THE SIGNIFICANCE AND TREATMENT OF DELIRIUM OR CONFUSION FOLLOWING THYROIDECTOMY FOR HYPERTHYROIDISM

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The development of either mental confusion or active delirium in a patient on whom thyroidectomy has been performed for hyperthyroidism is an unfavorable prognostic sign. This reaction can be produced by a number of factors as is shown by an analysis of the causes of mental changes in the following thirteen cases of postoperative delirium or confusion. These thirteen cases occurred in a series of 200 consecutive operations on the thyroid gland for hyperthyroidism, an incidence of 6.5 per cent.

CAUSES OF POSTOPERATIVE DELIRIUM OR CONFUSION

Fifteen years ago, before iodine was used to prepare the patient for thyroidectomy and at a time when acute Grave's disease was much more common than it is today, the postoperative delirium of a typical thyroid crisis was a common occurrence. Today, however, a true thyroid crisis resulting in delirium is unusual. In this series of 200 consecutive thyroidectomies for hyperthyroidism, there were only two instances in which an active stimulated type of delirium was associated with marked elevation of temperature and pulse rate so that a diagnosis of thyroid crisis could be made.

In recent years we have seen relatively more elderly patients with nodular goiters and low-grade hyperthyroidism of long duration. It is in this type of case that we most commonly observe a state of postoperative confusion. Usually the patient is more than sixty years of age, is emaciated, feeble, and has had symptoms of hyperthyroidism for several years. Although cerebral arteriosclerosis is often a potent factor contributing to the mental symptoms, other factors also play a part in their development.

Confusion following thyroidectomy can usually be demonstrated to be the result of (a) liver failure, (b) kidney failure, (c) a cumulative effect of some drug or medication, or (d) an unclassifiable type of metabolic exhaustion. In order to demonstrate more clearly the factors causing the mental symptoms the cases will be presented in some detail.

MENTAL CONFUSION ASSOCIATED WITH LIVER FAILURE

In this series, a clinical syndrome which appears to be the result of hepatic failure has been responsible for the greatest number of cases of postoperative confusion and delirium in this series. Four of the thirteen cases of postoperative confusion could definitely be ascribed to

liver failure and a fifth in all probability was the result of the same process.

Lahey[1], Frazier[2], Coller[3], and others have emphasized the importance of the liver in the production of the severe postoperative thyroid reaction. Coller[3] has shown that the level of the serum bilirubin is definitely elevated and that dye tests show diminished liver function during the height of severe thyroid reactions.

Beaver and Pemberton[4] analyzed the autopsy findings in 107 cases of exophthalmic goiter and found that three types of hepatic lesions predominated: (1) Acute degenerative lesions, fatty metamorphosis, focal and central necrosis, and changes secondary to stasis of blood; (2) simple atrophy; (3) subacute toxic hepatitis and toxic cirrhosis. Clinically recognizable jaundice was present in 21.5 per cent of these cases. There appeared to be sufficient damage to cause disturbance of hepatic function which was detectable by clinical tests of hepatic efficiency in approximately 40 per cent of the cases. The acute lesions appeared to be in proportion to the severity of the disease. The atrophy was more marked in the aged. The subacute toxic atrophy and cirrhosis appeared more frequently among the older patients when the disease was severe and of long standing.

Weller[5] showed that the liver may be and frequently is involved in Grave's disease. He states that this has been demonstrated "*Clinically*, by the occasional occurrence of icterus . . . . . in this disease; *physiologically*, by the accumulating evidence of altered liver function in such patients; *experimentally*, by the evidence of hepatic dysfunction following administration of thyroid substance and thyroxin, and *morphologically*, by structural changes in the liver, varying from slight degrees of chronic hepatitis to a widespread degenerative necrotizing process which must be considered an 'acute yellow atrophy.'"

Youmans and Warfield[6] showed that hepatic function is impaired in certain instances of thyrotoxicosis. In 22 per cent of the cases they studied there was some loss of liver function. This impairment of liver function correlated roughly with the amount of weight lost, but not with the remaining clinical data.

This brief review of the literature indicates the importance of the liver in cases of severe hyperthyroidism, particularly in aged people.

