A CASE OF PARATHYROID OSTEODYSTROPHY

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A 23 year old Teochew cabinet-maker complained of pain in the dorso-lumbar region of his spine of two years duration. Six months later, he also had pain in the bones of his left forearm, initiated by a fall, and aggravated by further falls. He did not have the other symptoms of general weakness, indigestion, abdominal cramps, vomiting or renal colic.

ON EXAMINATION

He was well-developed and in good physical condition. He had no palpable tumour in the neck, and systemic examination revealed no abnormality.

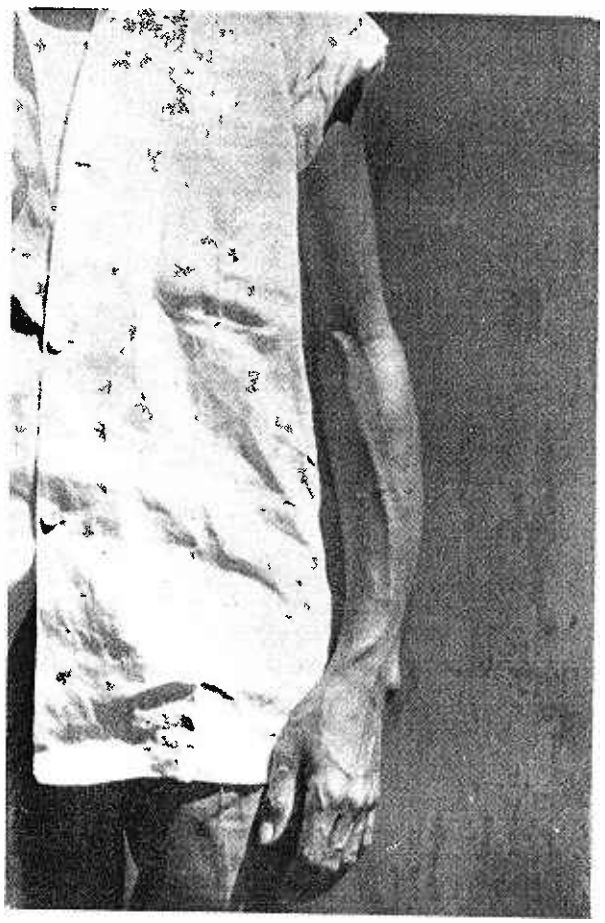

Fig. 1 — Left forearm.

His left forearm was deformed, and was held in the position of mid-rotation. The left radius was irregularly thickened in its upper two-thirds with a posteriorly curved deformity. At the elbow, there was limitation of extension by 15 degrees at the end of the range but flexion was full. Of pronation, he had a range of 25 degrees of movement from mid-position, and he was unable to supinate at all. At the left wrist, there was limitation of rotation as above, but other movements were normal.

A skeletal survey revealed generalised osteoporosis and coarse trabeculation of the skeleton as a whole. There was definite thinning of cortices generally. No calculi were found in the renal tract or elsewhere. An intravenous pyelogram showed no calcified stone, good excretion on both sides, normal filling of calyces, ureter and bladder.

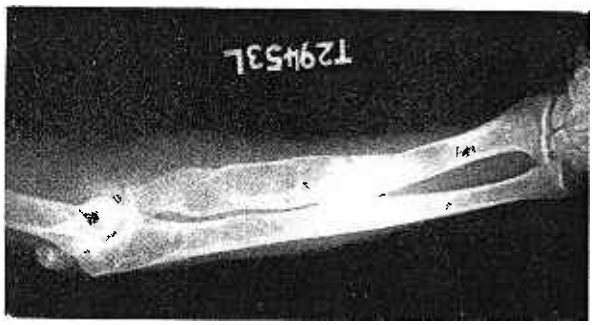

Fig. 2. Radius and Ulna.

The left radius was the most involved by cyst formation, which extended throughout the upper four-fifths of its shaft. This caused thinning and irregular expansion of the cortex and a posteriorly curved deformity of the bone. In both femora, there were large areas of rarefaction with thinning

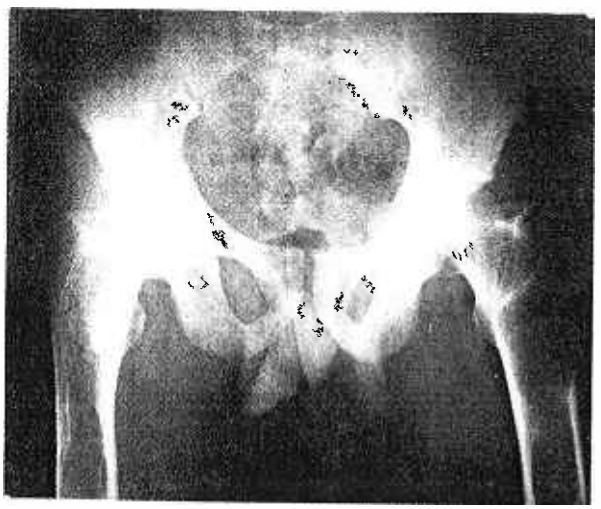

Fig. 3. Pelvis and upper femora.

