Extracellular Vesicle Capture and microRNA Detection

By

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Technical Summary

Cancer is one of the leading causes of death in the United states, and there is substantial focus on earlier disease detection through the discovery of novel, easily accessible biomarkers via liquid biopsies. Extracellular vesicles have shown promise as a noninvasive biomarker for disease diagnosis and monitoring, and have become a treasure trove of information because they have been found to carry proteins, DNA, mRNA and microRNA as well surface markers indicative of their cell origin. Thus, developing methods to profile extracellular vesicles and interrogate the contents of these vesicles is a growing area of research and has the potential to develop into a non-invasive diagnostic platform.

In this presentation, I highlight our work on extracellular vesicle capture and microRNA profiling, utilizing the numerous benefits of hydrogels for biomolecule detection assays, namely their biocompatibility, solution-like kinetics, non-fouling nature, and tunable chemistry. First, we developed various amplification strategies in hydrogel particles for microRNA detection, including a colorimetric detection platform that can be translated to point-of-care settings for a liquid biopsy. This colorimetric platform allows for multiplexed miRNA detection from complex samples using simple cell-phone images. Then we developed methods for extracellular vesicle lysis and microRNA detection in hydrogel particles using a one-pot lysis and microRNA capture method. Using rolling circle amplification, we performed multiplexed miRNA detection and quantification from serum-derived extracellular vesicles. Finally, we tuned hydrogel particle porosity and antibody conjugation for immunocapture of extracellular vesicles. We explored the use of the thiol-acrylate Michael addition reaction for antibody conjugation and optimized it for extracellular vesicle capture. Using these porous, antibody-functionalized hydrogel particles, we captured breast cancer serum and matched healthy serum extracellular vesicles using two surface markers. We believe that this work can be leveraged to improve upon and develop new technologies for extracellular vesicle capture and analysis, leading to more insights into this promising biomarker, eventually leading to earlier and more accurate diagnosis of disease.

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