We are grateful to Mr John Bruce and Miss Lesley Baker for permission to include patients under their care and also to the staff of the obstetric department at the Nottingham City Hospital for producing such a good working environment. We thank Mrs Lewis and her staff at the medical library, Nottingham General Hospital, for invaluable help with the references. The help of our secretaries Jane Richards and Geraldine Beirne is particularly appreciated. Dr Walford is supported by Novo Laboratories (UK) Ltd.

References

- ¹ Karlsson, K, and Kjellmer, I, *American Journal of Obstetrics and Gynecology*, 1972, **112**, 213.
- ² Essex, N, L, et al, *British Medical Journal*, 1973, **4**, 89.
- ³ Pedersen, J, Molsted-Pedersen, L, and Andersen, B, *Diabetes*, 1974, **23**, 302.
- ⁴ *Lancet*, 1975, **1**, 669.
- ⁵ *British Medical Journal*, 1976, **2**, 267.
- ⁶ Mintz, D H, Skyler, J S, and Chez, R A, *Diabetes Care*, 1978, **1**, 49.
- ⁷ Jervell, J, et al, *Diabetologia*, 1979, **16**, 151.
- ⁸ Walford, S, et al, *Lancet*, 1978, **1**, 732.
- ⁹ Sonksen, P H, Judd, S L, and Lowy, C, *Lancet*, 1978, **1**, 729.
- ¹⁰ Howe-Davies, S, et al, *British Medical Journal*, 1978, **2**, 596.
- ¹¹ Essex, N, *British Journal of Hospital Medicine*, 1976, **15**, 333.
- ¹² Persson, B, *Israel Journal of Medical Science*, 1975, **11**, 609.
- ¹³ Brudenell, M, and Beard, R, *Clinics in Endocrinology and Metabolism*, 1972, **1**, 673.
- ¹⁴ West, T E T, and Lowy, C, *British Medical Journal*, 1977, **1**, 1252.
- ¹⁵ Wibell, L, Dahlberg, P A, and Victor, A, *Acta Endocrinologica*, 1978, **88**, suppl No 219, p 76.
- ¹⁶ Pedersen, J, *The Pregnant Diabetic and her Newborn*. Copenhagen, Munksgaard, 1979.
- ¹⁷ Leslie, R D G, et al, *Lancet*, 1978, **2**, 958.
- ¹⁸ Mills, J L, Baker, L, and Goldman, A S, *Diabetes*, 1979, **28**, 292.
- ¹⁹ Gale, E A M, and Tattersall, R B, *Lancet*, 1979, **1**, 1049.

(Accepted 15 August 1979)

Contemporary Themes

Nuclear medicine in district general hospitals

DESMOND CROFT

British Medical Journal, 1979, **2**, 1336-1338

Summary and conclusions

Nuclear medicine is a recognised clinical specialty both nationally and internationally. Compared with other countries, it is inadequately developed in Britain, particularly in district general hospitals. To create clinical radioisotope services at district level physicians or radiologists with experience in nuclear medicine need to be trained and appointed. Such appointments would allow facilities to evolve that would provide either a comprehensive nuclear medicine service formed around a physician or an imaging service based on a radiologist. Such units would improve the care of patients at a reasonable recurring cost of £15-£30 per investigation.

Introduction

Nuclear medicine is recognised by the Department of Health and Social Security as a specialty, and there are 22 established consultant posts in Britain. In addition, 10 senior registrar training posts are recognised by the Joint Committee on Higher Medical Training. The interests of the specialty are promoted by the British Nuclear Medicine Society, which has some 200 members. This organises a two-day annual scientific meeting,

at which 400 participated this year. Last year, when its annual meeting was arranged jointly with the European Nuclear Medicine Society, 800 attended.

Thus in Britain a start has been made in developing an important part of clinical medicine, but the specialty has not progressed as far as in many other countries. The specialty is recognised by the World Health Organisation, which, jointly with the International Atomic Energy Authority in Vienna, produced a report entitled the *Use of Ionising Radiation and Radioisotopes for Medical Purposes (Nuclear Medicine)*.¹ In the United States and Canada nuclear medicine is well established, there being a formal system of training and examination of doctors by a conjoint board of nuclear medicine (formed by the boards of internal medicine, radiology, and pathology). Australia and New Zealand have a similar training system based on the Royal Australasian Colleges of Physicians, and each major city in these countries has at least one nuclear medicine consultant to supervise the clinical work concerned with radioisotopes. Closer to home, many European countries have more nuclear medicine consultants per head of population than we do. For instance, there are 58 in Czechoslovakia—four times the ratio in Britain. The EEC has not yet recognised nuclear medicine as a specialty although an application for it to do so has been made from Britain and Eire and this is being supported by countries including France, Italy, and Germany.