of cortices in the upper shafts. In the bones of the hands and feet were many small areas of rarefaction. There was slight periosteal thickening of many phalanges of the hands. Patches of rarefaction were also present in the pelvis. The cranium was fuzzy and mottled — the "moth-eaten skull".

Dental X-rays (Mr. F.A.C. Oehlers), showed generalised osteoporosis of the jaws, while the bone in between the teeth showed a "ground glass" pattern. There was loss of the lamina dura in several areas. Other radiological examination, chest X-rays and a barium swallow demonstrated no abnormality.

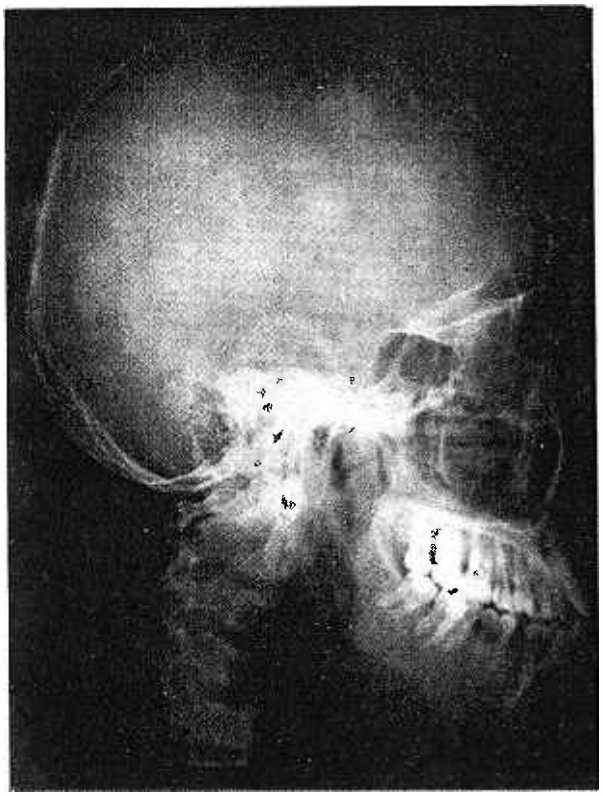

Fig. 4. "Moth-eaten" skull.

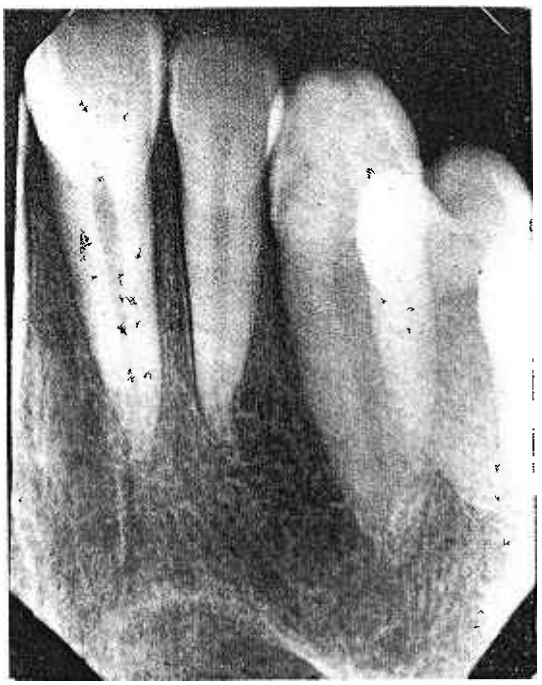

Fig. 5. Dental, showing loss of lamina dura.

Kidney function: His kidney function was normal. A urea clearance test showed a Mean Clearance of 132.6%.

Clinical laboratory investigations: Blood counts, total white and differential, total red and haemoglobin, B.S.R., were all normal. Routine and microscopical examination of urine were all normal, no albumen, no sugar, no Bence-Jones protein. Sulkowitch test for calcium in urine was positive, 2+.

Biochemistry of Blood and Urine revealed a high serum calcium and a low serum inorganic phosphate, together with an increased urinary calcium excretion. The serum calcium at its highest was 12 mg.%, and the serum inorganic phosphate at its lowest was 2.3 mg.% The serum alkaline phosphatase at its highest was 40 K-A units.

