sheep results in significant hypomagnesæmia accompanied by less well defined hypocalcæmia (Care & Ross 1963, Scott & Dobson 1965). The parathyroids and thyroids have been shown to influence calcium and magnesium homeostasis in the sheep (Care & Keynes 1964) and goat (Payne & Chamings 1964). It was decided to reinvestigate the possible role of mineralocorticoids in calcium and magnesium homeostasis in sheep by the use of 3 animals from which the parathyroids, thyroids and adrenals had all been removed.

In the first sheep, a 2-year-old Kerry Hill wether, after removal of the three sets of glands, the animal was maintained on 5 mg DOCA and 25 mg cortisone acetate I.M. daily, but without replacement of thyroid hormones. Withdrawal of the steroid therapy resulted in increases in the plasma potassium and calcium concentrations of 3·2 and 1·0 mEq/l respectively, but no significant changes in the magnesium concentrations of the plasma or its specific gravity.

The second sheep, a 2-year-old Merino ram, was totally thyroparathyroidectomized. This was followed by the usual fall in the plasma calcium and magnesium concentrations, and later return of the latter to a level in excess of that observed before operation. This hypermagnesæmia is primarily the result of the thyroidectomy and has been observed by us in thyroidectomized sheep and goats not subjected to replacement therapy. Conversely, the intramuscular administration of 5 mg tri-iodothyronine in arachis oil to thyroidectomized sheep reduces the plasma magnesium concentration and increases the plasma calcium. Bilateral adrenalectomy was performed in one stage, six weeks later, and the sheep maintained on 50 mg cortisone acetate and 5 mg DOCA I.M. daily. Over a two-day period this steroid regime was supplemented with 0·5 mg D-aldosterone trimethyl acetate injected I.M. three times a day. The plasma calcium concentration fell from 3·50 to 3·06 mEq/l and the plasma magnesium level decreased from 1·46 to 1·30 mEq/l.

The third sheep, a 1-year-old Merino × Welsh Mountain ewe, was first thyroparathyroidectomized and then bilaterally adrenalectomized eight weeks later. This sheep was maintained for the next eleven months on 25 mg cortisone acetate and 5 mg DOCA I.M. daily and a constant diet of hay. The changes in plasma potassium, magnesium and calcium associated with either withdrawal of the maintenance steroids, or supplementation with an additional 10 mg DOCA I.M. twice daily, were followed. Excessive DOCA administration was associated with a fall in the plasma potassium from 4·8 to 3·3 mEq/l, in the magnesium from 1·37 to 1·10 mEq/l, and in the calcium from 5·19 to 3·41 mEq/l. There was no change in the plasma sodium level. Short-term withdrawal of DOCA, however, did not result in significant hypercalcæmia, despite increases in the plasma potassium and magnesium concentrations.

In summary, 3 sheep have been studied in which the adrenal, thyroid and parathyroid glands were all removed, and the animals maintained by steroid replacement. Raising the daily dosage of mineralocorticoids gave falls in the plasma calcium and magnesium concentrations. Withdrawal of the steroids in one animal gave hypercalcæmia without change in the plasma magnesium level, and hypermagnesæmia without hypercalcæmia in another. It is concluded that adrenal steroids may contribute to calcium and magnesium homeostasis in sheep, but that their role in the intact animal is subordinate to that of the thyroid and parathyroid hormones.

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Calcium Metabolism and the Menopause

The relation between osteoporosis and the menopause was first noted by Albright *et al.* (1941) but has since been subjected to considerable attention. Recently, various workers (Nordin *et al.* 1965, Meema *et al.* 1965) have reported the appearance of osteoporotic changes in various parts of the skeleton within a few years of the menopause.

The present study concerns normal premenopausal women, normal postmenopausal women and women who have undergone an artificial menopause. Metacarpal densitometry according to the method of Anderson *et al.* (1966), radial densitometry by a method of our own and spinal densitometry by a modification of the method of Nordin *et al.* (1962) was carried out on these patients as well as fasting measurements of plasma and urinary calcium and phosphorus.

There was no significant change with age in any of the X-ray measurements in the premenopausal women but a significant fall with age in the X-ray

measurements in the postmenopausal women. After an artificial menopause, the X-ray measurements showed reduced values within one to two years.

There was a significant rise in plasma and urinary calcium and phosphorus values after the menopause. In the premenopausal women, fasting plasma calcium was 9·32 and the phosphorus 3·31 mg/100 ml. After the natural menopause the corresponding values were 9·62 and 3·52 mg/100 ml. After the artificial menopause the corresponding values were 9·81 and 3·62 mg/100 ml. The rise of plasma and urinary calcium was most apparent during the first years after the cessation of the menstrual periods. There were corresponding rises in urinary calcium and phosphorus but no change in the phosphorus excretion index to indicate that there was any change in parathyroid function.

We interpreted these changes to mean that the menopause is followed by a rise in bone resorption which leads to a rise in plasma and urinary phosphorus. These changes can be reversed by œstrogenic hormones (Jasani *et al.* 1965). The loss of bone occurs at the same time but whether the loss of bone should be looked on as a cause of the negative balance or the negative calcium balance as the cause of the bone loss, it is difficult to say.

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