In its widest form nuclear medicine embraces all the medical uses of radioisotopes, including in-vitro as well as in-vivo techniques. In many hospitals the in-vitro techniques are carried out in departments of biochemistry, chemical pathology, or general pathology. In Britain nuclear medicine in 1979 embraces the following aspects.

Radioisotope imaging—both static and dynamic imaging and function.

Radioisotope non-imaging function tests—including Schilling tests and tests of gut protein and blood loss, red cell survival, and thyroid uptake (and scan).

St Thomas's Hospital, London SE1 7EH

DESMOND CROFT, DM, FRCP, consultant physician, immediate past-president, British Nuclear Medicine Society, and chairman, South-east Thames RHA nuclear medicine subcommittee

Radioisotope treatment—mainly of thyrotoxicosis, but including thyroid carcinoma and polycythaemia vera in some centres.

There is a strong case in most hospitals for centralising the medical and non-medical skills and the equipment required to subserve these functions, and this is the real justification for having the specialty of nuclear medicine. In such departments doctors, physicists, nurses, radiopharmacists, technicians, and radiographers are needed, and the usefulness of the unit in clinical terms depends on the effective functioning of this team. Getting this team functioning correctly (and how to do so will vary from hospital to hospital) is much more important than acquiring expensive equipment and assuming that it will provide a useful clinical service. Too many units have foundered by buying the equipment before thinking out the service and appointing the people to run it.

Where is nuclear medicine needed?

The problem of how to organise nuclear medicine services throughout the country has been under consideration for the past 15 years. The Windeyer Report² was published in 1970 as the result of an initiative from the DHSS. It recommended that each region should have a centre and that nuclear medicine services should evolve from this centre. The implication of this report was that many patients would need to travel to the centre (usually a teaching hospital) for procedures such as radioisotope scans. In many regions this was inappropriate even by the early 1970s. For instance, in the South-east Thames Region all the major centres were in one corner of the region (London), many hours' travel from some of the district general hospitals on the Kent coast. As a result the Anderson Report³ of 1972 recommended that for the South-east Thames Region there should be five regional centres. Within a few years a successful unit was established at Canterbury, and patients in this part of Kent had to travel much shorter distances to have radioisotope investigations and treatment.

During the past ten years nuclear medicine facilities have developed at all teaching and regional centres in Britain. At some, but not all, there are specific departments of nuclear medicine with consultants in charge. In some centres these services are being provided in various other departments such as radiology, haematology, endocrinology, nephrology. Such arrangements are often appropriate when for historical or other local reasons the staff concerned are based on such departments.

Although at one time radioisotope services were in the charge of non-medical scientists there is now every reason for them to be the responsibility of a medically qualified staff. One reason is that the procedures are being increasingly used in patients with acute and life-threatening conditions such as pulmonary embolism and myocardial infarction. Furthermore, it will shortly be an EEC rule that only doctors can prescribe and give radioisotopes and that these doctors will need to be approved before they can do so. Regulations are being formulated, and area authorities will need to comply with them in 1980.

Teaching and regional centres are now generally satisfactorily served in terms of nuclear medicine. The current problem in Britain is that radioisotope techniques are becoming increasingly pertinent to the clinical management of many patients, and pressures are therefore mounting from clinicians for these procedures to be provided within district general hospitals. This is not unreasonable since important diagnoses (such as pulmonary embolism, hepatic abscess or metastasis, bone metastasis, spinal abscess, and cerebral abscess or haematoma) can be made after a simple intravenous injection (coupled with a ventilation study for emboli). Newer techniques include isotope scans that can simply and safely detect myocardial infarction and deep-vein thrombosis. When appropriately used the various procedures can prove invaluable in clinical management and need to be available at district general hospitals. There is

probably greater justification for having well-organised radioisotope services than, for example, ultrasound, for radioisotope scans are useful for more clinical problems and are help to more clinicians.

A district nuclear medicine facility with staff and equipment as shown in tables I and II could provide a service for a population of 200 000–300 000, which is about the size covered by most districts. One gamma camera can perform 2500 scans a year (10 a day). Experience in one district of 220 000 would suggest that initially 1200 scans a year would be performed. The figure would probably build up to about 2000 over a few years. At St Thomas's which serves a district of 190 000 and which has commitments beyond, 3500 scans are performed a year, a figure that also suggests that a reasonable demand for radioisotope scans for each district is 1500–2500 a year. The real justification for nuclear medicine is not related to statistics but to quality of patient care. For instance, it is reasonable not to have facilities available in every district for the easy diagnosis of pulmonary embolism by radioisotope scanning?

