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HYPERPARATHYROIDISM AND STEATORRHOEA

BY

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[WITH SPECIAL PLATE]

The association of bone disease with steatorrhoea has been well known since the classic descriptions of rickets in coeliac disease (Parsons, 1927) and of osteomalacia in idiopathic steatorrhoea (Bennett *et al.*, 1932). All the descriptions, however, whether based on clinical signs, biochemical studies, or radiology or histology of bones, state that the bone disease is identical with that of classical rickets or of osteomalacia, which of the two depending on the age of the patient. The possibility, however, that parathyroid overaction may also occur in this condition has been strongly stated by Albright and Reifenstein (1948). They suggest that the changes in plasma levels of calcium and phosphorus are closely related to overaction of the parathyroid glands. Those cases of steatorrhoea which tend to have a low calcium and normal phosphorus level correspond to cases in which calcium deficiency (due to the steatorrhoea) has occurred without secondary parathyroid hyperplasia. Cases in which the plasma calcium remains at nearly normal levels but the phosphorus level is low represent the result of the same calcium deficiency, but with sufficient parathyroid hyperplasia to maintain a nearly normal calcium level. This hyperplasia then causes a fall in phosphorus level owing to increased renal excretion of phosphorus by the action of the parathyroid hormone. This interpretation has many supporters, but is disputed also by other workers, including ourselves, on the grounds that other signs of parathyroid overaction are usually absent—for instance, the bone histology, the urine calcium output, and the size and histology of the parathyroid glands when obtained *post mortem*. An alternative hypothesis, which we ourselves favour and which can equally well explain the altered levels of calcium and phosphorus and many of the other findings in steatorrhoea, assumes that, for obscure metabolic reasons, the condition mimics a deficiency of vitamin D. This then leads to increased phosphate excretion by the kidney by a direct renal action. This hypothesis does not involve the parathyroid hormone in the explanation of the lowered plasma phosphorus level.

Arguments of this kind become exceedingly involved, and in the absence of parathyroid hormone assay they are impossible to settle either way. It is the purpose of this paper to describe two cases in which we think that unambiguous radiological signs of hyperparathyroidism

have occurred in the presence of steatorrhoea, and also to suggest that steatorrhoea may sometimes be the cause of apparent cases of "primary" hyperparathyroidism.

Case 1

A midwife aged 37 was seen by one of us (A.W.) on August 6, 1952, at the request of Dr. Oswald Savage. She lived in the Channel Islands and had remained there throughout the German occupation in the war. It was during this period, in 1942, that diarrhoea started. This was intermittent, with up to seven actions of the bowel in a day, but there were long spells of freedom, and in 1945 the diarrhoea ceased. In 1950 she developed abdominal distension and was admitted to a hospital for investigation. Sprue was diagnosed, and treatment with folic acid and "anahaemin" was followed by improvement in her condition. However, she abandoned the treatment after three months. In April, 1951, acute appendicitis developed, and following appendicectomy she noticed the gradual onset of stiffness, particularly of the back and hips, and a waddling gait. She had also lost about a stone (6.4 kg.) in weight in spite of a normal appetite, and had become easily fatigued and dyspnoeic on slight effort. Menstruation was normal, bowels regular without diarrhoea, and micturition normal. There was nothing relevant in the past or family history, except that she had had "consumption of the bowels" at the age of 9 months.

She was of spare build and weighed 8 st. 10 lb. (55.3 kg.). The waddling gait was striking, as though she had bilateral osteoarthritis of the hip-joint. She was obviously anaemic, but without glossitis or stomatitis. There was, however, scaling of the skin of the hands and feet, with brown pigmentation on the neck. The abdomen was moderately distended. Blood pressure 110/60 mm. Hg. Chvostek's sign negative. Urine normal. Blood investigation a week previously showed: haemoglobin 48% (Haldane); red cells 3,200,000 per c.mm.; colour index 0.75; leucocytes 5,200 per c.mm. Radiological examination of the hands, lumbar spine, and pelvis showed decalcification. It was thought that the symptoms were due to multiple deficiencies secondary to idiopathic steatorrhoea, and, as she refused to stay in London, she was advised to return to the care of her physician in the Channel Islands.

