HYPERTHYROIDISM IN THE EXTREMES OF LIFE

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Hyperthyroidism is rarely encountered in patients in the extremes of life. In a series of 13,200 consecutive cases of hyperthyroidism seen at the Cleveland Clinic since 1925, there have been only 42 cases in children under 14 years of age and only 45 cases in patients beyond the age of 70. The youngest child undergoing thyroidectomy for hyperthyroidism was a boy of 2½ years and the oldest patient was a man 81 years of age. (Figs. 1 and 2.)

FIGURE 1: This boy, two and one-half years of age, had diffuse goiter with severe hyperthyroidism. Subtotal thyroidectomy was performed and he was well two years after operation.
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The reaction of the feeble and elderly patient to hyperthyroidism and to thyroidectomy is quite different from that of the child or the young adult. A comprehension of these differences is of value not only in the treatment of the rare cases of hyperthyroidism occurring in children and in old age, but also in the management of the numerous cases of hyperthyroidism in patients in the fifth and sixth decades of life.

FIGURE 2: Photograph of man, 83 years of age, who had nodular goiter with hyperthyroidism. Thyroidectomy was performed and he is well two years after operation.

In this series, hyperthyroidism in children was always associated with a diffuse enlargement of the thyroid whereas adenomatous glands were present in 96 per cent of the patients over 70 years of age. In the aged, the clinical picture of hyperthyroidism is distorted by the myocardial, vascular, and cerebral changes of senility. Striking differences in the clinical expression of hyperthyroidism in children and in the aged are therefore found.

Exophthalmos occurred in 76 per cent of the children in this series, and in 14 per cent of the cases it appeared so early and was so marked that it was considered the leading symptom. In the aged, however, exophthalmos was rarely seen and was never severe.

In the aged, the predominating symptoms were nervousness, weakness, exhaustion, and loss of weight. In 20 per cent of these patients, the leading symptoms were attributable to cardiac decompensation and in 40 per cent either auricular fibrillation or cardiac decompensation was present. In the children, no instance of cardiac decompensation occurred and auricular fibrillation was not observed.

Hyperthyroidism in the aged expresses itself as exhaustion. The myocardial reserve, the nutrition of the body, and the energy of the

organism are depleted by the constant demands of hypermetabolism. It is in children and in young adults that the full-blown stimulation of exophthalmic goiter in its typical form is seen.

As a rule, children with hyperthyroidism do not lose much weight and remain fairly well nourished. Nervousness, ceaseless activity, emotional disturbances, tachycardia, and exophthalmos are the predominating symptoms. The nervousness and hyperactivity may even be so marked as to result in choreiform twitchings. In two cases in this series, chorea was suspected when the child was first seen. If it is remembered that hyperthyroidism in children is almost never "masked" and that it rapidly assumes the clear-cut state of stimulation characteristic of exophthalmic goiter, needless operations on simple adolescent goiters will be avoided.

It is chiefly in the aged that hyperthyroidism, masquerading as organic heart disease, is unsuspected until examination of the thyroid reveals the presence of an adenoma. Characteristic, then, of hyperthyroidism in the aged is the nodular goiter with nervousness, cardiac symptoms, or weakness as the chief complaint.

Although the presence of complications often obscures the diagnosis, the basal metabolic rate is reliable in the aged, and except in the presence of cardiac decompensation a consistent elevation of the metabolic rate is strong evidence for the diagnosis of hyperthyroidism. The basal metabolic rate which was determined in 27 of the cases varied from plus 9 to plus 70 per cent and averaged plus 27 per cent. In only two instances was it above plus 45 per cent.

Many of these patients had had large amounts of iodine for long periods of time and this treatment had produced hard nodular glands that were of a consistency suggestive of malignancy. In the presence of hyperthyroidism, however, malignant tumors of the thyroid are extremely rare, less than 0.5 per cent in our experience,[1] and hence it is well to consider any goiter associated with hyperthyroidism as benign unless unmistakable signs of malignancy are present.

