



The most selective LC-EC applications for Clinical & Diagnostics analysis

**Catecholamines**

Serotonin  
Metanephrines  
VMA  
HVA  
5-HIAA

**PET imaging tracer**

Fluorodeoxyglucose (FDG)  
FDG impurities

**Sulfides**

Homocysteine  
Glutathione  
Disulfides

**Vitamins, minerals**

A, C, D, E, and K  
Iodide  
Q10, Ubiquinols

## Catecholamines in Urine

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- **Urine kit, including sample prep**
  - **Standardized, fast and reliable assay**
  - **Robust and reproducible**
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### Summary

HPLC with electrochemical detection has been established as a fast and reliable method for the determination of catecholamines and metabolites in plasma and urine [1-5]. The ALEXYS Clinical Analyzer together with a commercially available kit has been evaluated. This dedicated system has proven to be robust and reproducible in routine analysis.

## Introduction

The quantitative determination of the urinary catecholamines noradrenaline (NA), adrenaline (A), and dopamine (DA) is a rapid and precise diagnostic method for the identification of pheochromocytoma and other tumor diseases of the nervous system such as neuroblastoma and ganglioneuroma. Approximately, half of all pheochromocytoma patients suffer from permanent hypertension, in others episodic hypertensive crises occur. In about 40 % of the latter group plasma catecholamine concentrations are not raised in the interval between two crises. Nevertheless, determination of catecholamine levels in the 24-hours urine allows the detection of pathologically increased values, even after a hypertensive crisis.



Figure 1: ALEXYS Clinical Analyzer.

## Method

Table 1

Set-up	
HPLC	ALEXYS Clinical Analyzer
Flow cell	GC type flow cell with Ag/AgCl salt bridge REF
Column	Analytical column for Catecholamines in urine
Flow rate	1.0 mL/min
Sample	20 $\mu$ L, extracted with sample preparation columns
Mobile phase	HPLC kit buffer
Temperature	D2 SDC 30°C (separation & detection), AS110 4°C (sample cooling)
E-cell	500 mV (vs. Ag/AgCl sat'd)
Range	10 nA/V
I-cell	Ca. 0.2 – 3.0 nA
ADF	0.1 Hz
Analysis time	15 minutes

A kit for catecholamine analysis contains all the necessary chemicals and materials for sample preparation and analysis. Urine samples are processed prior to analysis:

- 3 mL acidified urine sample (10 mL conc. 32% HCl per liter urine) or urine calibrator is mixed with 10 mL stabilizing reagent and 30  $\mu$ L internal standard (IS) and subsequently adjusted to a pH 3.0 – 7.0 using 0.5M NaOH.
- The mixture is applied to a sample preparation column to trap the catecholamines.
- The column is subsequently washed with 15 mL HPLC-grade water to remove interfering components.
- 6 mL of eluting reagent is then used to elute the catecholamines from the extraction column.
- The eluate is collected, mixed and 20  $\mu$ L injected in the LC system.

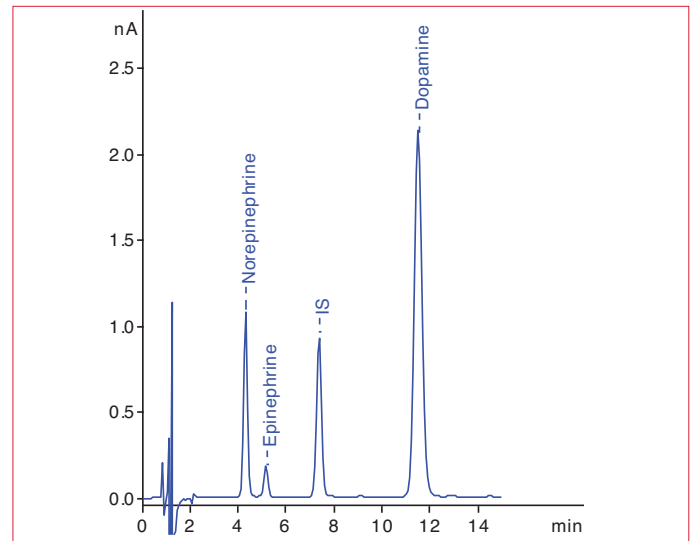


Figure 2: Analysis of 20  $\mu$ L urine calibrator. Concentration of catecholamines in the calibrator sample: 123  $\mu$ g/L NA, 29.5  $\mu$ g/L A and 227  $\mu$ g/L DA.

