W J Med Sci ISSN: 1817-3055

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Volume 1 Number (1): 1-8, Jan-Jun, 2006

Patho-Physiology of Lachrymal Glands in Old Age

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Abstract: Senescence or aging is the sum total loss of functions and structures in the human body. It is important to understand this process and the problems associated with it in order to lead healthy life. Many patho-physiological disorders have been described, tears in old age is one of them. The term does not imply the presence of a disease or an abnormality, but it is rather an annoyance, which may be because of varied causes. The present review describes various etiological factors and mechanisms for eyelid abnormalities, naso-lachrymal drainage pathologies, neurological causes, corneal disorders, irritation of lashes and hyper secretion of tears. Dry eyes are considered to be the commonest of all in causing excess of tears. Recent advances related to the cause and target oriented treatment of the tears have also been discussed that will open new avenues for further research.

Key words: Tears · old age · epiphora

INTRODUCTION

Aging is a normal physiological process in which every system of the body undergoes gradual structural and functional degeneration. With advancing age there is reduced vitality and therefore, vulnerability to various disorders. Everyone experiences an occasional overflow of normal tears during aging. These are produced in the gland, called lachrymal gland. Excessive watering of eyes and tears related complaints are due to less lachrymal drainage function among elderly people.

Overflow of tears, is usually caused by insufficient drainage of the tear film from the eye (epiphora). The most common cause is a blockage of the lachrymal (tear) ducts located next to the nose, but the condition may also result from the excessive production of tears. Epiphora is a symptom rather than a disease and may be caused by a variety of conditions.

It is important to differentiate between chronic epiphora, acute epiphora and normal tearing. Chronic epiphora results from a long-standing or continuous disorder, while acute epiphora usually results from a temporary condition such as a foreign body in the eye or environmental factors such as wind, pollen, eyestrain, emotional stress and sleep deprivation. The chronic variety nearly always requires treatment by a professional, while acute epiphora may or may not require treatment, depending on the severity of the condition.

A portion of tears evaporates, but the excess normally drains into the nose via the lachrymal canals and then into the throat or out through the nostrils. These types of tears are made continuously and are known as basal cell secretions. Reflex tears, on the other hand, are those produced in responses to emotions or irritation of the eye. The volume of tears produced by the reflex mechanism is larger, however, the basal tearing is more important for the health of the eye, but the volume of tears produced by the reflex mechanism is larger.

The function of tears is to lubricate, nourish and protect the eye from dust and other irritants thus preventing infections. Spread by blinking (about every six seconds), tears keep the surface of the eye optically clear and smooth. Tears flow into the eye through ducts from tiny glands located under the upper eyelids and drain from the eye through small openings near the nose (the puncta).

CAUSES OF EXCESSIVE TEARS IN OLD AGE

The common causes of tears in old age are:

Dry eye: Dry eye affect 10-15% of the adults in old age [1]. The cause of dry eyes is an imbalance in the composition of the tears, decreased tear production or excessive tear evaporation. Like skin and hair, tear production tends to dry up as one get older. When the tear production decreases, eyes become easily irritated. The medical term for this condition is keratoconjunctivitis sicca.

Dry eyes are also associated with medical conditions such as rheumatoid arthritis, lupus, scleroderma and Sjogren's syndrome. Damage to the tear glands from inflammation or radiation can hamper tear production Although dry eyes can affect both men and women at any age, the condition is more

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common among women, especially after menopause. This may be due to hormonal changes Common medications used by geriatric population can also cause dry eyes. These include, diuretics (drugs commonly used to treat high blood pressure), antihistamines, decongestants, sleeping pills, tricyclic antidepressants, Isotretinoin-type drugs for treatment of acne, opiate-based pain relievers such as morphine.

Blink rate: Something as innocuous as a blink can make the difference between maintaining the integrity of the ocular surface and leaving the eye open to the ravages of dry eye. In fact, researchers have shown that a blink facilitates the distribution and formation of the pre-corneal tear film across the cornea [2].

