

and 15% respectively of the populations at risk—far beyond the resources of any affordable hospital service.

The key both to effective anticipatory care and effective deployment of extended nurses is a more structured contact with patients so that responsibilities can be more clearly anticipated, defined, and audited. At present only about one practice in four (usually large groups) employs a practice nurse, and attached community nurses employed by district health authorities are tending to be withdrawn from clinical work with general practitioners to maintain care of the housebound and sick in conditions of financial drought. Though the contract for NHS general practitioners introduced in 1966 still allows each general practitioner to employ two whole time equivalent staff with 70% reimbursement of wages the number actually employed averages only 1.1 per doctor, and these are mostly receptionists. A general practitioner employing a nursing sister on scale II for 10 hours a week (who could cope with the follow up of all hypertensives and diabetics, do all the cervical smears and immunisations, and still have some time to spare for other work) pays out £39.80 a week, recovers 70% from the family practitioner committee reducing this to £11.94, and gets 40% tax relief on the remainder, leaving a final cost of £7.16. If she did only two reimbursable cervical smears a week, the practice would gain overall by £5.24. If all general practitioners employed their full complement of reimbursable staff we could add another 27 000 skilled workers to our present overworked teams, and as matters now stand neither the Treasury nor the DHSS could stop it. Given current government priorities we cannot assume that this unused opportunity will continue indefinitely.

Are there any risks in such a development? Granted that with the present contract it can proceed only on initiative from below, probably not; but if general practice were to move rapidly toward a variety of miniclinics there would be real danger of introducing the overstructured, impersonal style characteristic of many hospitals. The practice nurses presently employed by general practitioners seem to be working flexibly and imaginatively, without unreasonable pressure on patients to restrict their demands to those defined by the clinic, and preserving easy access to their own doctor for problems outside its scope. Innovative enthusiasm could, however, on a much wider scale degenerate into the familiar old conveyor belt. There is urgent and so far unmet need for inservice training for practice nurses,⁸ which few health authorities seem so far to have considered seriously. When they do there will be a shortage of credible teachers—that is, nurses who have themselves tackled the job. The enthusiasm of these nurses for their increasing autonomy in many practices, their readiness to adopt a self critical attitude through audit of their work, and their evident satisfaction with a new job, better done, are the best guarantees we could have against the dangers of excessive structure. Further up the nursing hierarchy, however, there seem to be a great many botanists but very few gardeners. Practice without theory may have been blind, but theory with vicarious practice is certainly sterile.

JULIAN TUDOR HART

General Practitioner,
Glyncorrwg,
West Glamorgan SA13 3BL

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Exercise and osteoporosis

Current gospel states that some exercise is good, and more exercise is better. The finding by Krolner *et al* that exercise could delay or reverse loss of trabecular bone from the vertebrae of postmenopausal women was welcomed¹; but when Drinkwater and her colleagues showed the abnormally low density of vertebral bone in young athletes with amenorrhoea it was time to think again.² Is exercise always good for osteoporosis, and if not, why not?

The size, structure, and mass of the skeleton result partly from its genetic make up and partly from the competing mechanical and hormonal demands made on it. Some individuals, some families, and some races have bigger skeletons than others, used bones have greater mass than unused, and immobility inevitably leads to bone loss.³ We perceive only dimly, however, why physical stress is osteogenic, and as a result bone research has concentrated on the firmer ground of hormone and mineral metabolism. In doing so it may well have neglected important lessons.

The activities of osteoclasts and osteoblasts—on which the viability of bone depends—are closely coupled, possibly by local hormones, whatever the turnover rate.⁴ In the so called bone multicellular units osteoclastic bone resorption is followed (after a pause) by osteoblastic bone formation. The continual activation of such units may be necessary to regulate the body's calcium content, to repopulate the skeleton with new cells, or to repair minor structural damage. Furthermore, it also provides a common mechanism to receive mechanical and hormonal messages.

If use increases bone mass—and disuse diminishes it—what are the appropriate stimuli, and which cells respond? Lanyon and Rubin investigated experimental weight loading systems in animals.⁵ They found that structurally useful remodelling of bone could be induced by changes in the amount and the distribution of strain well within the physiological range; and, further, that resorptive remodelling—which would otherwise lead to disuse osteoporosis—could be abolished by a fraction of the strains necessary for an uncoupled osteogenic response. From such data they suggested that osteogenic exercise should be made up of diverse, vigorous, but non-repetitive activity.

