THE BASAL METABOLISM TEST IN THYROTOXICOSIS

ITS VALUE TO THE CLINICIAN

BY

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All laboratory aids to clinical medicine ultimately come under critical review, when, after an adequate period of use and abuse, the clinician can fairly assess their limitations and the help they afford. The clinician, as such, is not concerned with the laboratory technique of various procedures, beyond the assurance that these are scientifically sound and are performed by skilled hands. Experience has shown that certain laboratory aids—for example, blood counts in pernicious anaemia and blood-sugar estimations in diabetes—are indispensable for adequate treatment or diagnosis, while others—such as the estimation of basal metabolism in thyrotoxicosis and the test for occult blood in the faeces in peptic ulcer—although of definite value, are not indispensable.

The purpose of this paper is to consider the position of the basal metabolism estimation in thyrotoxicosis and to evaluate its aid to the clinician in diagnosis, assessment of severity, and treatment. The subject can conveniently be considered under three headings.

Diagnosis

For practical purposes thyrotoxicosis may be said to occur in three main forms—namely, (1) florid, in which the classical symptoms and signs render the diagnosis obvious; (2) masked, in which classical signs are minimal or absent and the disease exists behind a façade of cardiac failure or muscular wasting; and (3) borderline cases, in which signs and symptoms are suggestive but a confident diagnosis cannot be made at the first examination.

Florid Cases.—The B.M.R. can only be confirmatory of the condition that is clinically evident, and patients would lose nothing were the test not performed.

Masked Cases.—A raised B.M.R. is valuable in clinching the diagnosis, although many clinicians would back their opinion to the point of advising thyroidectomy without its aid. Parsons and Twort (1939) reported an example of thyrotoxic myopathy in which a high B.M.R. proved thyrotoxicosis to be the cause of great muscular wasting in a man with none of the classical symptoms and signs. In this instance the B.M.R. put the diagnosis beyond doubt and the man was cured by thyroidectomy. In masked cases where the presenting symptom is cardiac failure, with or without auricular fibrillation, the patient may be too ill to undergo the test, and a diagnosis of thyrotoxicosis on clinical grounds alone must suffice for thyroidectomy, which may be almost an emergency operation. In other cases caution is needed in choosing the time to estimate the B.M.R., as well as in interpreting the results. Cardiac failure of non-thyrotoxic origin may of itself cause a raised B.M.R., and in doubtful cases a therapeutic test with iodine, after relief of failure, will cause a further fall in the B.M.R. if thyrotoxicosis is present. It must be admitted that thyrotoxicosis has been reported with a normal B.M.R. (Plummer, 1931; Morris, 1931), and in some cases the diagnosis was proved histologically but the B.M.R. level remained unaltered after thyroidectomy.

Borderline Cases.—In these cases, also known as "formes frustes," autonomic imbalance, or neuro-circulatory asthenia, signs and symptoms suggestive of thyrotoxicosis may be present, often with an enlarged thyroid as well, yet the B.M.R. is within normal limits and thyroidectomy does not improve the symptoms (Kessel and Hyman, 1923; Rasmussen, 1937; Prioleau, 1939). Much controversy, summarized by Möller (1927), has centred round these cases, the nature of which has been variously suggested as (1) Graves's disease without raised metabolism, (2) Graves's disease in persons with a subnormal B.M.R. in whom the disease has only raised the basal metabolism to normal levels, and (3) an entity entitled "Basedow's disease with no thyrotoxicosis" (Rasmussen, 1937). Möller himself considered that a raised B.M.R. was not essential for the diagnosis of thyrotoxicosis, for he regarded it as a sign which might equally be absent with other cardinal indications such as goitre or exophthalmos. Such an extreme view is justified if borderline states of thyrotoxicosis can be diagnosed confidently on clinical grounds alone, otherwise many unnecessary thyroidectomies will be done. It has been shown that in myxoedema the metabolic level is to some extent independent of symptoms (Dodds and Robertson, 1933); for the B.M.R. of a patient was raised to + 30 per cent. by dinitro-*o*-cresol without relief of symptoms, yet with thyroid extract symptoms were relieved at a B.M.R. of + 10 per cent. A similar principle may hold good in thyrotoxicosis, but it cannot be demonstrated as yet, for, apart from iodine, which also ameliorates the symptoms, we have no drug capable of lowering the B.M.R. Whatever views are held regarding borderline cases or whether a raised B.M.R. is essential for the diagnosis of true thyrotoxicosis, the fact remains that thyroidectomy does not relieve the symptoms of patients with autonomic imbalance, and, as with mild cases of undoubted thyrotoxicosis, surgeons are loath to operate upon them. For this reason estimation of the B.M.R. is of great value, as a reading within normal limits is a warning that thyroidectomy will not relieve symptoms. Dunhill (1937) stated that, apart from "formes frustes," he generally decided on the advisability or otherwise of operation in thyrotoxicosis on clinical signs and symptoms alone, while Hamilton and Lahey (1922) emphasized the need for discretion when interpreting the results of the borderline cases.