Factors influencing blinking:

- **Environmental factors:** Alterations in temperature, humidity, lighting and airflow can have a profound effect on blink rate. There are conflicting studies evaluating blink rate at different lighting levels [3], but this may be due to difficulties in accurately measuring blink rate.

  Factors that either directly or indirectly affect the ocular surface, such as wind, significantly affect blink rate [4].

- **Activity-related factors:** Engaging in conversation can increase blinking, while intently concentrating on a visual task can cause it to drop. One study showed that blink rate went from 17 blinks/min at baseline to 26 blinks/min during conversation and dropped to as low as 4.5 blinks/min during reading [5].

- **Psychological:** Though the neural pathways that control blink rate and how they are affected by mental processes aren't completely understood, it's apparent that blink rate changes during cognitive function. Blinking increases with excitement, frustration and anxiety, decreases with guilt, reading and occurs when mental load is at its lowest. Most blinks occur with ocular saccades analogous to line changes while reading [4]. The neurotransmitter dopamine and its levels in the central nervous system have been found to be associated with blink rates [6].

- **Physiopathological Factors:** Age, gender and muscular tension and certain disease seem to have effects on blink rate however not all physiological factors appear to have a significant effect. There appears to be no significant difference between the blink rate of males and females [7]. However, alterations in eye position (i.e., looking up or down) may affect blink rate [4, 8]. The neurotransmitter dopamine and its levels in the central nervous system have been found to be associated with blink rates [6]. As mentioned Parkinson's and schizophrenia, decrease and increase blink rate respectively [9].

Tear Film: The eyelids spread tears across the surface of the eyes in a continuous thin film. Studies have suggested that the pre-corneal tear film is composed of three layers composed of oil, water and mucus [10]. Problems with any of these layers can cause dry eye symptoms.

- **Oil:** The outer layer, produced by small glands on the edge of the eyelids (meibomian glands), contains fatty oils. These smooth the tear surface and slow evaporation of the middle watery layer. When the oil layer is abnormal, the watery layer evaporates at faster rate. Dry eye symptoms are common in people whose meibomian glands are clogged. Meibomian dysfunction is more common in people with inflammation along the edge of their eyelids. It may also be due to skin disorders such as rosacea and others.

- **Water:** The middle layer, which makes up about 90% of tears, is mostly water with a little bit of salt. This layer, produced by the lacrimal glands, cleanses the eyes and washes away foreign particles or irritants. A shallow water layer can predispose to tear film instability. If the eye produces only small amounts of water, the oil and mucus layers can touch and cause the stringy discharge.

- **Mucus:** The inner layer of mucus allows tears to spread evenly over surface of the eyes. Dry spots form easily in any part of the cornea that has patchy loss of the mucus layer.

The interaction of the time between blinks (the inter-blink interval, or IBI) and tear film break-up time (TFBUT) regulate ocular surface integrity. A protected surface exists when the TFBUT matches or exceeds the IBI. In contrast, the surface is unprotected when TFBUT is less than the IBI. This is clinically relevant, since intermittent exposure of a tear-film-deficient cornea leads first to ocular discomfort, then to clinical signs of keratitis and redness [11]. The development of an ocular protection index quantifies the interaction between the IBI and TFBUT and seems to be useful in assessing the factors that cause dry eye.

As TFBUT decreases, in dry eye [12], blink rate increases [13, 14] and pathological conditions such as dry eye worsen. It is shown that subjects experienced discomfort shortly after

break-up occurred [15]. Research has shown that an increase in corneal sensitivity can increase blink rate [4,16] and this may be a driving force behind blink rate.

