the sight. The value of chemotherapy was seen between 1947 and 1954 in the marked fall in the incidence and in the severity of lepromatous eye lesions. This was very striking. During this time chemotherapy undoubtedly prevented serious eye complications in a considerable number of patients.

I will not discuss treatment in detail. Sulphone treatment (diaminodiphenylsulphone given orally), if necessary in small doses, and cortisone, given either as eye drops or by subconjunctival injection in the acute phases, were the main measures. In some cases, thiosemicarbazone was used instead of sulphone.

Tuberculoid Eye Involvement

By this I mean the direct involvement of the eye in the inflammatory process of tuberculoid leprosy. Tuberculoid leprosy is localized, and usually the eyes escape, but there are cases in which the skin of the face is involved, or the part of the face round the eyes, and thus the eyes may be involved directly with tuberculoid inflammation of the conjunctiva and cornea. This in itself is not very serious; it usually subsides in a few weeks, with little permanent damage. It does become serious, however, when, as is not uncommon, there is an ascending tuberculoid involvement of the V and VII cranial nerves, with subsequent palsy. This is discussed below.

Paralytic Lesions of the Eye

These may arise in two ways. The first way has already been mentioned, the ascending neuritis from tuberculoid lesions of the face, but it can occur in lepromatous leprosy also. In lepromatous leprosy the nerves are involved, but are often little damaged because of the lack of tissue reaction. As the disease dies down, however, either spontaneously or under chemotherapy, the fibrosis of the nerves which accompanies healing may lead to destruction of nerve fibres and paralytic changes in various parts of the body, including the eye.

I will not describe the condition in detail; the characteristic findings are inability to close the eye, ectropion, lagophthalmos, loss of corneal reflex, and, in consequence of these changes, the complete destruction of the protective mechanism of the eye.

Conclusion

I have tried to give some general background to the picture of leprosy of the eye. In conclusion I would state my opinion that practically all serious eye involvement in leprosy is preventable, by early diagnosis, and thorough general treatment of leprosy. In very few cases does the eye become seriously involved in the earlier stages of the disease. If all cases could be promptly diagnosed and thoroughly treated, serious leprous eye lesions would also all be prevented. That is my experience in many hundrds of cases during the last seven years. Unfortunately, I believe that many of the cases seen in this country are relatively advanced when they come here and serious eye troubles are not uncommon.

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Ocular Leprosy, with Reference to Certain Cases Shown

By D. P. Choyce, F.R.C.S.

I should like to record my thanks to Sir Neil Hamilton Fairley, Sir George MacRobert and Professor A. W. Woodruff for permission to demonstrate their cases.

I have had experience of two contrasting types of case: first, the detailed and repeated observation of 30–40 cases of leprosy in this country; about half of these have ocular involvement. Also, having been fortunate enough to travel fairly extensively abroad, I have superficially examined several thousand inmates of leprosaria in Malaya, India, Pakistan, Egypt and East Africa. It is more difficult to draw conclusions about this type of case, partly because there has never been a corneal microscope with which to examine them, and partly because so many of them have had other ocular disease. An interesting feature of many of these cases was corneal and conjunctival anæsthesia due to involvement of the V nerve, so that the trichiasis caused no symptoms and the patients, therefore, refused to submit to surgical correction of the trichiasis, with continuation of the damage to the cornea: an interesting example of the difficulties confronting the tropical ophthalmologist.

(1) *Nerve involvement.*—(*a*) The upper division of the VII nerve is not uncommonly involved in non-lepromatous leprosy, leading to myo-atrophy of the superior part of the orbicularis oculi. This leads to characteristic loss of "winking" and blinking, lagophthalmos, ectropion of the lower lid, and later, to exposure keratitis. In this connexion it is interesting to observe how much exposure the cornea can stand in these cases, and it is wise to delay tarsorrhaphy as long as possible.

(*b*) Branches of the V nerve may also be thickened and palpable, and corneal anæsthesia may be pronounced. Under these circumstances corneal ulcers readily form, cause remarkably few symptoms, and take a long time to heal.

(2) *Lids and lacrimal apparatus.*—In lepromatous leprosy madarosis (loss of eyebrows and lashes)

is common and is thought by some to indicate certain involvement of the eyeball itself, but this is not necessarily so. On the other hand, when the eyeball is involved, madarosis is usually, but not invariably, present. When present it is permanent, so that female sufferers frequently provide themselves with artificial eyebrows. Lepromata of the upper lid occur, but are rare in the lower. Absence of madarosis is a good prognostic sign in long-standing cases. Involvement of the lacrimal gland has been recorded but is not serious. Dacrocystitis, secondary to collapse of the nasal cartilages, is common, but usually due to pyogenic organisms rather than to Hansen's bacillus.