Nuclear medicine in district general hospitals

In deciding how to set up nuclear medicine services in a district general hospital two questions need first to be asked of the clinical staff:

- (1) What nuclear medicine services are needed?
- (2) Will the clinicians want such services to be provided

TABLE I—Facilities required 1978–9

	Comprehensive service	Imaging service
	<i>Capital</i>	
Space	200 m ²	100 m ²
Equipment	1 gamma camera system with data processing ionisation chamber shielding, radiation monitor imaging trolley, in-vivo detectors, well counters and bench equipment	1 gamma camera system with data processing ionisation chamber shielding, radiation monitor imaging trolley, in-vivo detectors
	<i>Recurring</i>	
Medical staff	4–6 consultant sessions	2–3 consultant sessions
Non-medical staff	Physicist (One day equivalent from regional centre)	Physicist
	1 physics technician	1½ radiographers/technician
	1 radiographer	1/3 pharmacist
	1/3 pharmacist	1/3 nurse
	1 nurse	1/3 secretary
	1 secretary	1/3 secretary
Radiopharmaceuticals	£7000–£10 000 pa (From regional centre if possible)	£5000–£7000 pa (From regional centre if possible)
Radiation protection	From regional centre if possible	Small amount of equipment and physicist/physics technician, salary as table II
Equipment, maintenance, and running costs	10% of cost price of equipment	
Other recurring costs	Stationery, heat and light, cleaning	

TABLE II—Capital and recurring expenditure 1978–9

	Comprehensive service	Imaging only
	<i>Capital costs</i>	
Building	As per local requirements	85 000–125 000
Equipment	100 000–150 000	
Total	£100 000–150 000	£85 000–125 000
	<i>Recurring costs (pa)</i>	
Medical staff at £1000/session	4000–6000	2000–3000
Non-medical		
Physicist	2000	2000
Technician	3000	—
Radiographer/technician	3500	5500
Pharmacist	2000	2000
Nurse	3500	2000
Secretary	1500	1000
Radiopharmaceuticals	7000–10 000	5000–7000
Radiation protection	500	500
Equipment, maintenance, and running costs	7500–12 500	5500–8500
Other recurring costs	3000	2000
Total	£37 500–47 500	£27 500–33500

locally and will they support their development and use?

If these two questions are seriously considered and acted on the problems that arise from buying sophisticated equipment and having it inadequately and insufficiently used should be avoided. There are problems at many centres in Britain, as was shown by a recent survey conducted by the British Nuclear Medicine Society. This found that in half of 150 units that were attempting to provide nuclear medicine services the responsible clinician had not had an opportunity to obtain adequate training, and in one-fifth no clinician was responsible for the service.⁴ A gamma camera tucked away in a corner and doing a few scans is very poor substitute for a proper nuclear medicine service. In fact, it can be argued that under these circumstances the results may be clinically useless or even misleading.

The exact facilities needed and how they should be developed will depend on what services are required by the local clinicians. It is important that they should continue to support the unit both in terms of routine established procedures and also in the development of newer ones. A link with a larger or regional department is useful both for developing new procedures and for supplying radiopharmaceutical and medical and non-medical support. There are two main ways of organising nuclear medicine in a district general hospital.

A *comprehensive nuclear medicine service*, including radioisotope imaging, function tests, and treatment. This type of unit would arise from the appointment of a general physician with training and experience in nuclear medicine,^{5, 6} who would spend a few sessions a week organising a radioisotope service and the rest of the time doing clinical work. Such trainees now exist, and there are three training posts in Britain designed for such appointments. Trainees at senior medical registrar level could also acquire the necessary training in nuclear medicine. At certain large district general hospitals a full-time consultant in nuclear medicine might be an appropriate appointment.

A *nuclear medicine imaging service* could alternatively be developed in, or linked to, a department of radiology. An appropriate appointment here would be a radiologist with training in nuclear medicine, who would have a few sessions devoted to radioisotope imaging. At present there are not enough radiologists with adequate training in nuclear medicine. Although the FRCR training programme does include radioisotope imaging,⁷ the amount of training received at present is not enough for setting up a comprehensive nuclear medicine service. In many districts, however, a radiologist appropriately trained would provide the clinical service that was needed in terms of imaging.

It is hoped that the report of the Joint Royal Colleges (Physicians, Radiologists, and Pathologists) Working Party on Training in Nuclear Medicine⁸ will help to solve the difficulties of obtaining adequate training in nuclear medicine.