Eyelid abnormalities: Since it is pointing inward toward the lacrimal lake, an observer looking directly toward the eyelid cannot see the punctum. Malposition or eversion, more commonly, is an acquired anomaly in older individuals with eyelid laxity and senile ectropion (outward turning of eyelid margin), where the punctum is rotated vertically away from the globe. If the punctum is visible with the slit lamp without manipulating the eyelid, medial or punctual ectropion exists. Many patients with medial ectropion complain of tearing because of failure of the punctum to capture tears in the lacrimal lake. Long-standing medial ectropion and punctual eversion lead to stenosis or occlusion of the lower eyelid punctum, which is another cause of epiphora. Conjunctiva in the area may become injected, thickened, or keratinized due to chronic irritation. In most patients with lower eyelid punctual malposition, the cause is excessive horizontal lower eyelid laxity.

Ectropion may be mild or severe and may involve all or part of the eyelid margin. It progresses from punctal eversion to generalized ectropion. Horizontal laxity of the eyelid may be assessed by the snap back test. Placing a finger on the inferior orbital rim and pulling the lower eyelid down performs this test. The eyelid is pulled away from the globe and released. If it fails to "snap back" into approximation with the globe without a blink, the test is considered positive, that is, horizontal laxity of the lower eyelid is present. If the eyelid snaps back against the globe without a blink, the test is considered negative. The lower eyelid is also considered lax if it can be passively stretched more than 6 mm from the globe [17]. Lower eyelid laxity due to laxity of the LCT (lateral canthal tendon) may be diagnosed by directing gentle digital pressure in a nasal direction along the center of the lower eyelid. If this draws the lateral canthal angle closer to the temporal limbus, LCT laxity is present. In a similar manner, MCT (medial canthal tendon) laxity may contribute to overall laxity of the lower eyelid and may be diagnosed by directing lateral digital pressure on the eyelid. If the lower punctum is displaced temporally, MCT laxity is present. Medial ectropion or punctal eversion is a subset of involutional ectropion and is often the first sign of impending generalized involutional ectropion. Medial ectropion is manifest by ectropion of the medial one third of the lower eyelid.

Naso-lachrymal drainage system pathology: True lachrymal obstruction or dacryostenosis, is much more common in elderly. As much as 3% of the patients visiting the clinic are thought to be related to this problem [18]. It has been recognized that acquired dacryostenosis is a problem of elderly persons and that women are affected four times more often than men [19]. The exact pathogenesis of primary naso-lachrymal duct obstruction remains unclear, although chronic inflammation with secondary fibrosis of mucosal tissue seems to be an important factor. Obvious stenosis of the puncta or the caniliculus due to senility, inflammations or tumor can cause obstruction in the drainage path of the tears. The fact that the basal rate of tear secretion progressively diminishes after age of 40 years [20] suggests that many patients probably have complete lachrymal obstruction but no epiphora owing to their small tear volume.

Inflammation of the canalicular system can be secondary to dacryocystitis, but isolated bacterial infections of the canaliculus are rare. Perhaps Streptomyces, Actinomyces israelii, or Arachnia propionica (previously mislabeled as Streptothrix) causes the most common infection [21]. Fungus infections with organisms such as *Candida albicans*, *Aspergillus niger*, *Nocardia* and *Pityrosporum pachydermatis* was reported by Romano *et al*. [22]. In the clinical presentation, the lower canaliculus is usually involved and the patient complains of epiphora, Swelling and inflammation of the lid medially are noted. The punctum is swollen and red, with mucoid or mucopurulent discharge, irrigation may or may not be possible through the canaliculus and a small probe may encounter gritty resistance. Diagnosis is made on expressing yellow-tinged concretions from the canaliculus. On cytological examination, they show Gram-positive branching filaments. If the classic symptoms are absent, high-resolution ultrasonic examination (transducer frequency of 20 MHz) of the lachrymal drainage system demonstrates concrements (sulfur grains), measuring 1-2 mm in diameter [23].

