Water Deprivation Test

This is potentially dangerous and must be undertaken with great care. Patients unable to conserve water may become critically dehydrated within a few hours of water restriction.

Water restriction in the normal individual results in secretion of arginine vasopressin (AVP) from the posterior pituitary in order to reabsorb water from the distal renal tubules and concentrate the urine. Failure of this mechanism results in a rise in plasma osmolality due to water loss, and a dilute urine of low osmolality.

The two causes are a. A failure of AVP secretion (central DI)
b. Insensitivity of the renal tubules to AVP (nephrogenic DI)
The cause may be distinguished by the administration of DDAVP (synthetic AVP).

Indications

Investigation of suspected central diabetes insipidus (CDI), nephrogenic diabetes insipidus (NDI) and primary polydipsia (PP).

Contraindications
If there is evidence of the kidney's ability to concentrate the urine e.g. spot urine osmolality >750mOsm/kg.

Exclude other causes of polyuria (e.g. diuretics, chronic kidney diseae, hypercalcaemia, hypokalaemia, diabetes mellitus, UTI, therapy with carbamazepine, chlorpropamine, lithium). Anterior pituitary hormone deficiency renders results meaningless as, in particular, steroid and thyroxine deficiencies impair excretion of a free water load.

Precautions and preparations
Patients should not have any access to any food or drink throughout the test and must be closely monitored throughout the test to ensure this.
Inform the Duty Biochemist at least 1 day in advance of performing this procedure so that samples can be processed efficiently.

Side Effects
Patients with true diabetes insipidus may become severely water depleted during water deprivation and MUST be carefully monitored (by weighing and quantifying urine output regularly) throughout the test.
Patients suspected of having primary polydipsia may become severely hyponatraemic if they drink excessively after being given DDAVP, so MUST NOT drink more than 500mls fluid in total over the following 8 hours.

Requirements
- Accurate scales for weighing the patient
- Sarstedt urine containers for urine osmolality
- Brown top serum tubes for serum osmolality
- Urine measuring jug
- DDAVP 2µg IM

Procedure

PATIENT PREPARATION:

Patient should be admitted on the day before the test.

1. If the patient is on DDAVP, this is discontinued the evening before the test.
2. Monitor the patient's fluid balance for a complete 24 hour period the day before the test to accurately quantify fluid intake and output.
3. If indicated give normal steroid and/or thyroid hormone replacement before the test.
4. Tea, coffee, alcohol and tobacco are specifically excluded after midnight before the test and during the test because they directly stimulate (vagus) the secretion of AVP independently of the osmoreceptors.
5. Patient is allowed to drink freely until the start of the test i.e. 08.00h.
6. A light breakfast is permitted before test commences e.g. 07.00h.

TEST

1. Complete the Water Deprivation test template during the test.
2. At 08.00h the patient should empty their bladder and this urine should be discarded
3. 09.00h commence fluid restriction, weigh the patient and calculate 97% of their weight. Begin the fluid balance chart. Take urine and serum samples for osmolality and serum for sodium (Na). Urine volume should be measured throughout the test.
4. 12.00h, 14.00h, 15.00h the patient should be weighed and samples taken for serum and urine osmolality and serum Na and sent directly to the lab labelled correctly and including clinical details so that the tests can be prioritised.

INDICATIONS FOR STOPPING THE TEST:
- **Weight loss is >3% of initial weight**
- **Serum osmolality rises to >300 mOsmol/kg**

5. Review the results. If urine osmolality is <750 mOsm/kg or if urine osmolality failed to rise by more than 30 mOsm/kg over 3 successive urine samples, then administer 2µg DDAVP IM at 16.00h and allow food and fluids.
6. Check urine osmolality at 2hr and 4hr post-DDAVP and the next morning.

AFTERCARE
- Keep the patient in overnight for observation and issue the patient information leaflet for Water Deprivation Tests.