The basal metabolic rate is of less diagnostic value in children than in adults. The standards are not so accurately determined and wide variations occur as a result of failure of the child to cooperate. The highest basal metabolic rate in this series was plus 87 per cent, the average being plus 36 per cent. In the 20 cases in which the basal metabolic rate was determined, the reading was below plus 5 per cent in only one instance, and this patient had been treated with iodine before the test was made.

Although clinical findings are of much more value than laboratory tests in establishing the diagnosis of hyperthyroidism in children, the determination of the level of the blood cholesterol is of definite value. The cholesterol in this series varied from 110 to 160 mg. per 100 cc.

of blood and was low in every case in which its value was determined. Roentgen examination of the epiphyses will often show development in advance of that normal for the bone age. Determinations of the level of the blood iodine have been disappointingly variable.

The treatment of hyperthyroidism in children is the same as that in the adult, subtotal thyroidectomy. Prolonged attempts at conservative management are undesirable because of the danger of the development of permanent exophthalmos. In one case in this series, a child of four was first seen because of nervousness. A diagnosis of chorea, with a question of hyperthyroidism, was made and small doses of iodine were given. Marked exophthalmos developed within a period of two months and, although thyroidectomy was performed, the child, now seven, has a residual exophthalmos sufficiently marked to require a tarsoplasty.

The remission of hyperthyroidism in children in response to bed rest and iodine is usually satisfactory and the operation is therefore safe. There were no deaths among the 37 patients on whom operation was performed. Before the use of iodine, thyroidectomy in children was considered to entail considerable risk and a large proportion of the patients were subjected to stage operations. In the last 20 cases, however, we have divided the operation in only two instances and we now believe that a child with hyperthyroidism is an excellent surgical risk.

Following thyroidectomy, the reactions of the pulse and temperature in children are often severe. In seven instances, the pulse rose above 170 and the average temperature reaction was more severe than in an adult. Although the patients often looked quite sick on the first day after operation, the reaction always subsided quickly and in no instance was the patient's condition considered critical. Convalescence was rapid and smooth with the exception of two instances in which a transient tetany developed.

The end results of thyroidectomy for hyperthyroidism in children have been excellent. Thirty-two of the 36 traced patients have remained free of symptoms and have developed normally. In one case, a psychosis resembling an early schizophrenia appeared about four years after operation, and in one patient a troublesome neurocirculatory asthenia developed. Hyperthyroidism recurred in two instances, both patients being young children whose hyperthyroidism was severe. We formerly believed that a little more gland should be left in children than in adults in order to guard against the development of hypothyroidism during the years of the child's development. This complication has not occurred, and I now believe that the operation should be as complete in a child as in an adult with an exophthalmic goiter. A second operation has effected a permanent cure in both the cases in which there was a recurrence. The formation of keloids in the thyroidectomy scar of children

is a common occurrence and can best be controlled by irradiation with grenz ray soon after operation.

In children, our experience with conservative therapy has been unsatisfactory. Only three patients in the entire series improved enough on medical management to avoid operation. It is unwise from either a physical or psychological viewpoint for a child to lead a guarded life of chronic invalidism during the developmental years. The risk of operation is slight and the end results are excellent.

In the aged, however, it is my belief that cases should be selected carefully before surgery is recommended. In 20 of the 45 patients over 70 years of age, operation was considered inadvisable. Operation was performed on 24 patients with five postoperative deaths, a mortality rate of 21 per cent. In addition, one patient on whom merely a ligation was performed became delirious and died at home a few weeks after operation without ever having fully regained his reason.

Roentgen therapy is not of much benefit in the control of hyperthyroidism associated with a nodular goiter, but it was attempted with indifferent results in five cases. Satisfactory remissions were obtained with iodine alone in several instances, but many of the patients remained chronic invalids or soon expired. In justice to the conservative form of management, it must be remembered that the majority of the patients not subjected to operation were hopeless risks in which good results could not be expected from any form of therapy.

