A case report of hyponatremia after surgery for Conn's adenoma

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Abstract

Primary aldosteronism (PA), also known as Conn's syndrome, is a frequent cause of secondary hypertension. If PA is due to a documented unilateral adrenal adenoma, adrenalectomy is the treatment of choice. Endocrine Society guidelines suggest monitoring potassium after adrenalectomy, while there is no mention of sodium disorders after surgery. Here we report the case of a patient with Conn's syndrome who developed hyponatremia after surgery. This was an unexpected event in the course of the treatment, which sheds light on the fact that low levels of aldosterone strongly influence sodium concentration, and advises clinicians to monitor sodium after adrenalectomy.

Keywords

Hyponatremia, primary aldosteronism, Conn's syndrome, adrenalectomy

Introduction

Primary aldosteronism (PA) is a frequent cause of secondary hypertension. Jerome W Conn was the first physician who described it, reporting the case of a 34-year-old woman presenting with muscle spasms, weakness, hypertension and hypokalemia, hence the name Conn's syndrome.[1] Recent studies show that the prevalence of PA ranges between 5.9% and 6.8% in unselected hypertensive patients,[2,3] reaching an even higher prevalence among selected patients[4] and/or patients with resistant hypertension.[5]

Aldosterone is a mineralocorticoid hormone produced in the glomerulosa cell layer of the adrenal cortex. In the kidney, aldosterone acts on renal tubular epithelial cells where it increases sodium reabsorption and potassium excretion. Not surprisingly, excess aldosterone secretion is associated with hypokalemia, which is estimated to be present in 40% of patients with Conn's adenoma, usually in the most severe cases. As for sodium, its concentration is generally unaffected by PA because it is regulated primarily by the antidiuretic hormone (ADH) thirst system.[6]

If PA is due to a documented unilateral adrenal adenoma, adrenalectomy is the treatment of choice. Several authors[7] have reported that patients with Conn's syndrome may develop postoperative hyperkalemia, such that it is recommended to monitor potassium levels after adrenalectomy.[8] As for sodium, on the other hand, the Endocrine Society guidelines do not mention sodium disorders before and after surgery.

Here we report the case of a patient with Conn's syndrome who developed hyponatremia after surgery. This was an unexpected event in the course of the treatment, which sheds light on the fact that low levels of aldosterone strongly influence sodium concentration, and advises clinicians to monitor sodium after surgery for Conn's adenoma.

Case presentation

A 50-year-old woman presented with a 2-month history of tachycardia and hypokalemia. Her family and past medical history were unremarkable. She did not take any medication. On admission, her body mass index was 18.14 kg/m², her blood pressure (BP) was 140/90 mmHg and her heart rate was 110 beats per minute. The basic metabolic panel showed hypokalemia (potassium 2.75 mEq/L). Sodium, creatinine, complete blood count and thyroid-stimulating hormone levels were normal. ECG showed atrial tachycardia without any structural

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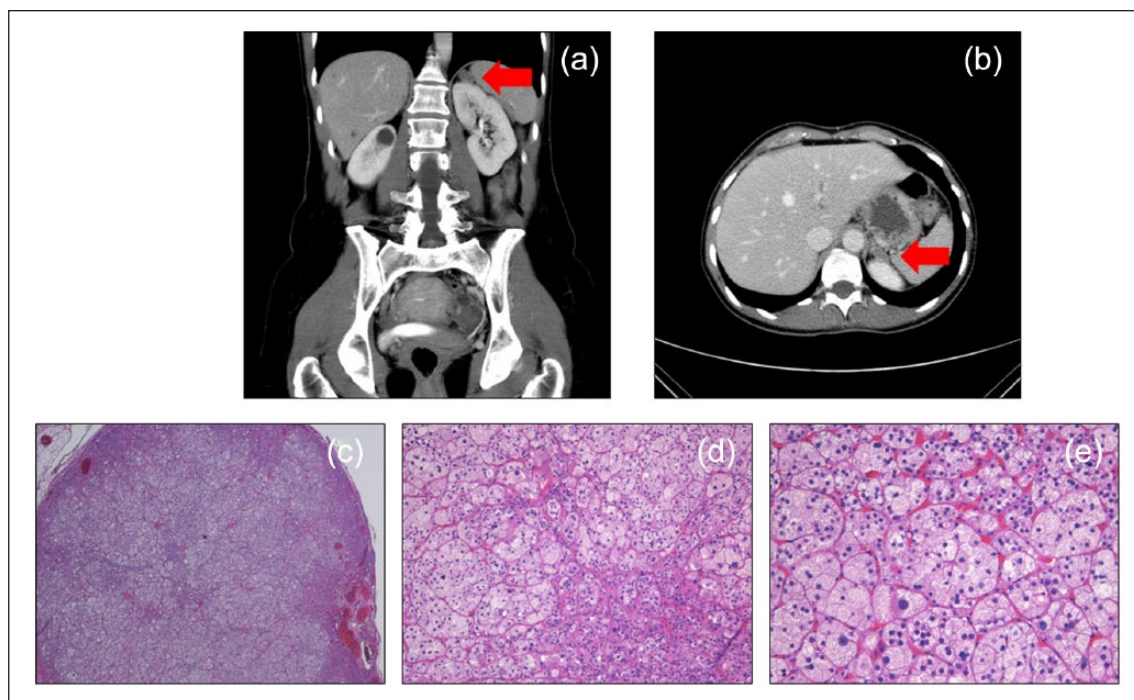Email: stella.bernardi@asuits.sanita.fvg.it

