Management of cataract in primary health care services

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The World Health Organization is a specialized agency of the United Nations with primary responsibility for international health matters and public health. Through this organization, which was created in 1948, the health professions of some 165 countries exchange their knowledge and experience with the aim of making possible the attainment by all citizens of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life.

By means of direct technical cooperation with its Member States, and by stimulating such cooperation among them, WHO promotes the development of comprehensive health services, the prevention and control of diseases, the improvement of environmental conditions, the development of health manpower, the coordination and development of biomedical and health services research, and the planning and implementation of health programmes.

These broad fields of endeavour encompass a wide variety of activities, such as developing systems of primary health care that reach the whole population of Member countries; promoting the health of mothers and children; combating malnutrition; controlling malaria and other communicable diseases including tuberculosis and leprosy; having achieved the eradication of smallpox, promoting mass immunization against a number of other preventable diseases; improving mental health; providing safe water supplies; and training health personnel of all categories.

Progress towards better health throughout the world also demands international cooperation in such matters as establishing international standards for biological substances, pesticides and pharmaceuticals; formulating environmental health criteria; recommending international non-proprietary names for drugs; administering the International Health Regulations; revising the International Classification of Diseases, Injuries, and Causes of Death; and collecting and disseminating health statistical information.

Further information on many aspects of WHO's work is presented in the Organization's publications.

Preface

Cataract, generally defined as an opacity of the crystalline lens of the eye, is a major cause of visual impairment and blindness worldwide. This disorder, which has been documented since very early times, was recognized by the Twenty-eighth World Health Assembly in 1975[1] as one of the most important causes of avoidable blindness.

Cataract accounts for nearly half of all blindness, and is particularly common in developing countries. The grim fact is that there already exists a formidable total of some 17 million people needlessly blind from cataract. With the rapid "greying" of the population, the problem of blindness from cataract will assume even more staggering proportions in the future.

In the present state of knowledge, there is no proven means of preventing cataract or its progression to blindness. The condition is, however, amenable to surgical treatment, which, together with the optical correction of the ensuing refractive deficit, results in the restoration of vision.

In developed countries, the availability of eye care services to those blind from cataract ensures that the large majority have their sight restored. In contrast, in the developing countries, in which the majority of the cataract blind are found, there has been over the years an accumulation of unattended persons blind from cataract, resulting in what is commonly referred to as the "cataract backlog".

It has therefore become imperative that programmes for the control of blindness should include, as an important component, interventions for the surgical restoration of vision in persons blind from cataract. These should be an integral part of the primary health care system, so that most of the people who now make up the "cataract backlog" will have better access to surgical services.

[1] Resolution WHA28.54.

This publication contains comprehensive guidelines on the management of cataract through primary health care. It includes a review of the available information on the prevalence of blindness resulting from cataract, strategies for action against cataract, guidelines for the planning of interventions, including development of human resources and infrastructure, as well as managerial requirements for effective action.

The basic guidelines outlined in this publication, which are intended for adaptation to suit local conditions, will help to ensure intensified action against cataract and the restoration of vision to those already blind or destined to become blind from cataract in the future.

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The colour photographs were kindly supplied by Dr Jock Anderson, Dr Allen Foster, Professor Gordon Johnson, Dr Murray McGavin, and Dr David Yorston.

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1. Clinical aspects

Definition

The term "cataract" is derived from the Latin word *cataracta*, which is in turn derived from the Greek word *kataraktes*, which means waterfall (breakdown, downrushing). Ancient practitioners probably gave this name to the condition in the belief that the liquid content of the eye was cascading down.

Defined strictly on the basis of the pathomorphological process involved, cataract is an opacification or loss of transparency in the crystalline lens of the eye. From a public health perspective, however, attention also needs to be paid to the consequences of such an opacification in terms of visual acuity.

In a large number of instances, the opacity, by virtue of its size or position, does not affect vision. In many cases, the opacity is not progressive and mere identification of such an opacity during mass eye examination surveys or clinical examination does not necessarily portend progression to blindness in the future. These considerations sometimes confound the data on cataract diagnosed during eye examinations in blindness surveys, in respect both of the actual prevalence of cataract and of the annual incidence of new cases requiring surgery. An accurate estimation of both rates is essential for determining the magnitude of the existing problem, as well as for predicting how it is likely to develop in the medium and long term. Such a prediction would make it easier to plan interventions against cataract as part of national programmes for the prevention of blindness.

