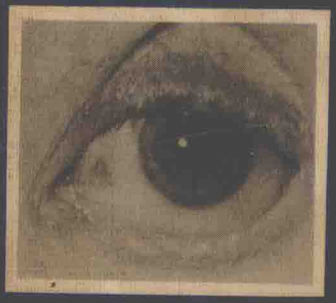

the EYE and its DISORDERS in the ELDERLY

Edited by
F I CAIRD
JOHN WILLIAMSON

WRIGHT

The Eye and its Disorders in the Elderly

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THE EYE AND ITS DISORDERS IN THE ELDERLY

Preface

The combination of an ageing population and the fact that many serious eye diseases increase dramatically in frequency with age makes it essential that those who are interested in the medicine of old age in its broadest sense should be aware of the importance of diseases of the eye. It is in the best interests of elderly patients that geriatricians should know more about ophthalmology, and that ophthalmologists should know more about ageing and the medicine of old age. Multiple pathology in a single patient is now recognized as a commonplace, but nowhere is the further development of this concept to cover multiple pathology in a single organ better illustrated than in the eye. The purpose of the present volume is to bring together the views of experts so as both to give an account of the present state of scientific knowledge, and also most importantly to provide practical advice on the numerous problems of management encountered in everyday practice.

It is a pleasure to thank Mrs M. Smith for secretarial skills, Mrs M. Williamson for the practical support to both of us which made the editing of this volume so enjoyable, and Mr Roy Baker of John Wright & Sons Ltd for his assistance and guidance with the practical problems of a multi-author volume, and for his tolerance of editorial delays.

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1. EPIDEMIOLOGY OF OCULAR DISORDERS IN OLD AGE

John Williamson and F. I. Caird

The uses of epidemiology include the measurement of the size of a clinical problem, as a guide to planning and assistance in the monitoring of success and failure of medical and other measures, and the provision of theories of aetiology for different conditions. Difficulties include the problems of defining and recording a population base, the practical problems of definition and recording of data (WHO (1966) recognizes no fewer than 65 definitions of blindness), and diagnostic and other medical fashions. The statistics of blindness, which may be likened to ocular death certificates, are no exception.

BLINDNESS STATISTICS

There are slight variations between countries in their definition of blindness, and a much greater variation in the reasons for and the advantages of registration, which bear on the likelihood of the completeness of any statistics. In most countries blindness registration is not compulsory, and carries with it few advantages. In others, such as the United Kingdom, registration is known to be incomplete, with up to a third of elderly women who qualify for registration unregistered (Graham et al., 1968). Registration may be refused, often because of the necessity of prior disclosure of personal finances, or patients may be placed on the Blind Register while awaiting treatment in order to gain the benefits of the Register, and then removed after successful treatment. This will clearly affect the apparent prevalence of blindness due for instance to cataract. Changing diagnostic fashions, particularly perhaps in the field of senile macular degeneration, are probably also important. Complexity, especially perhaps in the elderly, results from the existence of multiple causes of blindness, either different in the two eyes or combined in both; this is quite a common problem, and one so complicated as to defy rational description. Despite all these problems much useful information can be derived from blindness statistics on the incidence and prevalence of severe ocular disease leading to blindness.

The certification and registration of lesser degrees of visual impair-

ment is much less perfect. The definitions used are much more variable; registration is often linked to employment, and therefore does not apply to the elderly. Information of this kind, by comparison with that derived from blindness statistics, is virtually useless in the elderly. The determination of the effect of ocular diseases in causing lesser degrees of visual impairment than blindness must, in the elderly, rest almost entirely upon population studies (*see below*).

The most satisfactory and complete blindness statistics are probably those of England and Wales (Sorsby, 1972). They show a striking relation to age of the incidence of new registration as blind, with rates increasing from about 1/1000 per year at the age of 70 to 7/1000 per year at the age of 90 (*Fig.* 1.1). The age and sex specific incidence rates were stable throughout the 1960s; there is no evidence that there have been any significant changes since then, though in Scotland in 1980 there were more males than females registered over the age of 85 (Ghafour et al., 1983).