Figure 1. Coronal (a) and axial (b) images of a left radiolucent adrenal nodule with low density (< 10 Hounsfield units) on unenhanced computed tomography. Solid red arrows indicate the adrenal nodule. Representative H&E stained sections (c-e). Original magnification 2.5× (c); 10× (d); 20× (e). Tumour cells have a predominantly nesting or alveolar pattern. The tumour consists mostly of pale-staining, lipid-rich cells that resemble zona glomerulosa cells. Focal areas within the lesion have cells with granular and eosinophilic cytoplasm.

abnormality by echocardiography; 24-hour ambulatory BP monitoring revealed hypertension (24 h 143 ± 15/97 ± 9 mmHg; daytime 139/95 mmHg; night time 151/102 mmHg).

Given the coexistence of hypokalemia and hypertension, we aimed at excluding adrenal cortex disorders. While the 24-hour urinary free cortisol level was within reference ranges, the plasma aldosterone–renin ratio was high (aldosterone 18 ng/dL and renin 1 μIU/mL; aldosterone-renin ratio [ARR] 18).[8] PA was confirmed by the saline infusion test, as post-infusion aldosterone was 10.2 ng/dL and renin was 1.5 μIU/mL. Imaging showed a radiolucent nodule of 17 mm at the tip of the left adrenal gland, with low density (< 10 Hounsfield units) on unenhanced computed tomography (CT) (Figure 1 (a) and (b)), and low vascularity on contrast-enhanced CT. Given the presence of PA, hypokalemia, glomerular filtration rate (GFR) of 113 mL/min/1.73m^2 and typical Conn's adenoma on CT scan,[9] we diagnosed a left aldosterone hypersecretion and – in agreement with the patient – we scheduled left laparoscopic adrenalectomy. Pathology examination showed an adenoma of 20 mm made of zona glomerulosa-like cells (Figure 1(c)–(e)).

After surgery, the patient discontinued potassium and spironolactone, and in the following days she was released from hospital. At discharge, her BP was 124/80 mmHg, pulse was 64 bpm and potassium was 4.26 mEq/L. Unexpectedly, however, the patient presented to the emergency department three weeks later, complaining of tachycardia (pulse 110 bpm; BP 110/60 mmHg). This time, the basic metabolic panel showed hyponatremia and hypokalemia (sodium 128 mEq/L, potassium 3.41 mEq/L) (Figure 2). We prescribed a beta-blocker and intravenous saline with potassium. The following analyses showed hypoaldosteronism (aldosterone 1 ng/dL with renin 3.1 μIU/mL), without hypocortisolism (cortisol 102 ng/mL, adrenocorticotrophic hormone (ACTH) 24.5 pg/mL), and the presence of hypotonic hyponatremia (osmolality 274 mOsm/kg with sodium 128 mEq/L) with high urine osmolality (516 mOsm/Kg) and high urine sodium concentration (115 mEq/L). This was interpreted as dilutional hyponatremia with dilutional hypokalemia due to ADH stimulation in a patient with hypoaldosteronism.[10] The patient was treated with saline and a generous sodium diet for one week and monitored until normalisation.

Discussion

PA is considered much more common than was previously thought.[2–5] The clinical features of PA are not specific, some patients are completely asymptomatic, while others have symptoms related to hypertension and/or hypokalemia.[11] When these two are present, patients should be
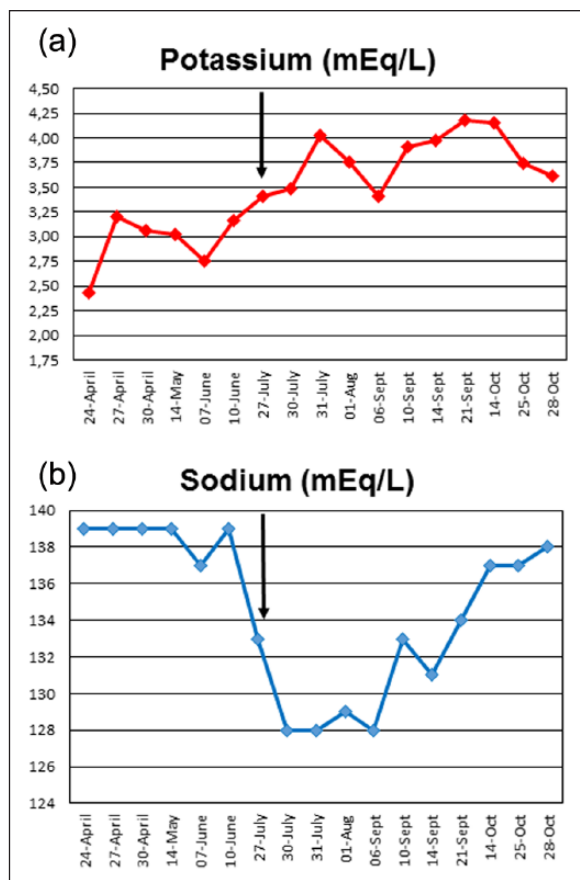
Figure 2. Demonstration of chronological potassium (a) and sodium (b) levels. Solid arrows indicate left adrenalectomy.