Illustrative Cases

Metal Confusion Associated with Liver Failure

Case 1: The patient was a woman 61 years of age who had had a nodular goiter with severe hyperthyroidism for eight months. Auricular fibrillation

was present and there was slight evidence of cardiac decompensation. Twenty pounds in weight had been lost. The value for blood sugar while fasting was 88 mg. per hundred cubic centimeters. The basal metabolic rate was plus 71 per cent. The pulse rate at entry was 160 beats per minute. The value for hemoglobin was 61 per cent. After the administration of digitalis and iodine, the pulse curve showed an excellent response and all evidence of cardiac decompensation disappeared. The liver was not enlarged. The bases of the lungs were clear.

A left hemithyroidectomy was performed. Immediately after the operation a blood transfusion was given and the administration of a 10 per cent solution of glucose was started by the continuous intravenous drip method. Thirty-six hours after operation, the pulse rate rose to 140 beats per minute, but there was no evidence of cardiac decompensation and the general condition remained excellent. Forty-eight hours after operation, the temperature and pulse reactions were subsiding but the patient looked a little sallow. The icterus index at this time was 25 and the value for blood urea was 21 mg. per hundred cubic centimeters. She had become a little confused during the second day postoperatively and on the third day postoperatively she became delirious. In spite of the fact that the temperature and pulse reactions had subsided, the respiratory rate was elevated. The lungs were normal to auscultation and percussion and a roentgenogram of the chest showed no abnormality. On the fifth day the value for blood urea was 21 mg. per hundred cubic centimeters, the icterus index was 25, and the patient was still irrational. On the seventh day the value for blood urea was 27 mg. and for nonprotein nitrogen 30.8 mg. per hundred cubic centimeters. The icterus index had risen to 50. In spite of the fact that the temperature chart seemed to indicate that the patient's condition was improving she appeared, from a clinical standpoint, to be losing ground rapidly. On the seventh day she began to cough and raised blood-tinged sputum. The icterus index rose to 75 and on the eighth day after operation she expired.

Autopsy showed bronchial pneumonia and examination of the liver showed it to weigh 1760 grams and measure 22 x 18 x 8 cm. The capsule of the liver was thin and it was purple-brown-gray in color and mottled with areas of muddy yellow. Numerous phleboliths were scattered over the surface of the liver. Multiple sections of the liver revealed a yellow-gray substance which was rich in fat and had distinct markings. There was about the liver an appearance of slight biliary stasis. Small amounts of bile could be scraped from the surface. The consistency of the liver was comparatively firm. Sections for microscopic examination showed quite marked fatty degeneration. An examination of the urine for tyrosine and leucine crystals made shortly before the patient's death was negative.

Comment: In this case it will be noted that the thyroid reaction was not especially severe and that there was no evidence of cardiac decompensation after operation. The delirium became more pronounced on the second and third day when the thyroid reaction should be subsiding. At the same time the icterus index was rising steadily. A terminal pneumonia developed on the seventh day postoperatively and this complication was in all probability the indirect result of the hepatic insufficiency.

Case 2: The patient was a man 27 years of age who had had severe hyper-

thyroidism for one year. The pulse rate at entry was 120 beats per minute, the basal metabolic rate was plus 55 per cent, and 24 pounds of weight had been lost. There was no cardiac decompensation and no auricular fibrillation. The value for hemoglobin was 78 per cent. The value for blood sugar one hour P. c. was 180 and fasting it was 82 mg. per hundred cubic centimeters.

Thyroidectomy was performed, and the immediate postoperative reaction was not severe. On the second night, however, the temperature rose to 103°F. and the pulse rate to 170 beats per minute. (Fig. 1.) In spite of this, the patient's general condition remained excellent. There was no evidence of cardiac decompensation and the rhythm of the heart was regular. On the third day although the pulse rate had fallen to 120, the patient became drowsy and at times appeared slightly confused. The icterus index at this time was 30 and the value for blood urea was 36 mg. per hundred cubic centimeters. Glucose was administered intravenously and a diet high in carbohydrates was given. Complete recovery soon occurred. The icterus index again fell to normal.

