ATRIAL FIBRILLATION IN THYROTOXICOSIS TREATED WITH RADIOIODINE

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RADIOACTIVE Iodine (^{131}I) is frequently recommended as the treatment of choice for thyrotoxicosis in patients over 45 years old without sufficient appreciation of the difficulties in management that occasionally occur. The increasing frequency of post-radiation myxoedema is now widely recognised (Green and Wilson, 1964) but less emphasis has been paid to the situation in some subjects in whom the first therapeutic dose may have little effect. Also little attention has been given to the management of a atrial fibrillation (A.F.) in thyrotoxicosis treated with ^{131}I , though most of these cases are now treated by this method. This is in contrast to the interest shown by the surgical pioneers including Dunhill (1930) who considered that reversion of A.F. to normal rhythm was a good clinical index of the effectiveness of thyroidectomy.

In this paper patients with A.F. and thyrotoxicosis who had been referred for ^{131}I treatment are reviewed with particular reference to reversion to sinus rhythm, the ultimate cardiac status and the risk of embolism.

Material and Methods

In the six years from July 1958 to June 1964, 170 patients with thyrotoxicosis have been treated with radioactive iodine at Lewisham Hospital. The dosage has been determined on the lines recommended by MacGregor (1957) whereby patients with small or impalpable glands have been given 4 to 6 mc., those with moderate goitres 8 to 10 mc., those with large goitres from 12 to 15 mc; in two very severe cases, 25 mc. were given in dividend doses initially.

Eighteen patients had been made euthyroid with carbimazole before ^{131}I treatment after which the drug was continued in decreasing dosage for three months. In the last two years 13 selected patients were given carbimazole for short periods starting one week after the ^{131}I to ensure that severe disability did not continue unnecessarily.

A follow-up has also been undertaken on 19 patients with A.F. out of a total of 86 with thyrotoxicosis treated with ^{131}I at St. Thomas's Hospital by one of us in 1956-57 with particular reference to the possibility of the subsequent occurrence of a cerebrovascular accident.

Results

Of the 170 subjects in the main series 39 (23%) had A.F. confirmed by electrocardiogram (ECG) at some stage of their illness. In eight subjects the A.F. was paroxysmal before definitive treatment was given and in one it occurred for the first time three months after the first dose of ^{131}I . The age distribution of these cases and the number with A.F. is depicted in Fig. 1, from which it is evident that A.F. is relatively uncommon under 55 years but thereafter there is a marked increase with advancing age. The average age of the subjects with A.F. was 62.5 years, range 37 to 77 years. 28 subjects were male but there was no apparent difference in the presentation, incidence of A.F., severity or response to treatment between the two sexes. 19 subjects had a toxic nodular goitre of whom eight had A.F. and one 2:1 heart block.

Reversion to Sinus Rhythm

The age distribution of the patients with established and paroxysmal A.F. and the number that reverted to sinus rhythm is depicted in Fig. 2. Of the 39 patients with A.F. one, with a severe hereditary cerebellar degeneration, died two days after the administration of ^{131}I ; 19 had persistent A.F. and 19 had sinus rhythm after the completion of treatment. The possible role of various clinical features, including the size of the goitre, length of history of A.F., presence of cardiac failure and associated heart disease, and response to treatment are summarised in Table 1.

Seven of the eight subjects with paroxysmal A.F. were ultimately in sinus rhythm, but the other, who developed persistent A.F. is briefly described:

Case No. 1. A female aged 64 was referred from another hospital with a 2-year history of thyrotoxicosis and the recent onset of paroxysmal A.F. She was given 8 mc. ^{131}I and in three months the thyrotoxicosis was improved though not cured, but A.F. had now become established. A further 4 mc.

FIG. 1.—Age distribution of 170 patients with thyrotoxicosis treated with radioiodine, and the numbers with atrial fibrillation.

¹³¹I were given after which she soon became euthyroid but A.F. persisted and was still present two years later.

