CONTINUING MEDICAL EDUCATION

Age Related Visual Impairment in the Elderly

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Summary

Visual impairment among the elderly is a major health problem. With advancing age, the normal function of eye tissues decreases and there is an increased incidence of ocular pathology. Demographic studies have shown that age is the best predictor of blindness and visual impairment. The most common causes of age related visual impairment in the elderly are presbyopia, cataracts, age related macular degeneration, primary open angle glaucoma and diabetic retinopathy. Untreated visual impairment leads to physical handicap, increased incidence of fall, depression, social isolation and dependency. Active screening for visual loss in the elderly should be part of the health examination. The elderly should be encouraged to come for formal 1-2 yearly eye assessment for early detection of visual impairment and to treat all associated problems in order to prevent permanent visual loss.

Key Words: Elderly, Age related visual impairment, Screening

Introduction

In the year 2000, a total of 1.452 million of the Malaysian Population (6.2%) were aged 60 or over. It is estimated that by the year 2020 this figure will rise to 9.5%[1]. Among the various issues that affect the elderly, common health problems including age related visual impairment will be one of the major concerns. Demographic studies have consistently shown that age is the best predictor of blindness and visual impairment[2]. It was also reported that legal blindness (best corrected visual acuity of less than 20/200 in the better eye) occurs in up to 3% of the world population by the age of 60 [2,3].

Burden of suffering from visual loss

Visual impairment in the elderly can interfere with daily activities tremendously. The effect on an elderly person's lifestyle can be quite profound and lead to dependency. Since vision is the most dominant mode of recognising and processing information about the environment, loss of vision can lead to inaccuracy in visual-motor coordination, decreased contrast sensitivity, reduced depth judgement when walking and driving, unsteady gait and eccentric viewing[2,3,4]. All these problems can lead to home trauma and accidents. It was reported that about 11% of elderly patients with visual impairment had a positive history of a fall in a year as compared to only 4.4% of those elderly with normal vision[5]. Since falls are a well recognised cause of morbidity and mortality in the elderly, visual impairment indirectly is the underlying factor that contributes to this. Chronic visual impairment is also associated with increased incidence of psychological morbidity such as depression, irritability, anxiety, low self esteem, social isolation and memory loss [2,4].

Causes of visual loss

The process of aging contributes to visual loss through the deterioration of function of the eye tissues and increased incidence of ocular pathology in the elderly[2]. The process of pathology takes place over months to

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years and patients usually have minimal symptoms initially. The 5 major causes of visual impairment in the elderly are presbyopia, age-related cataracts, age-related macular degeneration, primary open angle glaucoma and diabetic retinopathy[2,3].

Presbyopia

Presbyopia comes from the Greek word *presbus* (old man) and *opia* (eye), meaning an aging eye[4]. The two predominant theories of the causes of presbyopia are either (1) hardening or sclerosis of the lens substance, or (2) a loss of ciliary muscle and choroidal elasticity[4]. The lens gradually becomes thicker and loses its flexibility over time resulting in failure to accommodate light from objects of various distances. Patients will begin to notice changes in their vision beginning in their early to mid-forties and this condition worsens with aging. Presbyopia leads to significant visual impairment but it does not usually cause blindness. Several risk factors have been associated with presbyopia as shown in Table I.

The usual early signs of presbyopia are difficulty in reading fine print and feeling ocular fatigue while reading a book. Other complaints include difficulty in seeing close up resulting in holding reading material further away in order to see it clearly, need for brighter light for reading and less commonly headaches while using near vision.

Current treatment options for presbyopia include reading glasses, bifocal glasses, multifocal glasses, multifocal contact lenses, and intraocular lenses. However, the human lens continues to change over time, and thus a stronger correction is needed as age advances. New surgical options to treat presbyopia such as conductive keratoplasty are already available in many countries.