Case 3: The patient, a woman 63 years of age, had had a nodular goiter with hyperthyroidism for three and one-half years. She had lost 34 pounds in weight. The pulse rate was 118 beats per minute at entry, the basal metabolic rate was plus 26 per cent, the value for hemoglobin was 84 per cent, and the value for blood sugar was 98 mg. per hundred cubic centimeters, four and one-half hours

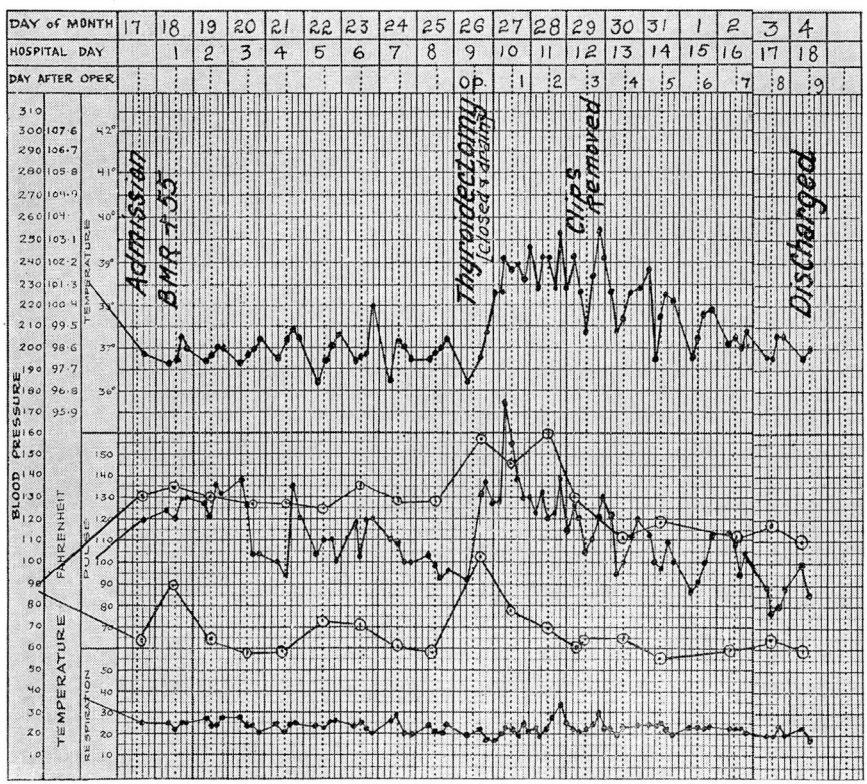

FIGURE 1: Temperature chart showing onset of confusion in relation to height of thyroid reaction.

P. c. Auricular fibrillation was present but there was no evidence of cardiac decompensation.

Thyroidectomy was performed and 36 hours after operation the pulse rose to 160 but by the third day it had fallen again to 95 beats per minute. At no time was there any evidence of cardiac decompensation. On the third and fourth days the patient was confused. The icterus index at this time was 15 and the value for urea was 30 mg. per hundred cubic centimeters of blood. The icterus index remained elevated until the sixth day postoperatively at which time it was still 15. After the administration of intravenous glucose and the forcing of high carbohydrate feedings, the mental symptoms cleared rapidly. At no time was the liver enlarged or tender.

Case 4: The patient was a woman 60 years of age who had had a nodular goiter with hyperthyroidism for two and one-half years. Auricular fibrillation was present but there was no evidence of cardiac decompensation. She had lost 25 pounds. The pulse rate at entry was 96 beats per minute, the basal metabolic rate was plus 32 per cent. The value for hemoglobin was 84 per cent and the fasting blood sugar level was 92 mg. per hundred cubic centimeters.

Hemithyroidectomy was performed on February 23, 1936, and the second lobe was removed one month later, March 24. The patient's condition was excellent for the first three days, but on the second day after the second operation she became somewhat confused. The icterus index on the third day postoperatively was 50 and the value for blood urea 45 mg. per hundred cubic centimeters. On the fourth day postoperatively the icterus index had fallen to 25. Glucose was administered intravenously, a high carbohydrate diet was given, and the mental symptoms cleared rapidly. During the height of the reaction there was slight epigastric distress and tenderness but the liver edge was not palpable.

Case 5: This patient showed no objective evidence of liver failure but it is probable that this was the fundamental cause of the reaction. She was 57 years of age and had had a nodular goiter with active hyperthyroidism for ten years. At entry the pulse rate was 120 beats per minute and the basal metabolic rate was plus 68 per cent. Twenty pounds of weight had been lost, the value for hemoglobin was 68 per cent, and the fasting blood sugar level was 107 mg. per hundred cubic centimeters. The patient was confused and delirious. She remained in the hospital for a month during which time she was given high carbohydrate feedings, Lugol's solution, and digitalis. The confusion gradually cleared.