Eight subjects with A.F. had been treated with carbimazole before ¹³¹I was given. Of these four had reverted to sinus rhythm before the ¹³¹I while the other four, one with severe rheumatic heart disease, all have persistent A.F. Three subjects with A.F. were given carbimazole for the first time after the ¹³¹I, all of whom reverted to sinus rhythm. One patient who reverted to sinus rhythm on carbimazole deserves brief mention, as A.F. developed again three months after the initial dose of ¹³¹I when the carbimazole was stopped.

Case No. 2. A female aged 62 was admitted to another hospital with cardiac failure and A.F. due to thyrotoxicosis. The cardiac failure responded to the usual measures and she was referred for ¹³¹I treatment. As she was a severe case it was decided to treat her initially with carbimazole and in six

weeks she reverted to sinus rhythm. Four months later when she was euthyroid, 11 mc. ¹³¹I were given four days after the carbimazole had been stopped. This was recommenced nine days later and continued in gradually reduced dosage for three months during which she remained euthyroid. Symptoms of thyrotoxicosis then soon returned with the recurrence of A.F. Carbimazole was again given with early return to sinus rhythm and after a further 6 mc. ¹³¹I she became euthyroid and remained in sinus rhythm when the carbimazole was finally stopped.

Onset of Atrial Fibrillation after ¹³¹I Administration

Three subjects are known to have developed A.F. again, after the initial dose of ¹³¹I had been followed by a period of sinus rhythm. One other developed A.F. for the first time during a period of emotional strain, three months after the first dose of ¹³¹I. Case 2 has been described already but two others deserve

FIG. 2.—Age distribution of thyrotoxic patients with established or paroxysmal atrial fibrillation, together with the cardiac rhythm after completion of treatment. N.B. * patient who died two days after the administration of ¹³¹I.

TABLE I

SOME CLINICAL FEATURES OF PATIENTS WITH ATRIAL FIBRILLATION IN RELATION TO HEART RHYTHM AFTER COMPLETION OF TREATMENT WITH ¹³¹I.

N.B. One patient who died shortly after the administration of ¹³¹I has not been included.

Clinical Features	Final Rhythm		Total
	Sinus	A.F.	
Moderate or large goitre	5	9	14
Impalpable or small goitre	14	10	24
Toxic nodular goitre	2	6	8
Paroxysmal A.F.	7	1	8
A. F. present > 6 months	4	10	14
A. F. present < 6 months	9	5	14
Cardiac failure on presentation	10	8	18
Associated heart disease present	4	2	6
Euthyroid with one dose of ¹³¹ I	8	9	17
Euthyroid with > one dose of ¹³¹ I	6	10	16
Hypothyroid after ¹³¹ I	5	—	5

TABLE 2

CARDIAC STATUS OF PATIENTS WITH ATRIAL FIBRILLATION AFTER COMPLETION OF TREATMENT WITH ^{131}I .

N.B. One patient who died shortly after the administration of ^{131}I has not been included.

Cardiac Status	Final Rhythm		Total
	Sinus	A.F.	
Normal Heart	9	3	12
Minimal dyspnoea, mild to moderate enlargement	2	4	6
Moderate dyspnoea, marked enlargement	1	4	5
Chronic cardiac failure, gross enlargement	—	1	1
Died, ? recurrent thyrotoxicosis partially responsible	—	1	1
Died from unrelated causes	2	2	4
Associated heart disease predominant	4	1	5
Not available for assessment, but rhythm known	1	3	4
Total	19	19	38

further mention, Case 3 because he illustrates that A.F. may be the only clinical manifestation of persistent thyrotoxicosis and Case 4 because he was one of only two subjects that we have ever seen who developed recurrent thyrotoxicosis after ^{131}I treatment.

Case No. 3. A male aged 58 was admitted to hospital with severe thyrotoxicosis, thyrotoxic myopathy and paroxysmal A.F. The thyroid was very large and as tracer investigation had shown a rapid turnover, 25 mc. ^{131}I were given in three divided doses under quinidine cover, the pulse rhythm remaining regular throughout. He improved rapidly but three months later he was found to have developed A.F. again. In the next two months A.F. persisted, this being the only clinical manifestation of persistent thyrotoxicosis but as the thyroid was still palpable a further 10 mc. ^{131}I was given. One month later he was in sinus rhythm though he shortly developed postirradiation myxoedema.