Table I: Risk factors for Presbyopia

Hyperopia
Occupation : higher risk in jobs that require near vision
Gender : earlier age of onset in females
Ocular trauma : damage to the lens or ciliary muscles
Diabetes mellitus
Drugs: alcohol, anti-depressants, and antihistamines
Geographic factors: tropical and equator area. Higher temperature and exposure to ultraviolet radiation

Cataract

Cataract refers to any form of lens opacity which interferes with vision[5,6]. It is a common cause of visual impairment in the elderly and the commonest cause of blindness worldwide[6]. About half of the general population between the age of 65 to 75 years will develop cataracts, and the incidence increases further by 20% after the age of 75 [5,6]. Cataracts are also the most common treatable cause of visual loss in the elderly, but it is often unrecognised.

The human crystalline lens is naturally clear and pliable. However, when the lens ages, it loses its clarity as well as pliability. Several factors have been associated with development of cataract as shown in *Table II.* Three distinct types of cataract are seen clinically according to the anatomical area of opacity: (1) nuclear sclerotic cataracts are associated with central lens opacification, (2) cortical cataracts consist of radial spokes extending from the periphery and (3) posterior subcapsular cataracts are located in the posterior cortical layer and often involve the central visual axis.[5,6] Patients can have a combination of more than one subtype.

Patients with cataract often describe their vision as foggy, blurred or fuzzy, and colour perception may also be affected. Driving at night may be difficult as they experience glare from oncoming headlights especially for those with posterior subcapsular cataract. If a patient has an associated refractive error, double vision in one eye or monocular diplopia may be a feature. Pain and photophobia are not features of cataract, thus if these symptoms are present, more serious ocular pathology needs to be excluded and urgent ophthalmology referral is indicated.

The most common objective finding of a cataract is reduced visual acuity by Snellen chart visual acuity assessment[5]. The pupillary reaction to light should be normal in cataract. A direct ophthalmoscope will demonstrate patchy dark opacities within the red reflex. Cataract is best visualised by using a slit-lamp microscope in the ophthalmology clinic[5].

When the activities of daily living of an elderly person are affected and quality of life is jeopardised, treatment of the cataract is indicated. Surgery should be an option when changes in eyeglasses are no longer effective. Surgery is also indicated if the cataract interferes with management of underlying eye diseases like diabetic retinopathy, macular disease or

glaucoma[5,6]. Modern cataract surgery is very safe and can be performed as an outpatient procedure under local anaesthesia. The techniques commonly applied are extracapsular cataract extraction and phacoemulsification. The extracapsular cataract extraction involves loosening and removal of the entire lens nucleus through an incision. Phacoemulsification involves ultrasonic fragmentation of the lens into tiny pieces which are then aspirated from the eye. With either technique, the subsequent steps involve removal of residual lens cortex and insertion of an artificial intraocular lens. Over 90-95% of patients who have undergone cataract surgery experience visual improvement achieving visual acuity of 20/40 or better[5,6]. The majority of patients have improved quality of life and achieve self independence after cataract surgery. Postoperative complications occur in less than 1% of patients and may include bleeding, glaucoma, infection, macular oedema or retinal detachment amongst others.[5,6]

Table II: Risk factors for Cataracts

Diabetes mellitus
Smoking
Excessive alcohol
Trauma (blunt and penetrating)
Family history
Exposure to sunlight/ultraviolet B radiation
Steroid therapy
Uveitis

Age-related macular degeneration

Age-related macular degeneration (ARMD) is a leading cause of legal blindness among the elderly above 60 years of age and it is a global public health crisis [6,7]. Risk factors for ARMD include advancing age, a positive family history of ARMD, hypertension and smoking. In this condition, central vision is lost, but peripheral vision almost always remains intact. Clinically ARMD occurs as two distinct categories: the nonexudative type which contributes to about 90% of ARMD cases and the remaining 10% belongs to exudative type ARMD. The non-exudative type is the milder type and carries a better prognosis. The hallmark of non exudative ARMD is small, round white to yellowish deposits of extracellular hyaline material at the Bruch's membrane called drusen[7]. Drusen alone usually do not disturb visual function. The cause of visual loss in non-exudative ARMD is geographic atrophy of the retinal pigment epithelium. Over time, the patches of atrophy may increase in size and also may coalesce to form a larger area of retinal atrophy. It occurs in only about 0.6% of patients but is associated with profound visual loss [6,7].