Trial ligations of the superior thyroid arteries were performed and this procedure was followed by a minimal reaction. A subtotal thyroidectomy was then performed. Two days later, the blood urea was 24 mg. per hundred cubic centimeters and the icterus index was 5. Glucose in 10 per cent solution was started immediately after operation by the continuous intravenous drip method but was discontinued on the second day postoperatively. On the third day the patient became confused and remained so throughout the third and fourth days. The icterus index on the third day was 10 and the value for blood urea was 24 mg. per hundred cubic centimeters. The liver was not enlarged. Glucose was given intravenously, high carbohydrate feedings were forced after the fourth day postoperatively, and the patient's mental symptoms cleared rapidly. The appearance of the mental symptoms after the withdrawal of the glucose and their disappearance after resumption of glucose, coupled with the slight elevation

of the icterus index, suggest that liver failure was the cause of the symptoms (Table 1).

TABLE I

FOUR CASES OF LIVER FAILURE

Sex	F	F	F	M	Average
Age	61	60	63	27	53
Duration in months	8	30	36	12	21½
Weight loss in pounds	26	25	34	24	27¼
Hemogoblin per cent	61	84	84	78	77
Pulse rate	160	96	118	120	124
Basal metabolic rate	+71	+32	+26	+55	+46
Cardiac decompensation	+ at entry 0 postoper.	0	0	0	0
Confusion—day of onset	3rd	2nd	3rd	3rd (drowsy)	3rd
Jaundice—day of onset	5th	3rd	5th Not Clinical	3rd	4th
Icterus index (highest)	75	50	15	30	42
Blood urea (lowest)	21	45	30	36	33
Blood sugar	88 Fasting	92 Fasting	98 (4½ hrs. P.c.)	180 (1 hr. P.c.)	

COMMENT

In the first four cases of this group, in all of which there was objective evidence of liver failure, the average age of the patients was 53 years. The average duration of the hyperthyroidism was twenty-one and one-half months. The average loss of weight was twenty-seven and one-fourth pounds. The basal metabolic rates averaged plus 46 per cent. In no case was there any evidence of cardiac decompensation. The onset of the confusion or delirium occurred on the third day, usually at a time when the postoperative febrile reaction was subsiding. Jaundice was detected on the fourth day. The highest icterus indices averaged 42. The values for blood urea averaged 33 mg. per hundred cubic centimeters.

In several of the earlier cases it was observed that the value for blood urea was relatively low during the period when the icterus index was high and it was thought that this might be the result of failure of the liver to convert the amino acids to urea. At the same time it was appreciated that a relatively low value for urea could be expected as a result of the large quantities of fluid and carbohydrates which the patients were receiving. In order to determine which factor was responsible for the

low urea levels that had been observed, the blood amino acids were determined in a series of control cases and in two cases in which there was clinical evidence of hepatic failure. In neither of these cases was the amino acid level found to be higher than normal, an observation which Coller[3] has also made. In only one case of liver failure was a blood sugar estimation made before operation 1 hour P. c. but in this instance the value was 180 mg. per hundred cubic centimeters of blood. Patients with severe hyperthyroidism frequently have characteristic alterations of the glucose tolerance curves. In these curves, the blood sugar reaches its peak in the first and second hour, often rising to over 200 mg., but by the fourth hour it has usually returned to normal. This reaction may well be the result of the inability of the liver to convert glucose into glycogen, thus resulting in the appearance of sugar in the urine immediately after the glucose is given. The utilization of carbohydrate is, however, unimpaired and the curve falls rapidly to normal. Therefore, the glucose tolerance test may represent a sensitive test of the type of liver damage that is associated with hyperthyroidism.

Delirium Associated with a Thyroid Crisis

The thyroid storm usually reaches its maximum severity on the second night after operation. At this time the temperature and pulse rate are elevated, the patient is stimulated, restless, and in severe cases may be in such an active state of delirium that restraint is required. When the patient has had adequate preoperative preparation with iodine and bed rest, when glucose is administered intravenously by the continuous drip method, when morphia is given in doses sufficient to keep the patient at rest, and when the oxygen tent is used to control the hyperthermia, such a reaction is rare.

Case 6: The first patient in this group was a woman 50 years of age. Her basal metabolic rate was plus 55 per cent, the pulse rate was 140 beats per minute. She had an extremely active hyperthyroidism and a large diffuse goiter.

