ISOLATION AND QUANTIFICATION OF SPERM ON A MICROFLUIDIC-INTEGRATED SHADOW IMAGING SYSTEM

Fatih Inci, Ph.D [1], Leonard Klevan, Ph.D [2], Utkan Demirci, Ph.D [1],
[1] Stanford University School of Medicine, Department of Radiology, Canary Center at Stanford for Cancer Early Detection
[2] DxNow Inc.

The 2013 National Institute of Justice Report titled "MAKING SENSE OF DNA BACKLOGS, 2012 —MYTHS VS. REALITY", reported a 10% increase in DNA cases processed when comparing 2011 to 2009, but "DNA backlogs nevertheless continued to increase because the demand for forensic DNA casework services in 2011 increased by 16.4 percent over 2009 demands, which continues to outpace the nation's capacity to work DNA cases." In particular, processing of sexual assault evidence in forensic casework remains a bottleneck in the laboratory due to the time consuming steps of selective cell lysis, centrifugation and separation into female and male DNA fractions.

To address these challenges, we described (ISHI, 2013) the development of a microfluidic process for selective sperm isolation involving a unique oligosaccharide capture moiety (SLeX), which is present in the extracellular matrix of the oocyte. We reported that a SLeX modified microfluidic chip had ~54% capture efficiency for human sperm cells. These results have been improved due to coupling of ABAH with this specific carbohydrate unit, so that capture efficiencies are ~77%. We are now investigating the efficiency of the microfluidic chip to capture sperm samples which are environmentally challenged, as often found in forensic casework.

In 2011, Zhang et.al from the Demirci Laboratory at Harvard Medical School described a novel sperm visualization system "Lensless imaging for simultaneous microfluidic sperm monitoring and sorting" (DOI: 10.1039/c1lc20236g). The technology for shadow imaging of biological cells requires no previous labeling of the sample and provides a low cost alternative to conventional processing methods for cell isolation and detection. The SLeX modified microfluidic chip will be employed with a shadow imaging detector which incorporates LED illumination and a CMOS image sensor to efficiently separate sperm cells from epithelial cells in sexual assault evidence. The microfluidic process will also allow for quantitation of sperms on the chip and help to identify the most probative samples and the most effective analytical system for forensic analysis.