Clinical Endocrinology

Hyperthyroidism

PAT KENDALL-TAYLOR

British Medical Journal, 1972, 2, 337-341

Hyperthyroidism results from an excess of circulating thyroid hormone (thyroxine—T-4—and tri-iodothyronine—T-3—or both) and may occur in several forms, of which Graves's disease is the commonest.

Types of Hyperthyroidism

GRAVES'S DISEASE AND TOXIC MULTINODULAR GOITRE

The term Graves's disease is used to denote the diffuse hyperplasia of the thyroid which occurs in young patients and is often accompanied by exophthalmos; in older patients the thyroid is more frequently nodular and exophthalmos is unusual. However, in practice no clear distinction can be made on either clinical or pathological grounds and the disease is regarded by many as a single entity.

The aetiology of the disease remains obscure. It has, however, been clearly established that thyroid-stimulating hormone (TSH) is not responsible for the excessive thyroid activity. An abnormal thyroid stimulator (known as long-acting thyroid stimulator, or LATS), which is both chemically and immunologically distinct from TSH, is found in the serum of many patients with thyrotoxicosis, but its significance is not clear, since in some patients with severe hyperthyroidism LATS cannot be detected. On the present evidence LATS is probably of aetiological importance in some patients. Since LATS is a γG immunoglobulin and reacts with thyroid tissue it has been suggested that thyrotoxicosis, like other thyroid disturbances, may be an autoimmune disease. The role of LATS in the pathogenesis of thyrotoxicosis has been discussed in two excellent reviews.[1 2]

Recently some patients with clinical hyperthyroidism have been found to have normal serum levels of protein-bound iodine (PBI), T-4, and thyroxine-binding globulin (TBG) but increased levels of T-3.[3] For these the term T-3 thyrotoxicosis has been coined.

SOLITARY AUTONOMOUS TOXIC ADENOMA

This may give rise to mild hyperthyroidism, which is not associated with the other features of Graves's disease. Radioisotope scanning shows hyperactivity localized to the adenoma, while the remainder of the thyroid is suppressed.

Hashimoto's disease is sometimes associated with clinical hyperthyroidism.

Other types of hyperthyroidism are extremely rare and include: congenital thyrotoxicosis[4]; iodine-induced hyperthyroidism[5] (Jod-Basedow effect); factitious hyperthyroidism; and malignant trophoblastic tumours.[6]

Department of Pharmacology and Therapeutics, Royal Infirmary, Sheffield
PAT KENDALL-TAYLOR, M.D., M.R.C.P., Lecturer

Clinical Diagnosis

The clinical features are related to three main factors. The first of these comprises the metabolic effects resulting from excess thyroid hormone and increased sensitivity to catecholamines. These include sweating, heat intolerance, weight loss, increased appetite, nervousness, irritability, tremor, fatigue, tachycardia, supraventricular arrhythmias, and cardiac failure.

The second factor is the thyroid gland, which is usually diffusely enlarged, but is sometimes nodular; occasionally it is not palpably enlarged in an untreated patient. A thyroid bruit is almost pathognomonic of hyperthyroidism.

The third factor is eye signs—that is, lid retraction, exophthalmos, and ophthalmoplegia. Exophthalmos is often asymmetrical and occurs in about 50% of patients with Graves' disease. Eye signs may occur in the absence of active thyrotoxicosis (ophthalmic Graves's disease), so that their presence and severity are not necessarily related to the thyroid state of the patient. The pathogenesis of exophthalmos is not understood, but it now seems to be fairly well established that LATS is not responsible.

In addition, miscellaneous features are sometimes encountered and include oligomenorrhoea (common), pigmentation, vitiligo, loss of head hair, osteoporosis, lymphadenopathy, and splenomegaly. Muscle involvement may take the form of myopathy, or very rarely myasthenia or periodic paralysis. Localized myxoedema, usually pretibial, is uncommon and is closely associated with the presence of LATS. Patients with pretibial myxoedema and exophthalmos may also develop acropachy, recognized by soft tissue swellings of the fingers and clubbing of the fingers and toes.