The exudative type of ARMD is more serious and accounts for 80-90% of cases of severe visual impairment related to ARMD[7]. It is characterised by abnormal choroidal angiogenesis in which there is a growth of abnormal vessels from the choroidal to the subretinal space. It is believed to occur because the Bruch's membrane has been damaged by drusen. The new vessels are fragile and thus leak fluid and blood into the macula, eventually leading to formation of a fibrovascular scar and resulting in irreversible blindness. The pathogenesis of ARMD involves possible genetic component ABCR gene and first-degree relatives of patients with exudative ARMD have three-fold risk of developing the disease as compared to the general population[7].

The majority of patients with non-exudative ARMD are asymptomatic. Loss of vision occurs in geographic atrophy or exudative ARMD. The classic symptoms of ARMD are blurring of central vision and distorted vision (metamorphopsia), and sometimes central scotoma. Other associated symptoms are difficulty in driving or reading, and requiring brighter light and magnifying glass for fine visual activity.

Two current treatment modalities for ARMD are laser photocoagulation and photodynamic therapy which has been proven to reduce the risk of severe visual loss and limiting the extent of damage caused by neovascularization. However, only a minority of patients are suitable candidates for laser surgery. New techniques of treatment such as anti-angiogenic drugs, low dose radiation therapy and surgical intervention are still currently under investigation. The use of antioxidant vitamin and mineral supplements is controversial. Some researchers believed that taking high dietary carotenoids may lower the risk of developing ARMD[6,7].

Primary open angle glaucoma

The prevalence of glaucoma is about 3-4% in the population above the age of 70 [8]. It is a significant cause of blindness in the world. Glaucoma is characterised by elevated intraocular pressure that causes progressive damage to the optic nerve resulting in optic atrophy and visual field loss. In primary open angle glaucoma, the pathological process is chronic,

slow and progressive over years. It is usually bilateral but may be asymmetrical. In this disease, there is an obstruction to the outflow of aqueous humor at the trabecular meshwork. Following this there is a rise in intraocular pressure which in turns causes direct mechanical damage to the retinal cells. Other theories are that the intraocular pressure impairs the micro circulation that provides nutrients to the optic nerve and glutamate toxicity leading to axonal loss. The intraocular pressure is typically above 21 mmHg, however some patients may have a pressure below 21mmHg, or normal-tension glaucoma. Therefore measurement of intraocular pressure alone is inadequate in making the diagnosis[6,8]. The diagnosis is made based on optic disc cupping associated with characteristic visual field defects that correspond to the optic disc findings. Several risk factors are associated with primary open angle glaucoma as shown in Table III.

Ophthalmological examination reveals an increase in the optic cup:disc ratio, thinning or notching of the disc rim and disc haemorrhages. Visual field examination would show peripheral visual field loss or arcuate scotoma and in the late stage tunnel vision. Patients with primary open angle glaucoma are generally asymptomatic until late in the course when optic nerve damage is quite advanced. Unfortunately during this stage the optic atrophy is usually irreversible, therefore early detection and prompt treatment are still essential in preventing visual loss[8].

Initial treatment aims at reducing the intraocular pressure by at least 20-50% of the initial pressure[8]. This may be achieved by medical treatment using topical beta blockers (such as timolol) in reducing aqueous production. If further reduction of intraocular pressure is necessary, other drugs such as epinephrine, miotics, carbonic anhydrase inhibitors, alpha2 agonists and prostaglandin analogues may be added in stepwise pattern. Argon laser trabeculoplasty reduces the intraocular pressure by increasing aqueous outflow, but this is often transient. The commonest surgical procedure used in treating glaucoma is trabeculectomy. Trabeculectomy creates a new channel in which the aqueous flow from anterior chamber to subconjunctival space is enhanced. Antimetabolites such as mitomycin and 5-fluorouracil may be used in conjunction with trabeculectomy to decrease post operative scarring and to maintain patency of the channel, thus improving the post-operative result.[6,8]