Facilities and costs

Table I lists the facilities required both for a comprehensive service and for an imaging service. The information in this table and the costs shown in table II are derived from a paper on nuclear medicine in district general hospitals issued by the council of the British Nuclear Medicine Society.⁹ As can be seen from the table, the capital cost for equipment is rather less for an imaging than for a comprehensive service but is still around £100 000. Recurring costs for imaging are about £30 000 a year and for a comprehensive service about £45 000 a year. Some of these costs may be absorbed if new staff do not have to be appointed and by the savings on transport and other costs for sending patients to have radio-isotope procedures at other centres. In view of the range of investigations and treatments provided by such a service the cost is not unreasonable. The service would provide 1500 to 2500 investigations (scans and function tests) a year at a reasonable recurring cost of £15 to £30 an investigation (table II).

In addition, a comprehensive service would do radiiodine

treatments for thyrotoxicosis, which would be cost effective since it would save admissions for surgical treatment. A respectable case for the unit as an economic proposition could easily be made, quite apart from the improved clinical care that would inevitably result.

Although the current economic situation will tend to inhibit the development of nuclear medicine facilities, it should not stop doctors and others from planning services that are clearly in the best interests of good patient care.

References

- 1 Joint International Atomic Energy Authority and World Health Organisation Expert Committee in the Use of Ionizing Radiation and Radioisotopes for Medical Purposes (Nuclear Medicine), *Nuclear Medicine*, Geneva, WHO, 1976.
- 2 DHSS Reports on Public Health and Medical Subjects No 126, *Report of the Working Party on the Organisation of Radioactive Isotope Services*. London, HMSO, 1970 (Windeyer Report.)
- 3 South-east Metropolitan Regional Hospital Board, Working Party on the Clinical and Laboratory Uses of Radioactive Materials, *Anderson Report*. Croydon, Surrey, South-east Thames RHA, 1972.
- 4 British Nuclear Medicine Society, *A Survey of the Degree of Involvement of Trained Medical Staff in Radioisotope Services*. London, British Nuclear Medicine Society, 1978.
- 5 Royal Colleges of Physicians of London, Edinburgh, and Glasgow Second Inter-Collegiate Committee on Nuclear Medicine, *McGirr Report*. London, RCP, 1975.
- 6 Joint Committee on Higher Medical Training at the Royal College of Physicians. *Second Report 1975. Supplement on Nuclear Medicine*, June 1976. London, RCP, 1976.
- 7 Royal College of Radiologists, *Syllabus for First Examination for Fellowship. (Radiodiagnosis and radiotherapy)*. London, RCR, 1975.
- 8 Joint Royal Colleges Working Party in Nuclear Medicine, *Draft report and recommendations: a discussion document*. In preparation. London, RCP, 1979.
- 9 British Nuclear Medicine Society, *Guidelines for setting up Nuclear Medicine Services in District General Hospitals 1978-9*. London, British Nuclear Medicine Society, 1979.

(Accepted 19 September 1979)

What is the optimum time after delivery to vaccinate women who have been found not to be immune to rubella at antenatal blood testing?

The sooner after delivery the better, as this will minimise the risk of conception during the months after immunisation. Vaccinees should, of course, be clearly warned against conception within at least three months of being immunised, and offered advice about contraception. I know of no reasons for delaying immunisation. Perhaps the optimum, in the sense of achieving maximum population coverage, might be to offer the vaccine to non-immune mothers before they leave the delivery suite.

Is a resting blood pressure of 110/70 unusual in an elderly person?

The mean blood pressure for people over 65 without heart disease is 145 (SD $\pm$ 25)/80 ($\pm$ 15) for men and 155 ($\pm$ 25)/85 ($\pm$ 15) for women. The figures are virtually the same for every quinquennium over 65.¹ A resting blood pressure of 110/70 is within the normal range for the elderly, but it is towards the tail of a normal distribution curve. Provided the patient is well it may be accepted as normal. This opinion is strengthened if it is known that 110/70 represents the blood pressure recorded in earlier life. And if this is so the patient's expectation of life is exceptionally good. It is important, however, to remember that orthostatic hypotension is common in the elderly, and it would be wise to check that the figure is the same whether the patient is lying, sitting, or standing. A figure of 110/70 taken when the patient is sitting may be 20 to 30 points higher when the patient is lying down and substantially lower when he stands up. Orthostatic hypotension has many causes and may represent a response to many drugs and diseases. The commonest cause, however, is probably impaired efficiency of the autonomic system in old age.

¹ Brocklehurst, J C, *Textbook of Geriatric Medicine and Gerontology*, 2nd edn, p 138. Edinburgh, Churchill Livingstone, 1978.