(3) *Involvement of the eyeball itself.*—In 1873 Bull and Hansen suggested that the globe became involved exogenously, i.e. that the bacilli were deposited in the lids or conjunctiva, and thence invaded the eye. This theory has been heavily criticized in recent years; Shionuma (1940) demonstrated leprous changes within the eye before bacilli appeared in the conjunctival sac. Fuchs (1940) suggested that the bacilli were deposited by the blood stream either in the episcleral tissues close to the limbus (whence they migrated into the cornea with the corneal nerves), or in the ciliary body. From the latter site they could spread forwards into the iris causing miliary lepromata, medially into the ciliary processes or posteriorly into the choroid causing chronic, destructive uveitis. In support of his theory Fuchs cites the well-known tendency of the tubercle bacillus to metastasize by the blood stream. While his assertion that clumps of leprosy bacilli are deposited in the limbal episcleral tissues and in the ciliary body may well be correct, it does not follow that they are conveyed thither by the blood stream. In view of the known predilection of the leprosy bacillus for peripheral nervous tissue an alternative, and to my mind reasonable, theory is that they migrate to these regions along the ciliary nerves. However they reach their destination, it is a fact that Hansen's bacilli cannot always be demonstrated in the conjunctiva in cases with leprous involvement of the anterior segment.

With regard to the macroscopic details, lepromata of the conjunctiva are rare; episcleral nodules occur but do not usually persist. The limbal region is frequently the seat of a characteristic sclerosing keratitis, involving the whole circumference. Nodules which superficially resemble pterygia may encroach upon the cornea.

The cornea itself is very frequently involved; the bacilli appear to reach it along the corneal nerves. All varieties of keratitis are encountered, but vascularization is very late. Pannus is usually confined to the upper segment, but may extend right round the cornea. It is distinguished from trachomatous pannus by the absence of involvement of the tarsal plates, abundant anastomoses between the vessels, and a lesser degree of infiltration of the substantia propria.

The iris is attacked in a number of ways. The most characteristic sign, never seen in any other condition, is the appearance of miliary lepromata near the sphincter in the deep mesodermal layer, between the frill and the pupillary margin. These lepromata have been shown to contain thousands of bacilli, with very little cellular reaction from the host. They may persist unchanged for years, causing little or no reaction, apart from slight atrophy of the stroma. Or the iritis may be acute with marked symptoms. Secondary glaucoma is frequent and of great danger to the patient, as it is this complication which is, in part, responsible for the high incidence of blindness in ocular leprosy. In this type of case complicated cataracts are a common sequel, and although lens extraction is practicable, the results tend to be disappointing. Finally, the iritis may be chronic and insidious and the patient may be unaware of eye changes until visual loss from atrophy of the ciliary body makes itself evident.

While iritis may be associated with antecedent corneal or iris changes, this is not necessarily so, and cases of severe iritis in an eye otherwise unaffected by the disease are often seen. Here it is reasonable to assume that the uveal tract has been sensitized in some way to the breakdown products of this disease, responding with an acute plastic iritis. Exacerbations of this nature can occur at any stage of the disease, even in the so-called "burnt-out" cases, and can be most alarming, calling urgently for expert ophthalmic attention.

With regard to the posterior segment, most authorities agree that such lesions are rare. Personally, I have never seen a choroidoretinal lesion which I was satisfied was due to leprosy and not due to syphilis, tuberculosis or some other intercurrent disease. Elliott (1948, 1949), of the United States Marine Hospital at Carville, firmly believes in the existence of these lesions which are said to be identical with those seen on the iris, and in the cornea. He states that these pearl-like lesions recede within eight months, leaving no trace behind. He may be right, but his observations so far as I know have not been confirmed by other workers. Pathologically, bacilli can readily be demonstrated in the ciliary body, occasionally in the anterior part of the choroid, but not at all in the retina.

There are some general points which need emphasis:

(1) Ocular lesions are common in lepromatous leprosy, almost unknown in the tuberculoid variety. Thus, the incidence of these complications varies markedly geographically according to the type of disease prevalent. Broadly speaking the incidence of ocular leprosy is low in India, high in Europe, Japan and certain parts of Africa, and particularly high in Central and South America.