Table III: Risk factors for primary open angle glaucoma

High hyperopia
High myopia
History of ocular trauma
History of uveitis
Diabetes mellitus
Family history of glaucoma
Long term steroid therapy

Diabetic Retinopathy

Diabetic retinopathy is the leading cause of blindness in the elderly suffering from diabetes mellitus[6,9]. Both type I and type II diabetes mellitus result in diabetic retinopathy. As the duration of diabetes increases, the prevalence of diabetic retinopathy also rises. However, some patients have advanced diabetic retinopathy at the time of diagnosis if the underlying diabetes mellitus has been undiagnosed for years. Diabetic retinopathy is broadly classified into two groups, that is non proliferative and proliferative retinopathy. Type I diabetes is more commonly associated with proliferative diabetic retinopathy whereas type II diabetes is more likely to cause macular oedema and maculopathy[3,9].

In non-proliferative diabetic retinopathy, retinal dot and blot haemorrhages, retinal exudates, microaneurysms and retinal oedema may be present. If these changes involve the macular region, it is known as diabetic maculopathy which is the most common cause of visual loss in non proliferative diabetic retinopathy. As the duration of diabetes mellitus progresses the retina may develop neovascularization in response to retinal ischemia. Proliferation of new vessels occurs at both the optic disc and the retina, it may even extend to the iris (rubeosis iridis). These new vessels are very friable and bleed easily. Some new vessels may also grow into the vitreous body and as the posterior vitreous detaches, this results in vitreous haemorrhage and tractional retinal detachment may follow. New vessel formation at the iris may lead to secondary rubeotic glaucoma[3,6,9].

Pan retinal laser photocoagulation has been proven to reduce the risk of visual loss by 50%[6]. The goal of laser therapy is to reduce the angiogenic stimulus for neovascularization. As neovascularization regresses, the macular function is preserved and the rate of progression to vitreous haemorrhage and retinal detachment also decreases[9].

Focal laser therapy is applied to microaneurysms and in patients with significant macular oedema, it reduces the risk of visual loss. In non resolving vitreous haemorrhage and tractional retinal detachments, surgical intervention such as pars plana vitrectomy may be performed[6,9].

Prevention of visual loss

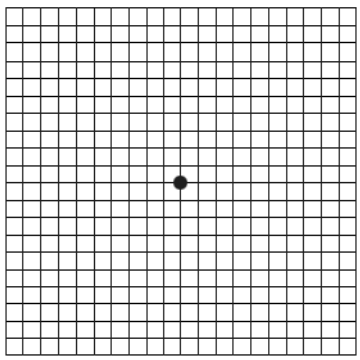
Age related visual loss in the elderly is usually asymptomatic at the early stage. Elderly people who experience visual impairment may not be forthcoming with the complaint, even when they consult their doctors for other medical problems. During consultation, elderly patients should be encouraged to discuss problems with vision. Simple screening questions should be asked in history taking to aid in identifying those who are at a risk of suffering visual loss. (Table IV)

Refractive errors such as presbyopia are readily corrected with spectacles or contact lenses. Patients must be encouraged to visit their optometrist for proper correction of refractive errors. Reduced visual acuity with lens opacity or loss of red reflex on direct funduscopy should arouse the suspicion of cataract. If cataract is present, the patient should be referred to an ophthalmologist for further evaluation and the patients are encouraged to get more information about treatment options from their ophthalmologist. Early symptoms of metamorphopsia or distortion of shapes, particularly when the patient looks at rectangular objects such as windows are characteristic of age-related macular degeneration. The use of the Amsler Grid is feasible in both the clinic and at home for screening of ARMD (Figure 1). Macular Computerized Psychophysical Test (MCPT) is a new screening technique recently developed and more superior than Amsler grid in detecting early ARMD[10]. Those with symptoms must be referred to an ophthalmologist for examination and specific diagnosis using fluorescein angiogram. Primary open angle glaucoma is associated with early peripheral visual field loss and affects central vision late, therefore most ophthalmologists recommend that the elderly should have a comprehensive eye examination every 1-2 years[2,6,9]. Besides measuring introcular pressure, patients are subjected to visual field testing and indirect ophthalmoscopy to evaluate the optic disc and early detection of cupping.

