

# Cholinergic nervous system and glaucoma: From basic science to clinical applications

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The cholinergic system has a crucial role to play in visual function. Although cholinergic drugs have been a focus of attention as glaucoma medications for reducing eye pressure, little is known about the potential modality for neuronal survival and/or enhancement in visual impairments. Citicoline, a naturally occurring compound and FDA approved dietary supplement, is a nootropic agent that is recently demonstrated to be effective in ameliorating ischemic stroke, traumatic brain injury, Parkinson's disease, Alzheimer's disease, cerebrovascular diseases, memory disorders and attention-deficit/hyperactivity disorder in both humans and animal models.

The mechanisms of its action appear to be multifarious including (i) preservation of cardiolipin, sphingomyelin, and arachidonic acid contents of phosphatidylcholine and phosphatidylethanolamine, (ii) restoration of phosphatidylcholine, (iii) stimulation of glutathione synthesis, (iv) lowering glutamate concentrations and preventing glutamate excitotoxicity, (v) rescuing mitochondrial function thereby preventing oxidative damage and onset of neuronal apoptosis, (vi) synthesis of myelin leading to improvement in neuronal membrane integrity, (vii) improving acetylcholine synthesis and thereby reducing the effects of mental stress and (viii) preventing endothelial dysfunction. Such effects have vouched for citicoline as a neuroprotective, neurorestorative and neuroregenerative agent.

Retinal ganglion cells are neurons with long myelinated axons which provide a strong rationale for citicoline use in visual pathway disorders. Since glaucoma is a form of neurodegeneration involving retinal ganglion cells, citicoline may help ameliorate glaucomatous damages in multiple facets. Additionally, trans-synaptic degeneration has been identified in humans and experimental models of glaucoma suggesting the cholinergic system as a new brain target for glaucoma management and therapy.

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