A Novel Application of Microfluidics to Develop a Rapid and Cost-Effective Objective Diagnostic Method for Parkinson's Disease

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Currently, there is no objective diagnostic tool for Parkinson’s disease, a progressive neurological disorder that affects more than ten million people globally. Specialists use visible symptoms to make a diagnosis, leaving room for subjectivity. A protein called alpha-synuclein has been found to be significantly upregulated in the blood of people with Parkinson’s disease. While protein quantification processes such as the enzyme-linked immunoassay (ELISA) can be used to determine alpha-synuclein levels in the blood, these processes are costly and time-consuming. Therefore, this research tests the use of microfluidics to cheapen and accelerate this quantification process. By accounting for fundamental fluid dynamics principles, an optimal microfluidic chip was designed for the sandwich ELISA protein quantification process. Despite using significantly smaller quantities of reagents, this microfluidic chip was able to detect alpha-synuclein quantities down to 0.313 ng/mL. Additionally, when compared to a regular ELISA, the microfluidic chip reduced the amount of time required for protein quantification from 14 hours to 2 hours and 40 minutes. Due to limitations in budget, the developed chip was tested as a proof-of-concept with different concentrations of alpha-synuclein. Future research will be conducted to evaluate the accuracy of the chip using real blood. Overall, this research supported the viability of an objective point-of-care diagnostic device for Parkinson’s disease using microfluidics. This chip can greatly improve the ability of people in third-world countries to get an objective diagnosis for Parkinson's disease while also possibly aiding the diagnosis of other diseases with protein biomarkers.