Patients who are followed up for diabetes mellitus should have comprehensive eye examination shortly after diagnosis. Visual acuity and visual field testing should be performed. Routine direct funduscopy should be part of the physical examination in the follow up clinic followed by annual review by an ophthalmologist in the eye clinic with pupil dilatation, indirect ophthalmoscopy examination and intraocular pressure measurements[2,3,9]. Good control of blood sugar is fundamental in retarding the onset and progress of diabetic retinopathy. Other associated medical conditions which can worsen diabetic retinopathy such as hypercholesterolemia and hypertension should be controlled appropriately.

Table IV: Screening questions in history taking for identifying those who are at risk of visual loss

Tell me more about your vision !
Have you recently experienced eye strain when reading or watching television?
Do you experience glare when driving or in bright light?
Have you been treated for any eye disease?
When did you last change your spectacles?
When did you last visit an ophthalmologist?
Do you experience frequent falls recently?
Any family members having serious eye problems with visual loss?



While focusing on the dot in the center of the grid, with one eye covered, ask yourself the following questions:

- Am I able to see the corners and sides of the squares? Do I see any wavy lines?
- Are there any holes or missing areas?

If the lines of the grid are missing or appear distorted you should visit an ophthalmologist.

Fig. 1: Amsler Grid for testing macular function

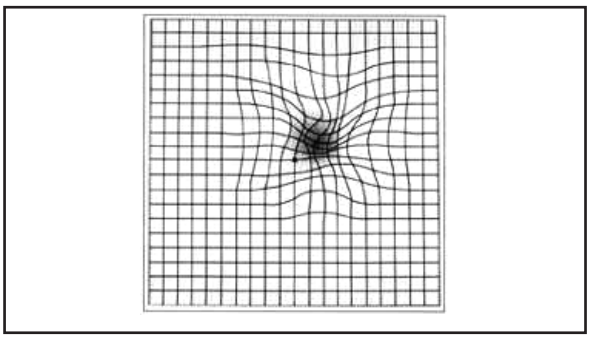


Fig. 2: Amsler Grid appearance in age related macula degeneration

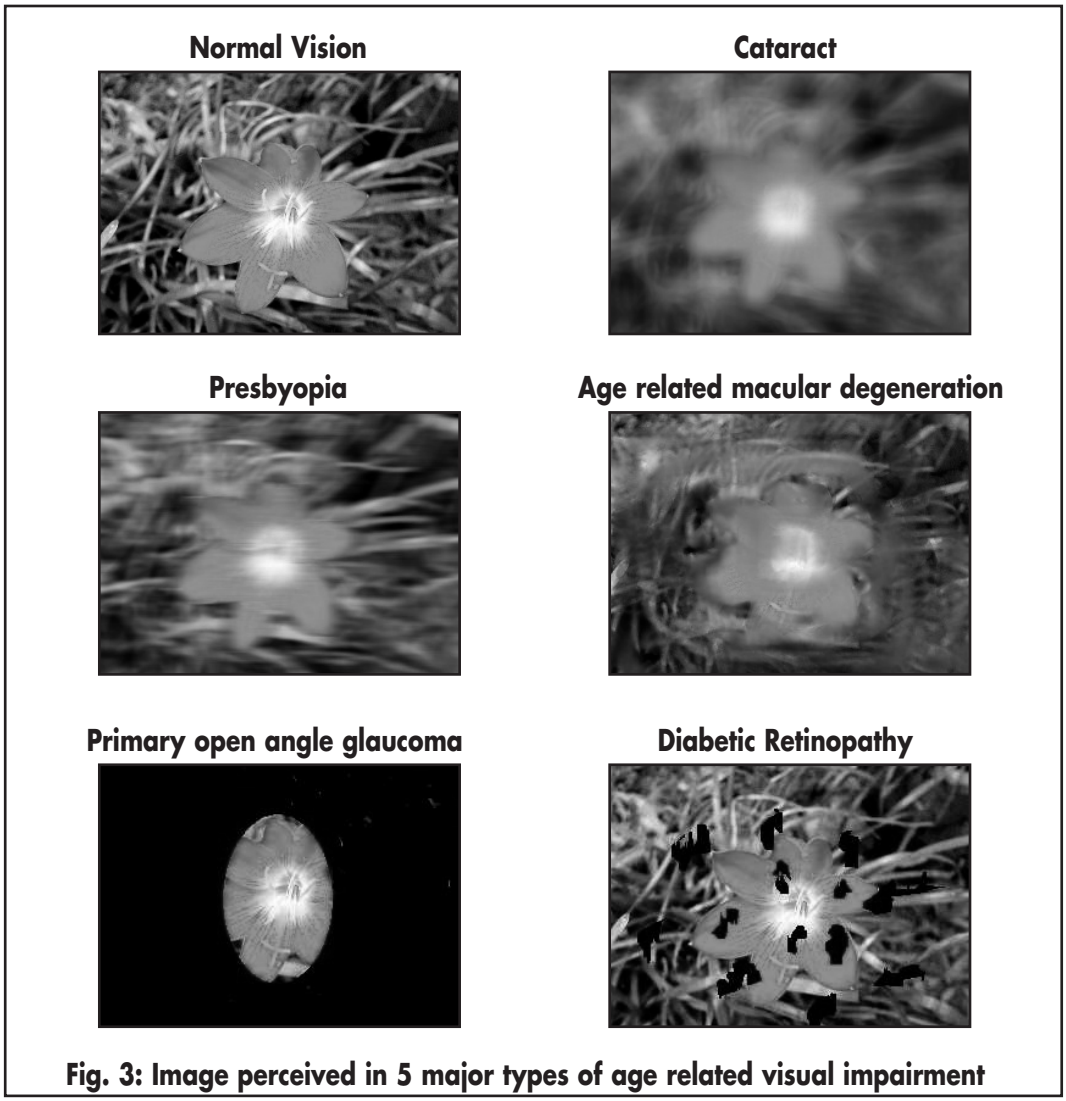


Fig. 3: Image perceived in 5 major types of age related visual impairment

Conclusion