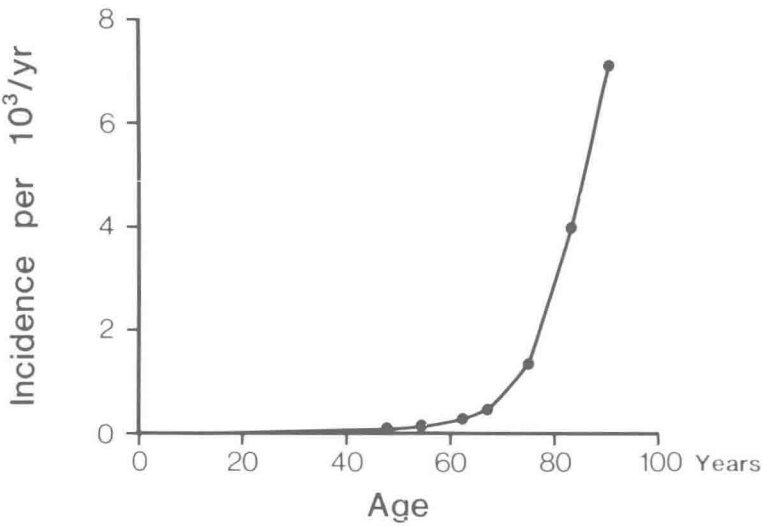

Fig. 1.1. New Blindness Registrations in England and Wales, 1968 (males; figures for females virtually identical; from Sorsby, 1972).

Since the incidence of blindness increases so dramatically with age, it is no surprise that the prevalence of a condition which does not carry an excess mortality (except for diabetic retinopathy) also increases with age: 48 per cent of men registered as blind, and 61 per cent of women, are over 70 years of age. The prevalence rate is about 2·5 per cent at age 85,

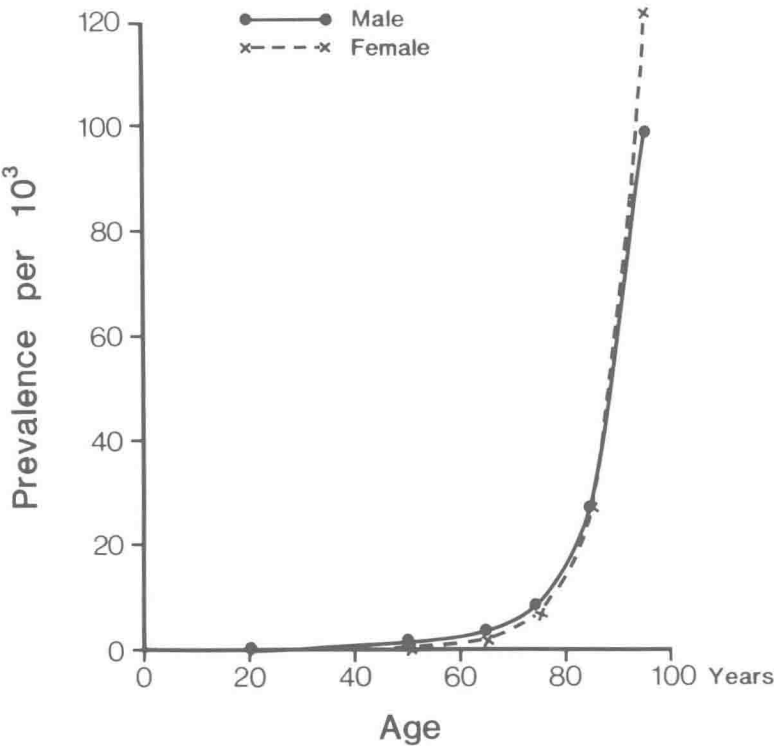

Fig. 1.2. Registered Blind in Oxford, 1966 (Caird, unpublished).

and as high as 10 per cent over the age of 90 (*Fig.* 1.2). It is therefore a common state of affairs, and one bearing very greatly on the rehabilitation of the elderly after any physical or mental illness (*see* Caird et al., 1983), and on their everyday life at home.

