

Adult Water Deprivation Test - Full Clinical Guideline

(Document Code: CHISCG23)

**THIS TEST IS ONLY TO BE PERFORMED FOLLOWING DISCUSSION WITH
A CONSULTANT BIOCHEMIST OR ENDOCRINOLOGIST**

1. Introduction

The water deprivation test is used in the investigation of polyuria, after common causes such as chronic renal failure, diabetes mellitus, hypercalcaemia, hypokalaemia and diuretic use have been excluded. In an adult, polyuria is defined as a consistent 24 hour urine volume in excess of 3 litres. The procedure is of use in the investigation of diabetes insipidus (pituitary or nephrogenic) and compulsive water drinking (also known as psychogenic polydipsia).

Initial assessment should include the exclusion of diabetes mellitus. A normal 24 hour urine volume (i.e. up to 3L) makes a diagnosis of diabetes insipidus (DI) unlikely. Initial assessment should also include the patient undertaking an >2hr fluid restriction followed by an early morning blood test for U&E, Copeptin and serum osmolality with matched urine osmolality measurements. An early morning overnight urine sample having an osmolality of greater than 750 mosmol/kg would exclude DI. A serum copeptin level <4.9 pmol/L or >21.3 pmol/L in the presence of a high serum sodium ≥ 150 mmol/L with a urine osmolality <750 mosmol/kg is also diagnostic of DI. Complete DI is characterised by a high or high-normal serum osmolality with a relatively fixed urine osmolality persistently below that of serum, although in milder cases (Partial DI) urine osmolality may be a little higher than serum osmolality. Low or low-normal serum osmolalities are typical of Compulsive Water Drinking (CWD), although urine osmolalities may be variable. In CWD early morning urine osmolality is often above that of the serum level while daytime levels fall below that of serum.

If these preliminary observations are inconclusive then the water deprivation test may be carried out. The object of this test is to deprive the patient of fluid in order to observe the effect on urine output and osmolality. Failure to concentrate urine above 750 mosmol/kg is suggestive of DI. The water deprivation test is often linked to a desmopressin (DDAVP) test which aims to demonstrate whether the kidneys can respond adequately to vasopressin. Restoration of concentrating ability following DDAVP implies vasopressin deficiency (pituitary DI).

2. Guideline

INDICATIONS

Differential diagnosis of polyuria. The test is NOT INDICATED if:

- 1) an early morning overnight urine osmolality is >750 mosmol/kg

OR

- 2) Copeptin <4.9 or >21.3 pmol/L with a serum sodium level ≥ 150 mmol/L

CONTRAINDICATIONS

None in the fully hydrated patient

PRECAUTIONS

This test is potentially dangerous and should be undertaken with great care.

- (a) Patients with DI who have marked polyuria may become severely dehydrated during fluid deprivation. The procedure should be stopped if the patient's weight decreases by more than 3%.
- (b) Thyroid function and adrenal reserve should be established as normal before embarking on the procedure and those patients whose endocrine function is deficient should be receiving appropriate replacement therapy.

PREPARATION

Planning

Inform the laboratory that this procedure is being undertaken. The investigation should be carried out on an in-patient or day case basis because of the dangers of severe dehydration and hypotension during the period of water deprivation, or of hyponatraemia and water intoxication when fluid restrictions are removed. Children should be admitted as an in-patient for this test and restriction of fluid should only start on the morning of the test (see separate protocol: Water Deprivation Test for Diabetes Insipidus In Children).

Patient

Any DDAVP must be stopped at least 24 hours before the test. Normal steroid and thyroid replacement therapy may be given before the test. During the test the patient must not eat, drink or smoke. The procedure should be performed under observation and any access to water absolutely excluded. The patient should be weighed at the start of the test and at hourly intervals during the procedure. If weight falls below 97% of the initial body weight the procedure should be stopped.

EQUIPMENT

Blood tubes for osmolality (plain or SST)

Urine MSU containers

Scales for weighing the patient

DDAVP 2 micrograms

PROCEDURE

Patient asked to minimise fluid intake overnight (taking no fluids from midnight if possible) and to take a light breakfast with minimal fluid. It should be realised that if the patient does have Diabetes Insipidus they could become severely dehydrated from omitting fluid intake. Therefore if the patient feels unwell whilst trying to minimise fluid intake they should drink to thirst. The patient should then attend at 8.30 am on the day of the test. Weigh the patient on arrival and note 97% of the body weight. Take samples of urine (for osmolality) and blood (for U&E, co-peptin and serum osmolality). Serum sodium results will be obtained using the direct ISE on the laboratory blood gas analyser to minimise turnaround times.

