Communicable ophthalmia: the blinding scourge of the Middle East

Yesterday, today and ? tomorrow

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Blinding and non-blinding trachoma

A year ago we introduced the concept that, from the public health point of view, trachoma should be divided into blinding trachoma and non-blinding trachoma (Jones, 1975). This concept has found a ready acceptance (Dawson, Jones, and Darougar, 1975) and has been of value in focusing attention on the urgent need for surveys in many countries to determine the presence and the magnitude of blinding trachoma.

Communicable ophthalmia

These surveys are the key to effective action but before considering them in detail it is necessary first to clarify the interrelations of trachoma: the classical chronic ophthalmia of chlamydial causation, and mucopurulent conjunctivitis (MPC), or acute ophthalmia, of bacterial causation. Both chronic ophthalmia (trachoma) and acute ophthalmia lie together within the single environmentally-determined complex entity that is well named 'communicable ophthalmia'.

'Ophthalmia' means inflammation of the eye; this is appropriate because it is the total lifelong load of chronic inflammation with acute exacerbations that yields the progressive harvest of needless blindness. 'Communicable' characterizes the essential nature of the Middle Eastern ophthalmia in that it is readily communicable from one individual to another. The conditions that lead to continuing massive pressure of communication of eye infection from one person to another are thus the roots of

communicable ophthalmia and constitute the unifying factor shared by both the chronic and the acute ophthalmias.

Trachoma: a multicyclic infection in which pressure of infection determines severity of disease

Our observations in Iran indicate clearly that trachoma can be a multicyclic infection in which each cycle adds its quota of damage (Jones, 1975). The continuing pressure of re-infection in a community thus determines the severity of the disease and the ultimate degree of damage. The eye-seeking flies appear generally to provide the additional dimension to transmission of infection that escalates the pressure and the duration of exposure to infection into a life-long environmentally-determined programme of re-infection with *Chlamydia trachomatis* and the pathogenic ocular bacteria, thereby producing the mass blinding scourge: blinding hyperendemic trachoma which is the central core of communicable ophthalmia (Fig. 1).

FIG. 1 Interrelations between acute and chronic ophthalmia, and blinding and non-blinding trachoma

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The role of flies in communicating ophthalmia

It has long been accepted that flies provide the main route of transfer of infection in the seasonal epidemics of bacterial conjunctivitis in the Middle East (Wilson, 1936) and in similar climatic zones of Africa and Australia where trachoma is at its worst. Our current studies in southern Iran have shown that the discharges from eyes and noses may contain viable *C. trachomatis*. By means of fluorescein tracing we have shown that such material is transferred in a barrage of fly-vomits to the eyes and nares of adjacent children in a matter of minutes, and we have grown *C. trachomatis* from the flies caught around these children's eyes (Fig. 2).

Acute ophthalmia overshadows and may mask the presence of active trachoma. In a study of acute ophthalmia, in collaboration with Professor M. Khalaf Al-Hussaini and his staff in the Hospital of the University of Assiut in Upper Egypt during November 1975, we demonstrated, by the micro-immunofluorescence test, the presence of antibody to *C. trachomatis* in the tears at 1/8 or greater titre in 18.6 per cent of 124 children under eight years of age presenting with acute ophthalmia. The antibody was to type A in 78.2 per cent; B in 13 per cent; C in 4.4 per cent and D/E in 4.4 per cent. This provides evidence of simultaneous infective trachomatous disease.

'Communicable ophthalmia'

We therefore see 'communicable ophthalmia' as a single, but complex entity consisting of two clinically and microbially discernible sections: mucopurulent conjunctivitis or acute ophthalmia, and trachoma or chronic ophthalmia that develops into blinding trachoma in the overlapping epidemiological conditions that lead also to epidemics of acute ophthalmia (Fig. 1).

Blinding hyperendemic trachoma, the overlapping core of communicable ophthalmia, is thus an environmentally-determined menace resulting from life in communities with open faecal and rubbish disposal, poor personal hygiene, and short interpersonal distance in climates favourable to the production of a high density of the synanthropic eye-seeking flies: *Musca domestica* and *Musca sorbens*, the latter breeding selectively in human faeces.

Laboratory models of environmentally-determined programmes of infection

The validity of these epidemiologically-derived concepts is being confirmed in our laboratory using animal models of the environmentally-determined programme of re-infection and mixed infection.

Dr Marjorie Monnickendam and Dr Sohrab Darougar have shown that after the third re-infection of guinea-pigs with the guinea-pig inclusion conjunctivitis (GPIC) chlamydial agent, this normally benign disease develops much more severe inflammation with conjunctival cicatrization resembling trachoma.

