

Nor is it helpful to qualify the extent of the growth with such terms as "scanty" or "moderate" (Fig. 2). On the other hand, the absence of growth on routine culture appears to be a reliable indication that the urine is not infected.

To decide whether a positive routine urine culture is due to contamination or infection it is a common practice for the urinary content of white cells to be used as a guide. The tendency of some laboratories to refuse to culture a urine unless it contains more than a "normal" number of white cells is an admission of this fact. Moreover, a positive urine culture is often ignored by the clinician if the number of white cells in the urine is not raised. But the results of routine methods for examining the white-cell content of the urine can be misleading; for instance, it has been shown that of 155 urines in which one to five white cells were seen per high-power field the white-cell excretion rate was raised in 42 (Little, 1962). In addition it has been shown above that even when the white-cell excretion rate is normal the urine may contain a large number of organisms, particularly in patients with chronic pyelonephritis or asymptomatic bacteriuria.

The patient's symptoms can be equally misleading in distinguishing between contamination and infection. Among the patients discussed above there were 29 with no urinary symptoms at the time when their urine contained more than 100,000 organisms per ml., and the presence of an asymptomatic bacteriuria in up to 8% of pregnant women is well recognized (Kass, 1959; Turner, 1961). Conversely, Boshell, MacLaren, and Metcalfe (1962) have described how 24 out of 99 pregnant women were treated with antibiotics for urinary-tract symptoms although only six had an infected urine.

### Summary

The number of organisms found on a quantitative urine culture has been compared with the report of a routine culture in 205 urines.

In many instances it was not possible to distinguish from the routine report whether the urine was infected or contaminated.

In some patients with chronic pyelonephritis or asymptomatic bacteriuria the urine may contain large numbers of organisms though the white-cell excretion rate is normal.

It is concluded that the only consistent way to distinguish between contamination and infection in the urine is to use some form of quantitative culture.

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## "HAIRBRUSH DIAGNOSIS" IN DETECTION AND ERADICATION OF NON-FLUORESCENT SCALP RINGWORM

BY

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*Trichophyton tonsurans* (var. *sulfureum*) in recent years has been the organism most frequently isolated from tinea capitis in Northern Ireland (Beare, 1958; Mackenzie and McArdle, 1960; Mackenzie, Corkin, and Bell, 1961). The infection is uncommon in adults, and as seen in dermatological clinics it is typically a disease of children. It is characterized by a comparatively low degree of infectivity, and clinical signs may range from the inapparent to the highly inflammatory. The former are chronic and may persist for many years (Pipkin, 1952).

In eradicating *T. tonsurans* from any community the presence of symptomless but infected individuals makes clinical detection exceedingly difficult. In addition there is no fluorescence of infected hairs under a Wood's lamp. For these reasons elimination of *T. tonsurans* from closed communities such as institutions has previously been regarded as virtually impossible.

From experience in Belfast (Mackenzie, Burrows, and Walby, 1960) it has been shown that clinical examination alone is inadequate for the detection of lesions that are trivial or virtually absent. Individuals with only a few discrete hairs infected can be regarded for practical purposes as carriers: although symptomless, they disseminate infection over a period of years, and can be responsible for a gradual build-up of infection potential. Thus in a

residential school for girls in Belfast 21 out of 128 children were shown to have become infected during a period of not less than four years (Mackenzie *et al.*, 1960).

When locating scalp lesions it was found that mycological sampling techniques were more practicable, more rapid, and more reliable than clinical examinations alone. By their means it was possible to detect all infected children in a school, and as a result total eradication of infection was eventually accomplished.

Of special significance in this earlier work was the fact that when the fungus was isolated on three or more successive occasions from any one child's belongings that child was invariably found to be infected. Using mycological techniques, seven children were shown to harbour infection after the fungus had been consistently isolated from their personal effects. In each case previous clinical examinations had failed to reveal its presence.

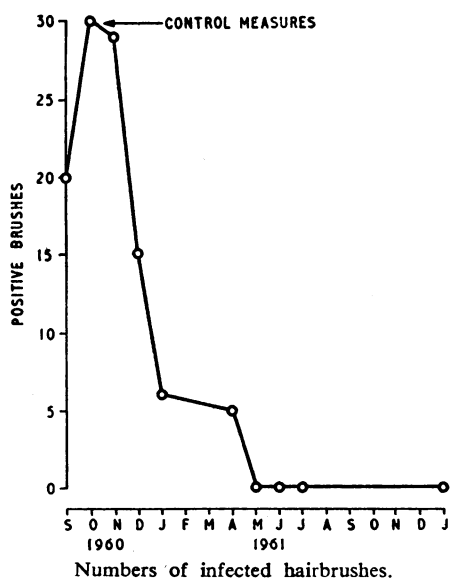
"Hairbrush diagnosis" was the term coined to denote the part played by mycological examination of hairbrushes in establishing diagnosis of non-fluorescent scalp ringworm. Other fomites which have been in contact with a child's scalp, such as hats, caps, combs, or pillow-slips, have also been examined on previous occasions, but in this study hairbrushes were used exclusively.

