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MANAGEMENT OF THE COMMON VARIETIES OF SCALP RINGWORM*

BY

J. MARTIN BEARE, M.D., M.R.C.P.

Consultant Dermatologist, Royal Victoria Hospital, Belfast,
and Royal Belfast Hospital for Sick Children

The differential diagnosis of the various types of scalp ringworm is of importance, since good treatment follows accurate mycological diagnosis. It is not necessary to have the result of mycological culture before treating any individual case. Considerable accuracy in clinical diagnosis can be achieved when one has, as a background, full knowledge of the various types of fungi which are endemic or epidemic

TABLE I

Fungus	Animal	Inflam- matory Reaction	Wood's Light	Outbreaks	Treatment
<i>M. audouini</i>	None	None	Green fluorescence	Large epidemics often occur	X-ray epilation
<i>M. canis</i>	Kitten	None or moderate	Green fluorescence	Usually small outbreaks affecting about 5-15 children	Fungicidal ointments
<i>T. sulphureum</i>	None	None	Nil	No very large outbreak so far reported, but general incidence is apparently increasing	X-ray epilation
<i>T. discoides</i>	Calf	Severe	Nil	Individual cases or 3-4 in a family	Starch poultices; extraction of loose hairs with forceps; soothing local applications

in the area. One can simplify diagnosis and arrive at sound practical treatment by concentrating on the three, four, or five fungi which occur in the locality (Table I). In the North of Ireland there are four important fungi (Beare and Cheeseman, 1953), which accounted for 99% of 1,157 cases of tinea capitis seen between May, 1948, and December, 1952, and

from which the responsible organisms were identified. These four fungi are *Microsporum audouini* (889 cases), *M. canis* (178 cases), *Trichophyton sulphureum* (55 cases), and *T. discoides* (24 cases). Three other fungi were encountered during this period—namely, *T. mentagrophytes* (8 cases), *T. equinum* (2 cases), and *T. schönleini* (1 case).

An easy and useful practical classification of the four common types of tinea capitis is by division into Wood's-light-positive and Wood's-light-negative cases, and subdivision of each of these two groups into human and animal types of fungi, as follows. Wood's-light-positive: human, *M. audouini*; animal, *M. canis*. Wood's-light-negative: human, *T. sulphureum*; animal, *T. discoides*. These four main groups are discussed in turn.

M. audouini Infections of the Scalp

Recently there has been considerable discussion regarding the possible effectiveness of local ointment treatment for cases of tinea capitis due to *M. audouini*. Among the best results are those obtained by Schwartz *et al.* (1946), who, in a carefully conducted and very practical trial, claimed 274 cures out of 445 children treated with local medications within a 16-months study period (61.6%). Similar results were obtained by Barlow *et al.* (1950). It would be fortunate indeed if we could cure this type of scalp ringworm by local application of a simple ointment, but the conservative treatment of this variety requires certain ancillary measures which the average general practitioner or school medical officer would find extremely difficult to carry out.

Treatment with Ointment.—The disadvantages of local ointment treatment for this condition, even assuming that this treatment is really effective and that cure is not spontaneous—and this is still in debate—include the following. (1) Treatment has to be carried out by reliable trained persons and not left to parents or friends. (2) During the time that the child is having treatment, unless supervision is very close, he will be infectious. (3) The failure rate over a reasonable period, such as six months, is considerable, as can be seen from an examination of the various clinical trials so far reported. (4) Some of the cures seem to have acted by producing local kerion-like reactions. I have seen these "artificially produced kerions" leave permanent scarring. (5) It is usually necessary to shave the children's scalps. (6) X-ray therapy centres are still required to deal with those children who fail to respond to ointment therapy.

Advantages of X-ray Epilation.—(1) X-ray epilation for this form of scalp ringworm offers an almost 100% certain cure within a period of four to six weeks. The treatment can be carried out in less than an hour, it is completely painless, and from all practical points of view it is safe if used by people who have been thoroughly trained in this method of treatment. Hair regrowth in boys is complete in six months. (2) The amount of co-operation required between hospital staff and parent is reduced to a minimum. One has only to get written consent, have the child for an hour, and then, no matter what the parents do subsequently, that child will almost certainly be free of infection in a month. (3) Unruly and obstreperous children can be conveniently managed under a light general anaesthetic.

