

was 2.1, 2.1, 2.3, 3 ml./min. When these tests were repeated after three weeks' treatment the average water excretion was 3, 3.5, 4.5, and 6 ml./min respectively. There was an increase in 17-ketosteroid excretion in all cases. Before treatment the output ranged from 2.8 to 4.7 ml. a day; after treatment it was from 5.5 to 11 mg. a day.

No significant changes were observed in the levels of serum sodium, potassium, or chlorides, and these levels were usually within normal limits both before and during treatment. Insulin sensitivity tests revealed a hypoglycaemic unresponsiveness in all cases, and this was unaltered by treatment.

No change was produced in the blood picture; in no patient was the anaemia of severe degree. The effect of administration of cortisone over a prolonged period might be worth observing, particularly as it is known that the anaemia of myxoedema responds very slowly to the administration of thyroid extract.

### Summary

The effect of cortisone treatment in five cases of myxoedema has been observed. No change was produced in the physical or biochemical state of these patients. A marked quickening of mental processes was, however, noticed. There does not appear to be any good reason for using cortisone as an adjuvant to thyroid extract in most cases of hypothyroidism. The quickening of mental activity produced in these patients by cortisone might make this drug helpful in those cases of myxoedema in which drowsiness is marked and in which the development of coma is a possibility.

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## PERCEPTIVE DEAFNESS IN HYPOTHYROIDISM

BY

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Deafness is a recognized symptom of hypothyroidism, and Means (1948, quoting Lerman) states that it occurs in 30% of cases, and that it may be a conductive, perceptive, or mixed type of deafness. Vertigo in addition to deafness has also been reported in hypothyroidism (Moehlig, 1927; McLaurin, 1945; Athens, 1946). We have been able to find few published records of investigation into the hearing of hypothyroid patients, and standard textbooks, beyond noting the occurrence of deafness in some of these patients, rarely mention that it may be perceptive in type. The usual aetiological factors quoted are: hypertrophy and oedema of the mucosa of the nose and eustachian tubes causing eustachian obstruction, hypertrophy of the mucosal lining of the middle ear, and thickening of the tympanic membrane. General cerebral retardation is also thought to be of importance (McMahon, 1947; Means, 1948; and others).

Apart from this last factor, all the others would give rise to some degree of conductive deafness. This type of deafness was found in 45 patients treated by Barnes (1947). However, in less than half these patients was there definite evidence of hypothyroidism, and no details of the hearing tests are given. In those patients whose hearing improved, eustachian catheterization, and often repeated catheterization, as well as thyroid medication, was used.

Perceptive deafness in hypothyroidism has received less attention, although in cretins deafmutism is common and it is certain that a purely conductive deafness would never be sufficient to give rise to deafmutism. Gray (1910) examined the temporal bones from four deaf-mutes, and in each there was marked degeneration of the cochlear branch of the auditory nerve. The outer and middle ears appeared normal and the vestibular branch of the auditory nerve and the facial nerve were normal. The appearances of the labyrinth suggested increased intralabyrinthine pressure. In hypothyroidism it is known that chromatolysis of nerve cells does occur (Brun and Mott, 1913).

In adults the only report that we can find of investigations in a patient with hypothyroidism and perceptive

### Summary of Cases

Case No.	Sex and Age	Duration of Symptoms	B.M.R. (Robertson Reid)	Rinne Test	Pure-tone Audiogram	Improvement in Hearing (Assessed from Audiogram after Treatment)
1	F 64	1 year	-30%	+	Very severe perceptive deafness	Marked
2	F 54	6 months	-28%	+	Moderate perceptive deafness	Nil
3	F 75	2 years	-23%	+	Severe perceptive deafness	..
4	F 52	1 year	-33%	+	Moderate perceptive deafness	Slight
5	F 31	2½ years	-23%	+	Slight perceptive deafness	..
6	F 56	3 ..	-33%	-	Severe mixed deafness	Marked
7	F 58	75 ..	-24%	-	Very severe mixed deafness	Nil

Deafness is assessed as:

Slight = 0-20 db. loss

Moderate = 20-40 .. ..

Severe = 40-60 .. ..

Very severe = over 60 db. loss

(Average of frequencies 512, 1024, and 2048 c.p.s.)

Hearing improvement is assessed as:

Nil = 0-5 db. improvement

Slight = 5-10 .. ..

Fair = 10-20 .. ..

Marked = over 20 .. ..