Types of cataract

Cataract can be classified by age of onset (e.g., congenital, juvenile, or "senile" cataract) or by location of the opacity within the lens (e.g., cortical or nuclear). In addition, cataract may be

designated as being the result of, or secondary to, other ocular diseases, systemic disorders, and genetic or environmental influences.

The type of cataract and consequent blindness that gives rise to public health problems is generally related to aging ("senile" cataract). However, congenital cataract and cataracts resulting from trauma, *inter alia*, pose special problems in management with regard to both prevention and treatment. While prevention is part of primary eye care, management of such cataracts is generally the responsibility of institutions that can provide the necessary sophisticated instrumentation often required for treatment and follow-up, and will not be described here.

Cataracts can also be classified in relation to their stage of maturity, i.e., as incipient, immature, mature or hypermature. An incipient cataract is a lens opacity that interferes with vision, if at all, to a very small extent and produces only a slight localized or generalized reduction of the red reflex. An immature cataract is a further stage of lens opacification which reduces vision to better than hand movements and in which there is a marked generalized reduction of the red reflex. A mature cataract is defined as a totally opaque lens which reduces the visual acuity to hand movements or less, and in which there is a total absence of the red reflex. Swelling of the lens may occur when a cataract has reached an advanced stage (intumescent cataract). Finally, the term *hypermature cataract* is applied to a cataractous lens that has shrunk, often with a wrinkling of the capsule. Vision is generally restricted to hand movements or less, and the red reflex is absent.

The above classification is important from a public health point of view, not only in eye examination surveys but also because of the deleterious effect that delay in surgery can have in the mature (Morganian) and hypermature stages. This has important implications for the planning of timely cataract intervention services and in assigning priorities for surgical intervention, if irreversible blinding complications are to be averted.

The pathway to blindness in cataract is generally direct and is the result of the impediment that the lens opacity poses to the entry of light beyond the pupil. However, where the lens becomes swollen (intumescent cataract) or hypermature, provoking an inflammatory or cellular (phacolytic) reaction, secondary glaucoma may supervene; if not urgently and appropriately managed, this can lead to irreversible loss of vision. Secondary glaucoma may also ensue from displacement of long-standing cataractous lenses in the very elderly, either spontaneously or often as a consequence of minor trauma.

Such dislocation may, however, be caused intentionally, as in the procedure called "couching". This ancient technique is still practised in some developing countries, often by itinerant traditional practitioners in remote rural areas not served by cataract surgical services. The procedure is very likely to produce severe complications which, more often than not, render the eye blind within a very short period of time.

Symptoms and signs

Symptoms

An opacity of the lens may be present without causing any symptoms, and may be discovered only on routine ocular examination.

A gradual and painless deterioration of vision in an older person is generally suggestive of cataract. However, other conditions, such as chronic glaucoma, macular changes in diabetes mellitus, and senile macular degeneration, need to be excluded.

One of the earliest visual disturbances with cataract is glare or intolerance of bright light, such as direct sunlight or the headlights of an oncoming motor vehicle. The amount of glare or dazzle will vary with the location and size of the opacity, those occurring in the pupillary area causing symptoms out of proportion to their size. In the early stages, the visual acuity may be normal on routine testing. As the lens opacity progresses, the quality of vision begins to suffer, with an associated fall in acuity of both distance and near vision.

However, where nuclear sclerosis predominates, an improvement in near vision may become apparent as a result of myopia of lenticular origin. Thus an individual who has hitherto required glasses for near work may find that it is possible to dispense with them. However, at the same time, the visual acuity for distance becomes impaired. Before long, the individual's activities are restricted as a result of the further progression of the opacity, and surgical removal of the lens is necessary.