Steps Taken in a Series of Cases

In 1948 it was estimated that there were about 1,000 cases of *M. audouini* scalp ringworm in the North of Ireland. The following steps were taken to deal with this campaign. (1) Examination of all schoolchildren within the affected areas by a nurse using Wood's light. In Belfast 50,000 such examinations were made and 225 cases found; 100 further cases were discovered among relatives of non-school age. (2) General practitioners and school medical officers were encouraged to refer their cases to a ringworm centre. (3) Wall maps were made out and coloured pins inserted to denote the homes of infected children. (4) An adequate

*Based on a paper read in the Section of Dermatology at the Annual Meeting of the British Medical Association, Cardiff, 1953.

follow-up system was started. Infected children were regarded as a danger to the community. (5) Infected children were kept from school, mainly because it was felt that this gave control of the case. If a child is not allowed to go to school then most mothers, however obstinate, will eventually yield and have whatever treatment is advised.

One amusing but troublesome difficulty was encountered over this decision to keep infected children away from school. So many children were away from school—in some cases all the children living in a street had ringworm—that a child who was not infected felt "out of it all." A market in ringworm was started by the more enterprising sufferers from this condition, and infection was sold at a price which at the height of the market reached sixpence a rub. To solve this problem the school authorities opened a special ringworm school: this allowed us to retain control of the case.

Results

About the summer of 1951 a very appreciable drop in the incidence of infection was noted, and by August or September of that year the falling off of cases was considerable. Only two cases from the Belfast and Newtownards areas were seen in 1952, and only one isolated case in 1953.

There is undoubtedly some as yet unknown factor which determines the virulence of *M. audouini*, and therefore the incidence of tinea capitis due to this fungus. Kligman (1952) found great difficulty in inoculating experimentally the scalps of children maintained in an institution in Philadelphia. He expressed the opinion that this disease was not so infectious as had had sometimes been claimed. I cannot agree with this, and the following data indicate the high degree of infectiousness in practice. The incidence of ringworm during the epidemic period in the town of Newtownards was 12%, 368 children from a total child population of 3,000 under the age of 17 years being affected between January, 1948, and August, 1949 (27.2% of the male school population were infected). In another epidemic in the North of Ireland which occurred in a residential school, 31.6%—or 116 children out of a population of 367—were affected (Walby, 1952).

M. canis Infections of the Scalp

During recent years we have carried out few x-ray epilation for cases of tinea capitis due to this fungus. Various authors in the past have stated that the majority of *M. canis* infections of the scalp clear spontaneously, and that x-ray epilation is not always necessary (Lewis and Miller, 1934; Lewis, 1935). When all the non-epilated children who had been seen in 1948 with scalp ringworm at the Royal Belfast Hospital for Sick Children were recalled during the early months of 1949 none were found to be infected by *M. canis*. These children represented a very mixed group of infections, and it can be safely assumed that some of them were originally cases of *M. canis* infection. It was therefore apparent that the great majority of these infections must clear quite quickly and spontaneously. However, during the time when we were primarily concerned with *M. audouini* it was felt that, from the point of view of the welfare of the community, all cases of non-inflammatory scalp ringworm should be subjected to x-ray epilation. Consequently a large number of cases of *M. canis* infection were epilated during 1949–51.

It is possible to make a clinical differentiation between *M. audouini* and *M. canis* infections in the majority of cases (Beare and Cheeseman, 1951).

Treatment

So far as I am aware, no properly controlled experiment estimating the time saved by subjecting children with the *M. canis* variety of scalp ringworm to x-ray epilation has been carried out. Useful information can be obtained by comparing the duration of infection in groups of children presenting with different inflammatory reactions. The in-

flammatory varieties cause no undue worry, and if it can be shown that the non-inflammatory cases, if not epilated, clear as quickly or nearly as quickly, then this would seem to be a strong indication not to use x-ray therapy with its attendant troubles and subsequent temporary alopecia for any case due to this fungus.

In 1949–50 there were 90 cases of *M. canis* scalp infection, and of these 42 were epilated. For the most part these were the non-inflammatory cases. In 1951–2 there were 88 cases and 5 were epilated (4 in 1951 and 1 in 1952). There was no special selection of these five cases for epilation. Of the 83 non-epilated cases the attendances of 61 were regular enough to allow of analysis (the other 22 did not re-attend just when requested, though all were eventually re-examined). These 61 cases were analysed from the point of view of duration of infection, and it is possible to divide them into two groups according to the severity of the inflammatory reaction present.

