NUTRITIONAL OSTEOMALACIA: A CASE REPORT*

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omalacia is defined as a metabolic bone disease acterized histologically by decreased mineralization one matrix.[1] Radiographic features such as pseudo- ures, and biochemical changes such as a low serum um and low serum phosphorus with a raised alkaline phatase level help to distinguish this disorder from much commoner metabolic disease of osteoporosis, h histologically shows normal mineralization. Osteo- cia is more amenable to treatment than osteoporosis, e the importance of establishing the correct diagnosis. he many causes of osteomalacia, pure nutritional malacia, the adult counterpart of vitamin-D-sensitive ts, is reported in a current textbook of endocrinology[2] ing extremely rare. However, in the British medical ture[3-8] there have been many recent reports of nutri- l osteomalacia occurring especially in the elderly, on inadequate diets and remaining indoors due to nity. We are not aware of any similar reports in the African literature and should like to describe this as a reminder that one must consider this diagnosis atients with bone pain, especially as the present nt had been extensively and fruitlessly investigated revious admissions. The diagnosis was finally con- d after bone biopsy and a therapeutic trial of ological amounts of vitamin D.

CASE REPORT

Admission

e patient, a White spinster, was first admitted to tal in 1939 at the age of 23 years. Following the of her nephew in a motor accident two years ously, she began having odd 'attacks', which she ibed as 'a queer feeling in the abdomen as if a was rising up in my throat and getting stuck there'. sister was at that time in a mental home and her r complained of 'a nervous stomach'.

examination no abnormality apart from severe myo- was found. Central nervous system examination and Wassermann reaction were negative. A diagnosis of chondriasis and psychoneurosis was made. She was arged from hospital and given a disability grant.

nd Admission

e patient was readmitted in 1953 complaining of des of vomiting, diarrhoea and abdominal pain g for one month at a time during which she would lose weight. She was reported to have had periods of abnormal behaviour with hallucinations, purposeless movements and strange speech. She was emaciated and weighed 36·3 kg (80 lb).

Investigations. Full blood count, ESR, stool examination, and barium meal and enema were all normal. During her stay in hospital she had one episode of hysterical convulsions. However, she began to eat better and her weight rose to 44 kg. Psychiatric opinion at the time was that the patient was a passive and inadequate psychopath.

Third Admission

In 1958 she was admitted to hospital for the third time. She complained of anorexia, vomiting, dysphagia, intermittent constipation and diarrhoea and weight loss of 13·6 kg during the previous 2 years. For the first time she complained of muscular pains. Again examination was negative except for marked cachexia. Her weight was 34 kg (75 lb) and full blood count and barium meal were normal.

Fourth Admission

In 1960 the patient was admitted for the fourth time. She again complained of a plethora of gastro-intestinal symptoms but she now added backache which had been present for the preceding 4 years.

Investigations. Full blood count and urine examination were normal. Her blood urea was 14 mg/100 ml; serum sodium 138, potassium 4·7, chloride 103 and bicarbonate 24·9 mEq/litre. X-rays were reported as showing healing fractures of the ribs and decreased bone density. Her serum calcium was repeatedly found to be normal but her serum phosphorus was persistently low (Table I). The alkaline phosphatase was in the normal range. Twenty-four-hour urinary calcium excretion was 42 mg and serum albumin 3·6 and serum globulin 4·2 g/100 ml respectively. Malabsorption studies which included xylose excretion and fat balance studies were normal. The patient was thought to have osteoporosis and was discharged from hospital.

Fifth Admission

In September 1969 the patient was admitted because of fractures of both ulnae and one clavicle that had been sustained following trivial trauma. She again complained of persistent vomiting. On examination she had marked kyphosis and was extremely thin, weighing 32·2 kg.

Investigations. Full blood count and ESR were normal

received: 19 October 1970.

TABLE I. SERUM VALUES

	Date							
	25/2/60	*7/3/60*	*12/3/60*	*16/3/60*	*18/9/69*	*5/10/69*	*6/10/69*	*1/12/69*
m calcium* mg/100 ml	10·5	11·2	8·8	10·7	10·9	9·7	10·6	10·7
m phosphorus† mg/100 ml	2·8	1·9	1·6	2·0	2·4	1·9	2·1	4·0
aline phosphatase‡ units	12·4	12·5	8·3	—	13·5	10·0	8·7	15·4

al range 9 - 11 mg/100 ml.
al range 2·5 - 4·5 mg/100 ml.
Bodansky units—normal range 4 - 12 units. 1969 Modified Bodansky
d—normal range 2 - 9 units.