To facilitate objectivity and improve the accuracy of clinical assessment a diagnostic index (Wayne's index)[7] has been designed, in which a score is given for the presence or absence of various features (Table I). Using this, or a recently introduced modification of Wayne's index,[8] the success rate in diagnosis is not dissimilar from that obtained with laboratory tests; thus the index is a useful diagnostic tool and is valuable in emphasizing the relative importance of certain clinical features.

TABLE I—*Wayne's Index, Showing the Scoring of Signs and Symptoms for the Diagnosis of Hyperthyroidism*

Symptoms of Recent Onset and/or Increased Severity	Score	Signs	Present	Absent
Dyspnoea on effort	+1	Palpable thyroid	+3	−3
Palpitations	+2	Bruit over thyroid	+2	−2
Tiredness	+2	Exophthalmos	+2	
Preference for heat	−5	Lid retraction	+2	—
Preference for cold	+5	Lid lag	+1	—
Excessive sweating	+3	Hyperkinesis	+4	−2
Nervousness	+2	Hands: hot	+2	−2
Appetite: increased	+3	moist	+1	−1
decreased	−3	Casual pulse rate:		
Weight: increased	−3	>80/min	—	−3
decreased	+3	>90/min	+3	—
		Atrial fibrillation	+4	—

Total Score: greater than 19 = toxic
11-19 = equivocal
less than 11 = euthyroid

Laboratory Investigation

In many patients in whom hyperthyroidism is considered likely a firm diagnosis can be made on clinical grounds and a single test will then be adequate for confirmation; for this purpose the PBI is generally recommended. Fuller laboratory investigation is reserved for those patients in whom doubt still remains after adequate clinical assessment, or when additional information is required to select the best method of treatment.

SERUM PBI

The serum PBI measures iodinated protein compounds, of which T-4 normally forms the major part. It is a most useful test and in general differentiates well between hyperthyroid and euthyroid states. Nevertheless, certain complicating factors must be remembered when interpreting results:

(1) *Iodine Contamination.*—Numerous drugs and therapeutic preparations, and also some foodstuffs, contain iodine and, if taken in sufficient quantities, will lead to an increased PBI level. Radiographic contrast media, excluding barium sulphate, may cause a rise in the PBI lasting from several days to, in some cases, months or years.

(2) *Abnormalities of Thyroxine-binding Protein.*—These may occur as a result of pregnancy, extrathyroidal disease, or the use of some drugs, the commonest of these being the oestrogen-containing oral contraceptives.

(3) *Other drugs* may give misleading results by interfering with thyroxine synthesis or by competing with T-4 for the protein-binding sites (for example, phenytoin, salicylates).

It is, therefore, mandatory to obtain a detailed drug history and to inquire about the use of radiographic contrast media before requesting a PBI estimation. The more important drugs which may interfere with the PBI are listed in Table II; for a detailed list the reader is referred to Acland.[9]

TABLE II—*Drugs which Influence Tests of Thyroid Function*

	PBI	T-3 Resin Uptake	^{131}I Uptake	Mechanism
Oestrogens Phenothiazines (prolonged)	increased	decreased	unchanged	increase in TBG
Androgens and anabolic steroids Corticosteroids (large doses)	decreased	increased	unchanged	decrease in TBG
Iodine-containing compounds	increased	unchanged	decreased	large iodide pool
Sulphonylureas PAS Phenylbutazone and related drugs Cobalt salts	decreased	increased	decreased	impaired synthesis of thyroxine
Phenytoin Salicylates	decreased	increased	unchanged	competition for binding sites on TBG
Heavy metals (mercury, gold, silver)	decreased	unchanged	unchanged	interference with chemical analysis of PBI

T-3 RESIN UPTAKE

This test, which is an indirect measure of the serum T-4, is based on the fact that T-4 binds strongly to TBG whereas T-3 is only weakly bound and is displaced by T-4. The capacity of a serum sample to bind ^{125}I-T-3 added to it depends on the degree of saturation of available binding sites by T-4, the unbound ^{125}I-T-3 being taken up by resin. In hyperthyroidism, where the serum T-4 is high, fewer binding sites are available on TBG and more ^{125}I-T-4 is taken up by the absorbent.