When there is a stenosis of nasolacrimal duct patients may present with symptoms of chronic epiphora, conjunctivitis and low-grade infections or with acute dacryocystitis. The clinical syndrome is most common in elderly Caucasian women. Stones in the lachrymal sac usually are not of fungal etiology. Studies have revealed inflammation, vascular gongestion and edema of the naso-lachrymal duct in the early phases and, ultimately, fibrosis with complete occlusion of the naso-lachrymal duct's lumen in the late phases [19]. The specific cause that triggers this sequence of events is not known. Nonetheless, it is reasonable to postulate that inflammation with partial ductal obstruction leads to accumulation of cellular debris, which further aggravates the ongoing inflammation and creates a vicious cycle that leads to permanent cicatrisation of the naso-lachrymal duct lumen. Generalized or localized stenosis of the naso-lachrymal duct can result from involution changes or can occur secondary to bouts of infection, stones, topical meditations, or other sources of inflammation. Jones and Wobig [24] described flaccid-canaliculus syndrome [25]. Involution changes may produce a naso-lachrymal system that appears

open to irrigation, but due to lid laxity and poor lachrymal pump function, will not drain tears through the system properly.

Neurological cause: The commonest neurological cause is Bell's palsy. This is an acquired weakness of one side of the face, due to an injury to the facial nerve. The symptoms on the affected side typically include inability to close the eye, to smile, wrinkle the forehead and whistle. Speech may be mildly slurred. Tearing occurs because the eye does not close completely. Taste sensation may be diminished on the front half of the tongue. Sounds may appear louder on the affected side (hyperacusis)-this may be caused by paralysis of the stapedius muscle but can also occur independently. The incidence of Bell's palsy is 20 to 30 cases per 100,000 people per year [26]; it accounts for 60 to 75% of all cases of unilateral facial paralysis [27]. The sexes are affected equally. The median age at onset is 40 years, but the disease may occur at any age [28]. The incidence is lowest in children under 10 years old, increases from the ages of 10 to 29, remains stable at the ages of 30 to 69 and is highest in people over the age of 70. The left and right sides of the face are involved with equal frequency. Most patients recover completely, although some have permanent disfiguring facial weakness [29]. Poor prognostic factors include older age [26], hypertension [30], impairment of taste [31], pain other than in the ear and complete facial weakness [32]. In the first three days, electrical studies reveal no changes in involved facial muscles, whereas a steady decline in electrical activity is often noted on days 4 to 10. When excitability is retained, 90% of patients recover completely; in the absence of excitability, only 20% of patients recover completely [33, 34].

Other causes of acquired peripheral facial weakness are much less common. Associated conditions include diabetes mellitus, hypertension, HIV infection, Lyme disease, the Ramsay-Hunt syndrome (facial palsy with zoster oticus caused by varicella–zoster virus), sarcoidosis, Sjögren's syndrome, parotid-nerve tumors, eclampsia and amyloidosis. Peripheral-facial-nerve palsy has also been reported among recipients of inactivated intranasal influenza vaccine [35].

Bell's palsy rarely recurs. Recurrent or bilateral facial palsy should prompt consideration of myasthenia gravis or lesions at the base of the brain, where the facial nerve exits the pons; such types of palsy occur in lymphoma, sarcoidosis and Lyme disease [36]. In rare cases, patients with inflammatory demyelinating polyneuropathy (Guillain-Barré syndrome) present with bilateral facial palsy but relatively little weakness of the extremities however, in immunocompetent people, the Ramsay-Hunt syndrome is neither recurrent nor bilateral.

Corneal disorders: Age-related changes in the cornea can affect the ability of the cornea both to protect the internal structure of the eye and to refract incoming light for vision.

Loss of corneal sensitivity to mechanical stimuli occurs with increasing age as the central cornea retains its sensitivity longer than other areas [37]. Measurement of the corneal touch threshold (CTT) in healthy people of different ages by stimulating the cornea with nylon micro filaments of various lengths indicates that the CTT remains almost the same between ages 7 and 40 years [38]. Beginning in the fifth decade of life, the CTT becomes significantly higher and continues to increase with age, such that by 80 years, the CTT is almost twice that of a 10-year-old [38]. The cause of the decline in corneal sensitivity may be attributed to the thickening of the fibrous structure of the cornea, to a decrease in water content, or to an atrophy of nerve fibers [38]. Moreover, Various corneal degeneration affecting the anterior surface of the cornea will cause irritation and reflex tearing.