Skeletal survey showed generalized diminished bone density and fractures through Looser's zones in the distal third of both ulnae (Fig. 1). On reviewing her chest X-ray it was decided that what was previously described as simple fractures were probably Looser's zones in the ribs. A barium meal showed a small reduceable hiatus hernia; a cholecystogram was normal. Blood urea, sodium, potassium, chloride, bicarbonate, pH and PCO_2 values were normal. Total serum protein was 7·6 g/100 ml with a normal electrophoretic pattern. Serum folate, serum vitamin B_{12} and urinary alpha-amino-nitrogen were normal. The serum calcium was again normal and the alkaline phosphatase was slightly elevated with a persistently low serum phosphorus (Table I). Urinary calcium excretion varied from 29 to 63 mg/24 hours.

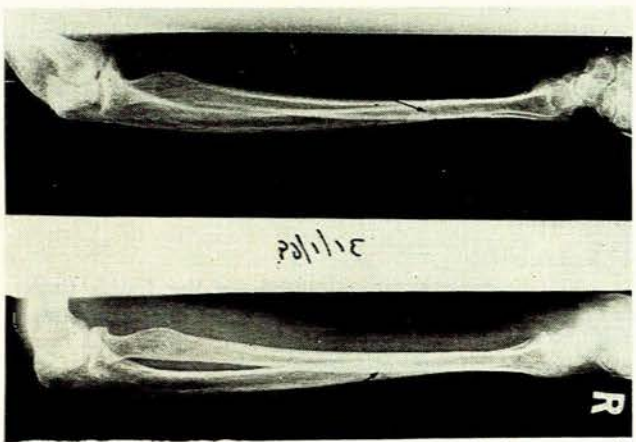

Fig. 1. X-ray of forearms. Note symmetrical nature of fractures.

Tubular reabsorption of phosphorus was normal. Calcium balance studies could not be done because of the patient's irregular eating habits and tendency to vomit. However, a 4-hour calcium retention test as described by Nordin and Smith[9] showed retention of 99·1% of the intravenously administered calcium load (normal 40 - 60% retention). The strontium test was done as described by Fraser *et al.*[10] This indicated an exchangeable calcium mass (Ca_E) of 25·4 total plasma units (normal 7·3 - 16·8). The rate of deposition of calcium in bone (Ca_B) was 5·8 total plasma units, the normal figures being 0·8 - 2·0.

A rib biopsy was performed and Dr Jenifer Jowsey of the Mayo Clinic, Rochester, Minnesota, reported as follows:

'The microradiograph (Fig. 2) shows clear evidence of a long-term history of failure of mineralization; this is demonstrated by areas of hypomineralization within the bone tissue. Both the microradiograph and calcified section (Fig. 3) demonstrate active osteomalacia shown by unmineralized osteoid tissue averaging twice normal in width (i.e. 30 U). The stained section indicates a low bone formation level. The over-all picture is one of a long history of active osteomalacia and would be consistent with vitamin-D deficient osteomalacia.'

A full dietary history showed that the patient took only 25 g of protein per day. She drank no milk and ate no milk products. Her diet consisted essentially of black tea and cereals made up with hot water in place of milk. Her vitamin-D intake was thus negligible. The patient was then put on small doses of oral vitamin D, 1 500 IU daily. When seen one month later her serum phosphorus was normal for the first time (Table I). She felt better but a repeat stable strontium test showed no change. The figures were Ca_E 26·3 total plasma units and Ca_B 5·9 total plasma units, indicating that there was still a large volume of unmineralized bone (osteoid) remaining.

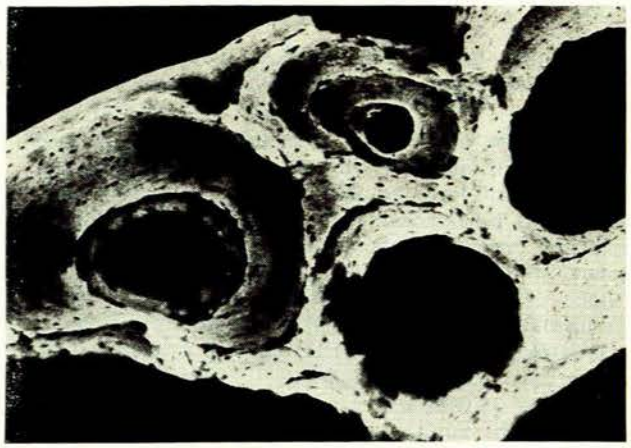

Fig. 2. Microradiograph showing increased osteoid tissue as darker areas.