	BLOOD			URINE	
	Serum Calcium mg.%	Serum Inorganic P. mg.%	Alkaline Phosphatase K-A units	Calcium mg./24 hrs.	Inorganic P. mg./24 hrs.
Normal Values	9-11	3-4.5	3-12	200	1000
Range in patient	11-12	2.3-2.9	30-40	264-421	451
Averages on Constant Diet: Ca. 0.8 gm./day; P.1.2 gm./day	11.9	2.7	45-58	372	902

TABLE I — BIOCHEMISTRY OF BLOOD AND URINE.

	CALCIUM gm./day			PHOSPHATE gm./day		
INTAKE			0.45			1.39
OUTPUT — Faeces	0.05	} =	0.33	0.52	} =	1.23
OUTPUT — Urine	0.28			0.71		
Positive balance			0.12			0.16

TABLE II — ONE 3-DAY METABOLIC BALANCE STUDY.

He was next put on a constant Calcium and Phosphorus diet (Mrs. Meyer and Miss Lau) calculated to contain calcium 0.8 gm. per day and Phosphorus 1.2 gm. per day. Three days were allowed for equilibration, and the above tests were repeated daily for the next four days. All blood samples were fasting specimens taken before breakfast. Again, the maximum serum calcium was 12 mg.%, with an average of 11.9 mg.%. It was never lower than 11.7 mg.%. The lowest serum inorganic phosphate was 2.5 mg.% with an average of 2.7 mg.%. The alkaline phosphatase was 58 K-A units at its highest.

During this period, among other tests being done, the blood alkali reserve and electrophoresis of plasma proteins gave normal results throughout.

Metabolic Balance study: A metabolic balance study was next arranged. The patient was maintained on a constant diet containing Calcium 0.45 gm. per day, Phosphorus 1.39 gm. per day and Fat 85 gms. per day. The food was cooked in duplicate. For each portion eaten by the patient, an equal portion was analysed in the laboratory. Again, three days were allowed for equilibration, and then one 3-day balance period was carried out. The result however showed an unexpected positive balance of Calcium 0.12 gm. and Phosphate 0.16 gm.

Fat Balance Test: Simultaneously, a fat balance test was also carried out. This showed a normal fat absorption of 94.6%.

Biopsy of left radius: Biopsy of the left radius was performed by Prof. Gunn. A cystic cavity was found and explored. The cavity was loculated, with fibrous septa. It was filled with a thin brownish fluid.

On histological examination (Dr. K. K. Tan), the bone cortex showed that the Haversian canals were uneven and enlarged. Most of them were filled with young fibrous tissue. The fibrous septa consisted mainly of fibrous and fibroblastic tissue in which were embedded bony spicules, foam cells some filled with brown pigment and mononuclears. Some bony spicules were being resorbed and some have degenerated into eosinophilic masses.

TREATMENT

Excision of the Parathyroid tumour was performed by Mr. Y. Cohen. He found a large tumour 2" long, ½" broad, and ½" thick, occupying the whole of the right inferior parathyroid gland. It lay posterior to the inferior pole of the right lobe of the thyroid. The tumour mass extended downwards and medially with a tract which subsequently was found to be thymus tissue on microscopic examination. The tumour was excised in

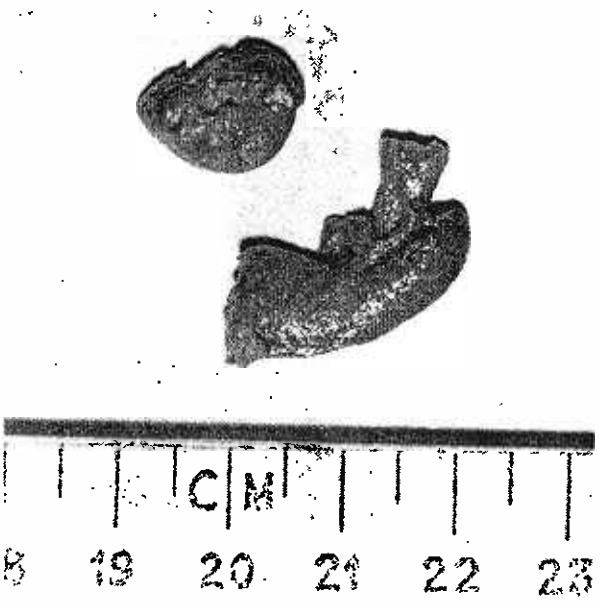

Fig. 6. The parathyroid tumour. The picture was taken after section.

toto. Exploration of the other sites were negative, and after the tumour tissue was confirmed as parathyroid by frozen section, the incision was closed.

