Vitamin D Intoxication Treated with Porcine Calcitonin

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Summary
Porcine calcitonin was used to treat three patients with hypercalcaemia due to vitamin D intoxication. In two patients a rapid and sustained fall to normal in serum calcium occurred within three days, in the third patient normocalcaemia was achieved in seven days. In view of its rapid and sustained effect calcitonin may be of value in the urgent treatment of hypercalcaemia due to vitamin D intoxication.

Introduction
Poisoning with vitamin D is now less frequent than formerly when vitamin D was prescribed for a variety of skin and arthritic disorders. Yet cases still occur and the associated hypercalcaemia may be life-threatening. The patient becomes anorexic, nauseated, develops mental impairment, and may lapse into coma, while cardiac arrhythmias and renal failure may occur. In severe cases urgent treatment of the hypercalcaemia is required.

The calcium-lowering hormone, calcitonin, has been shown to be active in man (Milhaud, Bourichin, Mouktar, and Perault-Staub, 1965; Foster, Joplin, MacIntyre, Melvin, and Slack, 1966), and we report here the treatment with porcine calcitonin of three hypercalcaemic patients with vitamin D intoxication.

References
the serum calcium fell from 15·8 to 15·0 mg/100 ml, after 12 hours of infusion it had fallen to 14·0 mg/100 ml, and after a further 12 hours to 13·9 mg/100 ml. The serum calcium fell to normal by 60 hours. Calcitonin was stopped after three and a half days, and thereafter the serum calcium remained normal apart from a transient rise to 10·9 mg/100 ml on one occasion.

Case 2

A 64-year-old woman, previously diagnosed as suffering from hypoparathyroidism and receiving treatment with calcium and calciferol, was admitted as an emergency after being found unconscious in the street. She had had a subtotal thyroidectomy 43 years previously, and had been seen two years previously complaining of cramps in the limbs. Her initial investigations showed a serum calcium of 6·3 mg/100 ml, and a phosphate of 5·6 mg/100 ml. The plasma proteins were 7·0 g/100 ml (albumin 4·1 g, globulin 2·9 g) and blood urea was 31 mg/100 ml. She was treated with calcium supplements by mouth and intermittent courses of calciferol. For the three months before admission she had received calciferol 2·5 mg (100,000 units) orally on alternate days. She complained of six weeks’ increasing constipation and cramp-like abdominal pains, and lost consciousness on four occasions.

On examination she was drowsy and mentally slow. There was generalized weakness in the limbs, but the tendon reflexes were normal. Investigations showed serum calcium 13·2 mg/100 ml and phosphate 4·7 mg/100 ml. The blood urea was 93 mg/100 ml.

Progress.—The patient was treated with porcine calcitonin 40 M.R.C. units intravenously twice daily, together with a slow infusion of porcine calcitonin 120 M.R.C. units every 12 hours. The serum calcium fell my 1·6 mg/100 ml within 12 hours and had fallen to 9·6 mg/100 ml by 48 hours (Fig. 2). Thereafter the serum calcium remained normal except for a temporary rise to 10·6 mg/100 ml. Calcitonin treatment was stopped on the fourth day.

Discussion

Calcitonin caused the serum calcium to fall to normal in all three patients. Rapid falls of 1·0-1·5 mg/ml occurred during the first one to three hours. In cases 1 and 2 the serum calcium reached normal by the second and third day respectively. In Case 3 serum calcium fell more slowly: acute falls of 1·0-1·5 mg followed individual injections of calcitonin, but some rise in serum calcium occurred between injections. Hypercalcaemia did not recur in any patient after treatment was stopped.

Steroid therapy is often effective in hypercalcaemia due to vitamin D overdose (Dent, Flynn, and Nabarro, 1953; Anderson, Harper, Dent, and Philpot, 1954; Verter, Engel, and McPherson, 1958) and normocalcaemia may be achieved after five to seven days, although in severe cases the fall in calcium may be delayed for two to three weeks (Anderson
et al., 1954; Verner et al., 1958). The faster action of calcitonin may, therefore, be of greater value than steroids in the treatment of severe cases, when urgent therapy is required. It is of interest that our third patient developed hypercalcaemia while she was already receiving steroid therapy.

Other methods of treatment of hypercalcaemia are available, but none are ideal (Lancet, 1967). Sodium edetate is only temporary in its effect and is nephrotoxic (Foreman, Finnegar, and Leabaugh, 1956). Sodium phosphate is effective (Dent, 1962; Goldsmith and Ingar, 1966) but may produce metastatic calcification, and its use is potentially hazardous in vitamin D intoxication in which renal calcification may have occurred already.

Vitamin D increases the gastrointestinal absorption of calcium (Jones and Rapoport, 1931; Henneman, Dempsey, Carroll, and Albright, 1956) and this is partly responsible for the hypercalcaemia in vitamin D intoxication. Serum calcium falls slowly if such patients are placed on a low dietary calcium intake (Howard and Meyer, 1948) and part at least of the hypocalcaemic effect of steroids is due to their action in decreasing calcium absorption (Dent et al., 1953; Anderson et al., 1954).

Excess vitamin D increases the rate of resorption of bone. Animals poisoned with vitamin D have a lessened mineral content in their bones and are in negative calcium balance (Hess, Weinstock, Rivkin, 1929; Hess, Benjamin, and Gross, 1931; McLean, 1941). If vitamin D acted solely to increase the gastrointestinal absorption of calcium then a positive calcium balance would be expected. The increased rate of bone resorption may therefore be the major factor responsible for the hypercalcaemia in vitamin D overdosage.

The hypocalcaemic effect of calcitonin is small in normal subjects (Foster et al., 1966; Bijvoet, Sluys Veer, and Jansen, 1968). Its main action is to directly inhibit bone resorption (Raisz, Au, Friedman, and Niemann, 1968; Reynolds, Dingle, Gudmundsson, and MacIntyre, 1968) and it is disputed whether it influences bone deposition. It has no effect on calcium absorption but does have a small calcific effect (Cochran, Peacock, Sachs, and Nordin, 1970). Calcitonin is most effective in conditions of increased bone resorption, as in Paget's disease and thyrotoxicosis (Bijvoet et al., 1968). The marked hypocalcaemic effect found in all three patients suggests that the increased rate of bone resorption is the major factor responsible for hypercalcaemia in vitamin D intoxication.

Vitamin D has a long biological half-life and hypercalcaemia due to vitamin D overdosage may continue for six to nine months (Howard and Meyer, 1948). The action of calcitonin is rapid in onset and the half-life of circulating porcine calcitonin in man is less than 10 minutes (Buckle, 1971). It was of interest therefore that the hypocalcaemic effects of calcitonin were sustained after treatment was stopped. The reason for this is not clear, although Pak, Wills, Smith, and Barter (1968) reported a similar sustained hypocalcaemic effect in a patient with a parathyroid carcinoma.

No patient developed any significant hypocalcaemia and toxic side effects were not encountered. Treatment of hypercalcaemia due to vitamin D intoxication with calcitonin seems to be an effective and safe procedure.

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