(Average of frequencies 512, 1024, and 2048 c.p.s.)

deafness is by Rau (1947). This patient was a man aged 38 whose chief complaint was deafness; it was perceptive in type, and his hearing returned "practically to normal" after thyroid medication.

In this paper we wish to record five cases of perceptive deafness and two of mixed conductive and perceptive deafness. All seven patients were women with symptoms of hypothyroidism, and were seen at the Middlesex Hospital recently. The Table shows the features especially studied in these patients.

### Case Histories

*Case 1.*—Referred to E.N.T. department complaining of hoarse voice, dysphagia, deafness, and lack of energy. A hearing-aid was issued, but she was found to be hypothyroid. Because of the known sensitivity of hypothyroid patients to thyroid, treatment was started with a small dose

of tab. thyroid. (B.P.)  $\frac{1}{2}$  gr. (32 mg.) b.d. This was increased at weekly intervals to  $\frac{1}{2}$  gr. (32 mg.) t.d.s.; to 1 gr. (65 mg.) b.d.; and to a maintenance dose of 1 gr. (65 mg.) t.d.s. Clinical improvement was slight at the end of the first week of treatment, considerable at the end of the second week, and maximal after the first month, at which time she dispensed with her hearing-aid.

*Case 2.*—Referred to medical out-patient department complaining of puffiness of the eyes and face, of feeling cold and depressed, and of constipation. She had noticed that she was getting deaf, and she also complained of hoarseness. Treatment was started with sodium triiodo-L-thyronine,\* 0.02 mg. t.d.s. This seemed to increase her depression, and thyroid, 1 gr. (65 mg.) b.d., was substituted one week later. This was found to be an adequate maintenance dose, and on this treatment all her symptoms improved, including slight subjective improvement in her hearing. Audiograms, however, showed no change.

*Case 3.*—Referred to medical out-patient department with indefinite complaints. She had "pains everywhere," felt the cold, and was very lethargic. She had noticed hoarseness and deafness. Thyroid,  $\frac{1}{2}$  gr. (32 mg.) a day was started, being increased four days later to  $\frac{1}{2}$  gr. (32 mg.) t.d.s. On this dosage she experienced angina of effort, and the dosage had ultimately to be reduced to  $\frac{1}{2}$  gr. (32 mg.) daily.

*Case 4.*—Referred to medical out-patient department with indefinite complaints, including weakness of the arms and legs, sensitivity to cold, and deafness. Thyroid was started at  $\frac{1}{2}$  gr. (32 mg.) a day, and three days later was increased to  $\frac{1}{2}$  gr. (32 mg.) b.d. Clinical improvement after three weeks was definite. The maintenance dose for this patient was  $\frac{1}{2}$  gr. (32 mg.) t.d.s.

*Case 5.*—Referred to medical out-patient department complaining of menstrual irregularity, pallor, backache, and weakness. She had not noticed her deafness. Thyroid,  $\frac{1}{2}$  gr. (32 mg.) b.d., for three weeks produced clinical improvement. Between 2 and 3 gr. (0.13 and 0.2 g.) of thyroid daily was found to be necessary for maintenance.

*Case 6.*—Referred to medical out-patient department complaining of progressive weakness of her legs, sensitivity to cold, and deafness. She had fragilitas ossium with blue sclerotics. Thyroid, 1 gr. (65 mg.) daily, produced gradual clinical improvement over three weeks, when she stated that her hearing had returned to normal. (Maintenance dose  $1\frac{1}{2}$  gr. (0.1 g.) daily.) This patient inadvertently discontinued her thyroid medication for a month. After two weeks she noticed the return of her deafness and sensitivity to cold. The hearing improved again on treatment with thyroid,  $1\frac{1}{2}$  gr. (0.1 g.) daily.

*Case 7.*—Referred to medical out-patient department with symptoms due to gallstones and mild hypothyroidism. Severe deafness, progressive during the last five years, was also present. Thyroid medication,  $\frac{1}{4}$  gr. (16 mg.) b.d. for a month,  $\frac{1}{2}$  gr. (32 mg.) b.d. for a month, and 1 gr. (65 mg.) b.d. maintenance dose, though lessening her symptoms of sensitivity to cold and lack of energy, produced no improvement in her hearing.