Other visual disturbances include misty vision, dulling of colour sense and occasionally monocular double vision. The consequences of lens-induced uveitis and secondary glaucoma have been referred to earlier; these are heralded by severe pain and redness in the eye. This often occurs in patients who have earlier had vision restored in one eye but have ignored a long-standing cataract in the other eye.

Signs

Evidence of lowered visual acuity together with a dull or absent red reflex is suggestive of the diagnosis of cataract. However, cloudiness of the cornea or vitreous body from any cause needs to be excluded. When the cataract is more developed, a grey or white pupil is observed. In mature cataract, vision may be reduced to hand movements or even light perception. It is important to test for light projection in such eyes to exclude possible underlying disease of, or damage to, the retina or optic nerve.

The pupil in eyes with cataract is normally briskly reactive to light. This is an important clinical sign which denotes healthy retinal and optic nerve function and is predictive of a successful outcome following surgery.

2. Cataract as a public health problem

The type of cataract that constitutes a public health problem is the age-related opacification of the lens that impairs vision to such an extent that occupational pursuits or the activities of daily living are severely restricted. Such restrictions lead to economic and psychological deprivation that adversely affects the quality of life.

The growing life expectancy worldwide, and particularly in developing countries, is already leading to a rapid increase in the number of elderly people. In the current absence of proven methods for preventing or delaying the progression of human cataract, this aging of the population will lead to a phenomenal increase in the number of the cataract blind.

Age-related cataract, which is usually bilateral, is amenable to surgical treatment that is both safe and effective. Surgical output, particularly in developing countries, cannot cope even with the new cases of blindness due to cataract, leading to an inevitable "snowballing" of the number unattended. This is the public health dimension of the problem that needs to be addressed.

Prevalence

In 1984, there were an estimated 27–35 million persons blind (vision less than 3/60 in the better eye) from all causes. Of these, approximately half were blind from cataract. There are marked differences in the prevalence of cataract, related both to ethnicity and to geographical location. The percentage of cataract-related blindness in relation to the overall prevalence of blindness is given for selected countries in Table 1.

Incidence

It is estimated that there is an annual increase in the backlog of people requiring surgery of over 2 million persons newly blind

Table 1. Prevalence of blindness and percentage of cataract-related blindness in certain countries

Region	Population (thousands)	Prevalence of blindness (%)	Cataract-related blindness per 100 blind
Africa			
Chad	5018	2.3[a]	48.0
Congo	1740	0.3[a]	81.0
Gambia	643	0.7[a]	55.0
Eastern Mediterranean			
Saudi Arabia	11542	1.5[a]	55.1
Tunisia	6890	3.9[b]	52.4
South-East Asia			
India	800000	1.5[b] 0.7[a]	81.0
Indonesia	150958	1.2[a]	66.9
Nepal	14667	0.8[a]	66.8
Thailand	49460	1.1[a]	56.6
Western Pacific			
China	1059521	0.4[a,c]	57.1
Japan	116807	0.3[b]	23.0
Philippines	51960	1.1[a]	87.2

[a] Less than 3/60 in better eye.
[b] 6/60 or less in better eye.
[c] Limited survey.

from cataract; this is compounded by the demand for surgery at earlier stages of visual impairment in many communities, in keeping with socioeconomic development. These figures for incidence are based on prospective studies in pilot areas, which do not lend themselves to extrapolation to other areas and particularly to developing countries, and are thus subject to considerable uncertainty.

In any computation of the target number of people to be treated within a given time, it is necessary to take a number of factors into account, including the existing backlog, the estimated surgical output, the attrition from mortality of persons blind from cataract, and the incidence of new cases estimated from demographic data.

Methods of estimating the annual incidence of new cases of cataract blindness have been described in some countries. One such calculation takes into account the point prevalence of cataract (derived from a blindness survey), an estimated annual incidence (based on questionnaire responses during the survey), the annual rate of increase in the age cohort with cataract blindness (from demographic data), and various assumptions about death rates and surgical coverage rates.

In another country, a simpler method for calculating annual incidence in different age groups was used taking into account the prevalence of cataract blindness in the age subgroup with the highest rate, i.e., over 60 years of age, life expectancy at age of entry into the group, the number of people entering this population subgroup annually (from demographic data), and the number of years from entry into this group until death.