Nothing more was heard of the patient until August, 1953, when the following letter was received from her doctor: "She has had amenorrhoea for four months, and I think she is pregnant. She is no longer anaemic, but her waddling gait is worse and she complains of excruciating pain in the sacro-iliac region which compels her sometimes to go on all fours." In view of this arrangements were made to

admit her to the Middlesex Hospital, where she arrived on October 3, 1953, the delay being due to her reluctance to enter hospital. She said that since August, 1952, she had taken folic acid, iron, and "multivite" tablets with improvement. The last menstrual period was in March, 1953, and with the pregnancy she had felt well but the stiffness and back pain had increased. However, she had been resting during the last two months with considerable relief of the pain. She had no further diarrhoea, but had nocturnal frequency of micturition (about four times a night).

On examination the mucosae were found to be normal; the fundus of the uterus lay half-way between the symphysis pubis and the umbilicus, and there was slight pitting oedema over the sacrum. The signs otherwise were unchanged. B.P. 120/60 mm. Hg. Chvostek's sign negative. Urine normal.

She was seen by Mr. Ian Jackson, who confirmed pregnancy. Pelvimetry showed the true conjugate measurement to be 3.7 in. (9.4 cm.) and the shape of the brim markedly android, while the subpubic angle was very narrow. The bones of the pelvis were porotic, and there was a fracture of the superior ramus of the pubis on both sides. Mr. Jackson advised caesarean section just before term, and Mr. P. H. Newman considered that weight-bearing should be avoided because of the risk of fracture of the femoral neck.

Investigations and Treatment

Owing to the pregnancy and the inability to stand, investigations were somewhat restricted. On October 6, 1953, the blood picture was as follows: Hb 9 g. per 100 ml., red cells 3,900,000 per c.mm., P.C.V. 34%, M.C.V. 87 c. μ , M.C.H.C. 26.5%, white cells 5,900 per c.mm.; plasma

GRAPH 1.—Case 1: Calcium and phosphorus levels.

sodium 140, phosphorus 4.5, chlorides 111 mEq per litre; plasma proteins (g. per 100 ml.): albumin 3.3, globulin 1.4; alkaline phosphatase 75 King-Armstrong units; urea 19 mg. per 100 ml. Urine calcium 110 mg. in the 24 hours. Calcium and phosphorus levels are shown in Graph 1. Two analyses for total faecal fat gave 43% and 57%; fat-balance determination showed 77% absorption. She was treated as follows: folic acid, 20 mg. daily; "cervon," 1 fl. dr. (3.552 ml.) thrice daily; one multivite tablet thrice daily; calciferol, starting with 50,000 units daily, increased to 100,000 units daily on October 15, 200,000 units daily on October 26, and finally 250,000 units daily on November 11, which was continued; calcium phosphate, 60 gr. (4 g.) thrice daily.

Progress

She was delivered of a normal boy, weighing 5 lb. 4 oz. (2.38 kg.), by caesarean section on December 8, 1953. The post-operative progress was uneventful. On December 16 she was allowed to start walking, as x-ray examination suggested that calcification had taken place in the pelvis. She left hospital on December 30. No further news of her was received till December, 1955, when she wrote to say that she continues in excellent health, without pain or stiffness, and is well able to do all her housework without getting tired. Her son is growing satisfactorily and enjoys perfect health.

Radiological Assessment

Radiographs are available of most of the skeleton dating from the first time she was seen in July, 1952, and during

her subsequent admission to the Middlesex Hospital from October to December, 1953.