On pathological examination (Dr. K. K. Tan), the tumour was cylindrical, well-defined, with a thin transparent smooth capsule. The surface was smooth and shiny and there were mild lobulations in one area. The tissue was soft, and the cut surface was dark brown and homogeneous. A whitish cord-like piece of tissue was attached to the main mass.

Microscopically, a very thin layer of fibrous tissue surrounded the tumour. The main cell type was the large vacuolated Wasserhelle cell, which had a distinct cell outline, clear cytoplasm, and a centrally placed large hyperchromatic nucleus.

The next common cell was the chief cell, which had an indistinct outline, pale pink granular cytoplasm and a large hyperchromatic nucleus, filling more than half the cell. It was smaller than the former. Some variation of nuclear size was present in both these cells.

Lastly, there were many occasional groups of cells of the oxyphil type which were larger than the chief cell, and had a well-demarcated cell outline with a reddish granular cytoplasm which filled the cell. The arrangement was in solid sheets interspersed with many vascular channels which were surrounded by some fibrous tissue. There was only one area where a very poor attempt at acinar formation was seen. The whitish cord-like structure was a portion of the thymus gland. The picture was that of a parathyroid adenoma with no evidence of malignancy.

PROGRESS

The patient made an uneventful recovery from his operation, and he was then put on a rich calcium diet. Tetany did not occur during convalescence. Two weeks after operation, he felt well and strong enough to express a wish to return to work. His serum calcium had dropped to 8.0 mg.%, and serum inorganic Phosphate had risen to 3.0 mg.%. Serum alkaline phosphatase was now 40 K-A units. Urinary excretion of calcium had dropped to as low as 12 mg./day.

He was accordingly discharged from the ward to continue in the followup clinic, where he had now been seen for two years. During this period the serum calcium gradually rose until it stood at 10.2 mg.% a year and a half after operation. Correspondingly, the serum inorganic phosphate had also risen to 3.6 mg.%, and the urinary calcium excretion rose to 49.6 mg./day.

When last seen he was obviously well and working, with no complaint of pain or weakness. Radiologically he had shown no improvement.

DISCUSSION

This is a case of parathyroid osteodystrophy due to a single adenoma of the right inferior parathyroid gland.

The clinical diagnosis was evident with pain in the back and in bone with deformity, the radiological changes, the blood biochemistry of high serum calcium, low serum inorganic phosphate, a raised blood alkaline phosphatase, and an increased urinary calcium output. He did not have weakness or indigestion, and there were no deposits of calcium in the body, or renal calculi.

This condition of osteitis fibrosa generalisata, first described by von Recklinghausen in 1891, is often confused with polyostotic fibrous dysplasia, but the latter appears in childhood and puberty; patches of abnormal cutaneous pigmentation are often present, and the blood biochemistry is normal. In addition, there is no generalised osteoporosis.

Of the four conditions with hyperplasia of the parathyroid glands — rickets, renal insufficiency with phosphate retention, calcium deprivation and pregnancy, all have a low serum calcium level.[1]

The positive balances obtained from the metabolic study were unexpected, but it did show that more calcium was eliminated in the urine (0.28 gm./day) than in the faeces (0.05 gm./day), and this is what occurs in hyperparathyroidism. In the normal person 70 to 90% of the calcium output appears in the stools and only 10 to 30% in the urine.[2] It would seem also that in failing to put in markers to define the limits of stool collection, coupled with the fact that the patient was somewhat constipated at that time, would be factors contributing to inaccuracy.

It is recognised that calcium metabolism is very variable. It varies widely in different persons and on different days in the same person. Other factors which influence excretion of calcium are sex, age, weight, activity, diet and metabolism of phosphorus.[3] In normal people a low calcium diet results in a marked negative calcium balance. In adults, this negative balance is decreased as

calcium intake rises, until at minimal requirement (0.45 gm./day) the balance is zero.[4]

R. Fraser and E. J. King quoted a case of primary hyperparathyroidism with a positive calcium balance of +370 mg./24 hours when on a moderate calcium diet containing 1.1 gm./24 hours.[5] Again, they quoted another case of the same condition with a negative calcium balance of —518 mg./24 hours on a low calcium intake of 0.21 gm./24 hours.[6]

It is perhaps of some interest to note that the diet used during the metabolic balance study was calculated from book tables to contain 0.8 gm. calcium and 1.4 gm. phosphorus per day. On laboratory analysis however, the actual content was found to be calcium 0.45 gm. and phosphorus 1.39 gm. per day.

ACKNOWLEDGEMENTS

I would like to thank my colleagues already mentioned, and Prof. T. F. Dixon and Dr. P. C. Leong for their advice on the biochemical investigations, the tests and analyses involved being done in the latter's laboratory.

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