Dr Hadi El Sheikh and Dr Sohrab Darougar have shown in cats that bacterial infection with streptococci alone causes only a mild, short-lived mucopurulent conjunctivitis. Infection with the feline chlamydial keratoconjunctivitis agent alone causes a chronic trachoma-like infection with pannus and conjunctival scarring. Mixed infection with both agents, however, produces a much more severe disease with rapidly blinding ophthalmia in half the cats (Jones, 1975).

Surveys for preventable blindness from communicable ophthalmia

These newly defined concepts make it clear that all countries that have, or suspect that they may have, problems of blindness from communicable ophthalmia, need urgently to carry out surveys of suspected rural communities. The recommended methods have been set out by Dawson and others (1975). It is essential that the full age range of the population be surveyed by means of a valid random sample. Thus all ages must be surveyed for: corneal blindness, potentially blinding trachomatous deformities of the lids (Jones, Barras, Hunter, Darougar, and Mohsenine, 1976), and for severe grades of intensity of upper tarsal conjunctival inflammation.

CORNEAL BLINDNESS

Corneal blindness comes progressively with age from trachoma whereas it comes suddenly from corneal ulceration complicating acute ophthalmia, strikingly in the young, but also in the old, especially those with trachomatous deformities of the lids.

POTENTIALLY BLINDING TRACHOMATOUS DEFORMITIES OF THE LIDS

The potentially blinding abrasive trachomatous deformities of the lids—trichiasis and entropion, or notching of the lid margin or other defects of lid closure resulting from subconjunctival fibrosis of the levator causing functional shortening of the lid (Jones and others, 1976)—are greatly aggravated if scarring has also caused xerosis by occluding the lacrimal ductules in the fornix, or if there is reduced corneal sensation.

These deformities of the lids keep eyes sticky,

(2a)

(2b)

FIG. 2* (a) Fly-borne transmission of ocular discharges within a pool of ocular promiscuity. Fluorescein placed in the eye of Child 1 transmitted by fly vomits to the eyes of Child 2 and Child 3 within 20 and 40 minutes (b) Child 2—Fluorescing spots of fly vomit photographed in blue light through a yellow filter, indicating fly-borne transmission of conjunctival discharge from Child 1 within a period of 20 minutes. Fluorescein was also present in the tear film of both eyes of both children

*Reproduced by permission of the *Trans. ophthal. Soc. U.K.*—Jones, B. R. (1975)

thereby making them a prime target for flies, thus holding the adult person in the infant pool of ocular promiscuity (Jones, 1975), and committing the individual to an environmentally-determined life-long programme of re-infection. Blindness is thus likely to ensue from relentless progression of trachoma, with the mixed chlamydial and bacterial load causing severe inflammation and scarring, aggravated by the physical trauma of trichiasis. Alternatively, blindness can ensue from acute ophthalmia complicated by corneal ulceration to which these eyes are especially liable. The trachomatous lid deformities thus play a determining role in both the chronic trachomatous and in the acute bacterial pathways to blindness.

To block this relentless progression requires immediate preventive action, continuing surveillance, and the maintenance of primary eye health care. The immediate preventive action requires the identification of individuals at risk and the provision of surgical correction and medical therapy. This should be accompanied by measures to reduce the pressure of re-infection by means of mass chemotherapy of the reservoir of infection in the community, especially in pre-schoolchildren and other young people. Reduction in the factors for transmission of infection, by means of personal and community sanitation, should also be of particular benefit to those at high risk because of lid deformities; but no measurements of this effect have been made.

Individuals with lid deformities require continuing surveillance for recurrence of trichiasis, and the community requires surveillance for recrudescence of transmission of infection. They are also the adults most likely to need good primary eye health care: immediate treatment of ophthalmia or the emergency care of corneal ulcers.

INTENSITY OF CONJUNCTIVAL INFLAMMATION

The survey will also reveal the (frequently unrecognized) prevalence of severe conjunctival inflammation that reflects a high pressure of transmission of infection. This requires mass chemotherapy of all infected persons, or at least of all those with moderate or severe grades of intensity of inflammation (Dawson and others, 1975). Some programmes may compromise and settle for delivery only to schoolchildren. However, Fig. 3, showing the age and sex distribution of active trachoma in the village of Sar Rig in southern Iran, indicates just how illogical and suboptimal is the delivery only to the five- to 15-year age range. In many communities this would also restrict delivery to the more favoured children of the more favoured families.

Mass chemotherapy for control of communicable ophthalmia

MASS ANTIBIOTIC PROGRAMMES

The WHO-recommended scheme of mass topical intermittent chemotherapy consists of the administration of a tetracycline eye ointment to both eyes once, or preferably twice, a day for five days each month for three, or preferably six, months. This is known to have an impact and, at present, should form the basis of mass control programmes.

