Music and Alpha-Synuclein: Protecting the Brain From Stroke and Glioblastoma

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Music reduces stress and improves health by affecting the autonomic nervous system, and transcriptomic studies show it increases alpha-synuclein (SNCA), which regulates neuronal activity. Although SNCA aggregation is well known in Parkinson's and Alzheimer's, its role outside neurodegeneration remains unclear. Interestingly, SNCA depletion in mice causes endothelial dysfunction and hypertension, and reduced SNCA in GBM patient biopsies contrasts with its overexpression, which suppresses U87 cell growth. These findings suggest a broader protective role in vascular and neoplastic disease. This project tested the hypothesis that SNCA is reduced in pathological states and regulates proliferation, stress responses, and immune signaling across ischemic stroke, vascular injury, and GBM. Public transcriptomic datasets from mouse vascular injury, mouse stroke, and human GBM were analyzed using differential expression and pathway analyses. SNCA was consistently downregulated in all three conditions. Comparative analysis identified 129 shared differentially expressed genes enriched in cell cycle pathways. Network modeling predicted that reduced SNCA promotes proliferation and inflammatory signaling, including pathways involving BIRC5, CCNA2, and IL6. Experimental validation using human vascular smooth muscle, endothelial, and glioblastoma cells cultured on stiffness-controlled hydrogels demonstrated that SNCA expression is stiffness-sensitive—higher on soft, healthy-like substrates and reduced on stiff, disease-like conditions. Together, these findings identify SNCA as a potential regulator of proliferation, inflammation, and vascular dysfunction across neurovascular disease and brain cancer, suggesting that music-induced modulation of SNCA may have therapeutic relevance.

Awards Won:
Arizona State University: Arizona State University ISEF Scholarship (valued at up to $32,000 each)