The method is simple and commercial kits are available; it does not entail any irradiation to the patient and is unaffected by iodine contamination. It is a rather less precise index of thyroid activity than the PBI and therefore its main use is in cases where the PBI alone, for one of the reasons already listed, is unsatisfactory. It is, of course, influenced by variations in TBG levels and when this is increased—for example, in pregnancy or in women using oral contraceptives—the resin uptake of T-3 is decreased.

FREE THYROXINE INDEX AND FREE THYROXINE FACTOR

Variations in TBG may be eliminated by combining the results of PBI determination, or serum T-4 when available, with the T-3 resin uptake (as % of standard), thus: free T-4 index = PBI (or serum T-4) × T-3 uptake.[10 11] Since the relationship between T-3 and globulin-binding sites is complex, greater accuracy may be obtained by applying a correction factor, and this result is termed the free T-4 factor.[12] These estimates are particularly useful in the diagnosis of hyperthyroidism in pregnancy and in patients taking oral contraceptives or other drugs which alter the TBG level.

RADIOIODINE TESTS

The basis of radioiodine tests is that thyroidal iodine turnover is related to the synthesis and secretion of thyroid hormone, which are increased in hyperthyroidism, and that radioiodine is metabolized in a similar manner.

Uptake

In hyperthyroidism the accumulation of iodine by the thyroid is both greater than normal and more rapid. For uptake studies ^{131}I (half life 8 days) is commonly used, but where a minimum dose of radiation is essential—for example, in children—^{132}I (half life 2·3 hr) is preferable. Counting over the neck within 4 hours of administration of an oral dose of ^{131}I gives good diagnostic discrimination. Disadvantages are that the patient receives a small dose of radiation, which would be undesirable, for instance, in pregnancy, and some degree of inconvenience. It is assumed that the iodide pool is normal but when this is not the case the results may be misleading—for example, high uptakes are found in patients with goitre due to iodine deficiency.

In the 48-hour uptake test the PB^{131}I level is measured at 48 hr. This is also raised in hyperthyroidism. Euthyroid patients having a small intrathyroidal iodine pool, such as occurs in Hashimoto's disease or after partial thyroid ablation, may also have a raised PB^{131}I.

Scintiscanning

Scintiscanning of the thyroid 48 hours after the dose is useful when a toxic adenoma is suspected; it also enables thyroid size to be assessed before giving radioiodine therapy.

T-3 Suppression Test

A T-3 suppression test may be performed where the diagnosis remains in doubt. A second dose of radioiodine is given after a short course of T-3; in normal people this leads to reduced TSH secretion and consequent suppression of thyroidal iodine uptake, whereas in hyperthyroidism the gland is not under pituitary control and therefore is not suppressed.

THYROID HORMONE MEASUREMENTS

Several more advanced techniques have recently been developed to enable thyroid hormones to be measured directly. Serum T-4 can be measured by competitive protein binding[13 14] and a kit has now been produced to make the procedure feasible for routine laboratories. The main advantage over the PBI measurement is that this test is not affected by iodine contamination, but

like the PBI it is influenced by variations in the TBG level. Urine T-4 can also be measured, after extraction, by a similar method.[15] Serum free T-4[16] and T-3[17] can be measured, but at present the techniques are too complicated for routine use, though they may be valuable for investigating atypical cases.