Irritation from lashes: Trichiasis is a posterior misdirection of eyelashes. Owing to constant corneal irritation, it can give rise to persistent reflex tearing, discomfort, recurrent infections, corneal ulceration and pannus formation.

In some individuals, the tarsal glands may be totally or partially absent. When this is the case, they are often replaced by an abnormal row of cilia, which invariably turn inward to abrade the cornea, a condition known as distichiasis [39]. Long-standing inflammatory disease of the lid margins may result in the tarsal glands assuming such a hair-bearing function, known as acquired distichiasis. The latter condition usually does not involve all four eyelids and the newly acquired eyelashes are usually short and non pigmented, or they may be lie crumpled along the epithelial surface of the eyelid margin [40].

Hypersecretion of tears: Sometimes, tears will result from hypersecretion. Ocular inflammation, corneal irritation, gustatory tearing, thyroid problems or nasal irritation can cause this, because of its rarity, hypersecretion is primarily a diagnosis of exclusion.

MANAGEMENT OF DRY EYE

Treatment for various causes of dry eye syndrome:

House-hold remedies: Several aspects are to be considered while treating dry eye patients.

- Like controlling the humidity by using a humidifier in the living and working areas, particularly the bedroom. Ideally, the humidity should remain at 40 to 50%.

- Four drops of preservative free artificial tears in each eye every day.
- Reduction or discontinuation of systemic drugs for allergies, insomnia and nervous disorders.
- As in mild dry eye good lid hygiene should be advised.
- As suggested by Mac Keen *et al*. [41], washing the faces with a Turkish face cloth twice a day, followed by a 30 second warm tap-water compress using a face cloth over both closed eyelids, also benefits such patients. After the warm (as opposed to hot) tap water compress, the lower lid margin of each eye should be wiped once with a tightly wound dry cotton-tipped applicator. The heat and mild friction created with a single wipe from side to side removes excess oils, mucous and debris from the lower lid margin [41]. Also, this will draw reflex tearing from the lachrymal gland, if it's available. Even a small amount of reflex tearing will decrease the need for artificial tear solutions.
- Moist chamber spectacles can also be considered when patient compliance is not a problem [42].

Tear replacement therapy: The replacement of newly identified tear components to maintain tear-film stability on the ocular surface represents an important innovation. An eye drop with low osmolarity, in turn, inverts the osmotic gradient between the tear film and the ocular surface. By lowering tear-film osmolarity and reversing the gradient, these substitutes rehydrate the dehydrated tissue and don't pull water out of the surface of the eye [43].

Many of the new substitutes are preservative-free and contain viscoelastic materials (hypromellose, methylcellulose, etc.) targeting the role of mucin on tear-film. These newly formulated drops allow adsorption to the ocular surface, increasing retention time. Further, preservatives are known to alter the normal electrolyte balance of the tear film and eliminating them will be not disturb this electrolyte balance.

Interventional therapies:

- Blocking the puncta with silicone plugs. If these plugs fall out more than once, suturing the punctum closed with 10-0 nylon is recommended.
- Lid tarsoraphies can be opted when there is a threat of impending corneal damage due to dry eye secondary to neurological causes.