Start the period of fluid deprivation. If at any time during this period urine osmolality exceeds 750 mosmol/kg then procedure may be stopped. Diabetes insipidus is excluded. **If Basal serum osmolality is more than 295 mosmol/kg with a urine osmolality less than 300 mosmol/kg and Serum Na of more than 145 mmol/L proceed to giving DDAVP straight away.**

1. Period of fluid deprivation

(a) Hourly

- Weigh the patient
- Measure urine volume and osmolality
- Measure serum Na and osmolality

FLUID RESTRICTION SHOULD BE STOPPED IF:

- There is a fall in weight of >3%
OR
- Serum osmolality increases to ≥ 305 mosmol/kg

If fluid restriction is stopped then the lab should be asked to perform a copeptin on the last fluid restricted serum sample. A weight fall of >3% potentially indicates a degree of dehydration which should never be reached with careful observation of the subject.

- (b) If weight falls below 97% of starting weight then serum osmolality should be measured urgently; if above 305 mosmol/kg, then give DDAVP 2 micrograms i.m. and oral fluids (see section 2); if less than 305 mosmol/kg, the patient may simply have been overloaded with fluid before the test.
- (c) Continue water deprivation for 8 hours, or until weight falls to below 97% of the starting weight, or until urine osmolality exceeds 750 mosmol/kg
- (d) Patient should be supervised at all times to avoid surreptitious drinking
- (e) Small amounts of dry food may be taken (e.g. toast), and severe thirst may be quenched by a *few* ice-chips

2. Administration of exogenous vasopressin

- (a) DDAVP does not need to be given if the patient develops fully concentrated urine (>750 mosmol/kg) during the test. If this happens, stop test and discharge without giving DDAVP.
- (b) When either serum osmolality is above 305 mosmol/kg or after 8 hours water deprivation (unless urine osmo >750 mosmol/kg as above) then measure serum copeptin and administer DDAVP 2 micrograms intramuscularly.
- (c) Patient may have a light meal
- (d) Patients should ideally remain in hospital for a minimum of 4 hours after DDAVP is given. Hourly urine volume and osmolality should be collected during this time (*see comment below).
- (e) Patient should drink, but no more than the equivalent of twice the volume of urine passed during period of fluid restriction, over the next 12 hours. Patients must be aware that if they do not follow this advice they are at risk of life-threatening hyponatraemia. It may be appropriate to keep the patient in hospital overnight to restrict hydration.

* The ideal test involves staying for 4 hours post DDAVP. Potential barriers to this can be patient (consent) based or resource (lack of beds) based. In those circumstances the case should be discussed with the responsible consultant. Acceptable alternatives depend on the patient but may include collection of some or all post DDAVP urine samples at home or return on a different day for a DDAVP injection with 4 hours of urine collection afterwards during normal working hours.

INTERPRETATION

See attached chart

TURNROUND TIME

Osmolality results are normally available the same day.

3. References

Baylis P H and Gill GV. The Investigation of Polyuria. Clinics in Endocrinology and Metabolism. 1984; **13**: 295-310.

4. Documentation Controls

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Lead Executive Director Signature	

INTERPRETATION

	Urine Volumes	Urine Osmolality	Serum Osmolality	Urine:Serum Osmolality Ratio	Serum Co-peptin	Comments
Normal Response	Fall progressively with water deprivation	Increases to >750 mosmol/kg	Increases but remains below 295 mosmol/kg	>2.0 at end of test	N/A	
Central DI	Remain inappropriately high in spite of rising serum osmolality	Fails to rise appropriately	Usually rises to above 295 mosmol/kg by end of the test	<2.0	<4.9 pmol/L when Na \geq 150mmol/L	Urine concentrates normally after DDAVP. If serum osmolality is not >295, then U:S ratio of <2.0 is not diagnostic as patient has not been adequately water deprived
Nephrogenic DI	Remain inappropriately high in spite of rising serum osmolality	Fails to rise appropriately	Increases	<2.0	>21.3 pmol/L when Na \geq 150mmol/L	Urine fails to concentrate after DDAVP
Psychogenic polydipsia	Fall progressively	Rises to a urine:serum osmolality ratio of 2.0 or more, but if adequate dehydration is not achieved a longer period of water deprivation should be considered	If patient is fluid overloaded at the start of the test the serum osmolality may not rise sufficiently to stimulate maximum vasopressin secretion and therefore concentration of urine	>2.0 (provided patient is adequately dehydrated)	N/A	

Note: Prolonged polyuria of any cause may impair the concentrating power of the renal medulla. Maximum urine osmolality achieved may be less than in normal subjects, even after DDAVP.

