

Dopamine (plasma, urine)

1 Name and description of analyte

- 1.1 Name of analyte
Dopamine
- 1.2. Alternative names
4-(2-aminoethyl)benzene-1,2-diol
- 1.3 NLMC code
To follow
- 1.4 Description of analyte
Dopamine is a catecholamine produced predominantly by chromaffin bodies of adrenergic nerves. Dopamine is synthesised from tyrosine. It has a short plasma half-life, of the order of several minutes.
- 1.5 Function of analyte
Dopamine functions predominantly as a neurotransmitter. It is thought to play a role in cognition, reward, voluntary movement, motivation and punishment. It exerts its actions through five dopamine receptors (D₁-D₅). Loss of dopamine-secreting neurones is a constant feature of Parkinson's disease; high plasma concentrations have been associated with psychoses including schizophrenia. Many antipsychotics function as dopamine antagonists, inhibiting the action of dopamine action at its receptors. Dopamine also functions as the neuroendocrine inhibitor of prolactin synthesis. Dopamine is used therapeutically for its effects on the kidneys, to promote natriuresis, and cardiac muscle, to increase cardiac output.

2 Sample requirements and precautions

- 2.1 Medium in which measured
Dopamine is usually measured in urine.
- 2.2 Precautions re sampling, handling etc.
Urine samples must be collected into acid containers (pH <3.5). A 24 h collection is preferred for adults and a random collection for children. In difficult cases, analysis of three separate collections may increase the clinical sensitivity of the test.

3 Summary of clinical uses and limitations of measurements

- 3.1 Uses
Dopamine is measured in the investigation of suspected catecholamine-secreting tumours e.g. neuroblastomas and dopamine-secreting pheochromocytomas
- 3.2 Limitations
None

4 Analytical considerations

4.1 Analytical methods

Dopamine is measured by high performance liquid chromatography (HPLC) with electrochemical detection or HPLC coupled to liquid-chromatography tandem mass spectrometry (LC-MS/MS). Both methods require extraction of catecholamines prior to analysis.

4.2 Reference method: none

4.3 Reference materials: none

4.4 Interfering substances

Grossly haemolysed samples are unsuitable for analysis.

4.5 Sources of error

1. Amitriptyline can interfere with HPLC analysis of plasma dopamine, causing falsely elevated results.
2. Several drugs used to treat psychiatric patients prevent catecholamine reuptake and may increase urinary excretion.
3. The following can interfere with or cause non-pathological increases in urine dopamine measurements:
 - paracetamol
 - L-DOPA
 - α -methyl-DOPA.

5 Reference intervals and variance

5.1.1 Reference interval (adults)

Urine: <3194 nmol/24 h (derived in a hypertensive population)

5.1.2 Reference intervals (children)

Plasma: dopamine is usually undetectable in plasma by HPLC analysis

Urine: 0–24m <2216 nmol/mmol creatinine; 2–4 y <1132 nmol/mmol creatinine, 5–9 y <774 nmol/mmol creatinine, 10–19 y <403 nmol/mmol creatinine. A comprehensive schedule of reference values is provided in Davidson DF *et al*, Ann Clin Biochem 2011;48:358-366.

5.1.3 Extent of variation (all figures relate to measurements in urine)

5.1.3.1 Interindividual CV: 18.5%

5.1.3.2 Intraindividual CV: 8.5%

5.1.3.3 Index of individuality: 0.46

5.1.3.4 CV of method: ~10% (urine and plasma)

5.1.3.5 Critical difference: 36.4%

5.1.3 Sources of variation

Urinary dopamine excretion increases with increasing salt intake.

6 Clinical uses of measurement and interpretation of results

6.1 Indications for measurement

Dopamine measurements are used:

- in the diagnosis of catecholamine-secreting tumours e.g. neuroblastomas
- to assess the completeness of surgical removal of catecholamine-secreting tumours

- to detect recurrence of a catecholamine-secreting tumour following surgical removal .

6.2 Confounding factors
None

7 Causes of abnormal results

7.1 High values

7.1.1 Causes:

- neuroblastoma
- consumption of a high-salt diet
- (extremely rarely) pheochromocytomas and paragangliomas.

7.1.2 Investigation

When high concentrations or urinary excretion of dopamine are demonstrated, further investigation is by imaging and/or venous sampling for localisation of the source.

7.2 Low values

7.2.1 Causes:

- low plasma concentrations of dopamine are found in patients with autonomic neuropathies including diabetic neuropathy and Parkinson's disease. However, dopamine measurements are of no value in the diagnosis or management of these conditions.

7.2.2 Investigation

Not applicable

7.3 Notes

Individuals on treatment with L-dopa for Parkinson's disease or dopamine-responsive dystonia have extremely high excretion of dopamine (usually >30,000nmol/24h). Medication should be stopped several weeks before samples are taken for diagnostic purposes. A high dietary salt intake has been shown to increase dopamine excretion to above the reference range.

8 Performance

8.1 Sensitivity, specificity etc. for individual conditions

Diagnosis of neuroblastomas (note that the figures given are approximate: exact values will depend on the precise cut-offs used).
Urine: sensitivity 61%; specificity 86%.

9 Systematic reviews and guidelines

9.1 Systematic reviews

Peaston RT, Weinkove C. Measurement of catecholamines and their metabolites. *Ann Clin Biochem* 2004;41:17-38.

9.2 Guidelines

1. Brodeur GM, Pritchard J, Berthold F *et al.* Revisions of the international criteria for neuroblastoma diagnosis, staging, and response to treatment. *J Clin Oncol* 1993;11:1466-1477.

2. Brodeur GM, Seeger RC, Barrett A *et al.* International criteria for diagnosis, staging, and response to treatment in patients with neuroblastoma. *J Clin Oncol* 1988;6:1874-1881.

9.3 Recommendations

1. Pacak K, Eisenhofer G, Ahlman H *et al.* Pheochromocytoma: recommendations for clinical practice from the First International Symposium. October 2005. *Nat Clin Pract Endocrinol Metab* 2007;3:92-102.

10. Links

10.1 Related analytes

3-Methoxytyramine is a metabolite of dopamine. This can be measured in both plasma and urine and is considered more sensitive than measurement of dopamine in the investigation of neuroblastomas. In addition, measurement of homovanillic acid, another metabolite of dopamine, is useful in the diagnosis of neuroblastomas.

10.2 Related tests

Dopamine is usually measured as part of a catecholamine assay set in combination with [adrenaline](#) and [noradrenaline](#).

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