INDICATORS OF POLYURIA AND POLYDIPSIA

- **Horses rarely drink more than 5% of their bodyweight daily (25 litres per 500 kg)**
- **Horses rarely urinate more than 3% of their bodyweight daily (15 litres per 500 kg)**
- **The only common causes of PUPD are psychogenic polydipsia and PPID**

Several logical steps below should lead to a firm diagnosis:

Polydipsia (PD) in adult horses can be defined as water intake >100 ml/kg daily (>10% BWT) although under UK management and environmental conditions it is probable when intake is > 70 ml/kg daily (>7% BWT). Typical water intake for horses is 40 - 60 ml/kg daily (4-6% BWT) although it can be as low as 10-15 ml/kg daily (1-11/2% BWT) in grazing horses or as high as 80-90 ml/kg daily (8-9% BWT) in lactating mares, horses in hard work and in hot environmental conditions. Smaller breeds tend to drink relatively more per kg BWT than larger breeds due to the effects of metabolic body size. Polyuria (PU) is usually defined as urine production > 50 ml/kg daily (5% BWT) though in practice it is far harder to measure than polydipsia. Normal urine production is typically between 15 and 30 ml/kg daily (1½ - 3% BWT) and faeces represent the major route of water loss in normal horses.

Before investigating PUPD cases it is important to rule out physiologic explanations such as hot weather, hard work, lactation, excessive dietary protein, excessive salt consumption, administration of glucocorticoids or diuretics

CAUSES OF PU & PD:

- PSYCHOGENIC POLYDIPSIA
- PPID (Cushing's Disease)
- Chronic Renal Failure
- Hepatic Insufficiency
- Diabetes Mellitus
- Diabetes Insipidus

1. QUANTIFY AND CONFIRM THE PRESENCE OF PD (AND PU?)

Pathophysiologic causes will invariably lead to both PU and PD even though only one and not the other may be recognised and reported by the owner. Therefore, it is both easier and diagnostically acceptable to verify and quantify water intake over a full 24 hour period with the horse stabled.

If water intake is >100 ml/kg/day (>10% BWT) then PD is confirmed (and PU is almost inevitable).

If water intake is 70-100 ml/kg/day (7-10% BWT) then PD may be suspected if there are no apparent physiologic causes (see above).

If water intake is <70 ml/kg/day (<7% BWT) then PD is not confirmed.

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2. INITIAL SCREENING BLOOD AND URINE TESTS

A panel of initial screening tests is worthwhile when investigating PUPD cases comprising the following:

Blood tests

Haematology

- Anaemia is a common finding with chronic renal failure. Polycythaemia may arise through dehydration suggesting that PU is the primary problem rather than PD (e.g. diabetes insipidus).
- Neutrophilia may indicate a glucocorticoid response or inflammatory disease.

Basal plasma ACTH or TRH stimulation test – for PPID (see Endocrine section)

Creatinine and Urea

- Very high in chronic renal failure cases: urea is usually >15mmol/L and creatinine >300µmol/L.
- A bit high (eg urea 8-12mmol/L, creatinine 180-250µmol/L) more commonly indicates dehydration or acute kidney injury but could also suggest early/mild chronic renal failure. Worth comparing with urine creatinine – see below.
- Low values (urea < 4mmol/L and creatinine <75 µmol) may occur in hepatic insufficiency or in cases of primary (psychogenic) polydipsia with washout.

Glucose: persistent hyperglycaemia indicates diabetes mellitus – mostly as a consequence of PPID. Short term hyperglycaemia will follow alpha-2 agonist sedatives and also pain/stress.

Hypercalcaemia (total Ca > 3.5mmol/L, ionised Ca > 1.7mmol/L) is often seen in chronic renal failure cases. The major other differential for hypercalcaemia is paraneoplastic disease.

GGT and AST can be used to rule-out liver disease.

Urinalysis

Specific gravity (always measure with refractometer and not a dipstick)

- Low (<1.008, hyposthenuria) suggests that the kidney is actively excreting water and is typical of primary (psychogenic) PD and diabetes insipidus.
- Medium (1.008-1.012, isosthenuria) suggests that the kidney is neither actively concentrating nor diluting the filtrate and is consistent with (but not diagnostic for) chronic renal failure (check serum urea and creatinine).
- High (>1.020, hypersthenuria) is not really compatible with persistent PUPD and confirms renal concentrating ability.

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Glycosuria

- diabetes mellitus (usually caused by PPID)
- Acute stress or transport
- alpha-2 agonists

Comparing urine creatinine to serum creatinine can be useful in cases with mild increases in serum creatinine (e.g. 180-250µmol/L). If increased serum creatinine is due to dehydration then this should be matched by high urine creatinine concentrations (>50 x serum concentration) whereas in chronic renal failure cases will have lower urine creatinine (e.g. <40 x serum creatinine).

3. FURTHER LABORATORY TESTS

On the basis of the above results it should be possible to confirm/rule-out most differential diagnoses including PPID, chronic renal failure, diabetes mellitus and liver disease. If these have been ruled out then 2 main differentials remain: ***primary (psychogenic) polydipsia*** and ***diabetes insipidus***. Further tests are needed to differentiate these two conditions.

Although a full water deprivation test is possible, it is generally more practical, safer and just as diagnostically useful to perform a partial water restriction test.

Water Restriction Test

The purpose of this test is to help ***differentiate primary (psychogenic) polydipsia from diabetes insipidus***, having already ruled out further differentials with the previously described tests. The important diagnostic principle is that psychogenic polydipsia cases CAN concentrate their urine whereas diabetes insipidus cases CANNOT.

Suitable subjects for this test will be systemically well, producing hyposthenuric urine (urine SG<1.008) and have normal serum creatinine and urea. This test MUST NOT be performed on azotaemic horses suspected to have renal compromise. There is no point in performing this test if the urine is already concentrated (SG >1.020).

Performing a water restriction test
Weigh horse (if possible) or make an informed estimate (weigh tape etc)
Check serum urea and creatinine are normal (if not, don't proceed)
Take baseline urine sample and measure SG (if > 1.008, don't proceed)
Keep horse stabled and provide water at a rate of 1% bodyweight every 6 hours (i.e. 4% bodyweight per 24h)
Check for signs of dehydration, serum urea and creatinine and urinary SG at least every 6 hours (and reweigh if possible)
The test is terminated when one of the following occurs:
72 hours has been reached
5% reduction in bodyweight (25 kg per 500 kg)
clinical signs of dehydration
creatinine > 200 µmol/L or urea >12 mmol/L
urinary SG > 1.020

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Interpretation

- If SG rises above 1.020 this confirms renal concentrating ability is present and therefore rules-out diabetes insipidus. This indicates ***psychogenic polydipsia***.
- If the horse fails to concentrate the urine and urine SG stays <1.020, or the horse becomes dehydrated or loses 5% bodyweight, this suggests ***diabetes insipidus*** (often happens by 12 hours).

Further Tests to verify and classify diabetes insipidus

Measure serum vasopressin at end of water restriction period

- Vasopressin > 5 pmol/L – indicates normal vasopressin secretion
- Vasopressin < 5 pmol/L – indicates *central diabetes insipidus*

Vasopressin response test.

- Inject 0.05 micrograms/kg desmopressin acetate iv and measure urine SG over 24 hours.
    - Urine SG > 1.020 – indicates normal response to vasopressin)
    - Urine SG < 1.020 - indicates *nephrogenic diabetes insipidus*