CASE REPORTS

Hyperkalaemia induced by carbonic anhydrase inhibitor

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Abstract

An 81-year-old man developed hyperkalaemic and hyperchloraemic metabolic acidosis following treatment with a carbonic anhydrase inhibitor for his glaucoma. He had mild renal failure and selective aldosterone deficiency was confirmed. In this case the treatment did not lead to hypokalaemia because of the limited potassium secretory capacity in the renal tubules from selective aldosterone deficiency; rather, it may have led to hyperkalaemia because metabolic acidosis induced by the carbonic anhydrase inhibitor caused transcellular movement of potassium.

Carbonic anhydrase inhibitors (CAIs) are widely used in the treatment of glaucoma. Hypokalaemic and hyperchloraemic metabolic acidosis is one of the common adverse effects, particularly observed in elderly patients with mild renal impairment or diabetes mellitus.¹ This is a report on a patient who developed hyperkalaemic metabolic acidosis following treatment with a CAI.

Case report

An 81-year-old man presented with developing blurred vision. Glaucoma and cataract were diagnosed, and he was first treated with topical timolol maleate. The ocular pressure was poorly controlled and he was admitted for an operation. A carbonic anhydrase inhibitor, dichlorphenamide, was given in the dosage of 25 mg a day prior to operation. Five to seven days after starting treatment confusion and disorientation were noted, associated with hyperkalaemic and hyperchloraemic metabolic acidosis. Dichlorphenamide was discontinued and he was referred to the renal division. Timolol maleate was not discontinued.

He was known to have mild renal dysfunction, but diabetes mellitus was not noted. On examination he was fully conscious and well orientated. He was mildly dehydrated but otherwise appeared normal. The laboratory findings are summarised in Table 1. The hyperkalaemic metabolic acidosis was corrected after treatment with sodium bicarbonate. He then moved to the ophthalmic division to undergo right intracapsular cataract extraction and peripheral iridectomy. Dichlorphenamide was given again in the dosage of 100 mg a day on the day of operation. Polyuria, disorientation, and hyper-

Table 1 Laboratory findings

Urine pH		5.5
Arterial pH		7.23
PaCO ₂	kPa	4.0
Total protein	g/l	78
Urea nitrogen	mmol/l	16.3
Creatinine	μmol/l	183
Sodium	mmol/l	133
Potassium	mmol/l	6.4*
Chloride	mmol/l	110
Bicarbonate	mmol/l	12
Anion gap	mmol/l	11
Phosphorus	mmol/l	3.3
Glucose	mmol/l	4.8

*The serum potassium concentration was 5.0 mmol/l on admission.

kalaemia developed again after the operation. The CAI was discontinued. The symptoms soon subsided and the serum potassium concentration returned to normal without a use of sodium bicarbonate (Fig 1). He underwent an operation on the contralateral side without pretreatment with a CAI. The postoperative course was uneventful. To investigate the cause of hyperkalaemic and hyperchloraemic metabolic acidosis, the renal response to acid, alkali, and furosemide load was examined while he was off all medications (Table 2).

Discussion

Hypokalaemic and hyperchloraemic metabolic acidosis has been commonly observed after treatment with CAIs.^{2,3} The CAI administration results in an increase in renal tubular flow, which is thought to enhance potassium excretion, and profound loss of potassium in the urine causes hypokalaemia.⁴ In the case reported here, hyperkalaemic rather than hypokalaemic metabolic acidosis developed. The results of NH₄Cl,

Figure 1 Serum potassium concentration rose following administration of the CAI and fell after the CAI was discontinued.

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Table 2 Renal response to acid, alkali, and furosemide load

	<i>NH₄Cl</i> provocative test	<i>NaHCO₃</i> loading test	<i>Furosemide</i> loading test
Plasma HCO ₃ mmol/l	16	25	
Urine pH	4.8		
PaCO ₂ kPa	4.0		
FEHCO ₃ %		<10	
U-BPCO ₂ kPa		3.3	
PAC pmol/l			89*

FEHCO₃: fractional excretion of bicarbonate.U-BCO₂: difference of partial pressure of carbon dioxide between urine and blood.

PAC: plasma aldosterone concentration.

*Furosemide was given in the dose of 1 mg/kg body weight intravenously.

PAC was 119 pmol/l before furosemide loading.

NaHCO₃, and furosemide loading tests indicated that selective aldosterone deficiency was complicated by mild renal failure.⁵ Thus potassium secretory capacity was thought to be limited, and the CAI did not cause renal loss of potassium in this case. Instead metabolic acidosis from bicarbonate loss by the CAI might have caused transcellular movement of potassium, yielding extracellular hyperkalaemia.

The topical use of timolol maleate might have also contributed to the development of hyper-

kalaemia by suppressing renin (and aldosterone) secretion.⁶ But hyperkalaemia was considered to be induced chiefly by the CAI, since timolol maleate was given throughout the entire clinical course and hyperkalaemia was not observed unless the CAI was given (Fig 1).

This is apparently the first report of hyperkalaemic metabolic acidosis induced by a CAI. CAIs could cause hyperkalaemia when given to patients who have a limited capacity for secreting potassium in the renal tubules, as seen in patients with renal dysfunction of tubular origin or to whom a β adrenergic antagonist is given concomitantly.

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