In July, 1952, there were signs of osteomalacia of comparatively acute onset, for early Looser zones were present in both pubic rami and ischia, without much deformity, the bones as a whole otherwise appearing well calcified and of normal structure (Special Plate, Fig. 1a). The lumbar vertebrae were slightly biconcave and showed increased density of their upper and lower regions to give the appearance of horizontal stripes ("rugger-jersey sign"). In the hands there were very early subperiosteal erosions of the middle phalanges with erosions of the tufts of the terminal phalanges (Plate, Fig. 2a). These latter changes are diagnostic of hyperparathyroidism of either primary or secondary origin.

When examined again in early October, 1953, the skeleton revealed evidence of simultaneous progression of all the radiological signs of the disease. The pelvic fractures now showed bony displacement; the vertebral biconcavity was perhaps more marked in the lumbar region, but, more convincing, it now affected the thoracic vertebrae as well, which also showed a "rugger-jersey sign." The hyperparathyroid changes in the fingers were also more extensive (Plate, Fig. 2b).

By the end of December, 1953, after the birth of the baby and after the patient had received large doses of calciferol, many of the radiological signs had regressed. The pelvic fractures were showing a callus reaction (Plate, Fig. 1b) and the hyperparathyroid lesions in the hands were healing (Plate, Fig. 2c). The biconcavity and "rugger-jersey sign" of the lumbar vertebrae were still unchanged (Plate, Fig. 3).

Case 2*

A married woman aged 41, employed as a coil winder, was referred to one of us (C. E. D.) by Dr. M. E. Morgans on account of bone pains and associated abnormal radiological findings. When admitted to University College Hospital on January 1, 1955, she complained of pains in both thighs intermittently for ten years and a loss of height of about 4 in. (10 cm.). Over the previous five years she had lost 2½ stones (15.9 kg.) in weight, and in the last three months had developed breathlessness on walking and additionally more severe pains had appeared in the arms, ribs, and back. She had been well until 1944, when the pains in the thighs began. These were first interpreted as due to rheumatism, but as they got worse and prevented her from walking she was admitted to another hospital, where tuberculosis of the hip was diagnosed and she was put to bed with traction on the right leg. (The radiographs taken at that time are unfortunately not obtainable.) After two months she was allowed up but found she was no better, and at the end of a further three months the pains gradually lessened and she was able to return to work. However, in 1945 there was an exacerbation, this time with pain in the chest and arms as well as both buttocks, and she was readmitted to the hospital. Radiographs then showed gross decalcification; the serum calcium was 12 mg. per 100 ml., alkaline phosphatase 28 K.-A. units, and urinary calcium 200 mg. in 24 hours. She had iron-deficiency anaemia, which was satisfactorily treated with oral iron. A diagnosis of hyperparathyroidism was then considered. Of a further short admission later that year the notes state that she had a waddling gait and pain in the buttocks; serum calcium 11.5 mg. per 100 ml., phosphatase 46 K.-A. units.

She was able to return to work soon afterwards and remained well until about two years ago, when the pains reappeared in the thighs, and more recently in the other parts of the body. She was able to work until admission, but was by that time in very great pain and could not have continued much longer. On further questioning she admitted to having occasional swelling of the ankles in the summer

*This case was described and discussed at a meeting of the Section of Endocrinology of the Royal Society of Medicine on May 23, 1956.

months. She said she was always constipated, having a bowel motion once every three or four days. Her periods were normal, and her general health was good apart from the pains.

Clinical Examination

Examination showed a short, pale woman of unusual body configuration, as can be seen from the accompanying photographs.

Case 2, showing body configuration suggesting coeliac dwarfism with additional more recent decrease in trunk length.

There was tenderness over the ribs and lower back; joint movements were full.

