Homan's operation for lymphoedema.

It is not usually possible to cure lymphoedema but an active and enthusiastic approach can achieve great benefit. Most patients require only conservative treatment but if this is rigorously applied the results can be good. A short period of treatment in hospital using a Lymphapress can alter the patient's perception of the leg and engender enthusiasm for self treatment; cellulitis must be avoided by rigorous attention to hygiene.

A few patients benefit from operation, but this must never be carried out for cosmetic reasons. Those with heavy cumbersome legs can have the volume of subcutaneous tissue removed (Homan's operation) and the results are usually good if the indications for operation are correct. Such operations may also permit support hosiery to fit better.

A small group may benefit from operations to relieve lymphatic obstruction (mesenteric ileal bridging operation or direct lymphovenous anastomosis) but this group do not impinge on the mass of patients who should be treated conservatively.

The diagram of distal obliteration and pelvic obstruction are reproduced by permission of the publisher, Butterworth Heinemann, from DeWeese J, ed. Vascular surgery. In: Dudley H, Carter D, eds. *Rob and Smith's operative surgery*. 4th ed. 1985, 361.

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Lesson of the Week

Adipsic hypothalamic diabetes insipidus after clipping of anterior communicating artery aneurysm

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Adipsic hypothalamic diabetes insipidus is a rare but life threatening complication of surgical clipping of anterior communicating artery aneurysms

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The development of inappropriate antidiuresis after subarachnoid haemorrhage from an intracranial arterial aneurysm is well recognised,^{1,3} with 5-10% of patients developing hyponatraemia.⁴ In contrast the occurrence of hypothalamic diabetes insipidus with the rupture of cerebral artery aneurysms is less well described⁵ and has an estimated incidence of only 0.04%.⁶ We report on two patients in whom severe hypothalamic diabetes insipidus occurred after clipping of a ruptured aneurysm in an anterior communicating artery. In each case there was a delay in diagnosis due to the absence of thirst and increased fluid intake, which are usually cardinal clinical features of diabetes insipidus, with consequent development of life threatening hypernatraemia.

Case reports

Case 1

A 39 year old woman developed sudden onset of severe frontal headache and vomiting. She had no history of headaches and no significant medical history. She was referred to hospital three days later because of persisting headaches. Clinical examination showed no focal neurological deficit, with a Glasgow coma scale rating of 15, and blood pressure of 100/72 mm Hg. Lumbar puncture showed xanthochromic cerebrospinal fluid. She was treated with nimodipine 60 mg four times daily. Plasma sodium concentration was 136 mmol/l (normal range 132-144 mmol/l). Two days later she had further sudden frontal headaches, and computed tomography showed a small frontal interhemispheric haematoma and cerebral angiography showed an aneurysm in an anterior communicating artery.

The aneurysm was successfully clipped through a

left pterional craniotomy. During clip placement, however, the aneurysm fundus ruptured. She was artificially ventilated for one day in the intensive care unit. On return to the neurosurgical unit she was noted to have hypernatraemia (plasma sodium concentration 155 mmol/l) and polyuria (urine volume >300 ml/h) with a urine specific gravity of 1005, though she did not complain of thirst. After impaired consciousness associated with tachycardia and hypotension further computed tomography showed evidence of intraventricular haemorrhage, moderate hydrocephalus, and an infarction in the right anterior cerebral artery territory. She rapidly improved after a burrhole insertion of a cerebrospinal fluid access device but still had polyuria and hypernatraemia with minimal fluid intake. The polyuria responded to intramuscular desmopressin, and she was thereafter managed with intranasal desmopressin twice daily and a fixed fluid intake of two litres a day. Because of poor compliance with oral fluid intake plasma osmolality fluctuated from 290 mmol/kg to 330 mmol/kg (normal range 282-298 mmol/kg). One month postoperatively she received an infusion of hypertonic (855 mmol/l) sodium chloride at 0.06 ml/kg/min for two hours.⁷

Despite pronounced hyperosmolality plasma vasopressin concentrations remained inappropriately low, indicative of hypothalamic diabetes insipidus (figure), and thirst ratings, measured on a visual analogue scale^{8,9} remained unchanged. In the two hours after the infusion she drank 175 ml of water. Anterior pituitary function was normal. Six months postoperatively her diabetes insipidus was treated with desmopressin twice daily, but because of adipsia she required a fixed fluid intake of two litres daily, with close supervision to monitor weight and plasma biochemistry and to encourage fluid intake.

