B26 The Development of a Multichannel Paper Microfluidic Device for the Detection of Drugs of Abuse Using Gold Nanoparticle/Aptamer Complexes

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The goal of this presentation is to describe a design of a multichannel paper microfluidic device that provides colorimetric detection based on the formation of a complex of gold nanoparticles and aptamers. Information provided will include the design of the multichannel paper microfluidic device, the multiplexed detection of different controlled substances, and the validation of the multichannel paper chip.

This presentation will impact the forensic science community by demonstrating an application of presumptive detection using a novel paper-based detection method. This new procedure is rapid, inexpensive, and applicable for the detection of multiple seized drugs, including cocaine, codeine, and methamphetamine.

Recently, new types of aptamers have been developed to bind specific drugs of abuse. Aptamers are oligonucleotides or peptide sequences that bind other molecules. This binding can be exploited for detection using various techniques such as colorimetry, amperometry, or surface plasmon resonance. An alternative platform for gold nanoparticle/ aptamer detection based on paper microfluidic devices has been investigated. To accomplish this, a paper microfluidic chip with a multiple-channel design has been created that combines gold nanoparticles and special aptamers into a ready-to-use format. To operate the procedure, samples are dissolved in a carrier solvent in vials, then applied to the paper just before analysis. The high specificity of aptamer binding can result in a useful presumptive test with minimal interferences. These devices are easy to prepare and inexpensive to operate.

Paper microfluidic devices were prepared with a wax-ink printer, thermal laminator, chromatography paper, gold nanoparticles, and aptamers. The melted wax ink creates hydrophilic channels on paper chips. Gold nanoparticles and the developed aptamers are then placed sequentially in each channel. Drug samples dissolved in ionic moving solutions migrate up the channel via capillary action, whereupon they reach a zone containing free aptamers followed by a zone containing gold nanoparticles. If the target drug is not present, the aptamers bind the nanoparticles in a non-specific fashion, and no color change occurs; however, if the target drug is present, the aptamers bind the drug and a salt-induced color change occurs since there are no aptamers left to prevent nanoparticle aggregation. The resultant color change from red to black indicates a positive response. The entire process takes five to ten minutes.

This new microfluidic device permits the development of rapid, inexpensive, and easily operated tests for drugs of abuse. The multi-channel design provides a safe and convenient presumptive tool for the detection of several drugs at once.

Presumptive Drug Testing, Aptamer, Gold Nanoparticles

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