DEVELOPMENT OF A RAPID (LESS THAN TWENTY THREE MINUTES) BIOCHIP BASED MULTI-ANALYTICAL DETECTION OF DRUGS OF ABUSE IN WHOLE BLOOD

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Introduction

In blood drug testing is beneficial to increase the information provided in the screening step from a single sample as it facilitates the testing process. Biochip array technology enables the multi-analytical screening of drugs, which increases the screening capacity. The application of the biochip based immunoassays to the Evidence MultiSTAT analyser allows rapid drug screening which is relevant in test settings.

This study aimed to develop a rapid (less than 23 minutes) and simple multi-analytical biochip based screening of different drug classes, including new psychoactive substances, from a single sample of blood.

Methodology

Based on biochip array technology, simultaneous biochip based immunoassays were applied to the fully automated biochip analyser Evidence MultiSTAT (EV4195, EV4115, Randox Toxicology Ltd, Crumlin, UK). This system processes a self-contained cartridge containing all the components required for the immunoassay reactions. After simple centrifugation and dilution (1:4) the blood sample is ready to be added to the biochip. The blood sample is tested against a cut-off sample, the results are qualitative.

Biochip (9 mm x 9 mm) | Discrete Test Regions | MultiSTAT Cartridge | Fully Automated MultiSTAT analyser

Test Menu and cut-offs

Assay	Cut-off (ng/mL)	Assay	Cut-off (ng/mL)
AB-CHMINACA	5	Fentanyl	1
AB-PINACA	2	6-Monoacetylmorphine (6-MAM)	10
alpha-Pyrrolidinopentiophenone (alpha-PVP)	5	Methadone	10
Amphetamine	50	Methamphetamine	50
Barbiturates	50	Phencyclidine (PCP)	5
Benzodiazepines	20	Pregabalin	1000
Benzoylecgonine/Cocaine	25	Opiate	80
Buprenorphine	2	Oxycodone	10
Cannabinoids (THC)	10	Tramadol	5
Ethyl glucuronide (EtG)	500	Tricyclic antidepressants (TCA)	60

Results

Repeatability

Repeatability was determined by assessing control material prepared at -50% of the cut-off, the cut-off, and +50% of the cut-off against a cut-off sample. The samples were analyzed twice a day for 10 days (n=20). The qualitative results were determined and presented as percentage agreement for the number of samples that correctly reported negative and positive.

Assay		-50% cut-off	Cut-off	+50% Cut-off	Agreement (%)
AB-CHMINACA	+	0	20	19	98
	-	20	0	1	
AB-PINACA	+	0	5	20	100
	-	20	15	0	
alpha-Pyrrolidinopentiophenone (alpha-PVP)	+	0	12	20	100
	-	20	8	0	
Amphetamine	+	0	12	20	100
	-	20	8	0	
Barbiturates	+	0	6	20	100
	-	20	14	0	
Benzodiazepines	+	1	6	20	98
	-	19	14	0	
Benzoylecgonine/Cocaine	+	0	12	20	100
	-	20	8	0	
Buprenorphine	+	0	16	20	100
	-	20	4	0	
Cannabinoids (THC)	+	1	4	20	98
	-	19	16	0	
Ethyl glucuronide (EtG)	+	0	10	20	100
	-	20	10	0	
Fentanyl	+	1	1	20	98
	-	19	19	0	
6-Monoacetylmorphine (6-MAM)	+	0	0	20	100
	-	20	20	0	
Methadone	+	0	5	20	100
	-	20	15	0	
Methamphetamine	+	0	2	20	100
	-	20	18	0	
Phencyclidine (PCP)	+	1	6	20	98
	-	19	14	0	
Pregabalin	+	0	0	20	100
	-	20	20	0	
Opiate	+	0	2	20	100
	-	20	18	0	
Oxycodone	+	0	12	20	100
	-	20	8	0	
Tramadol	+	0	2	20	100
	-	20	18	0	
Tricyclic antidepressants (TCA)	+	1	9	20	98
	-	19	11	0	

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Accuracy

The accuracy was determined by assessing spiked samples at varying concentrations (50 spiked positive samples prepared at concentrations greater than the cut-off, 10 negative spiked samples prepared at concentrations lower than the cut-off and 40 blank negative samples). Each sample was assessed against the cut-off material to determine a positive or negative result. The percentage agreement was calculated as the percentage of correct reports out of the total number of samples (n=100) analysed.

Assay		Spike +	Spike -	Agreement (%)
AB-CHMINACA	+	50	0	100
	-	0	50	
AB-PINACA	+	50	0	100
	-	0	50	
alpha-Pyrrolidinopentiophenone (alpha-PVP)	+	50	0	100
	-	0	50	
Amphetamine	+	50	0	100
	-	0	50	
Barbiturates	+	50	0	100
	-	0	50	
Benzodiazepines	+	50	0	100
	-	0	50	
Benzoylecgonine/Cocaine	+	49	0	99
	-	1	50	
Buprenorphine	+	45	0	95
	-	5	50	
Cannabinoids (THC)	+	50	1	99
	-	0	49	
Ethyl glucuronide (EtG)	+	50	0	100
	-	0	50	
Fentanyl	+	50	0	100
	-	0	50	
6-Monoacetylmorphine (6-MAM)	+	49	0	99
	-	1	50	
Methadone	+	50	0	100
	-	0	50	
Methamphetamine	+	50	0	100
	-	0	50	
Phencyclidine (PCP)	+	49	0	99
	-	1	50	
Pregabalin	+	50	0	100
	-	0	50	
Opiate	+	50	0	100
	-	0	50	
Oxycodone	+	50	0	100
	-	0	50	
Tramadol	+	50	0	100
	-	0	50	
Tricyclic antidepressants (TCA)	+	50	0	100
	-	0	50	

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Conclusion

Data indicate that different drug classes can be screened in less than 23 minutes from a single blood sample by applying simultaneous biochip-based immunoassays to the biochip analyser Evidence MultiSTAT. This application will facilitate the drug testing process as it allows a rapid and easy to use multi-analytical screening of blood samples.