Conditions which cause blindness are of great importance to geriatricians. *Table* 1.1 shows the proportions of the various causes. The commonest is senile macular degeneration, but the several types of condition included under this heading are not adequately distinguished. However, all refer to conditions with a very close relation to old age, especially extreme old age, and only recently considered as treatable. Glaucoma and cataract are not peculiar to, though common, as causes of blindness in the elderly; they are together its second most common cause, and should be diligently sought by geriatricians since they are curable or preventable causes of loss of sight. Myopic chorioretinal degeneration remains a not uncommon cause of blindness, but is neither

Table 1.1. Causes of blindness in 506 eyes in persons registered blind over age 65 in Scotland
(Ghafour et al., 1983)

Age	65–74	75–84	85+	65+
No. of eyes	214	216	76	506
Percent with:				
Senile macular lesions	26	48	49	39
Glaucoma	21	16	8	17
Cataract	11	9	30	13
Myopic chorioretinal degeneration	9	5	5	5
Diabetic retinopathy	5	7	—	7
Other	29	16	8	21

treatable nor preventable in our present state of knowledge. Diabetic retinopathy is relatively much more important in younger people, although over half of the patients blind from diabetic retinopathy are elderly (Caird et al., 1969); they make up a small percentage of the total elderly blind, owing to the predominance of other diseases.

Registration for blindness due to cataract is critically dependent on the effectiveness of local ophthalmological services and on the reasons for certification as stated above. The most reliable is likely to be from areas with good ophthalmic services where no one is placed on the blind register while awaiting operation, and the only patients certified as blind from cataract are those with complications of operation or those thought to be unfit for operation on medical or psychiatric grounds.

POPULATION STUDIES

Population surveys may be used to define the prevalence of both symptomatic and asymptomatic ocular disease, but careful scrutiny must be given to how the population study was defined, how it was recruited, what methods of examination were used, and also what definitions of given diseases were employed. Much the most satisfactory and comprehensive population study so far conducted in respect of ocular disease in the elderly is that in Framingham, Mass. (Kini et al., 1978; Sperduto and Seigel, 1980).

The wide variation in the lesions considered as resulting from senile macular degeneration makes it difficult to define and thus to establish its prevalence. However, in Framingham, it was reported as 35, 47, and 50 per cent at ages 51–64, 65–74, and 75–85 respectively (*Table* 1.2) visual symptoms were very much less common. It is thus clear that minor degrees of macular change are very common (but not universal), and that severer degrees producing symptoms are considerably less so. Never-

Table 1.2. Senile macular degeneration in the Framingham survey (Kini et al., 1978; Sperduto and Seigel, 1980)

Age		52–64		65–74		75–85	
Sex		M	F	M	F	M	F
Prevalence	Total	39	32	46	48	49	50
Per cent	Early	19	16	18	24	13	14
	Moderate/severe	20	16	28	24	36	36
	Reduced visual acuity (6/9 or less)	2	1	9	13	24	30

Early: pigment disturbance or less than 10 drusen.
Moderate/severe: 10 or more drusen, elevated pigment layer or retina, or perimacular circinate exudates.

theless, these lesions represent the commonest single cause of blindness in old age (*Table* 1.1).

The statistics for the population prevalence of glaucoma are very sensitive to definition. Hollows and Graham (1966) found that intraocular pressure in the population, whether defined by applanation pressures or Schiotz readings, is affected by age, both pressures considerably rising with age (*Table* 1.3), and are higher at all ages in

Table 1.3. Prevalence per cent of ocular hypertension (intra-ocular pressure 21 mmHg or more on one occasion)
(*After* Hollows and Graham, 1966)

Age	*M*	*F*
40–9	6·3	6·6
50–9	6·7	11·7
60–4	8·8	15·6
65–9	10·4	12·0
70–4	11·8	18·6

women than men. The problem is very similar to that of the distribution of blood pressure, the majority of the population being 'normal', and a minority having pressures raised above an age-related upper limit of normal. The prevalence of ocular hypertension, defined as a pressure of 21 mmHg or more, rose with age from approximately 5 per cent at age 45 to 15 per cent in women and 10 per cent in men at age 70. Approximately a third of those with pressure of 21 mmHg or over but under 25 mmHg had ocular hypertension in one in three readings only, and so were not considered as confirmed. Confirmed ocular hypertension still showed an increase in frequency with age. The prevalence of true chronic simple glaucoma was however very much lower; thus, at the age of 75, confirmed ocular hypertension as defined was calculated as

