A small cell bronchogenic carcinoma associated with
tumoral hypophosphataemia and inappropriate
anti-diuresis

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Summary: A patient is described with small cell carcinoma of the lung, associated with profound
hypophosphataemia and hyponatraemia. Increased phosphate excretion and inappropriately high urine
osmolality were observed. The abnormalities are consistent with tumoral hypophosphataemia and
inappropriate anti-diuresis. These tumour-related metabolic abnormalities have only been described once
before with this malignancy.

Introduction

Significant and prolonged hypophosphataemia is
an unusual metabolic disturbance. Causes include
hyperglycaemic diabetic emergencies, hyperparathyroidism, renal tubular acidosis, malabsorption and
malnutrition.\textsuperscript{1,2} Hypophosphataemia may also
be rarely associated with certain tumours,\textsuperscript{3} possibly
due to the autonomous secretion of parathyroid
hormone-related protein (PTHrP) inhibiting tubular
resorption of urinary phosphate, which may in
turn lead to ‘phosphaturic osteomalacia’ if
hypophosphataemia is prolonged. ‘Tumoral
hypophosphataemia’ may be associated with a
variety of neoplasms.\textsuperscript{3-8} It is always rare and is
especially so if associated with other syndromes of
tumoral hormone production. We report here an
unusual case of small cell carcinoma of the lung,
associated with tumoral hypophosphataemia and
also the syndrome of inappropriate anti-diuresis
(SIAD).

Case report

A 72 year old man was admitted with chest pain
and weight loss. He had a past history of myocardial
infarction and peptic ulceration. He had
smoked 20 cigarettes a day for many years but
drank little alcohol. Examination revealed finger
clubbing but no other significant clinical
abnormalities. Chest X-ray and computed tomography
(CT) showed a right hilar tumour with mediastinal
lymph node involvement. Bronchoscopic biopsy
revealed a small cell carcinoma.

Routine biochemical screening showed consistent
severe hypophosphataemia and hyponatraemia (see Table I). Urinary phosphate clearance
was increased and tubular reabsorption of phosphate decreased. Serum calcium was consistently
normal but alkaline phosphatase was moderately
raised. Isoenzyme electrophoresis demonstrated the
alkaline phosphatase to be of bone and liver
origin. Pelvic X-rays were normal. Serum bilirubin
and alanine aminotransferase (ALT) levels
were normal. Levels of aspartate aminotransferase
(AST) and gamma-glutamyl aminotransferase
(GGT) were slightly elevated, but liver ultrasound
scan was normal. Haemoglobin level, blood glucose,
plasma proteins, urea and creatinine were
within laboratory reference ranges. Urine analysis
by semi-quantitative dipstick showed no excess of
glucose or protein. Arterial blood gas concentra-
tions and pH were also normal.

Details of hyponatraemia are also given in Table
I. At the time of osmolality studies, serum sodium
was 117 mmol/l and serum osmolality similarly low
at 249 mosmol/kg. Urine osmolality was inappropri-
ately raised at 375 mosmol/kg. Renal function as
assessed by serum creatinine was consistently nor-
mal, the patient was not on diuretic drugs and was
clinically euvoalaemic. Adrenal function was nor-
mal by Synacthen testing.

Before further investigation or treatment could
be planned, the patient deteriorated rapidly and
died. Permission for autopsy was refused.

Discussion

Tumoral hypophosphataemia, sometimes also
known as ‘tumorous phosphaturic osteomalacia’,

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Table 1  Biochemical findings in a patient with tumour-associated hypophosphataemia and SIAD