Plasma vasopressin concentration (top) and thirst rating (bottom) according to plasma osmolality during infusion with hypertonic saline. Shaded area represents range of responses in 40 healthy volunteers

Case 2

A previously fit 30 year old man presented to hospital after sudden onset of frontal headache, nausea, vomiting, and photophobia. His blood pressure was 170/70 mm Hg and there were no neurological signs. His plasma sodium concentration was 132 mmol/l. Computed tomography showed blood in the anterior interhemispheric fissure and both sylvian fissures, and cerebral angiography showed an 8 mm × 8 mm bilobed aneurysm in the anterior communicating artery. He underwent craniotomy and clipping of the anterior communicating artery but developed a mild post-operative left hemiparesis. Six days postoperatively he was noted to be drowsy and incontinent of urine and had a plasma sodium concentration of 157 mmol/l and a plasma osmolality of 339 mmol/kg. He was rehydrated with 5% dextrose given intravenously but remained incontinent and hypernatraemic with poor fluid intake. Repeat cerebral angiography showed little perfusion of the anterior cerebral artery territory with no filling of the aneurysm, and computed tomography showed a low density area involving the corpus callosum, basal ganglia, and right internal capsule.

Subsequent rehabilitation was impeded by poor fluid intake, urinary incontinence, sustained hypernatraemia, and severe depression treated initially with fluoxetine. He failed to improve and was transferred to a psychiatric ward for treatment with chlorpromazine but was found to be dehydrated, with a plasma sodium concentration of 180 mmol/l. He was transferred to a medical ward, where he was found to be cooperative,

have a blood pressure of 110/60 mm Hg when supine, and have mild residual left hemiparesis. His plasma sodium concentration was 167 mmol/l, plasma potassium concentration 2.7 mmol/l (normal range 3.3-4.7 mmol/l), blood urea concentration 24.7 mmol/l (2.5-6.6 mmol/l), serum creatinine concentration 135 µmol/l (65-150 µmol/l), blood glucose concentration 14.7 mmol/l, serum cortisol concentration 653 nmol/l, plasma osmolality 370 mmol/kg, and urine osmolality 1025 mmol/kg, though heavy glycosuria was noted.

He was rehydrated with intravenous fluids and developed polyuria (urine volume 4-7 litres/day) when still hypernatraemic (plasma sodium concentration >155 mmol/l). At no time did he complain of thirst. During subsequent hypertonic (855 mmol/l) sodium chloride infusion at 0.05 ml/kg/h for two hours his plasma vasopressin concentrations were close to the assay detection limit despite having hyperosmolar plasma, confirming hypothalamic diabetes insipidus; there were no changes in thirst ratings during the infusion. In the two hours after the infusion he drank 400 ml of water. Subsequent testing of anterior pituitary function and oral glucose tolerance yielded normal results.

Intranasal desmopressin caused a fall in urine output. His adipsia remained despite continued mild hypernatraemia and treatment with desmopressin twice daily, a fixed fluid intake, and regular medical review were continued.

Discussion

Maintenance of plasma osmolality within a narrow physiological range depends on the regulation of water excretion by the antidiuretic actions of arginine vasopressin on the renal collecting ducts and the generation of thirst to promote water intake. Increases in plasma osmolality are thought to be detected by osmotically sensitive cells situated in the circumventricular organs of the anterior hypothalamus—most probably the organum vasculosum laminae terminalis.¹⁰ Excitatory connections project from the organum vasculosum laminae terminalis to the supraoptic nucleus—the site of vasopressin synthesis—which stimulate secretion of the hormone from the posterior pituitary into the bloodstream. The precise neural pathways involved in the generation of thirst are less well defined. It seems likely on the basis of animal data, however, that the nucleus medianus is the integrative centre for inputs projecting from the osmoreceptors in the organum vasculosum laminae terminalis, inputs for angiotensin II induced drinking from the subfornical organ, and inputs for hypovolaemic thirst from the nucleus tractus solitarius.¹¹ The destination of projections from the nucleus medianus is uncertain.

Water homeostasis demands the successful integration of thirst and vasopressin secretion and action; in the absence of vasopressin, however, patients with hypothalamic diabetes insipidus depend entirely on intact thirst perception to stimulate sufficient water intake to replace urinary losses. Most patients with hypothalamic diabetes insipidus have an intact thirst mechanism,⁹ though associated adipsia has been reported.^{5,7,9} Our patients both had clear evidence of hypothalamic diabetes insipidus with absent vasopressin responses to osmotic stimulation and in addition showed no change in thirst rating despite pronounced hyperosmolality. Although both subjects had some postoperative impairment of cognitive function that may have prevented full understanding of the visual analogue scale, the remarkably low water intake of each patient in the two hours after stopping the infusion (175 ml in case 1 and 400 ml in case 2) suggests

that both patients were truly adipsic (healthy controls drink between 1000 ml and 2400 ml of water and patients with diabetes insipidus and normal thirst perception between 1180 ml and 3090 ml in the two hours after hypertonic saline infusion.⁹). In addition, both patients could express hunger and had full bowel and bladder function, and neither suffered any disturbance of other hypothalamic functions such as sleep regulation or thermoregulation. It seems likely, therefore, that their adipsia was a result of a discrete lesion of the vascular supply to the thirst osmoreceptor rather than a component of a more generalised cognitive impairment or hypothalamic defect. The persistence of adipsia well beyond the period of postoperative confusion to a time when both patients had successfully returned to the community further supports this hypothesis.