MISCELLANEOUS TESTS

The finding of high titres of thyroid antibodies is useful in the diagnosis of hyperthyroidism due to Hashimoto's disease. It is of limited value in the initial diagnosis of hyperthyroidism as antibodies are also found in a small percentage of normal people as well as in patients with other, non-toxic, thyroid disorders. Measuring the serum cholesterol is of little value for the diagnosis of hyperthyroidism. Estimation of the basal metabolic rate has been superseded by other tests already described. Serum LATS is detected by bioassay,[18 19] but the present method is not really suitable for use as a diagnostic test since it is negative in about half of all cases of thyrotoxicosis.

Diagnostic Problems

HYPERTHYROIDISM IN PREGNANCY

This may give rise to both clinical and biochemical difficulties. Probably the best method of laboratory diagnosis at the present time is the estimation of the free T-4 factor. Radioiodine tests should be avoided; if considered essential, ^{132}I may be used in early pregnancy.

HYPERTHYROIDISM IN CHILDHOOD

About 1% of cases of hyperthyroidism occur between the ages of 10 and 15 years, but the disease is very rare in younger age groups. It is characterized by emotional disturbances, hyperkinetic movements, tachycardia, goitre with bruit, and eye signs. The diagnosis can be confirmed by the usual laboratory tests, but ^{132}I, with its smaller dose of radiation, should be used in preference to ^{131}I.

HYPERTHYROID CRISIS

Hyperthyroid crisis is now exceedingly rare but may be precipitated by surgery or infection in a patient with undiagnosed thyrotoxicosis. Features are restlessness and confusion, weakness, diarrhoea and vomiting, leading to loss of consciousness, tachycardia or arrhythmia, hyperpyrexia, and death. Prompt treatment is required but blood samples must be taken first for subsequent diagnostic confirmation.

APATHETIC HYPERTHYROIDISM

This is an atypical presentation of the disease, which occurs in the elderly[20]; prominent features are weight loss, myopathy, apathy, and depression with cardiac arrhythmias and failure. The thyroid may be impalpable and eye signs absent; there is a danger of crisis if untreated. The usual tests are diagnostic.

RECURRENT HYPERTHYROIDISM

The diagnosis may be complicated by the fact that goitre and eye signs frequently persist after treatment and symptoms may be wrongly interpreted by the patient. In general, the PBI or serum T-4 are satisfactory confirmatory tests; radioiodine tests may be difficult to interpret owing to alteration of the iodide pool by previous treatment.

TOXIC ADENOMA

Both the clinical picture and the results of blood tests may be equivocal in patients with toxic adenoma. Radioiodine scan of the thyroid shows a "hot nodule" which is not suppressed by T-3 and the remainder of thyroid can be stimulated to take up iodine by TSH.

Management

The ideal treatment of hyperthyroidism would enable a permanent euthyroid state to be rapidly achieved without prolonged drug taking or the risk of complications developing subsequently. This would probably entail correction of the basic pathology of the disease, which is not yet understood. Though none of the available methods of treatment entirely fulfils these criteria, hyperthyroidism can be satisfactorily suppressed by drugs, surgery, or radioiodine and a euthyroid state can normally be attained without much difficulty. Thereafter, the physician's aim is to prevent relapse and avoid the complications. Since no one method of treatment can be categorically stated to be the best, the choice is determined by the needs of the individual patient and, to some extent, by personal preference.