Laboratory Investigations

Haematological investigation showed haemoglobin 14 g. per 100 ml., red cells 4,160,000 per c.mm., colour index 1.14, M.C.D. 7.9 μ , M.C.V. 102 c. μ , white cells 6,000 per c.mm. (differential normal). In the bone marrow there were no definite megaloblasts, but some of the intermediate normoblasts had nuclei deficient in chromatin, suggestive of vitamin deficiency (Dr. E. Graves). Glucose-tolerance curve was flat, beginning at 96 mg. per 100 ml. and rising to a maximum of 123 mg. at 30 minutes. Plasma levels were: Ca 11.4 and P 2.0 mg. per 100 ml.; alkaline phosphatase 69 K.-A. units; Na 143, K 5.2, HCO₃ 19.2 and Cl 109 mEq per litre; albumin 4.9 and globulin 1.8 g. per 100 ml.; urea 24 mg. per 100 ml.; urea clearance 116% and 112%; maximum urea concentration 2.7 g. per 100 ml. Urine concentration and dilution test, S.G. 1020-1006 with greatly delayed excretion of water load. The urine was otherwise normal except for a very low concentration of calcium. Fat-balance studies (59 g. of fat daily) showed absorption values of 87.5% and 87.1% in two consecutive six-day collection periods.

Radiological Findings

Radiographs showed the thoracic cage to be very small (Special Plate, Fig. 4). The pelvis was trefoil in shape (Plate, Fig. 5), and the lumbar vertebrae had marked biconcavity as well as showing the "rugger-jersey sign." The bones throughout had a thin cortex and prominent fuzzy trabeculae. The suspicion of hyperparathyroidism thus aroused was fully confirmed by the typical subcortical erosions of the middle phalanges and phalangeal tufts (Plate,

Fig. 6a) and the fuzzy appearance of the skull (Plate, Fig. 7). These findings were held to indicate the presence of both long-standing chronic osteomalacia and more acute severe hyperparathyroidism with osteosclerosis. The small chest and dwarfism appeared to be consistent with a diagnosis of coeliac disease continuing in mild form into adult life. There were no deformities suggesting rickets in childhood.

Course and Treatment

Our first diagnosis, based on the patient's body build and the biochemical findings, was that she had lifelong steatorrhoea. Our subsequent finding of a macrocytic anaemia in the peripheral blood and of abnormal red cells in the bone marrow, as well as of a low urine calcium output and flat glucose-tolerance curve, seemed to confirm this, as also

did the fat balance, although it was not as abnormal as it might have been. The only inconsistency was the high plasma calcium level. We therefore argued that the patient had developed a parathyroid adenoma, perhaps as a result of long-standing hyperplasia, and that the constipation occurring in spite of the steatorrhoea was due to the high plasma calcium value. Further investigations were carried out to test this theory. Calcium balance with and without large

GRAPH 2.—Case 2: Calcium balance data before and after very large doses of pure dihydrotachysterol. Note negative balance before treatment, with high faecal excretion and low urinary output. A typical vitamin-D response obtained after giving the dihydrotachysterol. The response is, however, slow and small considering the large dose.

doses of dihydrotachysterol (given as pure compound) showed the changes expected of a case of steatorrhoea—namely, a very high faecal calcium level which the dihydrotachysterol treatment only slowly lowered (Graph 2). Her symptoms were partially relieved during this treatment, but there was no change in the radiological signs of hyperparathyroidism. We assumed that we were improving the osteomalacia somewhat, but that the hyperparathyroidism was not controllable by this means. While this investigation was proceeding she was given 10 mg. of folic acid twice daily, which rapidly reduced the size of the red cells.

As she was still incapacitated by pain, it was decided that surgical exploration of the neck should be undertaken for a parathyroid adenoma. The dihydrotachysterol was therefore discontinued and the neck explored on March 11, 1955, by Mr. D. R. Davies. Two of the parathyroid glands were normal; a third was large and was removed. It weighed 150 mg. and was identified as a chief-cell adenoma. The fourth parathyroid gland could not be found, so the wound was closed and the patient returned to the ward. She did well during the next few days, but subsequently developed fever with pain and swelling in the neck which proved to be due to a wound abscess. This was incised on March 25, when a great deal of pus came away. Coincident with the development of the abscess her plasma calcium level slowly fell and her aches and pains disappeared. A radiograph at this time showed definite improvement in the subperiosteal erosions in the hands.

