# QuanTear: A Tear Test for Stroke Detection and Monitoring

Xiao, James (School: North Allegheny Senior High School)

Stroke is a leading cause of both morbidity and long-term disability. Timely and accurate detection is critical, as ischemic stroke (IS), caused by blood clots blocking brain circulation, and hemorrhagic stroke (HS), resulting from ruptured blood vessels, require vastly different treatments. Current diagnostic tools rely heavily on the evaluation of physical symptoms, which are qualitative, subjective and unreliable. Hospital-based neuroimaging, the gold standard, is time-consuming, costly, and inaccessible in pre-hospital settings—often delaying treatment beyond the 4.5-hour window for effective therapies. To address this unmet need, tears were explored as a non-invasive, biomarker-rich biofluid for stroke detection. Using a novel in-capillary tear proteomics technology I recently developed, LC-MS/MS analysis was performed on tear samples from subjects with IS, HS, and healthy controls (HC) (n=10 per group). MaxQuant and Perseus analyses identified 1,293 proteins, with 55, 89, and 48 differentially expressed proteins (DEPs) in IS vs. HC, HS vs. HC, and HS vs. IS, respectively. Further interrogation of the DEPs revealed a biomarker panel comprising interleukin-6 (IL6), thioredoxin (TXN2), and fibrinogen (FIB), achieving 90% accuracy, 90% sensitivity, and 100% specificity in an independent cohort (n=5 per group). IL6 and TXN2 were elevated in both IS and HS, while FIB distinguished IS (elevated) from HS (decreased). Based on these findings, I developed QuanTear, a first-in-class, wearable nanoneedle-based contact lens biosensor capable of quantifying IL6, TXN2 and FIB using analog nano-colorimetric detection. QuanTear offers an affordable (<$50), non-invasive solution for pre-hospital stroke detection and monitoring, potentially saving lives through early intervention.

**Awards Won:**