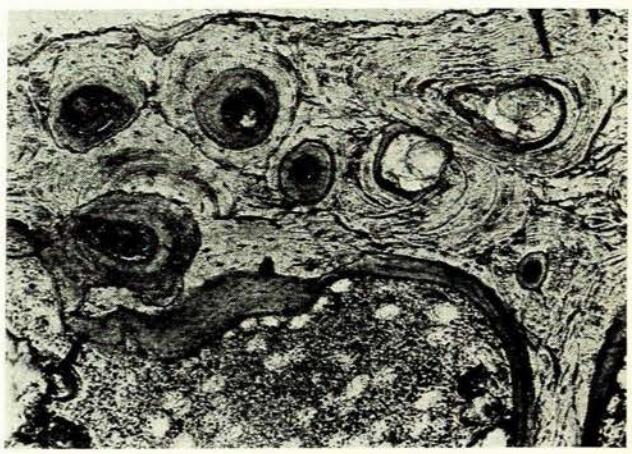

Fig. 3. Calcified section of bone showing broad seams of osteoid tissue as darker areas.

Summary of Case

This patient presented initially with a personality disorder and intermittent anorexia, nausea and vomiting for which no organic cause could be found despite extensive and repeated investigation. She then adopted an inadequate diet, low in vitamin D and calcium. Seventeen years later she began complaining of backache and muscular pains. This was followed 2 years later by the discovery of 'fractures' of her ribs. She later fractured both ulnae and a clavicle on mild trauma. It was the suspicion that these were not true fractures but Looser's zones, i.e. bands of osteoid tissue, that led us to diagnose osteomalacia. Her only biochemical abnormality was a persistently low serum phosphorus, although on a number of occasions the alkaline phosphatase was just marginally elevated. On a previous admission in 1960 it had been

ected that she might have normocalcaemic hyperparaidism because of her low serum phosphorus and ting, but the parathyroids were not explored.

DISCUSSION

ically one expects to find a low or normal serum ım, a low serum phosphorus and an elevated alkaphosphatase in osteomalacia, but it has been noted ously that one or even two of these parameters may ormal.[5] In a recent review by Arnstein *et al.*[11] it was ted that all three parameters may be normal. Dan- and Jackson also found normal biochemistry in children with radiological changes of vitamin-Dent rickets.[12] Arnstein *et al.* found, as have others, the calcium retention test was the most reliable of osteomalacia. The principle of this test depends the fact that calcium absorption is poor in the of vitamin-D deficiency but that the unmineralized (osteoid) is avid for calcium, and any calcium given venously will be taken up preferentially by the osteoid only minimal quantities excreted in the urine. The ır calcium retention test[9] showed that the patient bed 99·1% of the intravenously administered dose lcium (normal 40 - 60%) indicating a large mass of id. The strontium test provides the same information. skeleton does not distinguish between calcium and tium and in osteomalacia the intravenously administrontium is taken up rapidly into the osteoid. This hown by a high Ca_E of 25·4 total plasma units (nor-7·3 - 16·8) and a high Ca_B of 5·8 total plasma units nal 0·8 - 2·0).

ter only one month on small doses (1 500 internal units daily) of vitamin D the patient felt very better and her serum phosphorus had returned to al. Rosin[5] reported that the earliest biochemical re- in elderly osteomalacic patients was a rise in the n phosphorus which occurred within a few days of ting treatment. The fact that the strontium test ined abnormal after this month of treatment is not ising and corresponds with the findings of Fraser [10] that strontium studies were still abnormal several hs after vitamin-D treatment had been started in of osteomalacia. Only one of their patients had al strontium studies and this was after 2 years of nent.

ne biopsy showed broad osteoid seams and the osis of osteomalacia was confirmed. The cause of steomalacia in this patient was accepted as being y nutritional on the basis of:

Negative investigation for steatorrhoea and malabsorption which included fat balance studies and barium meal and follow through.

Absence of a past history of gastric resection.

A diet grossly inadequate in vitamin D.