Diabetes insipidus after subarachnoid haemorrhage is unusual, it occurred in only four of 1000 patients with intracranial aneurysms.⁶ In a review of 104 patients with longstanding diabetes insipidus only one had vasopressin deficiency after rupture of a cerebral aneurysm.⁵ Interestingly, this patient also had permanent hypodipsia, and diabetes insipidus followed rupture of an anterior communicating artery aneurysm.⁵ Baylis and Robertson additionally reported one case of diabetes insipidus with adipsia after surgery to an anterior communicating artery aneurysm.⁷ Although one of our patients (case 1) had transient postoperative hydrocephalus, adipsia and vasopressin deficiency in both cases probably resulted from ischaemic damage to the hypothalamic osmoreceptors governing thirst and vasopressin secretion or the supraoptic and paraventricular nuclei which synthesise vasopressin, or both. The blood supply to the organum vasculosum laminae terminalis—the putative site of the osmoreceptor¹⁰—is derived from small perforating branches of the anterior cerebral and anterior communicating arteries.¹² In both of these cases there was postoperative evidence from computed tomography and cerebral angiography of ischaemic damage in this territory, which strengthens the argument that the aetiology of the adipsic diabetes insipidus was vascular, either caused by the vasospasm or by direct damage to the anterior cerebral artery at the time of surgery. Whether the vascular lesion affected the osmoreceptor cells, which would result in loss of vasopressin response to osmotic stimuli but not to non-osmotic stimuli, or damaged the magnocellular neurones which synthesise vasopressin is speculative. Selective damage to the anterior hypothalamic region can occur without focal neurological deficit or prolonged disturbances of the conscious state,¹³ as was the case in these two patients, and clipping of anterior communicating artery aneurysms has been reported to cause lesions of sufficient selectivity to induce adipsia without diabetes insipidus.^{6,14}

One of our patients (case 2) presented to the medical unit with a urine osmolality of 1025 mmol/kg, which, even allowing for the presence of glycosuria, implies the presence of circulating vasopressin in sufficient concentration to produce maximal antidiuresis. Some patients with hypothalamic diabetes insipidus are, however, able to secrete vasopressin in response to severe hypovolaemia,¹⁵ so the presence of concentrated urine in this patient is compatible with either an osmoreceptor lesion in which baroregulated vasopressin secretion is preserved or straightforward diabetes insipidus.

Although the pathophysiology of the lesion in these two cases is of academic interest, the clinical lesion is important. It is clear from these two patients and other reported cases¹⁵ that patients who were previously well, have normal plasma sodium concentrations at presentation, and who undergo surgical clipping of aneurysms of the anterior communicating artery may

develop postoperative adipsic hypothalamic diabetes insipidus, an unusual but life threatening complication. In a series of 1000 patients with subarachnoid haemorrhage there was a 40% mortality in those with postoperative hypernatraemia (sodium concentration >155 mmol/l) whether due to diabetes insipidus or not,⁶ which emphasises the importance of early detection and treatment.

Physicians, neurosurgeons, and workers in rehabilitation medicine should be aware of this complication of surgical clipping of aneurysms in anterior communicating arteries. In the absence of thirst the diagnosis of diabetes insipidus may be missed, particularly if urine output is not monitored or difficult to monitor because of urinary incontinence. In such cases, and indeed with any patients with head injuries who are unable to regulate their fluid intake appropriately, measurement of urine volumes must be supplemented with daily monitoring of plasma concentrations of sodium and other electrolytes and prompt attention given to the results. The long term management of patients with adipsia, whether vasopressin secretion is preserved¹⁶ or abnormal,¹⁷ can be difficult, with wide fluctuations in plasma osmolality; this was particularly true of one of our patients (case 1), who was unable to keep up with urinary water losses on the day of saline infusion and clearly had hyperosmolality before the start of the infusion. We would therefore recommend that dynamic osmotic tests should be preceded in patients with adipsia by an urgent estimation of plasma osmolality to ensure patients do not have hyperosmolality before study. Patients with adipsic diabetes insipidus require regular measurement of plasma sodium concentration and a schedule of water intake based on daily changes in body weight for coping with day to day fluctuations in insensible water loss,¹⁸ though some patients find such a regimen difficult to follow.

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