All patients were treated simply by local application of Whitfield's ointment. Inflammatory reaction was absent in 27 patients and slight or severe in the remaining 34.

Duration of Infection

Table II shows the average duration of treatment, measured from the date when the patient was first seen to the date when judged to be clear of infection. In the group

TABLE II.—Analysis of Average Duration of Time Between Date Patient First Seen and Date Infection Cleared

	No Reaction	Slight to Severe Reaction
Number of patients ..	27	34
Mean duration (first seen—clear): days ..	57.00	47.59
Standard deviation of duration: days ..	22.33	26.83
Standard error of mean: days ..	4.30	4.60
Difference between means: days ..	9.41	
Standard error of difference: days ..	6.75	
Difference ÷ standard error ..	1.4	

with no inflammatory reaction the average duration of treatment was approximately 57 days, while in the group with slight to severe reaction it was 48 days. Although these averages do suggest that the condition takes longer to clear in patients with no reaction than in patients with reaction, the average difference is only about nine days, and, moreover, could quite easily have arisen by chance. (The table shows that the difference is less than twice its standard error and would be described as "not significant" at the conventional 5% probability level.)

Since the two averages are not significantly different, it is legitimate, for these data, to pool the two reaction groups to arrive at statistics for the complete group of 61 patients. When this is done the average duration of time between the date when the patient was first seen and the date when the infection was cured is approximately 52 days, and the series has a standard deviation of approximately 25 days. The latter suggests considerable variation between individual patients.

The absence of a real difference in duration of infection in the two groups from the time the patients were first seen implies that, if both types of case react similarly to the treatment given, there is no evidence, from these data, of a significantly longer duration in the patients with no inflammatory reaction compared with those with slight to severe inflammatory reactions.

Table III is an attempt to arrive at average durations of infection from time of onset—estimated at history taking—to time infection was clear. There is a marked similarity between the durations so obtained in the two reaction groups. Where reaction was absent the average duration of the condition was only four days (approximately) greater than where reaction was present. Again the difference is insignificant at the 5% probability level. When the two groups are pooled it is found that the average duration of

TABLE III.—Analysis of Estimated Average Duration of Infection Between Estimated Date of Onset and Date Infection Cleared

	No Reaction	Slight to Severe Reaction
Number of patients	27	34
Mean duration (onset—clear): days ..	72.81	68.38
Standard deviation of duration: days ..	27.87	24.17
Standard error of mean: days	5.36	4.15
Difference between means: days	4.43	
Standard error of difference: days	6.78	
Difference ÷ standard error	0.7	

infection from the time of onset to the time cleared for the 61 patients was about 70 days, and the standard deviation about 26 days.

It must be pointed out that in Tables II and III the longer average duration is, in fact, found in the group which experienced no inflammatory reaction. In these data, however, the excess could easily be attributed to chance, but the numbers involved are admittedly small. In view of the results of this tentative examination it seems wrong to accept at this stage the suggestion that, other things being equal, there is a real difference in the duration of the condition between groups of patients with different inflammatory reactions.

One could expect to clear all cases of *M. canis* scalp ringworm with x-ray epilation in approximately four weeks, certainly six weeks (28 to 42 days). This would imply that probably a little over half of the children in the present series (irrespective of the intensity of inflammatory reaction) would have been rendered free of infection more quickly had they been epilated with x rays. Against this, however, must be balanced the fact that these children would have been bald for some four months, long after they would have been free of infection had they been treated conservatively, and the epilated girls, of course, would actually be socially unacceptable for longer than four months.

It is of some interest that the number of new cases seen each year showed little variation (1949, 42 cases; 1950, 48 cases; 1951, 42 cases; 1952, 46 cases), which is further support for the thesis that x-ray epilation is not necessary in this infection. Thomas (1953) also supports this view. One might advocate x-ray epilation for cases of *M. canis* infection in which there is a complete absence of inflammatory reaction. The longest duration one has seen of this variety of tinea capitis is 149 days (about five months). This was exceptional, and if this long duration could be predicted in any individual case x-ray epilation would probably be justifiable.

Many of the non-inflammatory *M. canis* cases which clear within six weeks or so are probably the result of a third or fourth transfer of the organism. Duncan (1948) has pointed out that *M. canis* infections undergo a limited number of transfers; for example, kitten to child A—to child B—to child C, and then the organism probably becomes avirulent.