She was sent home almost symptom-free on April 8, with only 10 mg. of folic acid twice a day as treatment. The significant biochemical findings throughout her stay in hospital and subsequently are shown in Graph 3. It may be seen that the calcium content had returned to normal, with the phosphorus still remaining at a low level. The

phosphatase level had also fallen. It was thought that the hyperparathyroidism was relieved but that more vitamin D would be needed later for the osteomalacia. It was interesting that while the plasma calcium level was falling she began to pass loose, pale stools, typical in appearance of those of steatorrhea.

GRAPH 3.—Case 2: Main details of treatment and more important plasma changes. Note the slow fall to normal levels of plasma calcium after the first parathyroid tumour had been removed on March 11, 1955, followed by its return to abnormally high levels, and then finally the precipitous fall to tetany levels when the second parathyroid adenoma was removed on November 9, 1955. After the second (not the first) operation there was also a large rise in phosphorus level.

Out-patient Follow-up

When seen on May 2, 1955, she was well in herself but some pain had returned in the thighs. Radiographs on this date suggested some regression of the subperiosteal erosions and there was a rise in the plasma calcium level (Graph 3). In the following week her clinical condition was similar: the plasma calcium was still raised and she was definite that she had become constipated again. From then until September it seemed clear that her condition was deteriorating, the pains getting worse, and the constipation persisting. In case this was due to an increase in the osteomalacia, however, she was given five capsules a day (about 3 mg.) of "A.T.10." This had no appreciable effect on her clinical condition, and in a month or two it was obvious that the x-ray signs of hyperparathyroidism were much worse and that the phosphatase level had ceased to fall. It was therefore decided to readmit her, since the most likely explanation was that she had another adenoma in the fourth parathyroid gland, not identified at the previous operation, and that her improvement after that operation was probably due to its having been temporarily damaged at that time. This line of reasoning also suggested that if there was another adenoma it would probably be found in the neck, not in the mediastinum.

Second Admission

She was readmitted to University College Hospital on October 10, 1955. Her clinical condition was very similar to that on her first admission, and so were the biochemical findings (Graph 3). The A.T.10 treatment was stopped to see if the plasma calcium level would become normal, but it did not fall more than about 0.5 mg. per 100 ml. She was then given a ten-day course of cortisone, 150 mg. a day, to make sure that the raised plasma calcium level was not due to an overdose of A.T.10. When the calcium level is raised owing to an overdose of or sensitivity to a vitamin-D

preparation administration of cortisone in this dosage would cause it to fall, whereas this does not occur if the rise is due to a parathyroid tumour (Dent *et al.*, unpublished observations; see also Dent, 1956). As the cortisone had no effect in this case it was decided to re-explore the neck, and this was done on November 9. The two normal parathyroid glands on the right side were again identified. Thorough exploration of the left side revealed a large lump weighing 1 g. behind the clavicle near scarring due to the wound sepsis in the first operation. This was identified as a chief-cell adenoma of the parathyroid gland and was removed. The post-operative course was satisfactory, the wound healing well. However, two days after the operation she developed tetany, which continued for some time in spite of the administration of large doses of A.T.10 and of intravenous calcium gluconate. Her bone pains completely disappeared in a few days and the looseness of the bowels returned.

The biochemical changes and major treatments are shown in Graph 3. It is to be noted that after some time on A.T.10 alone she was given a short course of cortisone. This was in the hope of improving her steatorrhea and thus perhaps her response to the vitamin D. However, her symptoms and blood chemistry remained unaffected, therefore it was discontinued. Then 15 mg. of vitamin D₃ daily was added, and for a short time a very large dose in tablet form of calcium ascorbate ("calci-C," Physiological Chemicals Co. Inc.), as this compound is alleged to be especially well absorbed from the gut. However, no significant changes in plasma level occurred during this time, suggesting that the compound was not absorbed. After two weeks on both A.T.10 and vitamin D₃ the former was stopped altogether, but there was a slight fall in the plasma calcium level, presumably because the action of the A.T.10 was dwindling faster than the vitamin D₃ action was beginning. Calcium-balance determinations during this period showed that she was retaining about 1 g. a day. The dose of vitamin D₃ was then increased to 30 mg. a day, and on this enormous dose the plasma calcium level began to rise steadily.

