SHORT COMMUNICATION

PARATHYROID-HORMONE CONCENTRATIONS IN NUTRITIONAL RICKETS


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SUMMARY

1. Elevated concentrations of immunoreactive parathyroid hormone (P.T.H.) were detected in the pre-treatment plasma samples of seven out of ten children with nutritional rickets. The three normal values occurred in an inactive case, an infant with associated kwashiorkor and a child with late onset juvenile rickets.

2. Five children, reinvestigated after 6 weeks of vitamin D treatment, showed highly significant falls in P.T.H. concentration, confirming the functional nature of the secondary hyperparathyroidism. The activity of plasma alkaline phosphatase was less consistently decreased after treatment in these cases.

3. Convincing radiological evidence of (secondary) hyperparathyroidism was not detected in the hand bones of any of the rachitic children.

4. The possible diagnostic value of plasma P.T.H. measurement in active rickets is indicated.

Key words: parathyroid hormone, rickets, nutritional rickets, secondary hyperparathyroidism, vitamin D.

Nutritional rickets is by no means a vanishing disease. Biochemical criteria for its diagnosis include alterations in the amounts of serum alkaline phosphatase, inorganic phosphorus and calcium, with elevated alkaline phosphatase values occurring most consistently (Dancaster & Jackson, 1962). It has been suggested that secondary hyperparathyroidism may play a fundamental role in the evolution of the biochemical findings (Taitz & deLacey, 1962). With the development of specific radioimmunoassay methods for measuring circulating parathyroid hormone (P.T.H.) concentrations, the investigation of parathyroid activity has been greatly facilitated, and a recent report (Lequin, Hackeng & Schopman, 1970) describes markedly elevated concentrations of the hormone in two children with severe vitamin D deficiency. The present study was undertaken to examine parathyroid function in nutritional rickets.

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<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Plasma calcium (mg/100 ml)</th>
<th>Plasma phosphorus (mg/100 ml)</th>
<th>Plasma alkaline phosphatase (King-Armstrong units)</th>
<th>Plasma P.T.H. (pg/ml)</th>
<th>Pre-treatment samples</th>
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<th>Plasma P.T.H. (pg/ml)</th>
<th>Post-treatment samples</th>
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<tr>
<td>1. E.G.</td>
<td>6 months</td>
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<td>7.4</td>
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<td>2. E.K.</td>
<td>6 months</td>
<td>M</td>
<td>8.4</td>
<td>3.8</td>
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<td>365</td>
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<td>3. Z.M.</td>
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<td>F</td>
<td>8.6</td>
<td>3.6</td>
<td>32</td>
<td>725</td>
<td>9.8</td>
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<td>39</td>
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<td>585</td>
<td>10.6</td>
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<td>5. J.N.</td>
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<td>5.0</td>
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<td>660</td>
<td>8.6</td>
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Normal range in children: Plasma calcium (9-11 mg/100 ml), Plasma phosphorus (4-6 mg/100 ml), Plasma alkaline phosphatase (10-30 King-Armstrong units), Plasma P.T.H. (<25-400 pg/ml)
PATIENTS AND METHODS

Ten African children who presented with nutritional rickets during the period June–December 1970 were investigated. Their age and sex distribution are included in Table 1. In six cases (1–6) the diagnosis was active classical vitamin D deficiency; one child (patient 7) presented with severe leg deformities but was thought to have inactive disease. The three eldest children (8–10) were thought to suffer from ‘juvenile nutritional rickets’ (Taitz, 1962), differing from the classical disease in its later age of onset and possibly due to a separate dietary factor impairing calcium absorption or the action of vitamin D. No child showed evidence of renal disease or steatorrhea. Radiological confirmation (hand and wrist) of the diagnosis was obtained in all instances and signs of secondary hyperparathyroidism looked for in the films.

Heparinized venous blood samples were withdrawn in the fasting state before treatment was started, centrifuged and the plasma was immediately stored at \(-20^\circ\) for later P.T.H. determination. Five children were reinvestigated after they had received 6 weeks of daily supplementation with 2000 I.U. of vitamin D. The remaining children were unfortunately lost to follow up.

P.T.H. concentrations were measured by radioimmunoassay as described in detail elsewhere (Schopman, Hackeng & Lequin, 1970). All samples were assayed in duplicate in a single assay without reference to the clinical findings and results were expressed in terms of a bovine P.T.H. standard. Each value represented the mean of the duplicate determinations. (For all samples the variation between duplicate measurements was 11.2%.) The lowest amount of plasma P.T.H. detectable by the method was 25 pg/ml.

Routine biochemical determinations were performed by standard techniques.

RESULTS

Biochemical details of the pre-treatment plasma samples from the ten children are outlined in Table 1. Calcium concentrations ranged from 7.4 to 9.6 mg/100 ml and inorganic phosphorus from 3.0 to 5.0 mg/100 ml. Plasma alkaline phosphatase was elevated in all but two cases (one being the child with inactive disease). P.T.H. values were raised in seven of ten patients. The three normal values (all tending towards the upper limit) were found in the inactive case, an infant who had associated protein calorie malnutrition and in a child with juvenile dietary rickets; in two of these cases the plasma calcium was also normal. No radiological evidence of hyperparathyroidism was seen in the hand bones of any rachitic child.

After 6 weeks of vitamin D therapy, repeat plasma P.T.H. determinations in five children (patients 3, 4, 5, 8 and 9) showed a uniformly striking return to normal values. The mean (±SEM) post-treatment plasma P.T.H. value of 167 (±47) pg/ml was significantly below the pre-treatment value of 628 (±28) pg/ml \((P<0.001)\). Repeat plasma alkaline phosphatase values in these five children were less impressively decreased; two of the five cases (3 and 9) showed virtually unchanged values. The mean rise in plasma calcium was 1.1 mg/100 ml and in plasma phosphorus 0.8 mg/100 ml respectively.

DISCUSSION

The present study lends support to the concept of parathyroid overactivity in the majority of children with active nutritional rickets, presumably initiated by a prodromal hypocalcaemic
period. Prompt suppression of elevated P.T.H. concentrations after a short course of vitamin D therapy suggests that the hyperparathyroidism is functional in nature and subject to physiological control. An analogous situation has been described in adults with intestinal malabsorption and hypocalcaemia (Buckle, 1970).

Radiological evidence of secondary hyperparathyroidism was not detected in the hand bones of the rachitic children in our series, although a more extensive skeletal survey was not performed. The apparent rarity of subperiosteal digital resorption in nutritional rickets has also been commented on by Dancaster & Jackson (1962). Reasons for this are uncertain but may be related to the duration of the parathyroid hyperfunction, since radiological changes have certainly been reported in chronic vitamin D-resistant rickets (Thomas & Fry, 1970). It has also been shown that P.T.H. is less effective in its action on bone when an associated deficiency of vitamin D is present (DeLuca, 1969).

Elevation of P.T.H. concentrations in active nutritional rickets may be helpful in confirming the diagnosis of the disease, and perhaps in assessing the early response to treatment.

ACKNOWLEDGMENTS

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REFERENCES