screened for PA. If the ARR is greater than cutoff values, a definitive biochemical diagnosis of PA should be made by a confirmatory test, such as saline infusion, and subtype differentiation should be made by CT scan and adrenal venous sampling (AVS). AVS is considered the gold standard test to distinguish between unilateral and bilateral disease.[8] Nevertheless, the results of a recent randomised controlled trial have challenged this concept, as treatment of PA on the basis of CT or AVS did not show significant differences in clinical benefits after 1 year of follow-up.[12] In addition, AVS is expensive, invasive and complicated.[13] The main difficulty is encountered during right-side selective catheterisation, such that the rate of non-selective AVS can be as high as 20–40%.[14] Several authors have suggested that systematic AVS is not necessary if there is a well-defined lesion on CT scan,[13] and that AVS could be omitted in patients with a typical Conn's adenoma, hypokalemia and GFR greater than 100 mL/min.[9] Here, based on the patient's hypokalemia, biochemical PA and CT scan image of a typical Conn's adenoma we suggested left laparoscopic adrenalectomy.

After adrenalectomy, it is recommended to monitor potassium levels.[8] This is based on the case reports of postoperative hyperkalemia,[7] which can occur in up to 16% of patients

after surgery and require fludrocortisone replacement therapy in 5%.[7] Postoperative hyperkalemia has been ascribed to the ability of aldosterone excess to inhibit the remaining contralateral zona glomerulosa by way of suppressed plasma renin levels,[15] leading to hypoaldosteronism with impaired potassium clearance and hyperkalemia. Overall, the occurrence of postoperative hyperkalemia due to transient hypoaldosteronism, as well as the hypokalemia featuring in patients with PA, highlight the importance of aldosterone for the regulation of plasma potassium concentration.

The relationship between sodium and aldosterone is different. Sodium concentration is controlled mainly by the ADH thirst system, which overshadows the renin–angiotensin–aldosterone system under normal conditions. This concept relies on landmark experimental studies by Young and Guyton,[6] who demonstrated that a 20-fold increase in sodium intake led to a significant increase in plasma sodium concentration only in the case that the ADH thirst system was blocked, while it had no effect if aldosterone remained unchanged. Nevertheless, in the same work it was proved that a minimum level of aldosterone was required to avoid a fall in sodium concentration. In other words, hypoaldosteronism affects the plasma sodium concentration, while hyperaldosteronism does not. This is due to the fact that hypoaldosteronism stimulates ADH increase, through urinary loss of sodium and volume depletion, which in turn stimulates water retention, leading to a dilution of plasma sodium concentration. As a matter of fact, patients with Addison's disease have high levels of ADH.[16]

A few weeks after surgery our patient presented with hypotonic hyponatremia. Urine osmolality and urinary sodium levels were high, indicating unsuppressed levels of ADH.[10] This is consistent with the concept that the patient's hypoaldosteronism might have led to loss of sodium and water, ADH stimulation, and subsequent water retention with dilutional hyponatremia and hypokalemia. Dilutional hyponatremia has been increasingly described in runners,[17] who lose sodium and fluids during sweating, which can activate ADH, through a similar mechanism to that of hypoaldosteronism-induced hyponatremia. Interestingly, during marathons, women seem to be at increased risk of dilutional hyponatremia, because of a tendency to drink/receive more fluids than men in proportion to their body weight.[18] We hypothesise that our patient developed postoperative hyponatremia because of a transient hypoaldosteronism, which activated ADH, causing abnormal fluid retention in a woman who was slightly underweight. The slow increase in the serum values of potassium could also be attributed to a dilutional effect, further supporting the theory of fluid overload.[18]

In conclusion, this case highlights that a minimum level of aldosterone is essential for keeping sodium within normal ranges. Clinicians should be alert to the possibility of postoperative hyponatremia in patients undergoing unilateral adrenalectomy for Conn's adenoma. Women and underweight patients may be a subset at increased relative risk of this occurrence.

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Patient consent

Written informed consent for patient information and images to be published was provided by the patient.

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