The quantification of the catecholamines in the urine samples is performed by means of a single-point calibration method using a urine calibrator. The urine calibrator in the kit consists of lyophilized urine with a known amount of catecholamines. The urine calibrator should be processed exactly the same way as the urine samples. A chromatogram of a urine calibrator analysis is shown in Fig. 2.

An internal standard method is used to compensate for recovery loss during the sample preparation step. To every urine sample, calibrator or control 30  $\mu$ L of internal standard (IS) solution is added. The IS response of the samples is compared to that of a standard solution (standard) to determine the



recovery. The sample response is then interpolated to 100% recovery to establish the real catecholamine concentration in the urine samples.

## Results

### Analysis of controls

For validation of the analytical method 'urine controls' have been analyzed in both the normal (level I) and the pathological range (level II).

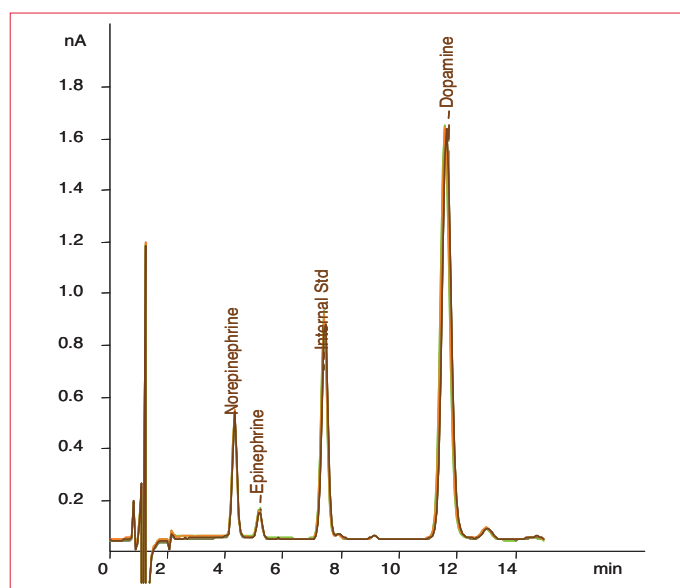


Figure 3: Overlay of 6 chromatograms of 20  $\mu$ L injections of control level I.

The control samples are lyophilized urine samples which have to be processed in the same way as the urine samples. Both control level I and control level II were analyzed and the analyte concentrations quantified using the urine calibrator. For both urine controls level I and II the determined concentrations were within the concentration ranges specified by on the urine control data sheet (see table 2).

Table 2

### Measured concentration of urine controls level I and II

Component	Specified ( $\mu$ g/L)		Specified ( $\mu$ g/L)	RSD (%)
	Min	Max		
<b>Control level I</b>				
NA	44	66	58.7	0.8
A	14	21	18.7	0.8
DA	120	180	176.6	0.8
<b>Control level II</b>				
NA	125	187	156.9	0.2
A	29	43	35.1	1.5
DA	186	278	236.9	0.5

Measured concentration of urine controls level I and II (n=6). Concentration range specified is given for reference (source: data sheet supplied with controls).

### Analysis of urine samples

Urine samples were collected from an apparently healthy volunteer and analyzed multiple times to determine the recoveries, LOD, intra- and inter-assay precision of the method. The intra-assay precision of the method was determined using two urine samples (A and B). The urine samples were worked-up 5 times and duplicate analysis were performed to determine the relative standard deviation (RSD, %).

Table 3

### Intra-assay precision of urine sample A and B

Component	RSD (%)	Conc. ( $\mu$ g/L)
<b>Sample A</b>		
NA	2.8	30.6
A	1.7	16.0
DA	3.7	102.5
<b>Sample B</b>		
NA	2.5	20.7
A	14	3.6
DA	2.3	115.2

Intra-assay precision of urine sample A and B, n= 5 (samples) x 2 (duplicate injections).