DRUG TREATMENT

The most useful antithyroid drugs interfere with the synthesis of thyroid hormone by blocking the binding of iodine (carbimazole, methimazole, propyl- and methyl-thiouracil); other antithyroid drugs prevent the uptake of iodine (perchlorate) or inhibit the release of thyroid hormone (iodide). Adrenergic-blocking drugs relieve the symptoms without affecting the thyroid itself. In addition to producing a euthyroid state antithyroid drugs may influence the course of the disease, as permanent remission is induced in about half the cases of Graves's disease, whereas spontaneous remission was previously observed in only about 25% of patients.[22]

Carbimazole

In Britain carbimazole is the antithyroid drug of first choice and its use is indicated in the following circumstances:

(1) In young patients with Grave's disease: it is given for one to two years, as this produces a higher remission rate than when it is given for shorter periods. Patients who remain hyperthyroid after an adequate course of carbimazole and those who relapse after treatment usually require some other form of therapy, as remission is then unlikely. Relapse has been observed up to 10 years after a course of treatment so that prolonged supervision is necessary. The explanation for recurrence is not known, but in some cases it may be precipitated by iodine intake.[23]

(2) In older patients carbimazole may be used, but the likelihood of remission is less and radioiodine is probably preferable to prolonged drug treatment.

(3) In children antithyroid drugs are preferable to other forms of therapy but may need to be continued for several years.

(4) In pregnancy carbimazole provides satisfactory control and is the treatment of choice. The drug should be kept at the minimum dose level consistent with health and can frequently be discontinued by the fourth month, though some patients will need to continue for longer. It is important to avoid maternal hypothyroidism and prevent the development of goitre in the fetus. If antithyroid drugs are required post partum, lactation should be suppressed.

(5) To hasten the attainment of a euthyroid state after radioiodine treatment.

(6) To produce a euthyroid state in patients designated for surgery.

(7) In young patients in whom hyperthyroidism has recurred after surgery.

(8) In patients with severe exophthalmos,[24] in whom it is desirable to produce a euthyroid state as soon as possible.

Carbimazole should be given at equally spaced intervals (for example, 8-hourly) throughout the 24 hours, since its action is short (four hrs). The dose is related to the severity of hyperthyroidism; in severe cases a starting dose of 15 mg, or even 20 mg, 8-hourly may be required, and this is regulated by frequent clinical assessment and serial PBI measurements; 2·5 mg 8-hourly is often sufficient to maintain a euthyroid state.

Rashes may occur, but agranulocytosis is extremely rare; it is wise to warn the patient to discontinue the drug if a severe sore throat develops. Enlargement of the thyroid in patients taking carbimazole is usually associated with overtreatment.

Propyl thiouracil, like carbimazole, blocks the synthesis of thyroid hormone. Its use is mainly reserved for those cases in which carbimazole has given rise to side effects.

Perchlorate is an effective antithyroid drug but may cause fatal aplastic anaemia and, therefore, should not be used for treatment.

Iodide is used when a rapid but short-term effect is required, such as thyroid crisis or congenital thyrotoxicosis. Its most common use is in the immediate preoperative preparation of patients for thyroidectomy.

Adrenergic-blocking Drugs.—The β-receptor blocking agent propranolol (40 mg given four times daily by mouth) reduces the heart rate and relieves the peripheral manifestations of hyperthyroidism.[25 26] In therapeutic doses it does not influence thyroid function directly and it has therefore been postulated that its effect is on the peripheral action of thyroid hormone.[27]

Propranolol alone should not be relied upon to control hyperthyroidism, but it is a useful adjunct to other therapy. It has been recommended for use after ^{131}I therapy until a euthyroid state is achieved[28] and is also useful in patients with cardiovascular complications; it may be given intravenously in thyroid crisis.[29]

Most other β-receptor blocking agents have some intrinsic sympathomimetic activity and should be avoided as they may exacerbate cardiac arrhythmias.

SURGERY

Subtotal thyroidectomy produces permanent remission in most cases, though why this occurs is not known. The remnant regenerates and after some months normal thyroid function is re-established; eventually the histological appearances revert to normal.

Thyroidectomy is indicated in young patients, particularly if relapse has occurred after a course of antithyroid drugs or if drug reactions have been produced; surgery is always to be preferred for a solitary toxic adenoma. Partial thyroidectomy is not performed until the patient has been made euthyroid by antithyroid drugs; these are usually continued until the day of operation and either iodide or T-4 is added two weeks before operation.