Case No. 4. A man aged 71 was admitted to another hospital in severe heart failure and A.F., two years after a proven posterior myocardial infarct. When the heart failure had responded to treatment thyrotoxicosis was diagnosed and 5 mc. ^{131}I were given with a very satisfactory response, sinus rhythm being restored in two months; he remained euthyroid with no significant cardiac symptoms. 16 months later at a routine visit he was found to have developed A.F. again and to have lost some weight. Investigations confirmed the recurrence of thyrotoxicosis and another dose of ^{131}I was arranged but unfortunately he died suddenly before this could be given.

Cardiac Status after Completion of Treatment

The cardiac status of these patients with A.F. when they were euthyroid is summarised in Table 2. 18 were normal, or had only minimal

disability and these included all with paroxysmal A.F. and the one patient who had A.F. transiently after the first dose of ^{131}I . Although there was a tendency for the patients with residual A.F. to be less satisfactory, three of them had no symptoms, a normal-sized heart and an otherwise normal ECG, while three who reverted to sinus rhythm had persistent marked enlargement of the heart; two of the latter had another cause for the heart disease.

The importance of associated heart disease in those patients with residual cardiac symptoms and signs was difficult to assess and only those in whom such other causes were undoubtedly have been included. They were three with ischaemic heart disease, two with rheumatic heart disease and one with severe hypertension. Only one of our subjects with A.F. had angina pectoris though there were several instances in patients who had normal rhythm throughout.

Seven subjects, one of whom died from an independent cause, had marked residual enlargement of the heart without clear evidence of associated heart disease. Most of these were elderly and in some instances it was probable that thyrotoxicosis had been present for a considerable time. Except for Case 6 they had few symptoms, any exertional dyspnoea being little more than would be expected for their age though the lack of symptoms may have been partly due to the great improvement following treatment of the thyrotoxicosis. Further they have shown no tendency to de-

teriorate in the 1 to 5 years since becoming euthyroid. Three patients had clinical and radiological evidence of mitral incompetence, but without an antecedent history of rheumatism or present evidence of mitral stenosis this may be a legacy of thyrotoxic heart disease. The patient who died, aged 73, did so from a refractory anaemia and at autopsy she had a very large heart, "surprisingly healthy" coronary arteries and small multiple areas of fibrosis microscopically.

Only two subjects had significant disability and as they illustrate different aspects of the problem they are briefly described:

Case No. 5. A male aged 50 in 1959, when first seen, had severe thyrotoxicosis for 18 months, A.F. for an indefinite time and heart failure for three months. He was difficult to treat with ^{131}I for he required 42 mc. in four separate doses over a period of 16 months before he became completely euthyroid. In the next five years he continued to complain of exertional dyspnoea which interfered seriously with his work. He had moderate cardiac enlargement and an attempt has recently been made to revert him to normal rhythm with the external D.C. defibrillator, unfortunately without success.

Case No. 6. A female, aged 61, presented at another hospital in September, 1962 with symptoms of progressive cardiac failure and A.F. for three months shown to be due to a toxic nodular goitre. As there was a poor response to carbimazole she was referred and treated with 12 mc. ^{131}I in December, 1962, and a further 10 mc. in July 1963 before she became euthyroid. She has severe persistent dyspnoea, a very large heart and repeated episodes of congestive cardiac failure. An attempt to revert her to normal rhythm with the DC defibrillator has been successful but it is too early to know whether this has been beneficial.

Cerebral Embolism in Association with A.F. and Thyrotoxicosis

There were two cases in the main series of 39 subjects with A.F. who had strokes presumed to be due to cerebral emboli and in the same period a further eight of our patients have been treated surgically or with carbimazole, none of whom have had a stroke. There have been no episodes of a cerebral vascular accident in the 131 subjects with sinus rhythm in the main series. The two cases who had cerebral emboli are briefly described:

Case No. 7. A female aged 56 in 1955 was admitted to hospital with a left hemiplegia from which she made a good recovery. She had A.F. and cardiac failure due to severe thyrotoxicosis with a large diffuse goitre and there was presumptive evidence that the A.F. had developed two months before the hemiplegia. She was treated satisfactorily with carbimazole; in two months she reverted to sinus rhythm and the drug was continued for two years until July 1957, sinus rhythm being present throughout. However six weeks after the carbimazole was stopped signs of thyrotoxicosis and A.F. returned. She was referred elsewhere for ^{131}I therapy, 10 mc.

being given in October 1957. There was only a partial response to this dose and in November 1958 she was again admitted to hospital with a popliteal embolism and severe signs of thyrotoxicosis. She was given a further 8 mc. ^{131}I in December 1958 and 8 mc. in March, 1959 which led to normal thyroid function, though A.F. persisted. In April, 1960 she had a further left hemiplegia, from which she has remained disabled though she was still alive in 1964.

Case No. 8. A female aged 77 in 1962, was admitted to another hospital in heart failure with A.F. due to toxic nodular goitre and hypertension. She had probably had thyrotoxicosis for three years and A.F. for an unknown period. She was referred for ^{131}I treatment, 8 mc. being given in August, 1962 with slight improvement in the next two months. She was admitted to a third hospital in January, 1963 with a right hemiplegia from which she made a partial recovery. In August, 1963 she was again referred from the first hospital with persistent thyrotoxicosis and A.F. Another 8 mc. ^{131}I were given with slow but steady improvement and in April, 1964 she was euthyroid but A.F. was still present. However, three weeks later she was admitted under our care with another right hemiplegia, the heart now being in sinus rhythm. She made a moderate recovery but she has a residual hemiplegia, hypertension and a very large heart.

Of the 19 subjects with A.F. treated at St. Thomas's Hospital in 1956-57, two died shortly after treatment, one from cardiac failure and one, who had previously had multiple pulmonary emboli, from a presumed cerebral embolus now described.

Case No. 9. A female aged 47 was admitted to hospital in March, 1957 in severe cardiac failure with A.F. due to a toxic nodular goitre, the goitre having been present for most of her life. In the preceding four months there had been repeated episodes of sudden dyspnoea, with pleurisy, which were attributed on good clinical grounds to recurrent pulmonary emboli, and she was put on anticoagulants, digoxin and mersalyl. Three weeks later 12 mc. ^{131}I were given followed by Lugol's iodine and in two weeks she was improved but cardiac failure and paroxysmal A.F. persisted. When the Lugol's iodine was stopped she became frankly thyrotoxic with persistent A.F. so a further dose of ^{131}I was given in July, 1957 at which time the anticoagulants were stopped.

Three weeks later she had a sudden complete left hemiplegia from which she soon died. The clinical diagnosis was presumed to be a cerebral embolus but the post-mortem was unhelpful for no adequate explanation of the hemiplegia was found. There was no evidence of cerebral infarction nor of any occlusion from thrombus or embolus in any branch of the carotid artery. Nor was there any evidence of the earlier pulmonary emboli, though these could have resolved. However, the heart was enlarged and antemortem thrombus was present in the tips of both atrial appendages and at the base of one of the papillary muscles. The coronary vessels were very healthy, but microscopically there was some interstitial fibrosis.

Of the remaining 17 subjects, 10 (six with persistent A.F.) are known to be alive and have not had any strokes whilst seven (four with

persistent A.F.) have died, five from unrelated causes, one from a proven cerebral haemorrhage and one, six years later, from a carcinoma of the thyroid which will be reported elsewhere (Staffurth, 1965).

A further patient has recently been seen with a cerebral embolus 11 years after treatment for thyrotoxicosis.

Case No. 10. A female aged 70 developed a sudden mild left hemiplegia followed two weeks later by an embolus in the right brachial artery for which she was admitted to another hospital for anticoagulants. 11 years before she had been treated for thyrotoxicosis and A.F. with methyl thiouracil which had been continued for two years. A.F. had persisted but at no time had there been any suggestion of a relapse of thyrotoxicosis and subsequent investigations confirmed that she was euthyroid.