Forty-eight hours after a hemithyroidectomy, the pulse rate had risen to 160 and the temperature to 103°F. The patient appeared stimulated, was delirious, and had to be restrained. Adequate doses of morphia were given, she was placed in an oxygen tent, and glucose was administered intravenously. The temperature and pulse rate came down rapidly in response to this therapy and within twelve hours she was clear mentally.

Comment: This is the type of reaction which can usually be avoided if careful preoperative management is followed out and if immediately after operation the patient is given adequate sedation, glucose in 10 per cent solution by the continuous intravenous drip method, and oxygen therapy. In this case it would have been preferable to have avoided the reaction by instituting the above measures immediately

after the operation instead of waiting for indications of a thyroid crisis to occur.

Case 7: The patient was a woman 51 years of age who was suffering from severe recurrent hyperthyroidism. She also had diabetes mellitus. The pulse rate was 120 beats per minute and the basal metabolic rate was plus 71 per cent. The preoperative response of the pulse rate was satisfactory but, because of the severity of the hyperthyroidism, the age of the patient, and the presence of diabetes, it was decided to perform only a left lobectomy. The patient was a foreigner, did not understand English and was both frightened and uncoöperative. From the time she entered the hospital she insisted that she would die after the operation. Immediately after the operation a definite stridor developed in spite of the fact that only a left lobectomy had been performed and that the preoperative examination of the vocal cords showed both to be functioning normally. The blood calcium and phosphorus levels were within normal limits. A bilateral abductor paralysis of the vocal cords was found to be present. The explanation of this is not clear but the technical difficulties involved in removing the recurrent hyperplastic gland which was wrapped well around behind the trachea could conceivably result in injury of the nerve of the other side had it been displaced by the scar of the previous operation. The patient showed definite signs of anoxemia and at times was slightly cyanotic. She was kept in an oxygen tent, was given glucose intravenously by the continuous drip method, and large doses of morphia. The morphia, however, appeared to excite her and she became wildly delirious. On the second night after operation, the temperature rose to 103.6°F. and the pulse rate to 190. The evidences of anoxemia became more pronounced and an emergency tracheotomy became necessary. Following this procedure, she was quieted with 20 cc. of paraldehyde which was given by rectum. A blood transfusion was administered and the patient was kept in the Trendelenberg position to afford better drainage of mucus through the tracheotomy tube. The temperature and pulse rate rapidly responded to this treatment and the patient became rational again. Pneumonia, however, developed, and on the sixth day postoperatively she expired.

Comment: In this case the combination of poor morale, lack of coöperation, and anoxemia exaggerated by the patient's restlessness was sufficient to precipitate a thyroid crisis. The attendant delirium as well as the temperature and pulse reactions subsided rapidly after the correction of the anoxemia and the administration of adequate sedation, intravenous glucose, and oxygen therapy. It is important to remember in this connection that anoxemia secondary to insufficient respiratory exchange will precipitate a thyroid crisis with great rapidity but that a tracheotomy definitely increases the susceptibility to pneumonia. It is therefore a fine point of clinical judgment to determine whether tracheotomy, with its attendant liability to pneumonia, is justified in order to control the exacerbation of a thyroid crisis resulting from an insufficient respiratory exchange.

Delirium or Confusion Associated with Renal Insufficiency

Apathy, confusion, or delirium may be early signs of an impending renal insufficiency. In two cases in this series, in spite of the fact that

the fluid intake and urinary output were adequate and the specific gravity of the urine was relatively high, mental confusion was the first indication of an elevation of the blood urea.

Case 8: The patient was a man 81 years of age who had a nodular goiter with a definite low-grade hyperthyroidism. The pulse rate was 90 beats per minute and the basal metabolic rate was plus 11 per cent. He had lost 25 pounds in weight and all the classical signs of hyperthyroidism were present. Examination of the urine showed no abnormalities with the exception of a faint trace of albumin. A test of the urea clearance at entry showed normal kidney function, the urea level being 36 mg. per hundred cubic centimeters and the clearance 102 per cent in the first hour and 76 per cent in the second hour.

Following thyroidectomy, the temperature and pulse reactions were minimal, the temperature rising only to 100.4°F. and the pulse rate to 110 beats per minute. The output of urine varied from 1,050 to 1,980 cc. per day, averaging 1,500 cc. and the specific gravity varied from 1.020 to 1.022. On the fourth day postoperatively, the patient became confused and on the fifth day the value for blood urea was found to be 87 mg. per hundred cubic centimeters. Glucose was given intravenously, fluids were forced, the urea level gradually came down, and the mental symptoms cleared.