Visual impairment among the elderly remains a major health problem. Active screening for visual loss in the elderly should be part of the health examination. The elderly should be encouraged to come for formal 1-2 yearly eye assessment for early detection of visual impairment and to treat all associated problems in order to prevent permanent visual loss. Having good vision indirectly minimised both the physical and psychological complications such as falls, social isolation and depression.

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AGE RELATED VISUAL IMPAIRMENT IN THE ELDERLY

CME Questions

1. The following are causes of chronic visual loss in the elderly:
A. Age related macular degeneration.
B. Retinal detachment
C. Central retinal artery occlusion
D. Senile cataract
E. Primary open angle glaucoma

2. Risk factors for primary open angle glaucoma include:
A. Family history of glaucoma
B. Previous history of ocular trauma
C. Steroid therapy
D. Long term beta blocker therapy
E. High myopia

3. The following are true regarding ophthalmology periodic health examination for the elderly:
A. Elderly diabetic patients should have annual eye review by ophthalmologist.
B. Amsler Grid is used for screening of primary open angle glaucoma.
C. Visual field examination is part of the screening for primary open angle glaucoma.
D. Physician should enquire about visual problems only when patients have ocular symptoms.
E. Ocular examination is part of the physical examination for an elderly who presents with fall.

4. The following are recognised clinical features of age related macular degeneration.
A. Arcuate scotoma
B. Metamorphosia (distorted image)
C. Central scotoma
D. Ocular pain
E. Difficulty reading

5. The following statements are true regarding senile cataracts.
A. Chronic exposure to ultra violet B predisposes to cataracts formation.
B. Posterior subcapsular cataract is associated with loss of central vision early in the disease process.
C. Inability to drive at night due to glare is a feature of cataract.
D. Pupillary reaction to direct light reflex is affected.
E. Phacoemulsification surgical techniques must only be performed for in-ward patients.