The most common complication of surgery is hypothyroidism, the incidence being as high as 40% in some series,[30–32] occurring within a year of operation. It appears to be related to high titres of microsomal antibody,[33] occurring rarely in patients with no thyroid antibodies, and is inversely proportional to the size of the thyroid remnant.[32] The PBI level is invariably low, or low normal, postoperatively, but rises as thyroid regeneration continues and, unless there are pressing clinical reasons, thyroxine replacement is better withheld for a few months to allow for this. Once started, replacement therapy must be continued indefinitely.

Recurrence of hyperthyroidism is rare and is probably associated with a large remnant[32]; it may not be apparent for some years after operation so that, as with other forms of treatment, long-term supervision is required. Recurrence is treated with antithyroid drugs or radioiodine as a second operation is technically difficult and the morbidity high.

Recurrent laryngeal nerve injury may occur at thyroidectomy and lead to vocal cord paralysis; damage to the parathyroid glands, or to their blood supply, results in either postoperative tetany or hypoparathyroidism, which may be latent.

RADIOIODINE TREATMENT

Radioiodine, like iodine, is taken up by the thyroid, incorporated into iodoamino acids, and deposited in the follicular colloid. The destructive β rays emanating from the colloidal radioiodine disturb division of cell nuclei. The isotope normally used is ^{131}I (half life 8 days); the dose, administered orally, is calculated from the turnover rate of a tracer dose of ^{131}I and the size of the thyroid gland; the latter is estimated by palpation or more accurately assessed from a scintiscan. The conventional dose is approximately 100 μCi/g giving a thyroidal radiation dose of 7,000 rads.

Radioiodine has several advantages over other methods: it is simple, cheap, and can be given on an outpatient basis; surgical risks are avoided; relapse is extremely rare, once the hyperthyroidism has been controlled. Prolonged follow-up studies have now shown that the incidence of thyroid carcinoma[34] and leukaemia[35 36] is not increased after ^{131}I therapy. Genetic abnormalities have not been observed.

Treatment with ^{131}I is usually confined to patients over 45. In some centres radioiodine is the treatment of first choice; others give ^{131}I only when antithyroid drugs have proved unsatisfactory, by reason of poor control, relapse, or drug reactions. It is the best method of treatment when relapse occurs after surgery and may be given to younger patients if thyroidectomy is contraindicated by serious intercurrent disease. If ^{131}I has been selected for an individual patient it should be given without preliminary drug treatment.

Radioiodine is obviously contraindicated during pregnancy, because of the risk of damaging fetal tissues and should be avoided in the young.

The disadvantages of ^{131}I therapy are related to the difficulty in selecting the optimum dose, as both the extent of thyroid damage and the rate of response are dose dependent. If too much ^{131}I is given hypothyroidism develops; if too little, control of hyperthyroidism is delayed and inadequate. The incidence of myxoedema increases with time, being as high as 70% at 10 years in one report.[37] If half the conventional dose is given the five-year incidence of myxoedema is reduced from 30% to 7%[38] but many patients require antithyroid drugs to control symptoms. It was hoped that the use of ^{125}I, which has theoretical advantages over ^{131}I, might improve results, but disappointingly this seems to be subject to similar problems of dosimetry.[39] While awaiting a response to ^{131}I therapy, antithyroid drugs or propranolol may be given, but if these are required for a prolonged period a further dose of ^{131}I is indicated. The optimum interval before a second dose is control versial but, as the effects are progressive, it should not be less than one year.

Conclusions

In summary, antithyroid drugs are used in the young, in pregnancy, and as a prelude to surgery; partial thyroidectomy is generally the best method of eradicating the disease in the young; and radioiodine in older patients. Whichever form of treatment is used, patients should ideally be kept under observation indefinitely.