Table 1.4. Senile lens changes in the Framingham study (Kini et al., 1978; Sperduto and Seigel, 1980)

Age		52–64		65–74		75–85	
Sex		M	F	M	F	M	F
Prevalence	Total	38	45	68	77	88	93
Per cent	Early	20	21	20	19	12	10
	Late	18	24	48	57	76	83
	Cataract	4	5	16	19	42	49

Early: lens vacuoles, water-clefts, spokes, or lamellar separations, on slit-lamp examination.
Late: cortical cuneiform opacities, decreased lucency of lens nucleus, posterior subcapsular or miscellaneous opacities.
Cataract: posterior or cortical lens changes or nuclear sclerosis, and visual acuity 6/9 or less, or aphakia.

being 19 times more common. It must be stressed that the term 'ocular hypertension' is a contentious one, and not accepted by all ophthalmologists. Differing definitions certainly make it difficult to compare these figures with those of the Framingham study (Kini et al., 1978); the latter shows a higher prevalence of raised intra-ocular pressure in males at all ages. Ocular hypertension leads to chronic simple glaucoma relatively rarely, and treatment must take this consideration into account. (*See* p. 85 for the epidemiology of glaucoma.)

The Framingham study shows conclusively the increase with age in senile cataract (defined as aphakia, or posterior or subcapsular lens changes or nuclear sclerosis, associated with a best corrected visual acuity of 6/9 or less); the prevalence is given as 5 per cent at age 52–64, 19 per cent at 65–74, and 46 per cent at age 75–85 (*Table* 1.4). The prevalence in the Edinburgh survey (Milne and Williamson, 1972)—22 per cent at ages from 62 to 79—is essentially similar.

There would appear to be few if any studies on the natural history of myopic chorioretinal atrophy, the fourth commonest cause of blindness in the elderly. It is generally believed that only those with myopia of high degree will develop this complication. Its importance as a cause of blindness is a clear demonstration of the effect of 'congenital' lesions in old age.

The prevalence of diabetic retinopathy is given in the Framingham study as 2, 3, and 7 per cent at ages 52–64, 65–74, 75–85, respectively. Again, definitions are difficult, especially in respect of the significance as diabetic of hard exudates alone, without the characteristic retinal haemorrhages or microaneurysms. These figures are, however, considerably above those given by Caird et al. (1969), but comparable to those in younger age groups. Nevertheless, there is no doubt of substantial variation from country to country in both the prevalence of diabetes itself, and of the frequency among diabetics of its various complications (*see* Caird et al., 1969).

OTHER METHODS

Operation statistics have been used to demonstrate the relation of cataract and age (Caird et al., 1965; Caird, 1973), but here many factors are involved before there can be any definite conclusions. The figures are affected by the efficiency and completeness of ophthalmological services in the area in question, the coverage of the target population, and what may be called the 'operation ratio', that is the proportion of patients fulfilling the ocular criteria for operation who are in fact operated upon. In cataract, although the operation ratio may well fall with age, the criteria for operation are in general the same in elderly men and women, though they differ from those applied to younger patients (Caird et al., 1965).

Admission statistics (e.g. Goldacre and Ingram, 1983) can by their nature only cover patients admitted to hospital, and are therefore only of value when admission to hospital is necessary, for instance for operation. Insofar as much ophthalmological practice, even in the elderly, is on an outpatient basis, they are likely to be of little value in many conditions.

SUMMARY

All these studies, though widely variable in their methods and in the weight that can be given to their results, show that ocular disease increases more or less exponentially with age, and thus that the very old are at a very considerable risk of one or more. They are thus of great importance to geriatricians, who must be alert to the problems presented, and aware of the early manifestations of those conditions that are amenable to treatment.