To summarize—in the diagnosis of thyrotoxicosis the B.M.R. seems to be superfluous in florid cases, of confirmatory value in masked cases, and of considerable value in borderline cases as a means of identifying the patients upon whom thyroidectomy would confer little or no benefit.

Assessment of Severity

The severity of thyrotoxicosis can only be assessed by taking into account the whole clinical picture, many components of which are rather intangible and incapable of expression by figures. The degree of nervousness and the amount of cardiac damage cannot be expressed numerically, while figures for pulse rate, loss of weight, size of neck, and degree of exophthalmos are variable individual factors and cannot serve as standards of comparison. The raised B.M.R. reading, as a factor common to nearly all cases of thyrotoxicosis, has therefore been seized upon as a means of estimating the absolute severity of any one case and of comparison with others. This has been most unfortunate; for it has fostered the illusion that a raised metabolism is the central point of cause, symptoms, and treatment in thyrotoxicosis.

Estimation of the severity of any disease resolves itself into an assessment of the most dangerous components, and in thyrotoxicosis there are at least three possible causes of death—namely, wasting from hypermetabolism, cardiac failure, and acute psychosis. The B.M.R. is only an index of the first of these, and hence cannot be a fair estimate of severity in every case or a reliable standard of comparison for all. It is common experience that a patient with thyrotoxic heart failure may be at death's door with a B.M.R. of + 40 per cent., yet a patient with exophthalmic goitre and a B.M.R. of + 70 per cent. may cause no undue anxiety. The clinical picture of thyrotoxicosis is a mosaic of which hypermetabolism is but a constituent fragment and not, of necessity, the centrepiece.

Treatment

As a means of indicating the right moment for operation repeated B.M.R. readings cannot be said to give more information than clinical observation of the pulse rate, weight chart, and general appearance of the patient—in short, consideration of the whole clinical picture. The main point in judging the moment for thyroidectomy is that the patient shall be improving in a remission induced by adequate iodine administration, which can be recognized accurately by clinical methods. We know that the B.M.R. falls coincidently with improvement of symptoms under iodine medication, but this is no reason for trusting to one sign rather than to the whole picture.

Many surgeons have ceased using the B.M.R. for this purpose, although Means (1937) states that he notes it every few days during pre-operative iodine therapy until a new low level is obtained. Lehman and Shearburn (1939), however, complained that no hard-and-fast criteria existed for assessing improvement under pre-operative iodine. They found no relation between the initial height of the B.M.R. and the duration of iodine therapy necessary before operation. Further, they found no relation between the initial height of the B.M.R. or duration of pre-operative iodine therapy and subsequent post-operative reaction—as judged by pulse and temperature readings.

As regards *x*-ray therapy, it is doubtful if the B.M.R. is of much assistance in checking the progress of a case under treatment. Möller (1927) was unable consistently to correlate alteration of the B.M.R. level with clinical change in patients undergoing *x*-ray therapy, and concluded that it could not be trusted as an accurate index of progress.