(2) Blindness is chiefly due to involvement of the iris and ciliary body either from gradual atrophy leading to phthisis bulbi, or from the less common but more dramatic secondary glaucoma. The corneal lesions play a subsidiary part in the causation of blindness.

(3) The ocular lesions are often of striking bilateral symmetry, thus lending themselves to clinical research in which one eye is treated on different lines from its fellow, which acts as a control.

(4) It is primarily an anterior segment disease, in which the bacilli are very numerous and the tissue reaction minimal, the only exception being some of the cases of plastic iritis.

(5) Eyes afflicted with ocular leprosy stand up surprisingly well to surgical procedures, such as lens extraction, provided the disease is in a quiescent phase.

This brief review of the clinical signs will now be illustrated by reference to some cases.

Case Reports

Case I.—Mrs. G. A., aged 40.

Anglo-Indian. Lived in India until 1947. No known contact with leprosy.

1943: Severe burns of hands. Noticed absence of pain. Since then she has had repeated burns of hands and legs due to cooking on an open fire, and has noticed gradual loss of digits and development of ulcers on soles of feet.

April 1953: Admitted to Hospital for Tropical Diseases. Found to be suffering from advanced lepromatous leprosy with destruction of nasal cartilage, hoarse voice from laryngeal involvement, loss of fingers and toes, analgesia of limbs, gross sepsis of right leg, unhealed burns of legs, and trophic ulcers of feet. Surgical treatment was carried out and treatment with D.D.S. (diaminodiphenylsulphone) was commenced.

Progress.—Clinical improvement has been good but bacteriological improvement has been slow. She has now had one and a half years' treatment.

Ophthalmic manifestations.—

1952: Bilateral naso-lacrimal obstruction due to destruction of nasal cartilages. Right dacrocystitis, controlled by penicillin and Albucid.

1953/1954: Occasional attacks of allergic iritis including one severe attack with secondary glaucoma. Controlled with mydriatics and cortisone locally. Systemic cortisone necessary for two days. No other stigmata of ocular leprosy. *Visual acuity* = 6/6 pt., 6/9 pt.

Comment.—This case shows: (1) The effect of destruction of nasal cartilages on the naso-lacrimal ducts. (2) Allergic iritis, satisfactorily controlled by mydriatics and cortisone.

Case II.—Mr. A. B., aged 39.

English. Was in various parts of the tropics (Army) from 1938–1943. No known contact with leprosy.

1949: Onset of erythematous macules on the skin.

1951: Nasal symptoms and epistaxis.

1952: E.N.T. specialist found a positive W.R. Venereologist was able to rule out syphilis on the strength of a negative treponemal immobilization test. A skin biopsy revealed very large numbers of acid-fast bacilli, and he was referred to the Hospital for Tropical Diseases in October 1952. Commenced treatment with a combination of Sulphetrone injections and I.N.H. (isoniazid), and this has recently been changed to D.D.S.

Progress.—Clinical improvement has been good but bacteriological improvement has been slow. He has now had two years' treatment.

Ophthalmic manifestations.—Has been observed for two years.

1952: N.A.D. Commenced sulphone therapy.

1953: Early superficial punctate keratitis above and early leprous pannus.

1954: I.S.Q., or possibly slight intensification of corneal appearances. No symptoms. *Vision* = 6/6, right and left.

Comment.—A case where minimal ocular involvement has occurred while patient is on systemic sulphone treatment.

Case III.—Miss E. K., aged 37.

Anglo-Indian. Lived in India until 1951. No known contact with leprosy.

Early lesions of leprosy appeared in 1950 and the disease has made a steady advance ever since. She is now an advanced case of lepromatous leprosy. She was admitted to Hospital for Tropical Diseases at the end of August 1954 and we are attempting to improve her nutrition and her anæmia before commencing treatment with sulphones. She is mentally deficient.

Ophthalmic manifestations.—A new case.

August 1954: Marked madarosis of eyebrows and lashes. Episcleral nodule, left temporal region. Marked leprous keratitis, punctate and sclerosing. Irides normal with loupe. Patient mentally defective and visual acuity impossible to determine. Put on atropine drops, right and left.

September 1954: One month's general hygiene (e.g. personal cleanliness, teeth, cleansing of necrotic areas) and treatment of anæmia has greatly benefited the ocular condition. Episcleral nodule almost healed.

As yet no systemic sulphone therapy.

21.9.54: Left conjunctival snip shows: numerous Hansen's bacilli.

Comment.—Gross corneal and limbal leprosy, with marked improvement with general hygienic and medical measures.

Case IV.—Mr. A. D. W., aged 24.