# Catecholamines in Urine

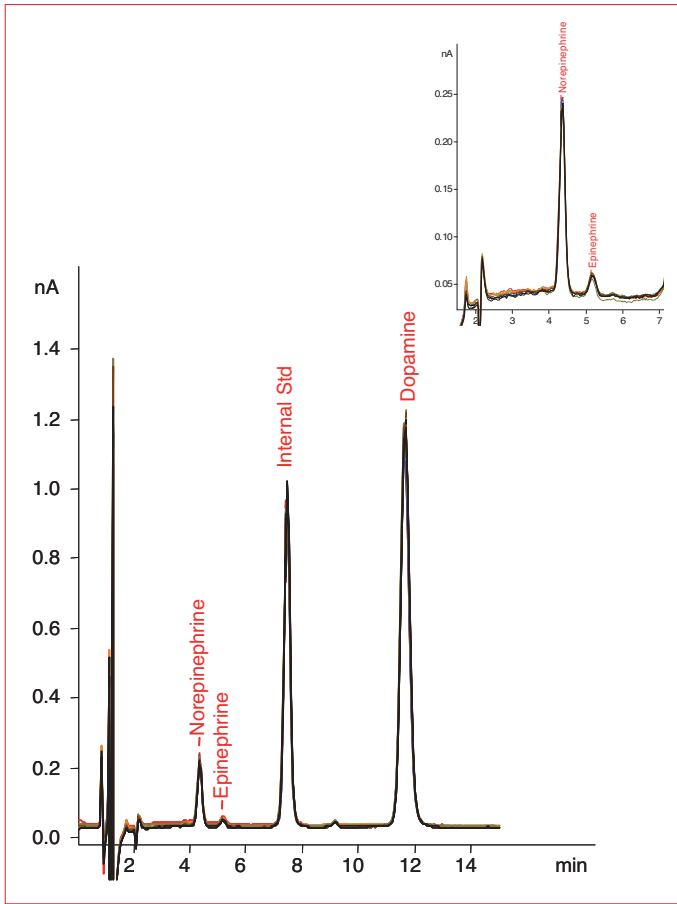


Figure 4: Overlay of 10 chromatograms of 20 µL injections of urine sample B. Zoom in on NA and A peaks.

The RSD's for all components were typically smaller than 4%. Only for low concentrations of adrenaline, near the limit of quantitation, a RSD of 14 % was found.

For all urine samples, controls and calibrator recoveries typically in the range of 85 – 95% were found, compared to a standard. The concentration limit of detection (CLOD) for the method was approximately 1 µg/L for all catecholamines. The CLOD here is based on a 20 µL injection and defined as the concentration that gives a signal that is three times the peak-to-peak noise. The method is linear for the determination of the catecholamines in the concentration range from 1 – 1000 µg/L [6].

To determine the inter-assay precision a urine sample (C) was worked-up 4 times and analyzed (duplicate injection), this procedure was repeated the next day and the relative standard deviation calculated.

Table 4  
Inter-assay precision

Component	RSD (%)	Conc. (µg/L)
Sample C		
NA	3.8	48.7
A	6.2	5.1
DA	3.2	225.1

Inter-assay precision (urine sample C, n= 4 (samples) x 2 (duplicate injections) x 2 (days).

The RSD's for noradrenaline and dopamine were smaller than 4%. For adrenaline, which was present in the sample in a significantly lower concentration, the RSD was slightly higher, 6.2%.



## References

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5. P. Bouloux, D. Perret, G.M. Besser, *Ann. Clin. Biochem.* 22 (1985) 194-203.
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## Conclusion

The ALEXYS Clinical Analyzer in combination with a commercially available kit provides a standardized method for fast and reliable analysis of catecholamines.



## Catecholamines in Urine

### Ordering information

180.0039E	ALEXYS Clinical Analyzer
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*For research purpose only.* The information shown in this communication is solely to demonstrate the applicability of the ALEXYS system. The actual performance may be affected by factors beyond Antec's control. Specifications mentioned in this application note are subject to change without further notice.

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