### Methods

The technique is simple; 10–12 ml. quantities of 2.5% malt agar incorporating penicillin, streptomycin, and cycloheximide ("actidione") were distributed in Petri dishes. Bristles of the hairbrushes were pressed several times into the medium, giving a multiple inoculation of the surface. After incubation at 26° C. for five to seven days, colonies of *T. tonsurans* appeared at the points of inoculation. The number of colonies gives a semi-quantitative estimate of the degree of infection, but greater significance was placed on obtaining a succession of positive plates.

In this study at a girls' residential school consisting of 120 children between the ages of 4 and 17, and situated at Londonderry—a distance of 75 miles (120 km.) from Belfast—"hairbrush diagnosis" was adopted, and its scope was increased by a logical extension of the technique, as follows: (1) No clinical examinations were made beyond an initial confirmation of the presence of infection in the institution, and all diagnoses were arrived at by isolation of the fungus with the technique described. (2) The course of treatment was followed by repeated examinations of hairbrushes belonging to the infected children. The criterion for cure was therefore not repeated failure to detect infection on the child, or the resolution of a lesion, but the repeated failure to isolate the fungus from an infected child's hairbrush.

Two visits were made to the school. On the first, all hairbrushes were examined mycologically and the existence of *T. tonsurans* was confirmed; 29 brushes were found to harbour the fungus. On the second visit children were



examined clinically, particular care being taken with the owners of heavily infected brushes. Three cases of infection were clinically diagnosed on this visit, but the lesions were most inconspicuous and might easily have been overlooked. In the previous attempt to eliminate *T. tonsurans* from a similar school, more than 700 clinical examinations, made over a period of one year, revealed lesions on only 14 out of 21 children ultimately found to be infected.

The following procedures were adopted in an attempt to eradicate infection from the school:

1. All hairbrushes and combs were wrapped individually in newspaper and sent regularly to Belfast, where they were

examined mycologically, then sterilized by immersion for 30 minutes in a proprietary phenolic disinfectant. After testing for sterility they were returned to the school. Owners of brushes harbouring the fungus were noted. At least one examination of all brushes was made each month. Acquisition by the school authorities of a duplicate set of hairbrushes facilitated the serial examinations by permitting retention of one set while the other was sent to the laboratory for investigation.

2. Any child from whose brush *T. tonsurans* was isolated on three or more occasions was given a three months' course of griseofulvin (250 mg. t.i.d.). Her hair was washed daily until her hairbrush was free from ringworm on three successive examinations.

3. School staff were requested to prevent indiscriminate use of hairbrushes and combs and to ensure, so far as possible, that each child used only her own article.

4. Wooden hairbrush compartments were washed with disinfectant after each dispatch of the brushes to Belfast.

The numbers of hairbrushes yielding the fungus during the trial are shown in the Chart.

### Results

Six months after control measures had been started only two children remained in whom infection was suspected on the basis of repeated isolations of the fungus from their hairbrushes. These children were segregated for eight days and infection was repeatedly demonstrated by daily sampling with fresh hairbrushes, despite twice-daily washes of the children's hair. In neither child were lesions seen on clinical examination. After a 10 weeks' course of griseofulvin no further isolates could be made from the brush of either child. Griseofulvin was eventually administered to 13 children. The criterion for total eradication of scalp ringworm from the school was failure to culture *T. tonsurans* from any hairbrush on three successive occasions. This was achieved 35 weeks after the control measures had been put into operation. Inability to isolate the fungus was thus considered to be an indication of its absence. A follow-up examination made after six months showed that no infection was present on the brushes.

### Discussion

In view of the proved sensitivity of the mycological techniques, the continued failure to isolate the pathogen from hairbrushes lends credence to the claim that infections had been detected, and the course of treatment followed, without the patients being seen; and, furthermore, that total eradication had been achieved.

It should be emphasized that mycological techniques are of greatest value in dealing with infections that are not immediately evident on clinical examination.

By analogy with Wood's lamp in the control of fluorescent scalp ringworm, diagnostic mycological procedures have the following applications: (1) *Preliminary screening*: Individuals and/or households, schools, institutions, etc., where infection is not suspected can be examined and the presence or absence of infection provisionally established. (2) *Detection of carriers*: The probability of an individual being infected increases with the number of successive isolations of the ringworm fungus from his/her belongings. (3) *Efficiency of control measures*: After the completion of control measures, sampling surveys could be used to determine the measure of eradication that had been obtained. If large quantities of infective material continued to be isolated from sites which were previously shown to be free from infection, active and undetected lesions would have to be considered.

In view of the epidemiological and clinical similarities between *T. tonsurans* and *T. violaceum*, it is suggested that methods of known efficacy in the detection and eradication of *T. tonsurans* could also be employed successfully in the control of *T. violaceum*.