References

[1] Kriss, J., *Advances in Metabolic Disorders*, 1968, 3, 209.
[2] Munro, D. S., *Current Topics in Experimental Endocrinology*, Vol. 1, ed. L. Martini and V. H. T. James, p. 175. New York, Academic Press, 1971.

[3] Sterling, K., Refetoff, S., and Selenkow, H. A., *Journal of the American Medical Association*, 1970, **213**, 571.
[4] McKenzie, J. M., *Journal of Clinical Endocrinology and Metabolism*, 1964, **24**, 660.
[5] Connolly, R. J., Vidor, G. I., and Stewart, J. C., *Lancet*, 1970, **1**, 500.
[6] Hershman, J. M., and Higgins, H. P., *New England Journal of Medicine*, 1971, **284**, 573.
[7] Crooks, J., Murray, I. P. C., and Wayne, E. J., *Quarterly Journal of Medicine*, 1959, **28**, 211.
[8] Gurney, C., *et al.*, *Lancet*, 1970, **2**, 1275.
[9] Acland, J. D., *Journal of Clinical Pathology*, 1971, **24**, 187.
[10] Clark, F., and Horn, D. B., *Journal of Clinical Endocrinology and Metabolism*, 1965, **25**, 39.
[11] Howorth, P. J. N., and MacLagan, N. F., *Lancet*, 1969, **1**, 224.
[12] Goolden, A. W. G., Gartside, J. M., and Sanderson, C., *Lancet*, 1967, **1**, 12.
[13] Ekins, P. R., *Clinica Chimica Acta*, 1960, **5**, 453.
[14] Murphy, B. P., *Journal of Laboratory and Clinical Medicine*, 1965, **66**, 161.
[15] Chan, V., and Landon, J., *Lancet*, 1972, **1**, 4.
[16] Sterling, K., and Brenner, M. A., *Journal of Clinical Investigation*, 1966, **45**, 153.
[17] Sterling, K., Bellabarba, D., Newman, E. S., and Brenner, M. A., *Journal of Clinical Investigation*, 1969, **48**, 1150.
[18] McKenzie, J. M., *Endocrinology*, 1958, **63**, 372.
[19] Ensor, J. M., Kendall-Taylor, P., Munro, D. S., and Smith, B. R., *Journal of Endocrinology*, 1971, **49**, 487.
[20] *Lancet*, 1970, **2**, 809.
[21] Hershman, J. M., Givens, J. R., Cassidy, C. E., and Astwood, E. B., *Journal of Clinical Endocrinology and Metabolism*, 1966, **26**, 803.
[22] Wilson, G. M., in *Symposium Thyroid Disease and Calcium Metabolism*, p. 51-76. Edinburgh, Royal College of Physicians, 1967.
[23] Harden, R. McG., Alexander, W. D., Koutras, D. A., Harrison, M. T., and Wayne, E., *Journal of Clinical Endocrinology and Metabolism*, 1966, **26**, 397.
[24] Aranow, H., and Day, R. M., *Journal of Clinical Endocrinology and Metabolism*, 1965, **25**, 1.
[25] Turner, P., Granville-Grossman, K. L., and Smart, J. V., *Lancet*, 1965, **2**, 1316.
[26] Shanks, R. G., Hadden, D. R., Lowe, D. C., McDevitt, D. G., and Montgomery, D. A. D., *Lancet*, 1969, **1**, 993.
[27] Hadden, D. R., *et al.*, *Acta Endocrinologica*, 1969, **61**, 393.
[28] Hadden, D. R., Montgomery, D. A. D., Shanks, R. G., and Weaver, J. A., *Lancet*, 1968, **2**, 852.
[29] Das, G., and Krieger, M., *Annals of Internal Medicine*, 1969, **70**, 985.
[30] Riddell, V., *British Journal of Surgery*, 1962, **48**, 291.
[31] Hedley, A. J., Flemming, C. J., Chesters, M. I., Michie, W., and Crooks J., *British Medical Journal*, 1970, **1**, 519.
[32] Michie, W., Pegg, C. A. S., and Bewsher, P. D., *British Medical Journal*, 1972, **1**, 13.
[33] Irvine, W. J., and Stewart, A. G., in *Thyrotoxicosis*, ed. W. J. Irvine, p. 111. Edinburgh and London, E. & S. Livingstone, 1967.
[34] McDougall, I. R., Kennedy, J. S., and Thomson, J. A., *Journal of Clinical Endocrinology and Metabolism*, 1971, **33**, 287.
[35] Pochin, E. E., *British Medical Journal*, 1960, **2**, 1545.
[36] Saenger, E. L., Thoma, G. E., and Tompkins, E. A., *Journal of the American Medical Association*, 1968, **205**, 855.
[37] Nofal, M. M., Beierwaltes, W. H., and Patno, M. E., *Journal of the American Medical Association*, 1966, **197**, 605.
[38] Smith, R. N., and Wilson, G. M., *British Medical Journal*, 1967, **1**, 129.
[39] McDougall, I. R., Greig, W. R., and Gillespie, F. C., *New England Journal of Medicine*, 1971, **285**, 1099.