Comment: This case is interesting because it illustrates the point that uremia not infrequently develops following surgical operations in elderly patients, in spite of the fact that laboratory tests show their kidney function to be apparently normal. In this case the elevation of the blood urea occurred in spite of an adequate fluid intake and an output of over 1,500 cc. per day of urine of a normal specific gravity. We can do no more than speculate as to whether this type of reaction is the result of actual renal insufficiency or whether it is due to a relative insufficiency resulting from an increased breakdown of body proteins in these elderly patients after the trauma of operation. The fact remains that we have not infrequently seen such elevations of urea in elderly patients in whom preoperative tests have shown normal kidney function.

Case 9: The patient was a woman 75 years of age who had active hyperthyroidism with a pulse rate of 100 beats per minute and a basal metabolic rate of plus 36 per cent. The value for blood urea at entry was 51 mg. per hundred cubic centimeters and the urea clearance was definitely diminished—49 per cent in the first hour and 38 per cent in the second hour. On the second postoperative day the patient became confused and began to vomit. The urea rose to 75 mg. The daily output of urine averaged 2,000 cc. and the specific gravity was between 1.022 and 1.060. She improved strikingly with the administration of glucose intravenously and the mental symptoms rapidly cleared.

Mental Confusion Resulting from Sensitivity to Medication

It is often difficult to determine whether or not delirium and confusion are the result of an organic pathological process or are caused by intolerance to medication. In the following two cases the rapid improve-

ment of the mental symptoms after the withdrawal of drugs suggests that intolerance to these drugs may have been a factor.

Case 10: The patient was a woman 48 years of age who had had an adenomatous goiter with hyperthyroidism of long standing. She had been mentally clear until two days after entry in another hospital where heavy sedation, probably with barbiturates and bromides, was given. The patient became progressively more irrational and after about ten days in which she appeared to be constantly losing ground, she was transferred to the Cleveland Clinic Hospital. The pulse rate and temperature did not indicate that she was suffering from an acute hyperthyroidism and it was felt that the delirium must have some other cause. In view of the history of heavy sedation with barbiturates and bromides, these drugs were eliminated, and paraldehyde by rectum was used as a sedative. Ten per cent glucose in normal saline solution was administered intravenously, and the patient was placed on a high carbohydrate, high vitamin diet. On this regimen her condition improved rapidly, the delirium subsided within two days, and somewhat later thyroidectomy was performed successfully with a minimum postoperative reaction.

Comment: The rapid disappearance of the mental symptoms after the discontinuance of heavy sedation makes it highly probable that the delirium was the result of excessive sedation. Bromides, as a rule, are safe and effective sedatives for use in hyperthyroidism but cumulative effects may occur. The barbiturates must be used cautiously because they not infrequently produce marked confusion and occasionally even maniacal behavior in elderly patients with hyperthyroidism. When there is any tendency to mental confusion, morphine or paraldehyde usually affords safer and better sedation than the barbiturates.

Case 11: This patient was a woman 64 years of age whose pulse rate at entry was 120 beats per minute. The basal metabolic rate was plus 30 per cent. Auricular fibrillation was present. It had been impossible to determine definitely whether or not the patient had had digitalis before her entry and in view of the auricular fibrillation she was given the full dosage of digitalis. On the fifth day postoperatively when the immediate postoperative reaction had subsided, she began to vomit, became dehydrated, and was confused. The value for urea was 30 mg. per hundred cubic centimeters of blood, the icterus index was 5, and the leukocytes numbered 11,000. The digitalis was discontinued, an adequate fluid intake was restored, and within 24 hours the patient's mental symptoms had completely disappeared.

Comment: It is unusual for digitalis to produce mental symptoms but this does occur occasionally and it is possible that the digitalis together with the dehydration precipitated the state of confusion.

Miscellaneous

Under miscellaneous we must classify those cases in which the patients became confused following thyroidectomy, in spite of the fact that there was no objective evidence of liver failure, uremia, or drug intolerance. In these cases the reaction appears to be one of metabolic exhaustion

and is quite different from the stimulated delirium associated with a true thyroid crisis.