The mycological techniques are simple in use and possess a considerable degree of objectivity. They were employed originally as an adjunct to clinical examinations, but their ease of application and their sensitivity are of positive value as an epidemiological tool.

#### Summary

Mycological techniques are used in locating scalp infections with *T. tonsurans* var. *sulfureum* among 120 children at a girls' residential school in Londonderry, Co. Londonderry. Clinical examinations were considered to be unreliable and were discarded in favour of the presumptive diagnosis afforded by repeated recovery of the

fungus from sterilized hairbrushes. Thirteen children were regarded as infected and treated with griseofulvin when the ringworm was isolated from their brushes on three or more occasions. Other control measures included disinfection of extra-human sites and prevention of communal usage of hairbrushes. Four successive failures to isolate the fungus from any brush over a period of nine months are considered to indicate its eradication by the methods adopted.

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## Medical Memoranda

### A Case of Methyl Chloride Poisoning

Methyl chloride is a colourless gas with a faint ethereal odour. It is used in the dye industry, in the preparation of chloroform, and as a refrigerant. Poisoning by the gas is characterized by progressive drowsiness, dizziness, mental confusion, stupor, nausea, pain in the abdomen, and vomiting. Diplopia, strabismus, and ptosis also occasionally occur. In severe cases epileptiform convulsions occur and may lead to death. Transient renal damage, manifested as albuminuria and casts, has also been reported (Hunter, 1957).

The following case is recorded because of its rarity.

#### CASE HISTORY

A young man of 23 was admitted to the Warrington General Hospital under the care of Dr. D. M. Freeman on March 8, 1962.

He was unable to give a coherent history, but his wife said that he had been well in the morning when he went out to work, that he had returned home at his usual time and complained that he was feeling very tired, drowsy, and dizzy, and that he had a severe generalized headache. He retired to bed and later became nauseated, vomited several times, became confused and restless, and was increasingly more difficult to rouse. There was no suggestion that he had taken any drugs. She further stated that his general health prior to this incident had been very good and there was no personal or family history of epilepsy.

He was a builder's labourer and had been engaged for the past few days in demolition work at a chemical plant.

On examination he lay curled up in bed on his side, covering his eyes with his arms. He was quiet unless disturbed, but he resisted movement. He could be roused, but was confused and could not give any coherent answers.

His pupils were moderately dilated but reacted to light, and there was no abnormality in the fundi. There was only slight neck rigidity and Kernig's sign was negative.

His blood-pressure was recorded as 55/? on admission, but within a few hours it was 110/80. Nothing abnormal was found in the cardiovascular and respiratory systems. His abdomen was soft, and nothing abnormal was palpable.

The possibility of encephalitis was considered and a lumbar puncture was done, sedation with 5 ml. of paraldehyde being given for the procedure. The fluid was colourless and clear;

protein was 40 mg. and sugar 57 mg./100 ml.; and one white cell and 80 red blood cells per c.mm. were present. The Wassermann reaction in the cerebrospinal fluid was negative and the Lange reaction was 0000000000. His haemoglobin was 105% and white-cell count 8,300/c.mm.; blood urea was 42 mg./100 ml. The urine was slightly turbid, pH 6.5. There was no albuminuria or glycosuria, and only an occasional red blood cell in the deposit.

The patient was treated symptomatically with cyclizine hydrochloride, and his nausea and vomiting decreased. His level of consciousness varied widely during the first 24 hours, but all the symptoms had cleared up within five days.

On the morning after admission inquiries were made at the place where he had been working, and it was found that for the previous three days he had been using a pneumatic drill to break up some very thick concrete at a chemical plant. The work happened to be near to a valve which had previously leaked and had been repaired, but subsequently was proved to be still faulty and leaking methyl chloride. It seems likely that the patient had been exposed to a heavy concentration of the gas, because he had had to work for several hours near to the valve inside a canvas tent.

In retrospect, the patient said that he had noticed a headache and slight dizziness since starting work at the plant.

He recovered fully and was discharged home. When seen in the out-patient clinic two weeks later he was symptomless. No sequelae were present.

#### DISCUSSION

Methyl chloride poisoning was first described by Gerbis (1914), who reported two cases in men working in a chemical plant. Most of the cases described in the medical literature have been in refrigeration workers, especially in refrigerator repairers who have to work in an atmosphere in which the concentration of the gas becomes dangerously high (Baker, 1927; Kegel, McNalley, and Pope, 1929; Jones, 1942). The addition, in a small percentage, of a pungent substance to the gas has been used to detect the escape of this almost inodorous, non-irritating, yet dangerous gas. The recent introduction of dichlorodifluoro-methane as a safe refrigerant has decreased the number of cases of poisoning by methyl chloride.

The severity of the clinical picture varies. In mild cases the patient is rarely ill enough to stay away from his work; in moderate cases he may be ill for several weeks; while in severe cases epileptiform convulsions may occur and lead to death. Sequelae such as ataxia, diplopia, misty vision, drowsiness, and anorexia have been reported as persisting for many months.