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Novel Ex-Vivo Translaminar Autonomous System to study effects of Intraocular and Intracranial pressure differential on central nervous system neurons

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Abstract:

Cerebrospinal fluid (CSF) functions as a mechanical and chemical buffer for central nervous system tissues. The homeostatic regulation of CSF generates a pressure called the intracranial pressure (ICP). Pathological changes in ICP are a common feature of various diseases including, intracranial hypertension, traumatic brain injury, hemorrhagic stroke, and brain tumors. Recently, modulations in translaminar pressure (difference between intraocular pressure (IOP) and ICP differentials have been associated with neurodegenerative conditions such as glaucoma and microgravity generated visual damage in astronauts. Traumatic or neurodegenerative visual impairments due to various mechanical, biological or physiological modulations in translaminar pressure could cause significant visual field loss. Current techniques to measure and stimulate ICP remain invasive and with significant clinical risks. To overcome aggressive surgical procedures and mimic the in vivo paradigm to recapitulate human translaminar pressure, we developed the translaminar autonomous system (TAS) with two individual IOP and ICP pressurized chambers. This model can regulate IOP and ICP using human donor eyes. In addition, we can decellularize human posterior eye cups and seed them with human induced pluripotent stem cell (iPSC) derived retinal neurons from patient skin samples to study effects of translaminar pressure in an individualized manner. We successfully cultured the posterior cup with human iPSC-derived retinal neurons in the TAS model (Figure 1). We then generated translaminar pressure differentials by raising the media reservoir connected to IOP and ICP chambers to different heights to induce various hydrostatic pressures for IOP (10-21 mmHg) and ICP (0-15 mmHg). The pressure within the posterior region of the eye (IOP) and around the ON (ICP) was modulated in an autonomous manner. Our TAS model will allow the study of IOP and ICP insults observed in translaminar pressure mediated pathogenesis and target various ICP associated diseases.

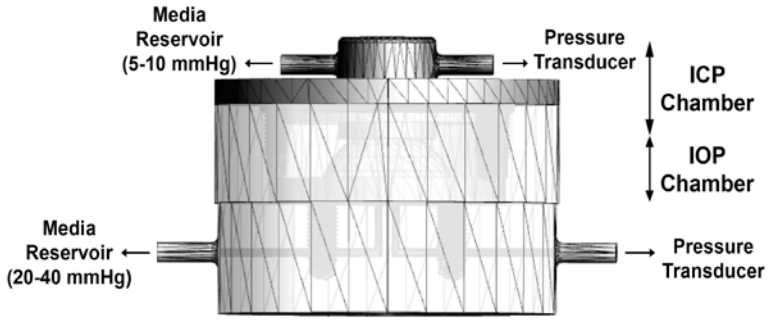

Figure 1: Translaminar autonomous system**.** Wireframe diagram depicting the TAS model and ICP and IOP chambers for regulating translaminar pressure differential.

Disclosure Block: Tasneem Putliwala Sharma, University of North Texas Health Science Center Code P (Patent); Colleen Mary McDowell, University of North Texas Health Science Center Code P (Patent); Abbot Frederick Clark, University of North Texas Health Science Center Code P (Patent)

Biography:

Tasneem Sharma is currently a scientist at the University of North Texas Health Science Center. Her passion lies in the scientific exploration of neuroregeneration, neuronal cell death and generation of patient-specific induced pluripotent stem cells (iPSCs) for disease modeling. She has utilized human iPSCs to develop different neuronal subtypes and retinal ganglion cells for treating degenerative diseases. She has expertise in CRISPR-based genome editing technology, RNA-Seq/bioinformatics analysis and neuroprotection/regeneration therapeutics. She has also expertly generated the pressurized translaminar autonomous system to model the intraocular and intracranial pressure chambers within the human eye. and study effects of translaminar pressure on iPSC-derived RGCs and their axons. She has published numerous impactful manuscripts during her scientific training including prominent peer-reviewed journals of Cell Death and Disease (Nature Publishing Group) and Stem Cell Research (Cover of Journal) and her work has been acclaimed both nationally and internationally through Association for Research in Vision and Ophthalmology, Association for Ocular Pharmacology and Therapeutics, and Golden Key National Honor's Society. She has received multiple accolades in a short period as a scientific researcher and acquired multiple scholarships. She was indicted as a graduate student into Sigma Xi, a prestigious national scientific research society designed to honor those who have made noteworthy contributions in research. In addition, she has recently been bestowed the prestigious P.J. Leinfelder Award from Iowa Eye scientific meeting of University of Iowa and a postdoctoral travel grant award at UNTHSC.