Case 12: The patient was a man 43 years of age who had severe hyperthyroidism with a pulse rate at entry of 120 beats per minute and a basal metabolic rate of plus 96 per cent. His response to bed rest and iodine was not satisfactory, the metabolic rate falling only to plus 68 and the pulse rate to 110. Ligations of the superior thyroid arteries were performed two days apart. No change in the pulse rate and no elevation of temperature followed these procedures, but the patient, whose weight had been constant on an intake of 5,000 calories, stopped eating and the caloric intake fell to between 1,000 and 2,000 daily. The fluid intake and output were normal. On the third day after the second ligation, although still practically afebrile, he became delirious; the pulse rate gradually rose to 140 beats per minute and his condition became critical. The intravenous administration of glucose was started by the continuous drip method, and morphia, in doses of one-half grain, was given to afford sedation. A nasal tube was inserted and 4,000 calories in the form of carbohydrates were given each day in 2,000 cc. of fluid. At the same time 5,000 cc. of 10 per cent glucose solution, (2,000 calories of carbohydrates) were given by the continuous intravenous drip method. Within two days the mental symptoms cleared and after the application of a radium pack to the thyroid he was sent home. The icterus index at the height of the reaction was 10 and the blood urea 39 mg. per hundred cubic centimeters.

Comment: In this type of case the excessive metabolism necessitates an enormous caloric intake. If this is diminished for any reason, the patient immediately uses up all reserves of liver glycogen and must of necessity oxidize his own tissues. It is impossible to state that this catabolic reaction is responsible for the mental symptoms but it is interesting to note how rapidly the symptoms clear up when an adequate caloric intake is reëstablished.

Case 13: The patient was a woman 66 years of age whose basal metabolic rate was plus 32 per cent. The pulse rate at entry was 104 beats per minute. During the preoperative stay in the hospital, an acute infection of the upper respiratory tract developed but this subsided completely before the operation was performed. On the second night postoperatively, the temperature rose to 102.2°F. The patient appeared exhausted and was almost pulseless. Auricular fibrillation was present. She was mentally confused and muttered constantly in an irrational manner. She was troubled with mucus but was too weak to raise it. She was placed in an oxygen tent, the foot of the bed was elevated, carbon dioxide inhalations were given, coramine was administered subcutaneously, and in a high Trendelenberg position she was able to raise the mucus. The cyanosis rapidly cleared. Three per cent glucose solution was given subcutaneously. The icterus index at this time was 5 and the value for the blood urea was 24 mg. per hundred cubic centimeters.

Comment: Although there was no definite evidence of liver failure in this case, it is quite possible that the reaction was secondary to hepatic insufficiency. The mental symptoms disappeared when the fluid and

carbohydrate intake was increased. We must, nevertheless, classify this as an undetermined type of metabolic exhaustion complicated by cerebral arteriosclerosis.

Summary

1. Thirteen cases of delirium or confusion occurring postoperatively in the course of 200 consecutive thyroidectomies for hyperthyroidism are reported and analyzed as to the causes of this reaction.

2. Liver failure was the most common cause, being responsible for four and possibly more of the cases in this series. Renal failure, drug poisoning, and thyroid crisis each accounted for two cases, and two cases were the result of an unclassifiable type of metabolic exhaustion.

3. Liver failure usually becomes apparent on the third day at about the time that the postoperative temperature and pulse reactions are subsiding. Mental confusion is usually the first sign and this is frequently accompanied by jaundice.

4. In order to avoid liver failure, it is essential to supply an adequate intake of carbohydrate. This can best be accomplished by administering glucose continuously by the intravenous drip method.

5. In elderly patients, even when renal function tests indicate no abnormality of the kidneys, there occasionally is a postoperative elevation of the blood urea to uremic levels.

6. The barbiturates or prolonged use of bromides may produce marked mental symptoms in patients with hyperthyroidism.

7. When a patient with severe hyperthyroidism fails to maintain a high caloric intake, the diminished glycogen reserve of the liver is rapidly depleted and the body proteins are oxidized. Once this cycle of catabolic processes is initiated, confusion or delirium may result, and unless the caloric intake is restored the outcome may be fatal. High carbohydrate, high calorie feedings given through a nasal tube are efficacious in restoring the nutritional balance.

8. Thyroid crisis is not as common a cause of postoperative delirium as it was in earlier years and can be more easily avoided than treated.

9. Two fatalities occurred in this series of 13 cases of mental confusion or delirium after operation for hyperthyroidism. Pneumonia was the immediate cause of death in both instances.

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