

Polyuria

Definition / Supporting Information

Clinical definition of polyuria: urine production $> 2 \text{ L/m}^2$ per 24 hours.

Functional definition of polyuria: inappropriately high urine output relative to circulating volume and osmolality.

Polyuria can be a manifestation of excessive fluid intake, osmotic diuresis (as in diabetes mellitus) or more rare but potentially life threatening conditions resulting in diabetes insipidus.

Diabetes insipidus is characterised by:

- Polyuria
- Polydipsia
- Dilute urine
- Dehydration
- Hypernatremia
- Growth failure (see Faltering Growth)

Central diabetes insipidus results from a deficiency in secretion of arginine vasopressin (AVP), also called antidiuretic hormone (ADH).

Nephrogenic diabetes insipidus is the result of reduced renal sensitivity to circulating vasopressin.

Keywords / also known as: diabetes insipidus, diabetes mellitus, drinking excessive amounts of fluids, increased urination, polydipsia

Essential History

Ask about:

- Age at onset
- Rapidity of onset
- Fluid intake
 - Excessive drinking
 - Diurnal pattern of fluid intake
 - Preference to drinking and not eating
 - Preferred fluids
- Urination
 - Frequency
 - Volume

- In infants, number of nappies per day
 - How wet are the nappies?
- Colour
 - Dilute
- New-onset enuresis
 - Daytime or bed-wetting
- Dysuria
- Signs of dehydration
- Vomiting
- Fever
- Irritability
- Faltering growth
- Weight loss
- History of head injury, neurosurgery, meningitis or encephalitis
- Fatigue
- Headaches
 - Consider increased intracranial hypertension
- Delayed or arrested puberty

‘Red Flag’ Symptoms and Signs

Consider diabetes mellitus in any child presenting with polyuria (see Type 1 diabetes: diagnosis and management of type 1 diabetes in children and young people [[NICE clinical guideline NG18, section 1.1](#)]).

See Diabetes insipidus [[Headsmart; be brain tumour aware](#)] for symptoms and signs suggesting a brain tumour may be responsible for polyuria.

Ask about:

- Drowsiness
- New-onset enuresis
- Poor appetite
- Fatigue
- Headaches
- Excessive drinking
- Weight loss

Look for:

- Signs of dehydration
- Fever
- Irritability
- Abnormal breathing pattern

- Reduced level of consciousness
- Any abnormal neurological signs including:
 - Visual field defects
 - Co-ordination difficulties
 - Gait problems
- Delayed puberty

Differential Diagnosis / Conditions

Polyuria due to osmotic diuresis

- Diabetes mellitus (type 1 or 2)
 - See See Diabetes (type 1 and type 2) in children and young people: diagnosis and management [[NICE clinical guideline NG18](#)]
- Induced by diet
- Induced by drugs

Polyuria due to diabetes insipidus

- Central diabetes insipidus (neurogenic [vasopressin](#) deficiency)
 - Genetic
 - AVP / neurophysin-2 gene (autosomal dominant or recessive)
 - Wolfram's syndrome
 - Congenital brain malformation
 - Septo-optic dysplasia
 - Holoprosencephaly
 - Encephalocele
 - Pituitary agenesis
 - Acquired
 - Head trauma
 - Vascular event
 - Thrombosis
 - Haemorrhage
 - Post infection
 - Meningitis
 - Encephalitis
 - Congenital cytomegalovirus
 - Toxoplasmosis
 - Tumour (See Diabetes insipidus [[Headsmart; be brain tumour aware](#)])
 - Craniopharyngioma
 - Germinoma
 - Optic glioma

- Systemic infiltrative diseases
 - Langerhans cell histiocytosis
 - Syphilis
 - Tuberculosis
 - Sarcoidosis
- Inflammatory
 - Lymphocytic hypophysitis
- Guillain-Barré syndrome
- Autoimmune disorders
 - Idiopathic
- Nephrogenic diabetes insipidus (renal **vasopressin** insensitivity)
 - Genetic
 - Familial nephrogenic diabetes insipidus (X-linked recessive therefore usually seen in males)
 - Autosomal dominant or recessive (aquaporin-2 gene)
 - Acquired
 - Post obstructive
 - Induced by drugs
 - Lithium
 - **Amphotericin B**
 - Associated with systemic disease
 - Sickle cell disease
 - Sarcoidosis
 - Amyloidosis
 - Metabolic
 - Hypercalcaemia
 - Hypokalaemia

Other renal disorders causing polyuria

- Renal tubular defects
 - Renal Fanconi's syndrome
 - Cystinosis
 - Distal renal tubular acidosis
 - Bartter's syndrome
 - Gitelman's syndrome
 - Arthrogyrosis–renal tubular dysfunction–cholestasis (ARC) syndrome
 - Nephronophthisis

