A strange case of hypokalaemia

A 60-year-old man who had known hypertension for over 10 years was referred because of hypokalaemia. He took his medications, including 12.5 mg hydrochlorothiazide, on an ‘off-and-on’ basis. His blood pressure was 170/110 mmHg. His lungs were clear, neck veins were not distended, abdominal examination was normal, and he had no oedema. The patient had curious, freely moveable subcutaneous tumours over his arms, chest, abdomen, and legs. He announced that these were lipomas that had been present ‘all his life’ and that they were harmless. An electrocardiogram showed prominent ‘U’ waves.

His sodium was 144 mmol/l, chloride 101 mmol/l and potassium 2.9 mmol/l. His pH was 7.5 in an arterial sample. The $P_{\text{aco}_2}$ was 44, the $P_{\text{ao}_2}$ was 83 (mmHg respectively) and the $\text{HCO}_3^-$ was 34 mmol/l. The potassium concentration generated considerable excitement amongst our cardiology colleagues who admitted the asymptomatic patient to the intensive care unit. A femoral catheter was inserted and potassium chloride was infused, raising his serum potassium concentration above 3 mmol/l. The patient was subsequently referred to the nephrology service. The urinalysis disclosed microalbuminuria, the serum creatinine was 1.2 mg/dl and the creatinine clearance 72 ml/min.

Questions

What is your diagnosis? Are additional investigations necessary?
The urine contained chloride 70 mmol (fourfold elevation). The fact that the plasma renin activity was 6.2 ng Ang I ml⁻¹ (upper limits of normal 6 ng Ang I ml⁻¹/h) led us away from considering primary aldosteronism without renin suppression. Our selective aldosterone samples suggest very strongly that the patient’s left adrenal gland is responsible for his primary aldosteronism. We do not believe that he has an aldosterone-producing adenoma. Instead, we favour a focal hyperplastic nodular adrenal gland that has become autonomous as described by Rao and Melby [7].

We are undecided how best to treat our patient. We have begun spironolactone which has effectively raised his serum potassium concentration and lowered his blood pressure. Spironolactone may cause hyperkalaemia in patients with primary aldosteronism due to a decreased filtered sodium load and decreased mineralocorticoid function [6]. Thus, we are monitoring our patient carefully. Celen et al. [8] reported that the prediction for a good outcome with surgery was related to adenoma classification, preoperative response to spironolactone, age younger than 44 years, and hypertension of less than 5 years duration. Our patient is most likely not to have a discrete adenoma, he is aged 60 years, and has been hypertensive for 10 years. In conclusion, primary aldosteronism can occur even without renin suppression in patients with nephrosclerosis.

Acknowledgement. We thank Professor Wolfgang Oelkers, Free University of Berlin, for providing us with a ‘curbside’ consultation.

References

Answer to the quiz on preceding page

The patient’s infusions were discontinued and he was given a diet containing 150 mmol sodium as the chloride salt and 70 mmol potassium. The calcium and magnesium concentrations were both normal. The supine plasma renin activity was 6.2 ng Ang I ml⁻¹/h (fourfold elevation). The urine contained chloride 70 mmol/l and the transtubular potassium gradient was 18. Doppler examination disclosed normal renal arteries. Magnetic resonance imaging (Figure 1) showed a normal right adrenal gland. The left adrenal gland was enlarged but not suggestive of adrenal adenoma. Lipomas were identified at numerous locations. However, none were suspicious.

In the right adrenal vein, the plasma renin activity was 10 ng Ang I ml⁻¹/h and the aldosterone concentration was 1374 pmol/l. In the left adrenal vein, the plasma renin activity was 8.7 ng Ang I ml⁻¹/h and the aldosterone concentration was 15,900 pmol/l. In the inferior vena cava distal to these sites, the plasma renin activity was 6.8 ng Ang I ml⁻¹/h and the aldosterone concentration was 1410 pmol/l. The data are consistent with primary aldosteronism without renin suppression.

Discussion

Our patient’s laboratory values strongly suggested hyperaldosteronism. The fact that the plasma renin activity was normal initially led us away from considering primary aldosteronism or Cushing syndrome and caused us to consider renovascular hypertension or renin-producing tumours. We had excellent duplex Doppler data suggesting that the renal arteries were not responsible. Juxtaglomerular cell tumours have been described; however, our patient’s kidneys appeared normal by magnetic resonance imaging and ultrasound examination [1]. Adrenal cortical cancers can cause a primary aldosteronism syndrome or can in rare cases, produce renin and cause secondary aldosteronism [2]. A renin-producing hepatoblastoma has been described [3]. However, we were most suspicious that a sarcoma might be present in our patient [4]. Nevertheless, magnetic resonance imaging revealed no tumour.

Patients with primary aldosteronism generally have suppressed plasma renin activity [5]. Fifty patients with primary aldosteronism were compared to patients with essential hypertension and normotensive subjects in an earlier study. Plasma renin activity was below normal in every case. However, Oelkers et al. [6] recently pointed out that renin is not invariably suppressed in patients with primary aldosteronism. In each of three patients, sufficient renal dysfunction was present so that a stimulus for renin release remained despite the high aldosterone concentration. An increased aldosterone/plasma renin activity ratio was still useful, as was the case in our patient. We did not perform a renal biopsy in our patient; however, the fact that he had a mildly reduced glomerular filtration rate and microalbuminuria suggests the presence of nephrosclerosis. Our selective aldosterone samples suggest very strongly that the patient’s left adrenal gland is responsible for his primary aldosteronism. We do not believe that he has an aldosterone-producing adenoma. Instead, we favour a focal hyperplastic nodular adrenal gland that has become autonomous as described by Rao and Melby [7].

Fig. 1. Magnetic resonance imaging study of the kidneys and adrenal glands (T1 weighted fat suppressed). The right adrenal gland was of normal size. The left adrenal gland can be seen medial and anterior to the left kidney. The gland is homogeneously enlarged and was described as ‘plump’ by the radiologist.

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Marcus Brand
Bastian Dehmel
Stephan Cristow
Ralph Kettritz
Franz Volhard Clinic and
First Clinic of Internal Medicine
Klinikum Buch
Medical Faculty of the Charité
Humboldt University of Berlin
Germany