However, neither of these methods is easily applicable and the results of proper cohort studies must therefore be awaited before one that is both practical and reliable can be developed.

Age

Senile cataract generally occurs in persons above the age of 50 years. It is estimated that 50% of all those in the sixth decade and nearly 100% in the age group 80 years and older have some opacity. These lens opacities are not necessarily associated with visual impairment or blindness.

The prevalence of senile cataract increases with age, and this trend is clearly seen in blindness prevalence studies. It is therefore important to look at the likely demographic trends in respect of the elderly population (over 60 years) in the developing countries over the next 20–30 years. In developing countries, infant and childhood mortality are falling and people are living longer. It is estimated that, while the size of the elderly population in the developed countries will double by the year 2020, in the developing countries there will be a fivefold increase. Thus, for instance, China and India alone can expect to have a further 270 million elderly citizens by that date. This has important implications in terms of the

absolute numbers of cataract-blind persons requiring attention over the next two or three decades. Moreover, in many countries in Asia and Africa, it is reported that senile cataract is being seen in 40 to 50 year olds, and sometimes even earlier.

Sex

Although a preponderance of cataract among females has been reported from some countries, this may merely indicate the relatively poorer access of women in general, for one reason or another, to surgical services in those countries. The longer life expectancy of women in some countries also needs to be taken into account.

Possible risk factors

The mechanisms of cataract formation in the human lens are as yet not fully understood. Several studies have focused on epidemiological parameters, such as genetic and environmental influences. Others have been directed towards developmental and molecular biological aspects of the lens and its metabolic and biochemical disorders.

The diversity of the cataractous process, in respect both of morphological appearance and of natural history, has rendered these studies particularly cumbersome and complicated, making it difficult to draw statistically significant and valid conclusions on causal relationships. This is further complicated by the multifactorial pathogenesis of senile cataract.

The possible risk factors for cataract can be grouped under the following headings:

- demographic factors;
- other host factors, including genetic and disease-associated factors;
- environmental factors.

The age of onset of "senile" cataract and its rate of progression also vary widely from one geographical region and climatic zone to another, and various environmental and nutritional or metabolic factors are considered to be responsible for these variations.

Demographic factors

The relation of cataract to the aging process has been described earlier (p. 7). The lens participates in the immunocytological and metabolic changes taking place in the body in aging, and the lens changes perhaps reflect these processes.

Host factors

Many drugs and chemicals induce cataract formation under experimental conditions, and some have been associated with cataract formation as a consequence of ingestion or topical absorption when used as medication, e.g., steroids.

Among a number of systemic, metabolic and neurological disorders associated with cataract, diabetes mellitus is perhaps the most important from a public health perspective. After 40 years of age, cataract is commoner in diabetics than in nondiabetics; it is also known that its rate of progression is more rapid in diabetics. With the increase in prevalence of diabetes in many parts of the world, including developing countries, diabetes-related cataract could well be of increasing concern in the future. Altered glucose metabolism in the lens, leading to the accumulation of sorbitol, is considered to be associated with osmotic changes leading ultimately to opacification. Trials are under way to test the efficacy of drugs such as aldose reductase inhibitors in preventing or delaying diabetes-related cataract.

A genetic predisposition to cataract formation seen in consanguineous relatives may also account for the ethnic differences in prevalence found in some epidemiological studies. The underlying cause may be the existence of pharmacogenetic variations that selectively predispose such individuals to environmental cataractogenic influences.

Cataractogenesis has been extensively studied, and it has been suggested that nutrition is one of the many factors that sensitize the lens proteins to change. Differences in nutritional status and dietary composition have been offered as an explanation for the differences in the prevalence and age of onset of cataract in developing as opposed to developed countries.

The coexistence of severe diarrhoea and malnutrition is well recognized. The role of severe diarrhoea *per se* in the causation of acidosis, dehydration and increased plasma urea concentration has been studied extensively. The effects of the osmotic imbalance resulting from rapid dehydration are compounded by those of the raised plasma urea on the lens protein itself through cyanate-induced carbamylation. One or more attacks of severe diarrhoea