from the presynaptic to the postsynaptic cells within the sympathetic and parasympathetic nervous system, and (2) they are the receptors found on skeletal muscle that receive acetylcholine released to signal for muscular contraction. In the immune system, nAChRs regulate inflammatory processes and signal through distinct intracellular pathways.

Nicotinic acetylcholine receptors (nAChRs) mediate fast synaptic transmission in autonomic ganglia, which innervate and control the activity of most visceral organs. By combining ultrastructural, immunocytochemical, and pharmacological analyses, we characterized the nAChR subtypes in the rat superior cervical ganglion (SCG) and the effect of pre- and postganglionic nerve crush on their number in the ganglion and their distribution at the intraganglionic synapses. Binding with radioactive nicotinic ligands, immunoprecipitation, and immunolocalization experiments revealed the presence of different nAChR subtypes: those containing the alpha3 subunit associated with beta4 and/or beta2 subunits that bind 3H-Epibatidine with high affinity, and those containing the alpha7 subunit that bind 125I-alphaBungarotoxin. After postganglionic nerve crush, the number of nicotinic receptors and immunopositive intraganglionic synapses for each nAChR subunit strongly decreased. Both the number of nAChRs and immunoreactivity recovered 26 days after injury, when regenerating postganglionic fibers had reinnervated the peripheral target organs, as shown by the restoration of tyrosine hydroxylase immunoreactivity in the iris. This observation and the lack of any effect of preganglionic nerve crush on the number of nicotinic receptors suggest that the peripheral targets affect the organization of intraganglionic synapses in adult SCG [1)].

Stimulation of brain nAChRs can induce elevation of plasma catecholamines through brain Nitric oxide synthase inhibitor (iNOS)-derived NO-mediated protein S-nitrosylation in rats. Therefore, brain nAChRs (at least α4β2 subtype) and Nitric oxide (NO) might be useful targets for alleviation of catecholamines overflow induced by smoking [2)].

1)
Del Signore A, Gotti C, Rizzo A, Moretti M, Paggi P. Nicotinic acetylcholine receptor subtypes in the rat sympathetic ganglion: pharmacological characterization, subcellular distribution and effect of pre- and postganglionic nerve crush. J Neuropathol Exp Neurol. 2004 Feb;63(2):138-50. PubMed PMID: 14989600.

2)
Higashi Y, Shimizu T, Yamamoto M, Tanaka K, Yawata T, Shimizu S, Zou S, Ueba T, Yuri K, Saito M. Stimulation of brain nicotinic acetylcholine receptors activates adrenomedullary outflow via brain inducible NO synthase-mediated S-nitrosylation. Br J Pharmacol. 2018 Jul 14. doi: 10.1111/bph.14445. [Epub ahead of print] PubMed PMID: 30007012.