Polyuria due to excessive fluid intake

- Polyuria may be secondary to excessive fluid intake
 - Habitual drinking
 - Common in toddlers and pre-school aged children
- Primary polydipsia (or compulsive water drinking)
 - A primary psychiatric disturbance associated with schizophrenia and termed psychogenic polydipsia

Investigations

To be undertaken by non-specialist practitioners (eg, General Practitioner (GP) Team), or by specialist practitioners (eg, Emergency Department / General Paediatric / Paediatric Nephrology / Paediatric Endocrinology Team(s)):

- Urine dip for protein, glucose, ketones, and specific gravity
- Blood glucose
- 24-hour measurement of fluid intake and urine output
- Urea, creatinine, and electrolytes
 - Serum sodium level
 - Central diabetes insipidus: normal or elevated
 - Nephrogenic diabetes insipidus: normal or elevated
 - Psychogenic polydipsia: low to normal
- Paired urine and serum osmolality (dilute urine with elevated serum osmolality is suggestive of diabetes insipidus)
 - Serum osmolality
 - Normal: 285–290 mOsmol/kg
 - Central diabetes insipidus: normal or elevated
 - Nephrogenic diabetes insipidus: normal or elevated
 - Psychogenic polydipsia: < 280 mOsmol/kg
 - Urine osmolality
 - Normal: 50–1200 mOsmol/kg
 - Central diabetes insipidus: < 200 mOsmol/kg
 - Nephrogenic diabetes insipidus: < 300 mOsmol/kg
 - Psychogenic polydipsia: < 200 mOsmol/kg
- Full blood count
- Calcium and magnesium levels

To be undertaken by specialist practitioners (eg, Emergency Department / General Paediatric / Paediatric Nephrology / Paediatric Endocrinology Team(s)):

- Above tests if not already done
- Urine electrolytes including phosphate

- Plasma vasopressin (ADH)
 - Central diabetes insipidus: low
 - Nephrogenic diabetes insipidus: normal or elevated
 - Psychogenic polydipsia: low
- Further imaging if appropriate
 - Magnetic resonance imaging (MRI)
 - Renal ultrasound

Treatment Approach

To be undertaken by non-specialist practitioners (eg, GP Team):

- Habitual drinking in toddlers
 - Advise parents to reduce the amount of drinks offered through out the day.
 - Switch sugary drinks to water or dilute sugary drinks with water
- Advice if diuresis induced by drugs or diet

To be undertaken by specialist practitioners (eg, General Paediatric / Paediatric Nephrology / Paediatric Endocrinology Team(s)):

- Careful fluid and electrolyte management
 - Cautious correction of hyponatraemia (do not allow increase in serum sodium of more than 12 mmol / 24 hours)
- Central diabetes insipidus
 - Replacement of vasopressin with desmopressin with advice from Paediatric Endocrinology Team
- Nephrogenic diabetes insipidus
 - Thiazide diuretics, amiloride hydrochloride and indometacin can be used with advice from Paediatric Nephrology Team

When to Refer

Refer urgently to specialist practitioners (eg, Emergency Department / General Paediatric / Paediatric Nephrology / Paediatric Endocrinology Team(s)) if:

- Suspected diabetes mellitus or diabetic ketoacidosis
- Suspected brain tumour
- Suspected diabetes insipidus
- Polyuria with dehydration
- Hypernatraemia
- Primary polydipsia
 - Referral to local child and adolescent mental health service

Escalate care to appropriate sub-specialist team such as Paediatric Endocrinology, Nephrology or Oncology Team if:

- MRI or neurological findings suggestive of a brain tumour
- Further investigation or management of suspected nephrogenic or central diabetes insipidus
- Structural renal disease leading to polyuria

‘Safety-Netting’ Advice

- Advise parents to seek medical advice if any ‘red flag’ symptoms or signs develop.

Patient / Carer Information

****Please note: whilst these resources have been developed to a high standard they may not be specific to children.***

- [Diabetes insipidus](#) (Web page), Headsmart; be brain tumour aware
- [Diabetes insipidus](#) (Web page), Patient.co.uk
- [Type 1 diabetes](#) (Web page), NHS Choices

Resources

National Clinical Guidance

[Diabetes \(type 1 and type 2\) in children and young people: diagnosis and management](#) (Web page), NICE clinical guideline NG18, National Institute for Health and Care Excellence.

Suggested Resources

****Please note: these resources include links to external websites. These resources may not have national accreditation and therefore PCO UK cannot guarantee the accuracy of the content.***

[Diabetes insipidus](#) (Web page), Headsmart; be brain tumour aware, RCPCH, The Brain Tumour Charity, CBTRC, The University of Nottingham, The Health Foundation.

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