K18 Application of Biochip Array Technology to the Simultaneous Screening of Drugs From a Single Hair Sample Using the Biochip Analyzer Evidence Investigator

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Learning Overview: After attending this presentation, attendees will gain an understanding about the application of biochip array technology to the simultaneous screening of drugs in hair using a semi-automated biochip analyzer. This application increases the screening capacity during the drug testing process.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing results from the evaluation of this new application that allows simultaneous screening of multiple drugs: amphetamine, benzodiazepines, benzoylecgonine/cocaine, cannabinoids, hydrocodone, ketamine, methamphetamine, opiates, oxymorphone, and phencyclidine from a single hair sample. Simultaneous immunoassays arrayed on the biochip surface allow this multi-analytical approach, which leads to test consolidation and an increase in the screening capacity in test settings.

Biochip array technology enables the simultaneous detection of multiple analytes from a single sample. The collection of hair samples is non-invasive and the use of this matrix for drug testing provides a large window of detection as well as the history of drug exposure over time for an individual. Society of Hair Testing (SoHT) and European Workplace Drug Testing Society (EWDTS) guidelines for drug testing in hair are in place.

Competitive chemiluminescent biochip-based immunoassays were employed. Ligands were immobilized and stabilized onto the biochip surface defining an array of discrete test sites. The signal output was inversely proportional to the concentration of drug in the sample. The immunoassays were applied to the biochip analyzer Evidence Investigator. With this system, 54 biochips can be handled at a time. The extraction of the drugs from hair samples (50mg) involved water addition, centrifugation, and the addition of methanol and zircon pulverizing beads. Following spinning and pulverization, methanol was added; after decantation and drying, the reconstituted sample was added to the biochip. The total assay time including wash, extraction, and assay, was 12 hours.

The assays presented the following cut-off and Limit Of Detection (LOD) values respectively: 0.04ng/mg and 0.032ng/mg for amphetamine, 0.02ng/mg and 0.004ng/mg for benzodiazepines, 0.2ng/mg and 0.018ng/mg for benzoylecgonine/cocaine, 0.01ng/mg and 0.008ng/mg for Δ9-THC, 0.001ng/mg and 0.0008ng/mg for THC-COOH, 0.04ng/mg and 0.01ng/mg for hydrocodone, 0.5ng/mg and 0.354ng/mg for ketamine, 0.15ng/mg and 0.06 ng/mg for methamphetamine, 0.04ng/mg and 0.02ng/mg for opiates, 0.1ng/mg and 0.046ng/mg for oxymorphone,and 0.02ng/mg and 0.01ng/mg for phencyclidine. Inter-assay precision expressed as percentage Coefficient of Variation (CV) (n=15, 50% cut-off, cut-off and +50% cut-off), was <18% for all the assays. Authentic hair samples (n=43) were assessed with the biochip-based technology and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS), the percentage agreement was 98% (amphetamine, benzoylecgonine/cocaine), 95% (cannabinoids, opiates), and 86% (methamphetamine).

In conclusion, the results indicate applicability of biochip array technology to the simultaneous screening of drugs from a single hair sample. Regarding the cut-offs, for drugs appearing in the SoHT or EWDTS guidelines, the cut-off for ketamine was the same and for amphetamine, benzodiazepines, benzoylecgonine/cocaine, Δ9-THC, methamphetamine, and opiates, the cut-offs were lower with the biochip platform, reflecting high sensitivity. Favorable agreement with LC/MS/MS was found for the drugs present in the authentic samples. With the Evidence Investigator, multiple samples can be assessed at a time (up to 54 biochips can be handled at the same time,) which further increases the screening capacity.

Biochip Array, Multi-Drug Testing, Hair Testing