WARNING: After completing the water deprivation test patients should NOT consume **>500ml fluid** for **8 hours**

Interpretation of results

Post-Dehydration Osmolality (mOsm/kg)		Post DDAVP osmolality (mOsm/kg)	Diagnosis
Serum	**Urine**	**Urine**	
<300	>750	>750	Normal
>300	<300	<300	Nephrogenic DI
>300	<300	>750	Central DI
<300	300-750	<750	Primary Polydipsia or partial CDI

NB. chronic primary polydipsia can dissipate the renal medullary osmotic gradient, thereby reducing the renal response to endogenous and exogenous AVP.

In severe central DI, maximal urinary concentration may be achieved only after repeated DDAVP.

EQUIVOCAL RESULTS

Many patients fall in the range 300-750 following water deprivation and it is often difficult to differentiate between PP and partial DI, especially following pituitary-surgery. In this instance, the plasma sodium may be helpful, since in PP, this is often low at the start of the test.

If there is a partial response, this test does not reliably differentiate between PP and partial CDI, and may indicate that the patient has been drinking during the test. In these cases the test can be repeated fasting the patient from midnight the night before the test.

If results are equivocal and there remains clinical suspicion of DI then proceed to hypertonic saline infusion test or Arginine Stimulated Co-peptin test.

Elderly patients may not achieve maximal concentration of their urine and therefore results should be interpreted on a case by case basis.

SENSITIVITY AND SPECIFICITY

When correctly performed, the water deprivation test has a sensitivity and specificity of 95% for diagnosing and differentiating severe central DI and nephrogenic DI. The incidence of false positive and false negative results for PP or partial CDI/NDI is 30-40% (investigate further).

WATER DEPRIVATION TEST TEMPLATE

Patient Name:		**Sex:**	
Hospital No:		**DOB:**	
Today's Date:			

Perform test under strict supervision to ensure the patient has no access to fluids

The test must be stopped if weight loss exceeds 3%, or if serum osmolality rises above 300 mOsm/kg

Weight patient: **kg** **Calculate weight minus 3%:** **kg**

Time							
0 Hrs	:	**Take sample for urine and serum osmolality/Na and send to the lab.**					
		Weight kg Loss >3%? Yes/No	**SerumOsmolality mOsm/kg** >300 mOsm/kg? Yes/No	**Serum Na mmol/L**	Urine Osmolality **mOsm/kg**	**Urine Volume ml**	**BP mmHg**
+3 Hrs	:	**Take sample for urine and serum osmolality/Na and send to the lab.**					
		Weight kg Loss >3% Yes/No	**SerumOsmolality mOsm/kg** >300 mOsm/kg? Yes/No	**Serum Na mmol/L**	Urine Osmolality **mOsm/kg**	**Urine Volume ml**	**BP mmHg**
+5 Hrs	:	**Take sample for urine and serum osmolality/Na and send to the lab.**					
		Weight kg Loss>3%? Yes/No	**SerumOsmolality mOsm/kg** >300 mOsm/kg? Yes/No	**Serum Na mmol/L**	Urine Osmolality **mOsm/kg**	**Urine Volume ml**	**BP mmHg**
+6 Hrs	:	**Take sample for urine and serum osmolality/Na and send to the lab.**					
		Weight kg Loss >3%? Yes/No	**SerumOsmolality mOsm/kg** >300 mOsm/kg? Yes/No	**Serum Na mmol/L**	Urine Osmolality **mOsm/kg**	**Urine Volume ml**	**BP mmHg**

If the urine osmolality is >750 mOSM/kg STOP the test
If urine osmolality is <750mOSM/kg or has failed to rise by >30mOSM/kg over 3 successive urines then **administer 2µg DDAVP IM** and fill in the table below.

DDAVP	:	**Record time that DDAVP was Administered**	Allow food and minimal fluids **DO NOT** allow excessive drinking
+2hrs	:	Collect urine for osmolality and send to the lab Result: mOsm/kg	
+4hrs	:	Collect urine for osmolality and send to the lab Result: mOsm/kg	