Challenges of future therapies: As the number of available treatment strategies for dry-eye and ocular-surface disorders increases, it's becoming difficult to determine the potential value of a therapeutic approach. Additionally, the diagnostic tests to evaluate success must be more accurate. Additional tear components being evaluated as tear substitutes include lactoferrin, a protein secreted by the lachrymal glands; lipocalin, a lipid binding protein; and waxes. Additionally, researchers have identified two components of meibomian gland secretion, phosphatidylethanolamine and sphingomyelin, that are decreased in obstructive meibomian gland dysfunction. Replacing these lipids may lead to increased stability of the lipid layer, minimizing evaporative tear loss. New tools such as fluorophotometry, confocal microscopy and lactoferrin analysis may assist researchers in understanding what's being measured and determining normative values for a population. Furthermore, the formulation of topical agents that address tear-film deficiencies, stimulate secretory processes or suppress inflammatory activities may result in products with multiple active ingredients.

Eyelid abnormalities: Punctal ectropion can be corrected by horizontal eyelid tightening procedures (viz. lateral tarsal strip procedure, blepheroplasties, transconjunctival tightening and rotation procedures, etc). These tightening procedures restore adequate horizontal tension to the lower eyelid and often correct any punctual ectropion. All these procedure are used in combination also.

Naso-lachrymal drainage system pathology:

- **For puctal stenosis:** Wide dilatation, punctoplasty (viz. one snip procedure) and silicone tube implantation are advocated.

- **For canalilculitis:** After a cytological examination or a high-resolution ultrasonic examination, curettage and debridement through the dilated punctum followed by antibiotic lavage is performed. Large diverticuli are excised or marsupialized.

- **For Nasolacrimal duct blocks:** Dacryocystorhinostomy (DCR) is the treatment in which a passage is created surgically between the nasal cavity and the lachrymal sac.

Neurological causes: If there are no central neurological lesions with facial palsy and no apparent cause (Bell's palsy) and is diagnosed within one week after the onset of symptoms, than no tests are indicated unless other cranial-nerve deficits develop (indicating more widespread disease). If there is no recovery three to six weeks after the onset of symptoms, or a facial twitch or spasm preceded Bell's palsy than that indicates continuous facial-nerve irritation suggestive of a tumor. Short course of Steroids (prednisone) within 2 to 14 days after the

onset of symptoms is the treatment of choice. Because Bell's palsy is associated with HSV infection, antiviral treatment may help. If complete facial paralysis is still present after one week of medical treatment, electroneurography should be performed. If electroneurography documents 90% nerve degeneration, than surgical decompression may be considered. Finally, for patients with permanent facial paralysis, various surgical procedures exist for dynamic reconstruction of the facial nerve.

Corneal disorders: If there is corneal insensitivity due to neurological cause than the treatment should be as described above. In mild loss of sensitivity lubricating tear supplements are the preferred mode of therapy.

Irritation from lashes: For trichiasis several modalities of treatment exist, which include epilation, electrolysis, cryotherapy, argon laser thermoablation [44-47] and full thickness pentagonal resection with primary closure (may be considered with the trichiasis confirmed to a segment of the eyelid only).

Management of distichiasis is difficult and often unsuccessful. In localized cases, a wedge resection with primary closure may be effective. Cryotherapy can be used after splitting the posterior lamella. The excised area may be replaced with full-thickness mucous membrane grafts.

RECENT ADVANCES

Tear-film dysfunction, collectively diagnosed as dry-eye syndromes, are classified into two major types: aqueous-deficient and evaporative [48].

Aqueous-deficient dry eye is due to a lack of tear secretion from the lacrimal gland. An example is Sjögren's syndrome, an autoimmune disease. The disease is associated with an extensive inflammation in lacrimal tissue, an immune-mediated destruction and/or dysfunction of epithelial cells and a precipitous decrease in aqueous tear output [49]. Sjögren's syndrome may be either primary (i.e., no associated connective tissue disease) or secondary (e.g., patients with systemic lupus erythematous or rheumatoid arthritis). Evaporative dry eye is typically caused by meibomian gland dysfunction and lipid insufficiency, leading to increased evaporation and reduced stability of the tear film [49]. It's estimated that meibomian gland disease, which also occurs in Sjögren's syndrome, may be a contributing factor in more than 60% of all dry-eye cases [50].