The operation was performed in stages in 58 per cent of the cases and in one-fourth of the cases ligations were done. In spite of this conservatism, the postoperative reactions were alarming. Approximately one-half the patients became delirious after operation and many were critically ill. Pneumonia was the cause of death in three instances while cardiac failure accounted for one death and "metabolic exhaustion" for the fifth (Figs. 3A and 3B). By "metabolic exhaustion" is meant the unclassifiable "fading away" which is occasionally seen following thyroidectomy in feeble and in elderly patients. Without any particular elevation of the temperature and often without alarming elevation of the pulse rate, the patient will become confused, enter a state of muttering delirium, and will succumb without any obvious cause of death either clinically or on postmortem examination.

Pulmonary complications, often intervening in the course of the reaction described above, are the greatest threat to the aged patient. Beyond the age of 60, pneumonia is the most common cause of death following thyroidectomy for hyperthyroidism. Starting with apathy or mental confusion, the aged patient will become progressively weaker. Pulmonary congestion may occur as a result of a failing myocardium.

A B

FIGURE 3A: A woman, 62 years of age, had severe hyperthyroidism of long duration. She had lost 62 pounds in weight, was emaciated, and extremely weak. Photograph shows the appearance of exhaustion. It is in this type of case that a postoperative reaction characterized by "metabolic exhaustion" is seen. FIGURE 3B: Same patient shown in Figure 3A. Alive and well four years after thyroidectomy.

Mucus from tracheal irritation accumulates and the delirious patient will be too weak or too uncooperative to attempt to cough it up. Oftentimes, by withdrawing all sedation and by giving caffeine, the patient can be aroused. The foot of the bed is then elevated on high shock blocks to an angle of nearly 30 degrees. The patient is placed on his side or on his abdomen and is urged to cough. With this form of postural drainage, large amounts of mucus can often be discharged, thus producing dramatic relief of cyanosis and dyspnea.

Far more important than the management of these complications is their prevention. In poor risk patients, the development of any complication will probably result in a fatality. The complications which are so difficult to treat are relatively easy to avoid.

Any patient who is over 60 years of age and has hyperthyroidism must be considered a relatively poor risk. The mortality rate in this group is more than four times as high as in patients under 60. Elderly patients should, therefore, be given the full benefit of bed rest and iodine until the pulse rate has fallen as low as it will fall and the patient is gaining weight. The diet is important and should be high in carbohydrate in order to insure an adequate supply of glycogen to the liver. We have found that the bromsulphalein test of liver function shows dye retention in a high percentage of the older patients with hyperthyroidism and we believe this weakness can best be corrected by the administration of a high calorie, high carbohydrate diet.

In children and in strong, young adults, it is neither necessary nor desirable to perform thyroidectomy under local anesthesia. In these cases, a basal anesthesia of 70 mg. of avertin per kilogram of body weight is of great value and results in analgesia without undue depression. Children and patients with extremely high basal metabolic rates are more tolerant of depressant drugs and the dosage must be increased in these cases in order to obtain the desired analgesic effect.

In the aged, depression, whether induced by inhalation anesthesia or by basal anesthetic agents, must be avoided. Any depression of respiration, of the cough reflex, or of the internal metabolism of the body may lower the vital reserve below the threshold of resistance to a terminal pneumonia. The operation must be performed under local anesthesia with a minimum of gas oxygen analgesia. In children and strong, young adults, even in the presence of severe hyperthyroidism, divided operations should rarely, if ever, be necessary. With modern methods of preparation for operation and with good postoperative care, severe thyroid crises are rare. Strong, young patients tolerate even severe reactions with relative safety. But when weakness and emaciation are associated with longstanding severe hyperthyroidism in an elderly patient, the risk is great, and the operation should be divided. Ligations are reserved for only the most desperate risks, but hemithyroidectomy should be performed in many cases. The opponents of divided operations have stated that this technic merely exposes the patient to the risk of two operations instead of one. When performed under local anesthesia, however, the risk of the second stage is negligible. Although there have been 49 deaths following the first stage of divided operations, we have never lost a patient following the second stage when he has been sent home to recuperate between stages. I am convinced that many patients who barely survived the first stage would not be alive today if a subtotal thyroidectomy instead of a lobectomy had been performed.