During her last two months in hospital the anaemia worsened. This was shown to be of iron-deficiency type with a serum iron level of only 56 µg. per 100 ml. It was treated with intramuscular injections of iron with good results.

A curious and unexpected feature of the post-operative recovery phase was the rise in plasma phosphorus level; this attained 3.3 mg. per 100 ml. a few days after the operation, then rose to about 4 mg. for a few days during the treatment with A.T.10 alone, to reach a peak of 7 mg. while the large dosage of vitamin D₃ was being given. It has fallen from these high levels since the plasma calcium has become almost normal. Her urine was occasionally analysed during this period and found to contain the usual quantities of phosphorus (400–700 mg. a day). There therefore appeared to be a definite change of kidney threshold, which would be consistent with some degree of hypoparathyroidism. We can only suggest that the function of the two remaining glands was subnormal because their blood supply had been disturbed or perhaps because our therapy was affecting them.

She was discharged symptom-free on February 6, 1956. Since then she has maintained excellent general health, and x-ray examination of her bones shows spectacular improvement (Special Plate, Fig. 6b). Final dosage and plasma levels are shown in Graph 3.

Discussion

We have described two cases of steatorrhea in which radiological signs thought to be specific for hyperparathyroidism (Pugh, 1951; Dent and Hodson, 1954) have been found. We are not aware that this has been previously described. Biochemical reasons for supposing that there is

some degree of hyperparathyroidism in many cases of steatorrhea have, however, been put forward many times (Albright and Reifenstein, 1948), while Salvesen and Bøe (1953) have carried the argument still further with their unusual suggestion that the hyperparathyroidism they assume to be present in steatorrhea is the cause of the osteomalacia. We do not wish to argue whether this purely biochemical evidence is valid, or even whether it is supported by our more unambiguous findings in these two cases. It can well be argued the other way round, that, because such radiological signs are exceedingly rare in steatorrhea, therefore the frequent occurrence of hyperparathyroidism is unlikely. We are still left with the problem of whether one is or is not convinced by the biochemical arguments as against radiological ones. It is of interest that Bennett *et al.* (1932) made no specific mention of hyperparathyroid changes in the bones in any of their 15 cases of steatorrhea. Professor Turnbull's report of the bone histology of their Case 12 does, however, strongly suggest this, since it states that "osteoclasts are present in considerable number . . . in this portion of bone active resorption by osteoclasts is undoubtedly greater than normal."

Our first patient had a remission of the radiological hyperparathyroid changes which coincided in time with the end of her pregnancy and with the administration of large doses of calciferol. It is possible that either or both of these factors may have been responsible for the remission, but we prefer to think it was due only to the calciferol, because of data which we have on other cases but which are not complete enough to present here in detail. It is interesting that our first patient also had marked signs of osteomalacia of the more acute type (Dent and Hodson, 1954) associated with Looser zones and without gross deformities of the long bones. Her spine, however (Special Plate, Fig. 3), showed clear signs of osteosclerosis in that the upper and lower borders of each vertebra were more dense than normal to give the appearance of horizontal bands previously described as the "rugger-jersey sign" (Dent, 1955). This triple combination of hyperparathyroidism, osteomalacia, and osteosclerosis has been previously described only, so far as we know, in chronic renal failure (Crawford *et al.*, 1954). This observation is most intriguing, for the usual explanations given for the pathogenesis of renal osteodystrophy can hardly have been applicable to this patient, whose renal function as ordinarily measured was normal and whose plasma levels of calcium and phosphorus were unlike those occurring in renal failure.