Discussion

The overall incidence of A.F. in thyrotoxicosis is about 10% (Means, DeGroot and Stanbury, 1964), the 23% incidence in this series being due to the high average age of patients referred for ^{131}I therapy. Half of our patients who originally had A.F. were in sinus rhythm when euthyroid, a figure which compares favourably with the reversion to normal rhythm of one-third of the subjects in a larger, but comparable, series from Sheffield (Sandler and Wilson, 1959). The difference in the two sets of results may be due to the number of cases with paroxysmal A.F. as Sandler and Wilson did not specifically mention paroxysmal A.F. and they may not have included these cases. When our subjects with paroxysmal A.F. are excluded the proportion ultimately in sinus rhythm was also only one-third.

By comparison, a reversion rate of even one-half compares unfavourably with some other series particularly when large number were treated surgically before ^{131}I was available. Dunhill, who was interested in this subject, first reported the success of thyroidectomy in patients with irregular pulse rhythms in 1909, and in 1930 he was able to report that 48 of 100 cases with established A.F. reverted spontaneously to normal rhythm and another 32 did so after quinidine, giving a total reversion rate of 80%, though this was with a 9% mortality.

Hudson (1959) reported the results of thyroidectomy in 254 subjects with A.F., average age 51.4 years, of whom 74% reverted spontaneously to normal rhythm after operation, the mortality being only 2.4%. His series included 61 with paroxysmal A.F. of whom 60 reverted, but more important 70% of those with established A.F. reverted to normal rhythm. He

commented that reversion was less likely when A.F. had been present for more than a year and when other forms of heart disease were present but even in this group there was a reversion rate of one-third, that is, similar to the results in all our patients with established A.F.

On the other hand Delit, Silver, Yohalem and Segal (1961) treated a large number of thyrocardiacs with ^{131}I with results apparently as good as these surgical series. 226 (15%) of 1,492 patients had A.F. before treatment whilst this was present in only 51 (4%) of 1,294 after treatment. Unfortunately no indication was given about the situation in the remaining 198 patients. They also state that 107 of their cases had A.F. as the only manifestation of heart disease, 80 out of 81 of whom had reverted to normal rhythm. This is so different from our results, those of Sandler and Wilson (1959) and another large series from the U.S.A. (Chapman and Maloof, 1955) that there must be some unexplained reason. For instance, were all their cases confirmed by ECG, as this is not specifically stated? And what happened to the 25% who were not followed up?

From this brief review it would seem that the results of surgical treatment are better than with ^{131}I though the material is not entirely comparable. Many of the subjects referred to us for ^{131}I are elderly with severe heart disease, their average age being more than ten years older than those of Hudson (1959) and there is often a suggestion that this is the reason why the physician asked us to treat them. In other instances the same physicians refer younger patients with A.F. for thyroidectomy and this has recently been our practice. These facts are probably the main reason why our results are not as good as the surgical series but nevertheless statistical excuses must not be allowed to hide individual failures, and in this context we would particularly draw attention to Case 7, where early surgery would undoubtedly have been more successful, and also Cases 5 and 6, where thyroidectomy would probably have produced a better result if the thyrotoxicosis had been controlled earlier.

The main deleterious effects from persistent A.F., *per se*, are the risk of embolus and possible impairment of cardiac output. Cerebral embolism, leading to death or disabling hemiplegia, is a common complication of A.F. due to any cause but its occurrence in thyrotoxicosis has received little attention. One can never be sure in an individual patient that a stroke was due to an embolism but the clinical his-

tories of our four subjects (Cases 7-10), particularly the presence of emboli elsewhere in three of them, suggest that these strokes were due to cerebral emboli. No indication of the frequency of this complication would be valid from our data because this appraisal was partly undertaken after our first two cases had been seen and is thus biased. However, the occurrence of four cases is, in itself, an indication that a risk of embolism exists in patients with thyrotoxicosis and A.F.

Little attention has been paid to cerebral embolism in the recent literature on the management of thyrotoxicosis. However, it cannot be all that uncommon for Carter (1963) collected six instances from A.F. due to thyrotoxicosis out of 108 cases of cerebral emboli. Further, the occurrence of cerebral embolism was recognised as a hazard, albeit a rare one, in the days when large numbers of patients with A.F. were treated by partial thyroidectomy, when the emboli tended to occur at the time of reversion to normal rhythm (Rundle, 1951; Hudson, 1959).