I have seen only one case of recurrent hyperthyroidism in a patient over 65 years of age at the time of the first operation. Since recurrent hyperthyroidism is rare in elderly patients, it is not necessary to remove as much of the gland as in younger patients. A fringe of gland protecting the trachea is additional insurance not only against injury to the recurrent laryngeal nerves, but also against tracheal irritation, the formation of mucus postoperatively, and the development of pulmonary complications.

Immediately following the operation, a blood transfusion should be given to all bad risk patients. It has been clearly demonstrated that the ice-cooled oxygen tent, by increasing the oxygen-carrying power of the blood and by refrigerating the inspired air, minimizes the postoperative reactions of the pulse and temperature. The hyperthermia of a

thyroid reaction will nearly always fall one or two degrees in response to this form of therapy. All aged patients are placed in an oxygen tent immediately after operation and remain there until the height of the reaction is passed.

A 5 or 10 per cent solution of glucose given in the anterior malleolar vein by the continuous drip method has been of the greatest value in combatting the postoperative thyroid reaction. On the first and second day after operation, at the time when the patient's metabolism and caloric requirement is the highest, his ability to take nourishment is at its lowest ebb. Glucose given intravenously by the drip method is easily, continuously, and rapidly oxidized, prevents acidosis, insures adequate renal function, protects the liver, and minimizes the postoperative febrile reaction.

The administration of barbiturates to elderly patients with hyperthyroidism may precipitate a psychosis or even a state of maniacal delirium. Morphia and codeine are the most valuable drugs at our disposal in the postoperative treatment of patients with hyperthyroidism. In children and young adults, morphia should be given in doses sufficient to obtain complete relaxation and analgesia. In the aged, however, undue depression may result if the usual doses are given and we have found that confusion, delirium, and depression are minimized if the dosage of morphia is limited to ⅛ of a grain or if only codeine is given. As Dr. Crile Sr. has stated,"Old age is its own analgesia."

In the child or young adult with severe hyperthyroidism, we must do everything in our power to combat the hyperthyroidism and depress the stimulation and the emotional drive of the thyroid crisis. A basal anesthesia of avertin and postoperative sedation with large doses of morphia are our allies in this campaign. In the aged, however, we must direct our therapy toward maintaining and building up the dwindling vital reserves of the patient. Excessive sedation combats this end and should be avoided.

Summary

The following table summarizes, in contrast, the manifestations of hyperthyroidism in the extremes of life.

Children under 14	*Patients over 70*
Hyperthyroidism expresses itself as stimulation	Hyperthyroidism expresses itself as exhaustion
Exophthalmos is the rule	Exophthalmos is rare
Goiter is diffuse	Goiter is adenomatous
Cardiac complications absent	40 per cent of patients have auricular fibrillation or cardiac decompensation
Diagnosis usually clear	Complications may obscure diagnosis
Basal metabolic rate unreliable	Basal metabolic rate reliable
Reaction of pulse and temperature to operation tends to be severe but patients do well	Reaction to operation tends to be mild but complications are common
No deaths following 37 operations	Mortality rate 21 per cent
Treatment of choice— Subtotal thyroidectomy, one stage	Treatment of choice— (1) Conservative management in 50 per cent of cases (2) Thyroidectomy in stages in selected cases
Basal anesthesia with avertin	Local anesthesia
Keep patient relaxed and analgesic with sedation	Avoid excessive sedation and attempt to build up resistence of patient
Postoperative complications very rare	Delirium occurs in 50 per cent of cases and pulmonary complications are common

Reference

1. Crile, George, Jr.: Hyperthyroidism associated with malignant tumors of the thyroid gland, Surg., Gynec., & Obst., 62:995-999 (June) 1936.