SELECTIVE ISOLATION OF SPERM FROM BIOLOGICAL SAMPLES USING A UNIQUE OLIGOSACCHARIDE CAPTURE REAGENT IN A MICROFLUIDIC PLATFORM

Fatih Inci [1], William T. Sharp [2], Leonard Klevan [2], and Utkan Demirci [1]
[1]Demirci Bio-Acoustic-MEMS in Medicine (BAMM) Laboratory, Department of Medicine, Brigham and Women's Hospital, Harvard Medical School
[2]DxNow Inc.

A method for rapid and efficient processing of sexual assault evidence will accelerate forensic investigation and reduce casework backlogs. In the USA there are over 200,000 reported rapes and sexual assaults per year and it has been estimated that a rape occurs every 10 - 20 minutes in India and South Africa. Processing of sexual assault evidence generally requires separation of the victim's cells (epithelial) from the perpetrators cells (sperm) and involves time consuming steps of selective cell lysis, centrifugation and separation into female and male DNA fractions.

To address these challenges, microfluidics and lab-on-a-chip technologies hold an invaluable potential by integrating multiple steps on a single device, improving the scaling capacity, providing the ability to couple various detection platforms, minimizing reagent consumption and reducing the need for skilled analysts. At the Bio-acoustic MEMS in Medicine Laboratory at Harvard Medical School, we have developed microfluidic-based platforms that incorporate novel flow and detection capabilities including optical, electrical and mechanical tools for the capture and sort of various type of cells and pathogens (*e.g.,* sperm cells, white blood cells, bacteria and viruses) by utilizing highly specific recognition elements. These platform technologies can be tailored to isolate, detect, capture and sort multiple cell types from unprocessed bodily fluids for forensic science applications.

The ability to selectively capture inactive sperms from complex biological fluids is of great interest. Recent investigations have identified a unique oligosaccharide (*i.e.,* sialyl-Lewis^x sequence [NeuAca2-3Galb1-4(Fuca1-3)GlcNAc]) located on the extracellular matrix (*i.e.,* zona pellucida (ZP)) of the oocyte. This oligosaccharide sequence is the most abundant terminal sequence on human ZP that represents a ligand for human sperm-egg binding. Here, we have proposed to develop a disposable microfluidic chip that can detect and capture sperm cells from unprocessed bodily fluids. In this study, microfluidic channels will be functionalized using silanization based surface chemistry, and then, sialyl-Lewis^x oligosaccharide will be immobilized to selectively capture sperm cells. Sialyl-Lewis^x oligosaccharide has a great advantage over antibody-based methods by presenting long shelf life and storage capability. Spiked and mixed samples (comprised of sperm and epithelial cells) will be evaluated using this technology. Thus, the proposed separation and detection platform will allow efficient separation of sperm cells from epithelial cells in sexual assault evidence, reducing analyst time and accelerating the forensic process.