Anglo-Indian. Lived in India until 1947. No known contact with leprosy.

Between the ages of 7 and 15 he noticed slowly increasing sensory loss on the skin of hands, arms and feet. At the age of 16 he developed a trophic ulcer on the sole of the right foot, and three years later (1949) he noticed redness of his eyes and nodules appearing on face and backs of hands.

September 1950: Diagnosis of leprosy was made in Liverpool and treatment with D.D.S. was commenced.

July 1952: Developed sudden blindness in left eye.

September 1953: Admitted to Hospital for Tropical Diseases (Jordan Hospital, Surrey) where treatment with D.D.S. has been continued.

Progress.—Skin lesions have virtually disappeared and bacilli are slowly decreasing. Sensory impairment over arms, feet and legs has remained, and there is slight weakness of the right little finger. He has now had four years' treatment.

Ophthalmic manifestations.—

1951: On systemic sulphone therapy.

1952: Left vitreous hæmorrhage. This gradually cleared, revealing an extensive simple retinal detachment nasally. Right and left marked leprous keratitis and sclerosing keratitis. Right and left irides show some atrophy with numerous *miliary lepromata*, mainly above. No iritis. Media clear and fundus normal.

1953: No change.

1954: Possibly slight intensification of ocular changes, notably pterygium-like nodule of the right limbus at 9 o'clock, although systemic response to sulphones is good.

Comment.—(1) Severe ocular leprosy, yet: (2) no madarosis, (3) no iritis, despite miliary lepromata ++, (4) no fundus lesion. *Visual acuity* = 6/6 right; counts fingers, nasal field left.

Case V.—Mr. M. F., aged 70.

South African. Has spent most of his life in South Africa and in South America. No known contact with leprosy.

In 1938 he was diagnosed as suffering from lepromatous leprosy and treatment with hydnocarpus oil was commenced. In 1946 treatment was changed to sulphones, and the disease has been completely arrested. He is still taking D.D.S. He has sensory loss of the skin of feet, legs, hands and forearms, and there is a partial dropped foot (right) following an attempted biopsy of common peroneal nerve.

Ophthalmic manifestations.—

1948: Madarosis. Severe bilateral iritis with secondary glaucoma in right eye. Iritis presumably of allergic origin as no other stigmata of ocular leprosy present. No cortisone available at that time. Mydriatics insufficient to control tension. Iridectomy necessary.

1949/1954: Gradual intensification of complicated cataracts. Accurate light projection both eyes. Patient very anxious for something to be done.

June 1954: Right separation of posterior synechiæ and intracapsular extraction. Eye stood the operation well, but visual result disappointing. Optic disc pale. *Right Visual Acuity* = 2/24 with + 9/+3 ↓ 90, in lower nasal quadrant only. *Left visual acuity* = 2/60 unaided, not improved.

Comment.—This case illustrates the severity of the allergic iritis, and how pre-cortisone measures were not adequate to deal with it. Also that a major surgical intervention can be withstood by such a badly damaged eye, but that the visual result is likely to be disappointing.

Case VI.—Mrs. L. L., aged 30.

Anglo-Indian. Lived in India until January 1947. No known contact with leprosy. Treated for leprosy in India in her youth and discharged apparently cured.

1947: Nodules gradually reappeared over the next three years, and, by the time she was sent to the Hospital for Tropical Diseases in October 1950, she was an advanced case of lepromatous leprosy. Treatment was commenced with Sulphetrone injections and later she was transferred to the Jordan Hospital, Surrey.

Progress.—Her progress has been interrupted by frequent recurrences of reactional phases characterized by fever and erythema nodosum leprosum necessitating stoppage of treatment, and now she is on 50 mg. cortisone daily while continuing parenteral treatment with D.D.S. in the form of Avlosulfon Soluble. She has made considerable clinical improvement, however, and there are half as many bacilli in the skin as compared with 1950. She has now had four years' treatment.

Ophthalmic manifestations.—

1951: Left episcleritis with nodules. Systemic sulphone therapy.

1952: Left episcleral nodule smaller and asymptomatic.

1953: I.S.Q.

1954: I.S.Q. The episcleral nodule temporally has hardly changed in two years of systemic sulphone therapy. Asymptomatic. *Vision* = 6/6, right and left.

Comment.—While this case has improved it has not been cured; it is probable that if this patient had not received systemic sulphone therapy the ocular involvement would be very much greater than it is to-day.

Treatment

(1) *General hygiene and medical measures*, designed to eliminate septic foci such as teeth and secondarily infected areas of necrosis and to deal with any secondary anæmia, may have a beneficial effect on the ocular lesions.