OCULAR THERAPEUTIC SYSTEMS AND ORAL CHEMOTHERAPY

Other methods of delivering chemotherapy are, however, under investigation. Continuous delivery ocular therapeutic systems of poor retention in children have been shown to be at least as effective as twice daily ointment regimens (Jones, 1975).

FIG. 3* Active trachoma (a) upper tarsal and (b) in whole conjunctiva, in right eye in total population, by five-year age groups and sex, in Sar Rig, 1972

*Reproduced by permission of the *Trans. ophthalm. Soc. U.K.*—Jones, B. R. (1975)

Improved devices with much better retention may have a great deal to offer.

Long-acting oral tetracycline chemotherapy has potential advantages in terms of ease, certainty, and continuity of delivery (Jones, 1974, 1975). The possibility of large-scale control of trachoma by the community-based administration of a single short course of, say, three weeks of three oral doses a week of doxycycline (5 mg/kg), is shown by the persisting effect still strikingly apparent in the village of Sar Rig in southern Iran two years after a course of six such doses given only twice-weekly for three weeks, two years earlier. In that case the three-week oral treatment was given to all persons with moderate or severe conjunctival inflammatory disease; approximately half of them had previously received intermittent monthly treatment with either oxytetracycline eye ointment twice a day for one week each month, or single monthly doses of doxycycline (5 mg/kg) for one year.

The Table indicates that before oral chemotherapy, 25 per cent of the population (427) had grade 3 or 4 (moderate or severe) upper tarsal conjunctival inflammatory disease, despite earlier intermittent treatment. The three-week oral chemotherapy was given in November 1973. When the whole population, less deaths and emigrants, but including new births and immigrants, was examined one year after chemotherapy, the figure had been reduced to 12 per cent. At a two-year follow-up the preliminary figures showed 9 per cent. Examination of absentees will probably reduce this figure. It

Table Persistence of effect of a single period of three weeks' oral chemotherapy (doxycycline 5 mg/kg twice a week, i.e. six doses) in November 1973 to all persons in Sar Rig, Bandar Abbas, southern Iran, with grade 3 or 4 intensity of trachomatous conjunctival inflammation, after earlier intermittent monthly topical oxytetracycline, or systemic doxycycline, treatment in approximately half the cases

Date	No. persons examined	Examination					
		Whole eye (per cent)			Upper tarsal (per cent)		
		Grade 3	Grade 4	Grade 3 + 4	Grade 3	Grade 4	Grade 3 + 4
November 1972 (before treatment)	427	20	8	28	15	10	25
February 1975 (1 year after treatment)	396*	6	8	14	2	10	12
February 1976 (2 years after treatment)	375*†	5	5	10	3	6	9

*Whole population including new births and arrivals not treated in 1973

†Data on absentees to come, mainly adults working elsewhere

should be noted that these figures show prevalences in the whole population, including new births and new arrivals, not only in those who were treated among whom there was a lower prevalence of active disease.

Much remains to be done before this could be recommended for widespread use, but these preliminary results indicate that such a course of chemotherapy can reduce the reservoir of infection to a level at which, in present environmental conditions, transmission of infection is controlled for an encouragingly long period. The full results with findings in the adjacent control village will be published elsewhere.

Expected effects on trachoma and acute ophthalmia

Within the complex, communicable ophthalmia, it is likely that trachoma is easier to control by chemotherapy than may be the case for acute ophthalmia. Trachoma, being a chronic infection, waits for the delivery of chemotherapy whenever that is delivered. Acute ophthalmia, on the other hand, comes and goes and does not wait. Topical chemotherapy programmes that control trachoma should ameliorate transmission and severity of acute ophthalmia; but they are not likely to eliminate the problem, which is therefore likely to persist in the villages, as it does in many of the urban populations of the Middle East. This requires the provision of primary eye care: immediate availability of antibiotic therapy of acute ophthalmia whenever required, and the emergency care of corneal ulcers.

However, real control of communicable ophthalmia should come from fly control. There is, therefore, an urgent need to converge resources of rural sanitational and agricultural technology, health education, and current developments in fly control to evolve effective, acceptable, long-term, low-cost methods of fly control.

MONITORING OF EFFECT OF CONTROL PROGRAMMES

Whatever the detail of the antibiotic programme, or other intervention, it is essential that control measures should include provision for monitoring the effect and efficiency of the intervention. This can be done by 'before and after' comparisons, and by simultaneous observations in untreated control communities. These should be followed by long-term follow-up of appropriate samples and the maintenance of long-term surveillance for recrudescence of transmission of infection. In each case the observations should include quantitative clinical data on the intensity of conjunctival inflammation, the presence of lid deformities, and

the prevalence of corneal blindness. It is desirable that this be supplemented by data on the presence of *C. trachomatis* by direct demonstration of the agent, or by isolation, and by data on antibody levels to this agent in tears and sera (Jones, 1974).