A good clinical and biochemical response to small doses of oral vitamin D.

is of interest to note that two out of the three cases itritional osteomalacia reported by Gough *et al.*[3] had nality defects not unlike our patient. They are re- d to have been 'shy and apathetic, had little interest e and did not bother about food'. Their second case like our patient, 'been taking a restricted diet because of recurrent attacks of nausea and vomiting for which no organic cause could be found'. In South Africa's sunny climate it would be expected that vitamin-D deficiency would be rare. Rickets in South African children is not uncommon. Dancaster and Jackson[13] estimated that active rickets was present in between 30 and 80% of non-White children aged 3 - 12 months who attended the outpatient department at Groote Schuur Hospital. Robertson[14] found rickets in one in 7 infants of all races in the Cape Town area. These authors[14,15] found that exclusion of sunlight was by far the most important single aetiological factor. Our patient asserted that she did go out and expose herself to sunlight but, because of her apathetic nature, we strongly doubt this.

CONCLUSION

Nutritional osteomalacia is a disorder that may be easily treated but equally easily overlooked in the eccentric, because of their many other 'functional' complaints; and in the elderly because of other complicating illnesses.[5] From the onset of her bone pain it took 13 years for our patient to be correctly diagnosed and treated.

It therefore appears justified to repeat some of the points stressed by Chalmers *et al.*[6] in their excellent review.

History

Osteomalacia should be suspected in the patient with prolonged bone pain, particularly if it involves the pelvic girdle and limb extremities. The chronic pain of osteoporosis almost always involves the spine only, but can result in episodes of pain in other areas usually associated with a fracture. Muscular weakness occurs in osteomalacia and not in osteoporosis. A past history of gastric surgery or a story of food faddism should make one suspect osteomalacia in the patient with bone pain.

Examination

The patient with osteomalacia may have bony deformities and tenderness of the bones even in the absence of a fracture.

Radiology

Looser's zones are pathognomonic of osteomalacia but their absence does not exclude osteomalacia. A skeletal survey should be done paying particular attention to the pelvis, ribs, scapulae and forearms in suspected cases.

Serum Chemistry

Routine serum calcium, phosphorus and alkaline phosphatase estimations should be done in all patients with bone pain. Abnormality favours osteomalacia as opposed to osteoporosis where these parameters are usually normal. It should be stressed, however, that other disorders such as Paget's disease and liver disease may elevate the alkaline phosphatase and that all biochemical findings should be interpreted in the light of the clinical setting. Normal values for calcium, phosphorus and alkaline phosphatase do not however exclude osteomalacia and if the clinical suspicion is strong enough on the basis of the history and examination it is best to proceed to the next investigation.

Four-hour Calcium Retention Test

This appears to be the single most useful test, a high calcium retention indicating osteomalacia.

Bone Biopsy

This is the final court of appeal and it should be done without hesitation in doubtful cases.

Therapeutic Trial of Vitamin D

A therapeutic trial of small doses of oral vitamin D will help to differentiate nutritional osteomalacia from osteomalacia secondary to malabsorption or vitamin-D resistance. Failure to respond in a patient with histologically and biochemically proved osteomalacia should lead one to search for these and other rarer causes. It should be stressed, however, that vitamin D should not be given indiscriminately in pharmacological doses to patients with backache and decreased radiological density of bones. Osteoporosis is far more common than osteomalacia and there is the danger that overenthusiastic treatment in the wrong patients will lead to hypercalcaemia and nephrocalcinosis with permanent renal damage.

SUMMARY

A case of nutritional osteomalacia has been reported due to psychogenic vomiting and a diet low in vitamin D. The diagnosis was suspected on finding Looser's zones on X-ray and was confirmed by the 4-hour calcium retention test, the stable strontium test and bone biopsy. The only persistent biochemical abnormality was a low serum phosphorus level although the alkaline phosphatase was marginally elevated on occasions. The serum phosphorus level reverted to normal when estimated one month after starting small doses of oral vitamin D. There was no evidence of malabsorption and the patient's clinical and biochemical response to oral vitamin D in small doses confirmed the diagnosis of simple nutritional vitamin-D deficiency. The importance of suspecting osteomalacia in patients with bone pain is stressed and steps in making the diagnosis are outlined. The danger of indiscriminate vitamin-D administration is also stressed.

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ADDENDUM

Six months after initiating treatment, repeat skeletal survey showed all Looser's zones to have disappeared although the bone was still undermineralized.

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