The second patient we think was probably an adult survivor of coeliac disease, since she was very small in stature and of a bodily configuration similar to that found in other patients we have seen in whom coeliac disease in childhood had been adequately diagnosed. It seems clear, however, that something else happened to this patient during the last ten or more years, because her symptoms of bone pains and loss of height date from this time. It is possible that she reached adult life with some degree of dwarfism due to coeliac disease and then developed more severe osteomalacia and hyperparathyroidism. Presumably at first the latter was due to parathyroid hyperplasia, as in our first case, but after some time two of her glands became adenomatous, and from then on behaved in an uncontrollable fashion. This would lead to the rise in serum calcium level and produce the constipation which was such a paradoxical finding in a patient in whom steatorrhea had been diagnosed on the other clinical evidence. It is interesting that in this case we have twice witnessed the disappearance of symptoms, a lowering of the plasma calcium level, and a loosening of the bowels. The first occasion was after the initial parathyroid exploration when the first adenoma was removed; the second after the removal of the second and last adenoma, which was much larger. The first operation was followed by wound sepsis, which we think must have interfered temporarily with the function of the other parathyroid adenoma, which had not then been discovered and removed.

If our interpretation is correct, hyperparathyroidism may sometimes occur in steatorrhea. It can at first be reversed by giving vitamin D (Case 1). It may, however, become uncontrollable in this way, and then it produces a clinical picture easily confused with that of primary hyperparathyroidism (Case 2). When this happens the bone changes of hyperparathyroidism are found combined with those of osteomalacia, and the urine calcium level is low (not high, as in primary hyperparathyroidism). We strongly suspect now that one of our own cases treated for primary hyperparathyroidism in University College Hospital some years ago was indeed such a case of steatorrhea, but we have unfortunately been unable to carry out a reinvestigation. We also have records of another case with mild steatorrhea following partial gastrectomy, in which "primary" hyperparathyroidism is very strongly suspected on biochemical and radiological grounds. Unfortunately surgical intervention, and hence confirmation of our diagnosis, is contraindicated on other grounds. It is of interest that a case of parathyroid adenoma associated with pancreatic steatorrhea has recently been reported (Page, 1954). It is a plausible speculation that hyperparathyroidism as described here in steatorrhea may also occur as an occasional complication of rickets or osteomalacia due to causes other than steatorrhea.

Summary

Two cases of steatorrhea are described in which radiological evidence of hyperparathyroidism as well as of osteomalacia was obtained.

In one case the serum calcium level was always 9–10 mg. per 100 ml. Treatment with vitamin D led to a remission of the bone pains and of the radiological signs of osteomalacia and hyperparathyroidism.

In the second case the plasma calcium level was 11–12 mg. per 100 ml. Some relief of bone pains followed treatment with vitamin D, and the calcium balance responded in the expected way. There was, however, no change in the radiological signs of hyperparathyroidism. Symptoms were relieved and plasma calcium level and radiological signs returned towards normal temporarily after one, and permanently after a second, parathyroid adenoma had been removed.

It is concluded that in some cases of steatorrhea a parathyroid hyperplasia occurs which is reversible with vitamin-D treatment. In other cases, however, presumably of longer duration, one or more adenomata will develop. Treatment by operation will then be required, as in primary hyperparathyroidism.

It appears that radiological signs of both osteomalacia (or rickets) and hyperparathyroidism can occur in steatorrhea as well as in renal osteodystrophy. Both of our cases also demonstrated osteosclerosis of the vertebral bodies, as may sometimes be found in renal disease.

We wish to thank Sir Harold Graham Hodgson and Dr. Campbell Golding for help in the radiology, and Sir Charles Dods for the biochemistry, in Case 1; also Dr. J. Hodson for help in the radiology, and Professor M. Maizels and his Department and Mr. G. Philpot for help with the biochemistry, in Case 2.