#### Perceptive Deafness

Perceptive deafness was diagnosed in five of these patients by the presence of a positive Rinne test in conjunction with a pure-tone audiogram showing reduced hearing by both bone and air conduction. In each of these patients the deafness was approximately equal in the two ears and was severe for high tones. Four of these patients were tested on the speech audiometer. In each case the deafness for speech was approximately the same as the deafness for pure tones, and all four patients were able to repeat correctly, with adequate amplification, over 90% of the syllables.

\*Sodium triiodo-L-thyronine, supplied by the kindness of Messrs. Glaxo, is three to seven times more active than L-thyroxine. Therefore 0.02 mg. is approximately equal to 1 gr. (65 mg.) of thyroid.

It was considered that pure-tone audiometry conducted reasonably slowly in a sound-proof room was a simple test for these patients to perform, and that the results would not be affected by the cerebral retardation that all these patients showed in some degree.

Speech audiometry represents a rather more complex test for such patients, and if cerebral retardation was a factor in their deafness they would show a greater hearing loss for speech than for pure tones. Such a difference was not found in any of these patients.

As the deafness was bilateral and equal in each case recruitment tests were not done.

Of these five patients, three had definite improvement in their hearing following thyroid medication. Two showed no improvement in hearing. One of these (Case 3), aged 75, could not tolerate more than  $\frac{1}{2}$  gr. (32 mg.) of thyroid daily. It is not possible to decide whether her deafness was caused by hypothyroidism or whether it was in part or wholly senile deafness. In the other patient (Case 2) no other cause for her deafness could be found, and the audiograms after treatment do show slight improvement in the low frequencies in one ear (128 and 256 c.p.s.).

#### Mixed Deafness

Mixed deafness was diagnosed in two patients. Both had negative Rinne tests in conjunction with pure-tone audiograms showing reduced hearing, and the hearing loss was greater by air conduction than by bone conduction. In each case one ear was more deaf than the other. In both patients the tympanic membranes appeared normal and the eustachian tubes were patent. In both some deafness had been noticed before the symptoms of hypothyroidism.

One patient (Case 7) noticed no alteration in her hearing with thyroid medication (and her Rinne tests and audiograms showed no change). It is probable that her very severe deafness was not related to the hypothyroidism. The other patient (Case 6) improved markedly with thyroid medication. The Rinne test remained negative on one side and was equivocal on the other side. The pure-tone audiogram, however, showed an equal degree of improvement in each ear, and it was striking that the bone conduction had improved to the same degree as the air conduction. It therefore appeared that the conductive element was unchanged but the perceptive element had greatly improved. The conductive element in her deafness was probably due to otosclerosis, commonly found in fragilitas ossium (Duel, 1929).

*Vertigo.*—None of these patients complained of vertigo. Caloric tests were performed on two patients, and these showed no abnormality.

#### Conclusion

Experience from this investigation would suggest that deafness in hypothyroidism is common and is perceptive in type and that striking improvement may follow thyroid medication. It is possible that a conductive type of deafness cannot be ascribed to hypothyroidism alone.

All our patients have been middle-aged women, and, though hypothyroidism may give rise to manifold clinical features, in this series we found that sensitivity to cold, tiredness, puffiness of the eyelids, sallowness of the skin, and falling hair were to a greater or lesser extent common to all patients. The basal metabolic rate is the most useful special investigation.

It is of particular importance that the presence of hypothyroidism should not be overlooked when perceptive deafness is discovered, as the response to treatment may be considerable, unlike that found in most other forms of perceptive deafness.

#### Summary

Seven cases of deafness associated with hypothyroidism have been investigated.

The deafness was perceptive in type.

Improvement in hearing with thyroid medication occurred in four cases; in two of them it was striking.

We wish to thank Mr. C. P. Wilson and Professor Kekwick for allowing us to study patients under their care; also to thank Professor Kekwick and Mr. D. Ranger for their advice and encouragement, and Miss Harris and Miss Evans for numerous audiometric studies.

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## DIABETIC PNEUMATURIA

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Pneumaturia is an uncommon symptom. If instrumental introduction of air can be excluded it is usually taken to indicate the presence of a fistula between the bladder and intestine or vagina. The possibility of pneumaturia as the result of infection alone must be considered, especially in diabetic patients. We have been able to trace reports of only two cases of diabetic pneumaturia in the British literature (Ralfe, 1887; Eve, 1909) and Spring and Hymes (1952) listed a total of 21.