Others have looked at cell systems. The prime cellular candidate for receptor of mechanical signals is the osteoblast or its derivative the osteocyte. Its responses to mechanical or electrical stimuli were discussed in 1983 at the Kroc Foundation conference on functional adaptation in bone tissue.⁶ When tensile forces were applied to osteoblast rich cells grown on collagen ribbons they stimulated the production of prostaglandin E₂.⁷ Similarly, the direct application of physical strain by distortion of dishes containing cultured cells showed that osteoblast like cells specifically produced prostaglandin E₂.⁸ In this second system prostaglandin E₂ itself induced the production of cyclic AMP in several bone cell types but of DNA synthesis only in osteoblast like cells.

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Furthermore, different populations of cultured bone cells seemed to be specifically stimulated by certain intensities of electrical fields. Such electrical stimuli might circumvent the prostaglandin E_2 system, triggering adenyl cyclase directly and inducing DNA synthesis.

How prostaglandins might convert a mechanical stimulus into an osteogenic one is uncertain. Prostaglandin E_2 is a powerful bone resorber, but its effect depends on its amount, and it may also enhance osteogenesis. The study of the behaviour of bone cells in culture—and in other experimental systems—may be said to have little present relevance to man; but it does suggest how mechanical forces might act on the osteoblast and provides a way forward for future investigation.

If this extraordinary cell, the osteoblast—which synthesises bone matrix, mineralises it, and controls the activity of other cells⁹—is in fact sensitive to mechanical (and electrical) stimuli, why is exercise not universally successful in increasing bone mass? Some reasons are obvious. One is the coupling of bone formation to resorption; another, as in the athletes with amenorrhoea, is oestrogen deficiency. Doubtless there are many unrecognised limitations to the osteogenic effect of exercise on bone. Clues may come from the striking effect of immobilisation or satellite travel on the skeleton, where there appears to be an uncoupled decrease in osteoblastic and increase in osteoclastic activities, and where in neither case is the loss of bone alleviated by exercise.¹⁰

Should we therefore recommend exercise as a treatment for osteoporosis? Certainly some are not impressed by its efficacy.¹¹ But in the elderly, where osteoporosis may be partly due to sleepy osteoblasts, the answer is probably yes.¹² In the young the answer is not so clear, and where exercise is

so excessive that it produces amenorrhoea loss of bone from the spine will be aggravated rather than prevented. In this regard we must remember the differences in the behaviour of weight bearing, predominantly cortical bones and that of predominantly trabecular bones.¹³

We still have a lot to learn about the effects of mechanical forces on the skeleton. As jogging and space travel become more popular and the population ages, the answers will be sought more avidly. The search will not only be advancing our knowledge of bone disease but also throwing light on an important problem in cell biology.

ROGER SMITH

Consultant Physician,
John Radcliffe Hospital and Nuffield Orthopaedic Centre,
Oxford OX3 7LD

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Regular Review

Is peritoneal dialysis a good long term treatment?

G A COLES

Long term treatment for terminal renal failure with peritoneal dialysis was first achieved successfully by Boen and colleagues.¹ The technique did not become suitable for general use, however, until a satisfactory permanent peritoneal catheter was developed.² Since then very many patients have received intermittent peritoneal dialysis. Continuous ambulatory peritoneal dialysis was first developed in 1975.³ This technique is now used widely, particularly in Britain, where 1104 patients were undergoing treatment at the end of 1982.⁴ In 1983 nearly half of all children in Britain having dialysis were receiving continuous ambulatory peritoneal dialysis⁵; in Canada, too, nearly half of all new patients are being offered this treatment.⁶ Continuous ambulatory peritoneal dialysis has

helped individual units in Britain to increase the numbers of new patients they can take on.⁷

Despite the phenomenal growth in the use of this form of treatment, the long term prognosis for patients receiving peritoneal dialysis remains uncertain. In the June 1984 issue of the *Peritoneal Dialysis Bulletin* Oreopoulos described a patient maintained in reasonable health for over 10 years with intermittent peritoneal dialysis alone and then continuous ambulatory peritoneal dialysis.⁸ This woman may well be the longest survivor on peritoneal dialysis in the world to date.

More patients have received intermittent peritoneal dialysis than continuous ambulatory peritoneal dialysis, since the treatment is often used as a temporary measure