Medical Training

Survey of Surgical Registrar Promotion in the Birmingham Region 1960-70

P. G. BEVAN

British Medical Journal, 1972, 2, 341-344

In recent years increasing interest has been shown on all sides in the training content and potential of surgical registrar posts. In all regions Fellowship courses and teaching have been promoted, schemes of rotation initiated, and academic meetings arranged at individual hospitals in increasing numbers. There is a continuing debate on the optimum proportion of training and service in registrar posts, and an annual allowance of study leave is now a recognized part of a registrar's work.

There is surprisingly little information available about the results of this considerable expansion of training activities. Do such courses and rotation schemes still need to be increased, or have we already enough? Is the training standard of individual posts adequate? Is the proportion of registrars to senior registrars in general surgery still unsatisfactory in providing reasonable promotion chances to the consultant grade? It does not seem possible to answer these questions at present.

To regulate training and decide the right staffing structure it is important to know what has been happening to our surgical trainees—how many have attained consultant status, how many have gone abroad, and how many doctors from abroad come to the United Kingdom for surgical training.

Dudley Road Hospital, Birmingham 18

P. G. BEVAN, CH.M., F.R.C.S., Consultant Surgeon and R.C.S. Regional Adviser in Postgraduate Training in Surgery

Present Study

In March 1970 the Surgical Registrar Training Committee in the Birmingham region felt the need of precise data on the training of surgical registrars and their career prospects. It was decided to undertake a retrospective survey of the subsequent careers of surgical registrars and senior house officers who had worked in the region during the previous decade.

We report here the result of the survey. The following hospitals supplied statistics, for which we are grateful.

In Birmingham: Accident Hospital; Dudley Road Hospital; East Birmingham Hospital; Good Hope Hospital, Sutton Coldfield; Royal Orthopaedic Hospital; Selly Oak Hospital; and United Birmingham Hospital (General and Queen Elizabeth). Outside Birmingham: Bromsgrove General Hospital; Burton General Hospital; Coventry (Coventry and Warwickshire and the Walsgrave Hospitals); Hereford County Hospital; North Staffordshire Royal Infirmary (Stoke-on-Trent); Shrewsbury (Royal Salop Infirmary); South Warwickshire Group (Leamington-Warneford, Stratford, and Warwick Hospitals); Stafford General Infirmary; Stourbridge (Corbett and Guest Hospitals); Walsall (General and Manor Hospitals); West Bromwich (Hallam and District Hospitals); and Wolverhampton Royal Hospital.

These represent 17 of the 18 hospital groups in the region, including the undergraduate teaching group and two of the specialist hospitals—the Accident and Royal Orthopaedic Hospitals. Although not fully comprehensive most hospitals have been included where general surgical registrars have been employed.