Our routine now for *M. canis* scalp infections is local treatment with a fungicidal ointment. The advantages of using a rather sticky ointment such as Whitfield's probably lie in the fact that this prevents loose hairs and spores from falling in all directions, not only on to the child's environment, but also on to other parts of the child's scalp.

T. sulphureum Infections of the Scalp

Fifty-five patients with tinea capitis due to this fungus have been seen during the period 1949–52. This variety of ringworm has recently attracted considerable attention. Howell *et al.* (1952) have described 37 cases seen in Texas and California. Under Wood's light there is complete absence of fluorescence, but clinically these infections are often very much like those caused by *M. audouini*.

In the present series 36 of the 55 cases showed little or no inflammatory reaction. Eleven were classified as kerions. It is curious that these kerions were seen for the most part during the last year of the present four-year survey. Forty-one cases were seen within two months of

onset of infection, but four had had the infection for more than one year, and one had had an infection for over two years. Two boys were affected to every one girl. The average age was 7, but there was a fairly even spread throughout the first 14 years of life. No adults with this infection of the scalp were seen.

In the North of Ireland the infection is practically confined to Belfast, and in general is probably a disease of large centres of population. There is no animal reservoir, and infection passes from patient to patient. There was a steady rise in the number of new cases seen each year (1949, 10 cases; 1950, 11 cases; 1951, 13 cases; 1952, 21 cases).

It has usually been extremely difficult to establish the source of infection, and indeed only once, when brother and sister were infected, was this possible. Extensive scalp infections were seldom seen, and the most usual picture was that of a single small scaly non-inflammatory patch, often like a mild seborrhoeic dermatitis, but with some broken-off hair stumps. Thirty-four of the 55 cases had only one patch.

In addition to the cases of tinea capitis, 16 cases of tinea corporis due to this fungus were seen. The areas most often involved were the face and neck.

Local epilation was used in preference to total epilation because so many cases had only one patch, but of 31 cases so treated 6 were failures. In these particular cases the infection appeared in the adjacent non-epilated hair. Eight cases had total epilation, and in one of these it was a failure. A few cases cleared without epilation, including the 11 with kerions. Treatments used when x-ray epilation was avoided included Whitfield's ointment locally and manual epilation of hair stumps. Since the infection is non-fluorescent under Wood's light this is a very tedious and unreliable procedure.

The treatment of choice for non-inflammatory infections is probably a whole-scalp epilation even when only a single patch is present.

T. discoides Infections of the Scalp

This fungus is the common cause of cattle ringworm in the United Kingdom. It causes an extremely severe local reaction which sometimes progresses to a chronic granuloma that may persist for six months or more and often leads to scarring and areas of permanent baldness.

Most Ulster patients first seek cure from the local charmer, and have a smouldering twig waved three times round the affected area on the night of a full moon. This procedure does much less harm than tincture of iodine, and the results are probably just as good. It is extremely doubtful whether anything we do can actually shorten the duration of a *T. discoides* infection. A possible exception to this statement is manual epilation of the loose affected hairs, using a small pair of forceps. For patients who can be admitted to hospital this procedure should certainly be carried out. Sticky starch poultices and removal of the affected hairs by this method are also of value. Symptomatic treatment is, of course, appreciated, since the condition is uncomfortable or even painful.

T. discoides infections can usually be differentiated from *T. sulphureum* infections by (a) the degree of reaction, which is so much greater with *T. discoides*; (b) a history of contact with infected cattle, which is always given for *T. discoides* infections; and (c) in the North of Ireland finding out where the patient lives: a non-fluorescent scalp ringworm from Belfast is *T. sulphureum* and from outside Belfast is *T. discoides*.

Conclusions

It is possible to differentiate the four chief varieties of scalp ringworm by simple clinical inspection and Wood's-light examination.

The presence of *M. audouini* represents a danger to the child community and a challenge to the doctor.

It should be possible to eradicate completely this variety of ringworm from a community. X-ray epilation should ideally be carried out at the child's first attendance at a dermatological clinic. All contacts in the home and school should be examined with Wood's light.

The importance of *M. canis* ringworm lies in its differentiation from the *M. audouini* variety. X-ray epilation is seldom indicated.

T. sulphureum is likely to cause great anxiety and trouble in the near future, since diagnosis of the non-inflammatory varieties is difficult, and the disease may last for years if untreated. X-ray epilation of the whole scalp is probably the best treatment in most cases.

It is very doubtful whether any procedure can actually shorten the duration of *T. discoides* infections, but symptomatic treatment is appreciated by the patient.