It is surprising that cerebral emboli have not been reported in patients who have been treated with ^{131}I but it is possible that they have not been recognised. Chapman and Maloof (1955) reviewed 520 patients with 16 deaths in the follow-up, nine of whom were "aged, chronically ill and had vascular thrombosis in vital areas". Blomfield, Eckert, Fisher, Miller, Munro and Wilson (1955) had 30 deaths out of 500 cases, in 18 of whom "death was due to cardiovascular disease presenting as congestive cardiac failure, myocardial infarction or cerebral thrombosis", and Delit and others (1961) reviewing a large series state that "the cardiac patients including 'pure' fibrillators, contributed a disproportionately large percentage of the total deaths" without indication of the number or nature of those deaths. Were any of these "cerebral thromboses" really emboli? That none of these authors have commented on the occurrence or even the possibility of non-fatal emboli in their cases which include a large number with A.F. is remarkable. A possible discrepancy between these experiences and the earlier surgical ones is that ^{131}I being effective more slowly, any untoward events are likely to occur when patients are outside the immediate care of the centre that arranged the treatment and so may not be reported.

Although the heart may be involved in thyrotoxicosis without the development of A.F. our patients in sinus rhythm have not been

considered here as the whole subject is well reviewed by others (Cookson, 1959; Sandler and Wilson, 1959; Summers and Surtees, 1961; Delit and others, 1961). Our findings as regards the incidence and severity of heart disease are similar to those generally reported, in that before treatment there is an increasing incidence of A.F., cardiac failure, and enlargement of the heart with advancing age, and a corresponding decrease in a satisfactory response to treatment. However, one can never forecast how an individual patient will respond. We did not find, as have others, that the presence of cardiac failure with A.F. before treatment adversely affected the chances of reversion to normal rhythm and it should be noted that three of the four subjects over 75 reverted to normal rhythm, one of them having had A.F. for two years (Case 8).

Sandler and Wilson (1959) and Summers and Surtees (1961) commented on the number of subjects with residual heart disease, particularly enlargement of the heart, which could not be explained by associated disorders, and both considered that there is a form of permanent heart disease which is a legacy of thyrotoxicosis. Most of their subjects, like seven of ours who were similar, were elderly so that in an individual case it is impossible to be sure whether or not an associated condition, particularly ischaemic heart disease, is also present. Sandler and Wilson (1959) reviewed the literature on autopsies on this subject and added six of their own, five of whom had "healthy coronary arteries" and one, a woman aged 37 had patchy myocardial fibrosis. This was the finding in our only available autopsy, a patient aged 73 when she died with marked cardiac enlargement two years after being euthyroid.

Many of these patients appear to have had undiagnosed thyrotoxicosis for a long time but Summers and Surtees (1961) reported an important patient who developed thyrotoxicosis and marked cardiac enlargement in four months while under their observation for another complaint, and in whom the cardiomegaly persisted after treatment. In one of our subjects (Case 6) the antecedent history was only a matter of months so we do not think one can always blame delay in diagnosis for this important complication.

When these cases are considered together they amount to a considerable number and there is little doubt that a form of chronic heart disease may persist after the successful treatment of thyrotoxicosis. We suggest that

this be called post-thyrotoxic cardiomyopathy. The possibility of this developing is a good reason why all subjects with thyrotoxicosis, particularly those with heart disease, should be treated promptly and properly (Hudson, 1959). Although ^{131}I therapy is a satisfactory method of treatment it should not be advised automatically in all subjects over 45, for the recent development of A.F., particularly in an otherwise healthy middle-aged subject, may be better treated by thyroidectomy, as the evidence suggests that a return to normal rhythm is then more probable.