(2) *General treatment of leprosy.*—The introduction of sulphones used systemically raises certain questions concerning the ocular complications of the disease. In view of the extreme chronicity of leprosy and the comparatively short period that has elapsed since this group of drugs was first used, it will be several more years before precise answers can be given.

(*a*) Do the sulphones prevent or delay the occurrence of ocular complications? In view of their markedly beneficial effect systemically, the common-sense view is that these drugs are more likely to prevent, mitigate or delay ocular complications than any previous systemic therapeutic measures used in leprosy.

(*b*) What effect do the sulphones have on established ocular leprosy? In several of my cases shown at this Meeting the signs have been arrested, in others partial regression appears to have taken place, but in none can it be said that complete cure has occurred. Furthermore, the ocular condition of one case (A. D. W.) appears to have deteriorated slightly while his systemic disease has improved. It is probably safe to say, however, that even if these cases are far distant from cure, their ocular state would to-day be appreciably worse in the absence of sulphones given systemically.

(3) *Local treatment of the eye.*—So far, there have been no reports of the use of sulphones locally, in the forms of drops, ointment or by subconjunctival injection. This problem is engaging our attention at the present time. Various gold preparations have been used locally, but reports of their effects are conflicting. The antibiotics are of use in restricting any secondary infection, e.g. of an obstructed lacrimal sac.

The local treatment of the plastic iritis, the most dreaded ocular complication of leprosy, is of the first importance. Mydriatics, reinforced by early local use of cortisone, represent a great advance in the management of this condition. Colonel Kirwan and I have successfully treated a number of these cases, who still retain a visual acuity of the order of 6/6–6/9, who would otherwise probably be seeing less than 6/60. Leprosy bacilli are noted for their sluggish powers of reproduction and in the eye for the minimal fibroblastic reaction they provoke, which probably explains the fact that we have, so far, seen no evidence of multiplication of the bacilli beneath the cortisone umbrella.

Prognosis

Twenty to thirty years ago a dissertation on leprosy would have included the statement that the ocular complications progressed remorselessly towards blindness, being unaffected by any known therapeutic measures. I have personally noted while abroad a certain apathy and want of interest in the treatment of ocular leprosy, engendered, no doubt, by the onward march of the disease. While the word "cure" can still not be applied to leprosy, I would suggest that it is now possible to talk of delaying the progress of ocular leprosy with systemic sulphones and that a proportion of the blindness associated with the disease can be prevented by the timely use of cortisone.

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Ocular Leprosy

By Lt.-Col. E. W. O'G. Kirwan, C.I.E., M.D., F.R.C.S.I.

In tropical countries leprosy is one of the great causes of blindness and partial loss of sight. There is no disease that has been so greatly dreaded through the ages. Horrible to live with, difficult to die with, slowly destroying the nerves and marrow, causing deformities and mutilations and finally, to complete the holocaust, often causing blindness. Thanks to the researches of a number of specialists in more recent years, we now possess in the improved treatment and better knowledge of the epidemiological conditions under which leprosy infections arise, the means greatly to reduce and eventually, we hope, to eradicate this terrible disease.

More than three million cases of leprosy are supposed to exist in the world, the great strongholds being India, China and Central Africa. India has a million or more cases and it is calculated that 15,000 children develop the disease annually. The first fifteen years of life is the period of highest contagion and especially the period 5–15 years. The incidence of the disease is greater in low-lying, humid areas in which the climate is hot and the rainfall heavy, rather than in more elevated dry ones. Great Britain is responsible for a very large number of patients in her colonies and only a small proportion are as yet receiving the benefits of established treatment.

It is difficult to determine the extent of leprosy in these islands in the past but at present there are about 150 cases in England and Wales. All these patients acquired the disease outside the country. Many cases seek refuge here and the disease is not easy to detect. The last British leper whose infection could not be traced directly or indirectly to the tropics died in 1897 in the Shetland Islands.

All the changes that affect the body in leprosy can affect the eye and its adnexa, and so the ocular manifestations have no mystery of their own. As in the body, the disease is one of relentless chronicity and presents very serious complications.

Ocular involvement is common but varies tremendously in different countries and amongst different races. The gravity of this involvement is directly dependent upon the type of the disease.

In the lepromatous type the eye complications are serious and caused by actual leprous infiltration both superficial and deep. In the non-lepromatous type, in which the peripheral nerves are involved, there is no actual leprous lesion of the eyeball. The branches of the VII nerve are frequently