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ATELECTASIS AS A COMPLICATION IN ARTIFICIAL PNEUMOTHORAX

BY

R. L. SADLER, E.R.D., M.B., B.Sc., D.P.H.
 Senior Registrar, the Cheshire Joint Sanatorium

Since 1920 therapeutic pneumothorax has had a vogue which was certainly excessive at first, but lately the balance has swung the other way and some authorities seem to regard it as a dangerous procedure which should be used only in exceptional cases (Harris *et al.*, 1952; Jackson, 1952; Simmonds *et al.*, 1952).

Young (1949) believes that the cause of this trend of opinion is the fact that the technique seems so easy that it has been carried out by workers inexperienced in the proper selection of cases or in the finer points of its conduct. In the management of artificial pneumothorax (A.P.) cases the physician must be experienced enough to recognize the circumstances that demand the immediate termination of the pneumothorax treatment. Also, to give the best chance to his patients who need the help of an A.P., he must know what "complications" may be disregarded with reasonable safety. One such complication often appearing in an otherwise perfect pneumothorax is the occurrence of an area of atelectasis; and the object of the present investigation is to try to decide whether or not such an occurrence is an indication for suspending this type of collapse therapy.

Some writers have associated atelectasis occurring in an A.P. with such sequelae as progressive tuberculous disease (Rafferty and Shields, 1943), with relapse (Maher-Loughnan, 1950), and with tuberculous pleural effusions and empyemata (Houghton, 1950). On the other hand, Scadding *et al.* (1952), Foster-Carter *et al.* (1952), and Beric Wright (1952) have recorded satisfactory results in small groups of cases with atelectatic lobes or segments, while earlier writers (Brooks, 1938; Erwin, 1939) regarded its occurrence as a favourable event.

At the Cheshire Joint Sanatorium the clinical impression has long been that the occurrence of lobar or segmental atelectasis does not of itself warrant the interruption of the course of an A.P. Adequate material is therefore available at this institution for the numerical examination of the prognostic effects of such atelectasis.

Data

Data for this investigation were obtained from consecutive cases of A.P. induced at the Cheshire Joint Sanatorium between early 1935 and the end of 1945. That all these cases were finally complete was shown by thoroscopic examination as well as by x-ray films. In all cases sputum was either negative throughout or converted to negative by effect of the A.P.

The collecting of data from earlier sanatorium cases has the advantage of allowing a long period of follow-up—of five years in all cases and of ten years in about half of them. Also, in earlier years case selection for therapeutic pneumothorax, and the subsequent management, were less informed than at the present day. We are thus able to collect for assessment groups of cases which would not be seen in current practice, such as those in which there is a persistent cavity in an anatomically complete A.P. One disadvantage of collecting data from earlier cases is the absence of information from routine bronchoscopic examinations.

Where disease in the contralateral lung was regarded as a possible factor in life prognosis the case was excluded—for instance, if on the contralateral side there was an incomplete A.P., or if an attempt at induction of an A.P. had failed on the contralateral side. With regard to contralateral disease, the cases included had (a) no radiological evidence of disease; (b) disease controlled by an uncontroversial A.P.; or (c) disease of moderate extent, healing, and not sufficient to warrant active intervention and not producing a positive sputum.

Disease in the pneumothorax lung, as it appeared prior to A.P. induction, was classified according to its type and its extent.

The type of disease was dealt with under three headings. (1) Cavitated disease: the cavity was at least 5 cm. in diameter, or multiple cavities had a total diameter of at least 5 cm. (2) Exudative disease: the disease was predominantly of a type with a confluent and ground-glass radiographic appearance. (3) Productive disease: cases not classified under (1) or (2) appeared under this heading, so that a variety of radiographic appearances of tuberculous infiltration are included.

The extent of the disease was classified according to the total number of zones in the P.A. x-ray film of the chest which showed infiltration of tuberculous infection. The zones are demarcated by two horizontal lines passing through the second and fourth costal cartilages, thus dividing each lung field into three zones. This classification of disease extent was used by Hartley *et al.* (1935).

Atelectasis is recorded only if it persisted for three months or more. Transient atelectasis following thoracoscopy (Hess, 1951; Penman and Miller, 1952) is thus excluded. In regard to the extent of atelectasis, the cases were classified into four groups—total, lobar, segmental, and nil. Lobar atelectasis includes that of an upper or a lower lobe, there being