ADMINISTRATION OF TRACHOMA CONTROL ACTIVITIES

Health Administrators should consider the general principle that in setting up single categorical disease control programmes such as are required for trachoma-communicable ophthalmia, the exercise should be planned as the first step in provision of primary rural (eye) health care, and not as an independent, indefinitely self-perpetuating organization. As trachoma comes under control the trachoma team, with skill in eye disease and community medicine, should integrate with the primary rural health care service, and provide primary eye care to contribute importantly in control of acute ophthalmia, and in maintaining surveillance as outlined above. The trachoma team, thus integrated in community medicine, must, however, maintain effective links with secondary urban ophthalmic care units, upon which it will be dependent for training, guidance, and the referral of patients. In this way, permanent careers could be provided, thus avoiding the loss of skilled manpower for primary rural health care.

Communicable ophthalmia: the blinding scourge

Communicable ophthalmia has certainly been the blinding scourge of the Middle East in the past. It is certainly a continuing problem of major importance in rural communities that are largely bypassed by economic development, as is the case in southern Iran (Jones, 1975). The future in such populations is in the balance. In the absence of economic development bringing major changes in sanitation and medical services, it will depend on governmental decisions and the correct implementation of effective action.

We see blinding trachoma and acute ophthalmia which together constitute 'communicable ophthalmia', as one of the greatest, but preventable, afflictions of mankind which has its roots in life in communities with open faecal and rubbish disposal, with poor personal hygiene in climates that favour high densities of the synanthropic eye-seeking flies. Can we continue to allow such a harvest of needless blindness to persist, while throwing vast resources into increasingly expensive small-return areas of urban curative medicine? What country can afford indefinitely to neglect its rural population?

ACTION TO PREVENT BLINDNESS

We would urge action to prevent this needless blindness by carrying out surveys of under-served rural populations to determine the location of high risk communities and by implementing topical ocular chemotherapy programmes in these. At the same time, we would urge action to assess alternative chemotherapy, such as may be provided by continuous delivery ocular therapeutic systems or by oral chemotherapy. But, especially, we would urge action directed at the roots of the problem, to assess the practicability and efficacy of fly control by personal and community sanitation and by other means.

ACTION BY GOVERNMENTS

This demands action by governments. The implementation of large-scale surveys and chemotherapy programmes are clearly the responsibilities of governments. Research now needs to be integrated with governmental action. Research in this field of prevention of blindness falls into three phases. The first has concerned case studies, work with animal models, and clinical trials of therapy. This has been done by universities with support from grant-giving bodies.

The second phase concerns field studies, work with animal models of the environmentally-determined human ecology, and field trials of therapy. This is being done by universities and supported by internationally orientated grant-giving bodies. Knowledge accumulated from these studies now requires the third phase to begin: namely, operational research at the pilot control programme scale, to compare various methods of control, to make measurements of cost and effect, and not to shrink from attempting to tackle the roots of the problem. This clearly requires the collaboration of national administrations for health, universities with support by international agencies, and governments.

LACK OF STAFF, CAREERS AND TRAINING FACILITIES FOR PREVENTIVE WORK IN EYE DISEASE

If action to halt this needless blindness is decided upon, the choice of what to do is reasonably straightforward. But the implementation may be delayed by lack of knowledge of clearly defined rural health technology, and by shortage of staff trained for preventive work in eye disease, both at medical and ancillary levels.

Osler epitomized the sense of this obstacle in his comments about the medical teachers of his time: '*Cabin-cribbed, confined within the four walls of a teaching hospital, practising the cloistered virtues of*

clinical medicine, how can they train men for a race of dust and heat, of which they know nothing?

To bridge this gap, and to help to meet this need 'It is proposed to establish in London a centre for training, recruitment, and research in public health ophthalmology and communicable eye disease, . . . with the immediate objective of making a substantial impact on the major problems of preventable rural world blindness'.

There is an urgent need for financial support for the establishment of such academic centres in preventive ophthalmology to ensure exposure of trainees to the challenges of community ophthalmology, and to encourage the recruitment of persons of high calibre into this field by the provision of attractive career posts in this work.

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References

- DAWSON, C. R., JONES, B. R., and DAROUGAR, S. (1975) *Bull. Wld Hlth Org.*, **52**, 279
 JONES, B. R. (1974) *Brit. J. Ophthal.*, **58**, 438
 ——— (1975) *Trans. ophthal. Soc. U.K.*, **95**, 16
 ———, BARRAS, T. C., HUNTER, P. A., DAROUGAR, S., and MOHSENINE, H. (1976) *Ibid.*, **96**, 45
 WILSON, R. P. (1936) *A.R. Giza ophthal. Lab.*, **11**, 95