Surgical treatment also presents an opportunity to try to induce sinus rhythm, if this does not occur spontaneously, before the patient is discharged from hospital (Dunhill, 1930). After ^{131}I therapy attempts at reversion to sinus rhythm have been less often reported though Sandler and Wilson (1959) used quinidine on a small number with some success. We have rarely used quinidine because of practical difficulties, for after ^{131}I treatment one must wait until the patient is euthyroid and almost certainly back at work before an attempt at reversion is likely to succeed. The patient, now without symptoms, has to be readmitted for several days, which is psychologically bad management. With the advent of DC defibrillation it is possible that more attempts will be made to revert patients with persistent A.F. and we have now tried this on two subjects (Cases 5 and 6).

Because of the delay in the control of thyrotoxicosis that may occur after the first dose of ^{131}I , attempts have been made to precede or follow the ^{131}I with antithyroid drugs in order to ensure early control. This method has its disadvantages for Crooks, Buchanan, Wayne and Macdonald, (1960) found that methyl thiouracil given before the ^{131}I reduced considerably the number of patients who were cured by the first dose and also that the average total dose for cure was increased. Bloomfield and others (1959), with a smaller number of cases, did not notice any such differences. Our experience with carbimazole has tended to agree with that of Crooks and others, but our series has not been controlled and we have thought that the less good response may have been due to selection, for it is the more severe cases with large thyroids that have more often been pretreated in this way.

Crooks and others (1960) did not discuss an important difficulty that occurs in the management of the patients who did not respond to the first dose of ^{131}I , namely that such a patient,

who has become normal on antithyroid drugs at the time of administration of the ^{131}I , at some stage has to stop the drug to see if the ^{131}I has been effective. Those who have not been cured by the first dose may then become thyrotoxic again, having been controlled for several months, before their final cure. This is an untidy method of management that calls for close supervision, the difficulties being well illustrated in our Case 3.

Werner (1962) and others have tried beginning the antithyroid drug after the first dose of ^{131}I , a method we have been using in selected cases recently. Our experience is, as yet, too short to assess its effectiveness but it is clear that the same difficulties in management exist. Nevertheless, it does ensure that most patients become euthyroid rapidly and we think that the disadvantages are preferable to the possibility of otherwise uncontrolled thyrotoxicosis. Treatment with an antithyroid drug, whether before or after the ^{131}I should probably be undertaken in all patients with severe thyrotoxicosis, selected for definitive treatment with ^{131}I , particularly if there is A.F. or other evidence of heart disease.

We agree with Sandler and Wilson (1959) that ^{131}I therapy is usually satisfactory for thyrocardiacs and that it should be used in severely ill or elderly patients because of the increased operative mortality in this group (Crile, 1949). However, it is not always immediately successful for a small number of subjects may get little benefit from the first dose of ^{131}I . Also, patients with established A.F. even when they have improved considerably, may not revert to normal rhythm until they are unequivocally euthyroid (Maloof and Chapman, 1951), a fact well illustrated by Case 5. As a consequence of either of these factors, A.F. may persist for a considerable time so that the ultimate prospect of reversion is seriously lessened.

Some of the practical difficulties of ^{131}I therapy have been stressed because they have been insufficiently discussed in the past and also because they have been particularly evident in these patients with A.F. Further experience will be necessary to see whether the use of an antithyroid drug with ^{131}I will be more successful and whether this combination will be as effective as thyroidectomy.

Summary

1. An assessment has been made of the results of radio-iodine treatment in 39 patients with thyrotoxicosis and atrial fibrillation (A.F.). Nineteen similar patients treated elsewhere have

been followed up with particular reference to the possible occurrence of cerebral embolism.

2. After completion of treatment half of the patients were in sinus rhythm but when those with paroxysmal A.F. were excluded the proportion was reduced to one third. These results compare unfavourably with earlier surgical experiences and possible reasons for this are discussed.

3. The cardiac status after treatment is described and attention drawn to a persistent form of heart disease which is not uncommon and which it is suggested should be called post-thyrotoxic cardiomyopathy.

4. Four instances of suspected cerebral emboli are described and attention drawn to the possibility of this complication in thyrotoxicosis with A.F.

5. The use of antithyroid drugs before or after radioiodine is discussed with emphasis on the necessity for care in management that this entails.

6. It is concluded that all subjects with thyrotoxicosis and A.F. should be treated energetically whatever method is chosen.

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