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Intracellular Calcium Regulation in Rat Intracardiac Ganglion Neurons

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Vagal regulation of the mammalian heart is mediated by the release of acetylcholine (ACh) and the subsequent activation of postsynaptic nicotinic and muscarinic ACh receptors (AchRs) in postganglionic intracardiac neurons. Activation includes the induction of membrane currents and increases in intracellular free Ca^{2+} concentrations ($[Ca^{2+}]_i$).
Experiments have shown that $[Ca^{2+}]_i$ increases induced by selective activation of muscarinic AChRs are independent of the presence of extracellular Ca^{2+}. This observation implicates that Ca^{2+} mobilization by muscarinic AChRs does not rely on a transient Ca^{2+} current over the cell membrane, but on Ca^{2+} release from IP_3- sensitive Ca^{2+} stores. Pirenzepine, a selective m1 muscarinic AChR antagonist, nearly abolished the Ca^{2+} increase evoked by muscarine. This result strongly suggests that the m1 muscarinic AChR subtype is involved in generating Ca^{2+} signals in response to the application of muscarine.
This work also demonstrates that the increase in $[Ca^{2+}]_i$ following the activation of the ionotropic nicotinic AChR is dependent on the presence of extracellular Ca^{2+}. The selective activation of nicotinic AChRs at voltage clamped neurons leads to an increase in $[Ca^{2+}]_i$ not significantly different to that observed in unclamped neurons. This result strongly suggests that the $[Ca^{2+}]_i$ signal is triggered by a transient flux of Ca^{2+} ions over the cell membrane through neuronal nicotinic AChRs which are known to be highly permeable to Ca^{2+} ions.
Furthermore, the nicotinic AChR- induced response was significantly reduced by the application of ryanodine suggesting that intracellular ryanodine- sensitive Ca^{2+} stores may contribute to the nicotinic AChR induced $[Ca^{2+}]_i$ response. However, this work gives evidence that Ca^{2+}- induced Ca^{2+} release triggered by the activation of nicotinic AChRs is present in rat intracardiac neurons.
Here performed experiments show that the $[Ca^{2+}]_i$ of postganglionic intracardiac neurons is also modulated by angiotensin II.
The role of the neurotransmitters ATP and UTP in the regulation of neurotransmission in rat intracardiac neurons has been investigated previously. This work presents the dose response relationship for ATP- and UTP- induced $[Ca^{2+}]_i$ increases in these neurons.
In conclusion, different signaling pathways mediate the rise in $[Ca^{2+}]_i$ and membrane currents evoked by nicotinic and muscarinic ACh receptor activation as well as activation of ATP, UTP, and angiotensin II receptors in rat intracardiac neurons.