REFERENCES

- Albright, F., and Reifenstein, E. C. (1948). *The Parathyroid Glands and Metabolic Bone Disease*. Baillière, Tindall and Cox, London.
- Bennett, F. I., Hunter, D., and Vaughan, J. M. (1932). *Quart. J. Med.*, 1, 603.
- Crawford, T., Dent, C. E., Lucas, P., Martin, N. H., and Nassim, J. R. (1954). *Lancet*, 2, 981.
- Dent, C. E. (1955). *Proc. roy. Soc. Med.*, 48, 530.
- (1956). *British Medical Journal*, 1, 230.
- and Hodson, J. (1954). *Brit. J. Radiol.*, 27, 605.
- Page, F. (1954). *Arch. Midx. Hosp.*, 4, 216.
- Parsons, L. G. (1927). *Arch. Dis. Childh.*, 2, 198.
- Pugh, D. G. (1951). *Amer. J. Roentgenol.*, 66, 577.
- Salvesen, H. A., and Bøe, J. (1953). *Acta med. scand.*, 146, 290.

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FIG. 1.—Case 1: Radiographs of pelvis—(a) July 31, 1952; (b) December 17, 1953. Early signs of Looser's zones present in (a). These have progressed, leading to deformity, in (b), where some callus reaction due to recent treatment is visible.

FIG. 2.—Case 1: Radiographs of terminal phalanx of right middle finger—(a) July 31, 1952; (b) October 20, 1953; (c) December 25, 1953. Note erosion of terminal tufts so highly characteristic of hyperparathyroidism. This gets much worse from (a) to (b) while disease was spontaneously progressing. In (c) tuft has re-formed to show sharp outline, corresponding to short period of calciferol treatment.

FIG. 3.—Case 1: Radiograph of lumbar vertebrae on December 17, 1953, showing marked biconcavity due to osteomalacia and increased density of upper and lower margin of each vertebral body, giving appearance of horizontal stripes—"rugger-jersey sign."

FIG. 4.—Case 2: Radiograph of chest on January 3, 1955. Note small thoracic cage, drooping clavicles, winged scapulae. Appearance very similar to case of proved lifelong steatorrhoea shown as Fig. 5 in paper of Dent and Hodson (1954).

FIG. 5.—Case 2: Radiograph of pelvis on January 2, 1956. Note deformities of osteomalacia of fairly long standing. Looser's zones, present in pubic rami in January, 1955, now rapidly healing.

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FIG. 6.—Case 2: Radiographs of index finger of right hand—(a) January 3, 1955, typical of its appearance throughout time hyperparathyroidism was operative; (b) February 3, 1956, two months after removal of parathyroid tumour. Note marked refilling of subperiosteal erosions and beginning re-formation of tuft of terminal phalanges. Improvement still continuing.

FIG. 7.—Case 2: Radiograph of skull on January 3, 1955. Note typical fuzzy appearance of hyperparathyroidism. This was maintained till the second operation, two months after which it started to regress.

M. DARGENT: RADICAL THYROIDECTOMY FOR CANCER OF THYROID

FIG. 1.—Specimen removed at radical thyroidectomy for small deep-seated cancer adherent to trachea with apparently idiopathic paralysis of recurrent laryngeal nerve. (Three-quarters size.) FIG. 2.—Low-power view of section of internal jugular vein filled with a tumour bud with calcified arteries. (Patient cured eight years.) FIG. 3.—Predominantly papillary micronodular cancer; cervical lymphadenopathy; venous invasion. *a*, lymphadenopathy; *b*, endojugular bud; *c*, tumour nodule. (Half size.)

FIG. 4.—Specimen removed at radical thyroidectomy with total laryngectomy for cancer, showing infiltration of muscles. *a*, left lobe; *b*, passive congestion of laryngeal mucosa; *c*, tumour nodule in omohyoid. (Half size.) FIG. 5.—Operative specimen from same patient as Figs. 4 and 5 in text. *a*, cervical lymphadenopathy; *b*, mediastinal tumour. (Half size.)