<table>
<thead>
<tr>
<th>(A) Mineral metabolism</th>
<th>Reference range</th>
</tr>
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<tbody>
<tr>
<td>Serum phosphate</td>
<td>0.27 mmol/l</td>
</tr>
<tr>
<td>(0.22–0.40)</td>
<td>0.70–1.60</td>
</tr>
<tr>
<td>Phosphate clearance</td>
<td>23 ml/minute</td>
</tr>
<tr>
<td>Tubular reabsorption of phosphate</td>
<td>64%</td>
</tr>
<tr>
<td>(when serum phosphatase 0.27 mmol/l and serum creatinine 64 µmol/l)</td>
<td>80–90%</td>
</tr>
<tr>
<td>PTH-related peptide (PTHrP)</td>
<td>&lt;0.9 pmol/l</td>
</tr>
<tr>
<td>PTH</td>
<td>4.5 pmol/l</td>
</tr>
<tr>
<td>1,25 diOH vit D</td>
<td>1.1–6.9</td>
</tr>
<tr>
<td>24 OH vit D5</td>
<td>11.6 pg/ml</td>
</tr>
<tr>
<td>Serum calcium</td>
<td>&lt;6 ng/ml</td>
</tr>
<tr>
<td>Serum alkaline phosphatase</td>
<td>2.28 mmol/l</td>
</tr>
<tr>
<td>(isoenzymes bone and liver mixed)</td>
<td>216 U/l</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>43 g/l</td>
</tr>
<tr>
<td>35–45</td>
<td></td>
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</tbody>
</table>

(B) Water and electrolyte metabolism

| Serum sodium                               | 117 mmol/l      |
| Serum potassium                            | 3.9 mmol/l      |
| Serum chloride                             | 84 mmol/l       |
| Serum bicarbonate                          | 22 mmol/l       |

| 1,25 diOH vit D = 1,25 dihydroxy vitamin D; 25 OH vit D₃ = 25 hydroxy vitamin D₃. | |

is a well-recognized but rare syndrome¹,² characterized by hypophosphataemia, normocalcaemia, hyperphosphaturia, elevated serum alkaline phosphatase and often clinical features of osteomalacia (bone pain, muscular weakness, X-ray changes, etc.). Most cases reported have been associated with benign mesenchymal tumours,³,⁴ although malignant neoplasms also have occasionally been involved.⁵ Of these, only three non-mesenchymal malignancies have been reported – two carcinomas of prostate⁶ and one of lung.⁷

Our patient had a histologically proven small cell carcinoma of the lung with good biochemical evidence of tumoral hypophosphataemia. Low serum levels of 1,25 dihydroxy vitamin D are well known to be low in this syndrome, probably due to inhibition of hydroxylation.⁵ Serum 25 hydroxy vitamin D levels are usually normal.⁵ Our patient’s low level may have been because he presented in the middle of winter. He had no clinical or radiological features of overt osteomalacia, presumably because of his short-duration history. There were no overt features of poor nutrition, and haemoglobin and serum albumin were quite normal. Serum calcium and PTH levels were also unremarkable. There was also no evidence of renal tubular acidosis (or other tubular dysfunction) as a cause for the patient’s hypophosphataemia. Arterial pH was normal, serum chloride was not elevated and serum bicarbonate, urea and creatinine were normal.

Hyponatraemia was also present, associated with serum hypo-osmolality, relative urine hyperosmolality, normal renal and adrenal function, and absence of hypovolaemia or diuretic treatment. This fulfils the classical criteria of Bartter and Schwarz⁸ for the diagnosis of associated inappropriate antidiuresis (SIAD) and this case represents only the second reported case of small cell carcinoma of lung with the combined metabolic abnormalities of SIAD and tumoral hypophosphataemia.⁷

The putative humoral mediator of tumoral hypophosphataemia is uncertain. It certainly inhibits renal tubular resorption of phosphate, and appears to interfere with vitamin D hydroxylation.⁹ This combined abnormality is similar to that found in X-linked hypophosphataemic rickets.¹⁰ PTHrP is a possible mediator of the tumoral hypophosphataemic syndrome.¹¹ As in our case, however, levels are not always raised, and it is possible that there are other as yet undetectable PTH-like peptides, which may lead to hypophosphataemia. In this context, it is of considerable interest that a recent report¹² appears to identify a humoral factor which inhibits renal tubular reabsorption of phosphate, and which is distinct from PTHrP, as a mediator of oncogenic osteomalacia.
References