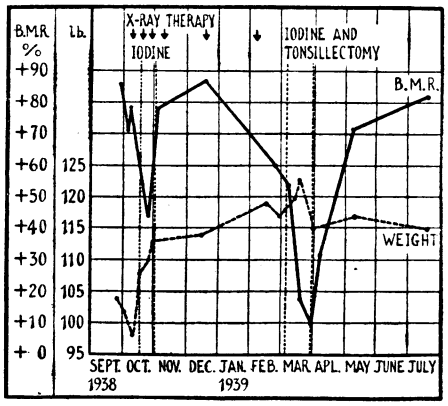
The following case is an example of striking clinical improvement and gain of weight in a thyrotoxic patient, whose B.M.R. has remained at a remarkably high level in spite of *x*-ray therapy.

Illustrative Case

A housewife aged 25 attended the out-patient department of Addenbrooke's Hospital, Cambridge, in November, 1937, after an attack of tonsillitis in October of the same year. In April, 1937, her friends had remarked on the goitre and the staring eyes, which the patient herself had not noticed. She felt quite well in herself, was not nervous, and had no excessive sweating or dislike of hot weather. Her weight then was 7 st. 7 lb., her highest known weight having been 9 st. in 1931. Her appetite was not remarkable and had not increased. Mild primary thyrotoxicosis was diagnosed, and as active treatment did not seem called for she was treated by sedatives.

She attended the out-patient department again in August, 1938, having remained well except for amenorrhoea since November, 1937. Her weight was 7 st. 11½ lb. In September, 1938, she was admitted to hospital under Professor J. A. Ryle. Her weight was 7 st. 6½ lb. in nightclothes. There was a fine tremor of the hands, but she was not nervous or flushed. The pulse was regular at 120 a minute, with a diffuse forcible apex beat, maximum in the fifth space four inches from the midline. The blood pressure was 175/90. She had a moderate-sized smooth symmetrical goitre and the following eye signs: marked exophthalmos, lagging of the upper lids, widened palpebral apertures, and a smooth forehead on looking upwards. The tonsils were large and fleshy but not obviously inflamed.

On clinical grounds she was considered to have a mild to moderate degree of primary thyrotoxicosis. Considerable surprise was caused by a B.M.R. reading of + 86 per cent., confirmed during the ensuing few days by further results of + 71 per cent. and + 79 per cent. She would not consent to thyroidectomy, and in view of her good general condition *x*-ray therapy was recommended, with tonsillectomy later if necessary. She was subsequently admitted on four occasions for tonsillectomy and B.M.R. readings. The accompanying chart shows the further progress of her weight, B.M.R., *x*-ray therapy, and the occasions when she was given iodine. It shows that she has maintained her increased weight despite



an astonishingly high B.M.R. level, and that iodine was able to lower the B.M.R. temporarily.

The patient remains under observation, leading a normal life in her home, and attends hospital for *x*-ray therapy. Despite the high B.M.R. she feels perfectly well and has given no cause for anxiety, either after tonsillectomy or at any other time. The eye signs persist unchanged, but the goitre is now barely visible or palpable. The pulse rate remains in the neighbourhood of 100, and for this reason she may still be pressed to undergo thyroidectomy. However, no matter what the future course of this patient may be, she illustrates very well the complete lack of relation between B.M.R. readings and the clinical state, both as regards degree of severity and progress under *x*-ray therapy.

Estimation of the B.M.R. after thyroidectomy is valuable to the surgeon as a check upon the amount of thyroid tissue removed. Post-operative myxoedema may be anticipated, and substitution therapy instituted and regulated before symptoms appear, so that in this respect the B.M.R. can give more information than clinical observation alone.

Conclusions

Virtually all cases of thyrotoxicosis have a raised B.M.R.; but hypermetabolism is only a part of the symptom-complex, and is neither a sound index of severity of any particular case nor a reliable standard of comparison.

For diagnostic purposes it is confirmatory in florid and masked cases, and has its greatest value in borderline cases, where a normal reading is a warning against thyroidectomy.

As a means of indicating the right moment for thyroidectomy during pre-operative therapy or checking progress during *x*-ray therapy it does not surpass clinical observation, but it is a valuable means of indicating post-operative myxoedema before symptoms appear.

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