Investigating the role of retinoic acid in the vertebrate and invertebrate nervous system

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Abstract

Although abundant in the developing central nervous system (CNS) of vertebrates, the precise role of all-*trans* retinoic acid (RA) in neuronal development and regeneration is undetermined. This study suggests that all-*trans* RA acts via its RARβ receptor to stimulate neurite outgrowth from adult newt spinal cord explants, and may represent an important chemotropic molecule for nerve dependent limb regeneration. All-*trans* RA's effects are not limited to the vertebrate species, as it was found that all-*trans* RA induces neurite outgrowth and retains electrical excitability in isolated adult molluscan invertebrate neurons. Using analytical chemistry techniques, both all-*trans* RA and its isoform, 9-*cis* RA, were identified in the invertebrate CNS. 9-*cis* RA showed a similar neurotrophic role to that of all-*trans* RA on cultured molluscan neurons. Further, all-*trans* and 9-*cis* RA were capable of inducing growth cone chemoattraction. This occurred in the absence of the neuronal cell body, unlike the growth promoting and increased survival effects of all-*trans* RA, suggesting a novel signaling mechanism for all-*trans* and 9-*cis* RA for growth cone guidance. This study demonstrates a similar role for all-*trans* RA in the invertebrate and vertebrate species. Investigating the factors involved in promoting neurite outgrowth may ultimately aid in designing strategies to prevent nerve degeneration and developing approaches to support axonal regeneration in humans.