### Case 1

An obese woman aged 67 was admitted to hospital as an emergency in September, 1954. She had had diabetes for twenty years, inadequately controlled by diet and 10 units of protamine-zinc insulin each morning. For two years before admission she had been getting attacks of colicky abdominal pain, most severe in the left iliac fossa, associated with constipation. The pain was relieved when the bowels moved. She was admitted on account of a severe attack of pain associated with fever and vomiting. On being questioned she said she had had frequency of micturition, with burning, intermittently for twelve months. She also volunteered the information that for the previous ten months she had at times passed gas per urethram with her urine. Her only complaint about this symptom was of the noise that it made.

On examination she was febrile and obese. Some tenderness was felt on the left side of the abdomen, and the rectum was loaded with faeces. Evidence of peripheral neuritis was present; ankle

reflexes were absent, and there was loss of vibration and position sense in the legs and impairment of tactile sensation. The urine was cloudy and acid in reaction. It contained 1% sugar and a trace of ketone bodies and of protein; on microscopy there were numerous pus cells and occasional red cells. Culture grew *E. coli* sensitive to sulphonamides. Treatment included an enema, which relieved her pain, insulin, and a low-calorie low-carbohydrate diet. Sulphadimidine was given for the urinary infection. An intravenous pyelogram showed a gas shadow in the pelvis, and its outline and the fact that it decreased after micturition suggested that the gas was in the bladder (Fig. 1). This was confirmed by catheterization with the outlet of the catheter under water. The gas coming from the bladder was odourless.

Cystoscopy showed that the bladder mucosa lacked lustre and that there was an oedematous area above the left ureteric orifice, with surrounding hyperaemia and a central pit. However, gas bubbles did not appear even on pressure over the colon, and, although the symptoms and the site of hyperaemia were suspicious of a vesico-colic fistula, none could be demonstrated. Barium enema and sigmoidoscopy failed to reveal any abnormality, but, in view of the patient's complaint of attacks of abdominal pain and the cystoscopy findings, it was decided to perform an exploratory laparotomy. This was done, and no abnormality was found. Recovery from the operation was rapid and the patient left hospital. Subsequently both the urinary infection and pneumaturia recurred, and it has been found necessary to give small daily doses of sulphonamide to maintain a sterile urine and ensure the absence of symptoms.

### Case 2

An obese man of 63 was seen in February, 1949, complaining of difficult micturition and attacks of cystitis following litholapaxy eight years earlier, when the urethra had evidently been injured, with a resulting stricture. He was known to have glycosuria, which was controlled by diet. He occasionally noticed a hissing on micturition, with frothy urine.

On examination there was a ventral hernia through the scar of a cystotomy which had been required for clot retention after the litholapaxy. The external urinary meatus had been enlarged and the stream on micturition was double, with moderate projection. The prostate was not enlarged, and the urine contained albumin but no sugar.

On admission to hospital the blood urea was 48 mg. per 100 ml. and the urine gave a culture of *E. coli* sensitive to streptomycin; from time to time it contained a little sugar, amounting to 0.1%. He was found to have a stricture in the penile urethra and a blind false passage in the prostatic urethra; the bladder was trabeculated, but no fistula was seen.

Treatment consisted in urethral dilatation and a course of streptomycin; the stream improved and the urine was sterilized, but the infection recurred five weeks later, when he again noticed hissing on micturition. He attended for

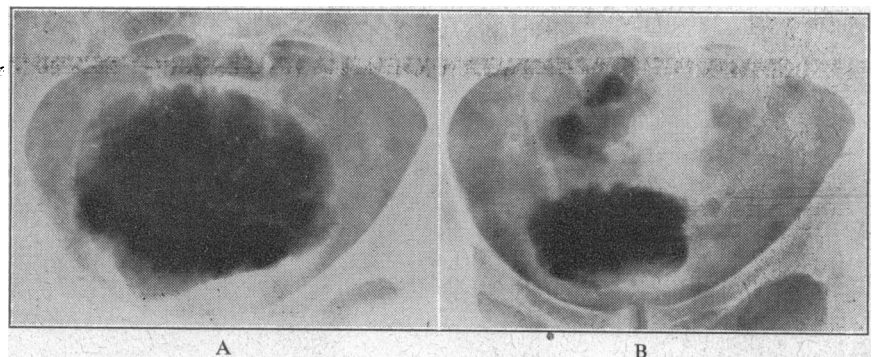


FIG. 1.—Case 1. Pelvis and bladder. (A) Before micturition. (B) After micturition.