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2. PATHOLOGY OF THE AGEING EYE

Ralph C. Eagle jun. and Myron Yanoff

Ageing of the eye reflects the composite effect of ageing on its constituent cells and extracellular tissue. Basic cytopathological mechanisms in the elderly eye include cellular death or proliferation, the degeneration or elaboration of extracellular matrix material, and accumulation of pigments, minerals and other substances intra- or extracellularly. Visual loss, in both elderly and young, results generally from either death or dysfunction of the photosensory system, or opacification of transparent ocular media.

CELLULAR DEATH

Ocular cells vary in their ability to proliferate. Some, like the corneal epithelium, divide continually throughout life, replacing older cells that are discarded. In contrast, postmitotic cells such as retinal neurones are incapable of replication, and their number is thought to decrease with advancing age (Adams and Victor, 1981). The gradual loss may reflect, in part, 'preprogrammed cellular senescence'. *In vitro,* and presumably *in vivo,* human cells have a limited replicative lifespan (Cristofalo and Stanulis-Praeger, 1982). The faltering replicative capacity of older cells is thought to result from an acquired inability to initiate DNA synthesis, caused by regulatory abnormalities, not from accumulated genetic damage (Cristofalo and Stanulis-Praeger, 1982). Cells also succumb to the continual stress of environmental factors, such as free radicals (Tappel, 1975; Robbins and Cotran, 1979). Bathed with light and oxygen, the metabolically active outer retina is fertile soil for the generation of these highly reactive molecules. Produced by oxygen interactions during oxidation-reduction reactions, or by electromagnetic radiation, or both, free radicals are thought to damage cells by peroxidizing polyunsaturated fatty acids in their membranes (Tappel, 1975; Robbins and Cotran, 1979). Free radical damage to photoreceptor outer segments is probably the initial step in the accumulation of lipofuscin pigment in the retinal pigment epithelium (RPE) (Feeney, 1978). Genetic factors, i.e. the array of biochemical machinery encoded in each cell's inherited complement of DNA, also are important in the

response of cells to environmental stress. The stigmata of ageing may develop prematurely if cells harbour dysfunctional enzymes (e.g. the development of presenile cataract in galactokinase deficient individuals (Prchal, Conrad and Skalka, 1978)).

Under pathological conditions, major alterations in the cellular environment, e.g. profound retinal ischaemia secondary to central retinal artery occlusion, lead promptly to massive cellular death or dysfunction. The cells of a complex organ like the eye are highly interdependent. For example, the energy-intensive photoreceptors of the avascular outer retina are totally dependent on the RPE and inner choroid. Photoreceptor degeneration rapidly ensues when detachment of the retina anatomically precludes normal cellular interaction (Kroll and Machemer, 1968; Aaberg and Machemer, 1982). Fragile, postmitotic neurones also die when homeostatic mechanisms fail to maintain the intra-ocular environment within a relatively narrow physiological range. Glaucomatous retinal and optic atrophy is a striking example. Finally, cells may be killed by trauma. In the elderly, ocular trauma often is iatrogenic and surgical in nature.

THE PROLIFERATION OF CELLS

Non-neoplastic cellular proliferation is an important pathogenetic mechanism in ocular pathology. The presence of biochemical mediators or growth factors in their environment may induce normal cells to proliferate. Such substances are important in the proliferative reparative phase of inflammation. Hypothetical angiogenic factors produced by ischaemic retina are thought to stimulate ocular neovascularization (Henkind, 1978). Growth also may commence when suitable substrates or space for proliferation become newly available. Minor degenerative alterations in pristine ocular anatomy, e.g. posterior detachment of the vitreous, may provide *lebensraum* for cellular proliferation. This mechanism is operative in the formation of glial epiretinal membranes (Foos, 1980) (*Fig.* 2.1). In other instances, cellular proliferation results from a loss of normal cellular contact inhibition. Following cataract surgery, disease or atrophy of the corneal endothelium appears to facilitate surface epithelial invasion of the anterior chamber (epithelial downgrowth) (Yanoff and Cameron, 1977).

The increasing prevalence of neoplastic proliferation in the elderly reflects the progressive impotence of the immune surveillance system, as well as accumulated environmental damage.

THE EXTRACELLULAR MATRIX: ELABORATION AND DEGENERATION

The effects of ageing are obvious in the eye's extracellular tissues. When the ciliary processes of young and old eyes are compared, the latter