The majority of dry-eye sufferers are women and female gender has been identified as a risk factor for dry-eye development [51, 52]. This sex-related prevalence is not surprising, given that more than 90% of the individuals with primary or secondary Sjögren's syndrome are women and that these autoimmune disorders are among the most frequent causes of aqueous-deficient dry eye.

Numerous published studies document that sex and sex steroids exert a significant impact on the health and well-being of the eye [25]. Sex-associated differences have been identified in the lachrymal gland, meibomian gland, conjunctiva, goblet cells, cornea, anterior chamber, iris, ciliary body, lens, vitreous and retina. Many of these differences appear to be due, in part, to the action of sex steroid hormones (i.e. androgens, estrogens and progestins).

The recognition of these sex-related differences and the determination of their underlying basis (e.g., sex steroid action), is extremely important. Such understanding may lead to new insights into the physiological control of ocular tissues, as well as the development of novel therapeutic strategies to treat diverse eye disorders.

Androgens are known to regulate structure and function of lachrymal tissue in a variety of species. Androgen receptors are located almost exclusively in nuclei of epithelial cells and the density of androgen receptors is far higher in males, as compared to females. The distribution of the androgen binding sites in lachrymal tissues is under the influence of gender and endocrine system [53].

Androgen receptors has been reported to be present in the meibomian gland of human, rat and rabbit [53-55]. The meibomian gland is also a target organ for androgen [56, 57]. Production of fatty acid, total and neutral lipids in the meibomian gland is regulated by the hormone action. The changes in lipid contents affect the stability of the tear. Chronic androgen deficiency is associated with meibomian gland dysfunction, which results in dry eye, a common disease both in males and females. The onset of dry eye is very common during menopause and may result from the loss of hormonal support. In human tear production is correlated with serum prolactin and Sex Steroids Hormones levels prior to and during menopause [58]. Androgen has been shown to elevate a secretory activity of production of the tears in the lachrymal gland of rats [59, 60]. Estrogens may or may not be inhibitory to the androgen effect [61]. Lachrymal fluid peroxidase has cyclic variation during the menstrual cycle [62]. Thus an altered hormonal balance at menopause may affect tear production. Recently it has been shown that premature ovarian failure women show more symptoms of dry eye than age matched controls [63]. These on-going researches may lead to a discovery of new specific modalities for tears related problems.

CONCLUSIONS

In summary, like many other geriatric problems, such as dry eye is not very uncommon. It has a diverse etiology with

varied treatment modalities. Dry eyes remains to be the major concern for the geriatric population. Meticulous diagnosis is required for better management of dry eye syndrome. The knowledge of influence of sex hormones on the etiology of these tears in old age has opened new avenues for researchers, to find out specific treatment measures.

REFERENCES

1. Sutphin, J.E., J. Chodosh, M.R. Dana, W.C. Fowler, J.J. Reidy, J.S. Weiss and P.W. Turgeon, 2003-2004. External disease and cornea: Section 8, Basic and Clinical Science Course. San Francisco: American Academy of Ophthalmology, pp: 7.
2. Carney, L.G. and R.M. Hill, 1982. The nature of normal blinking patterns. Acta Ophthalmologica, 60: 427.
3. Tinker, M., 1949. Involuntary Blink Rate and Illumination Intensity in Visual Work. J. Exp. Psychol., 29: 558-560.
4. Nakamori, K., M. Odawara, T. Nakajima, T. Mizutani and K. Tsubota, 1997. Blinking is controlled primarily by ocular surface conditions. Am. J. Ophthalmol., 124: 24-30.
5. Bentivoglio, A.R., S.B. Bressman, E. Cassetta, D. Carretta, P. Tonali and A. Albanese, 1997. Analysis of blink rate patterns in normal subjects. Movement Disorders, 12: 1028-1034.
6. Ponder, E. and W.P. Kennedy, 1928. On the act of blinking. Quart. J. Exp. Physiol., 18: 89-119.
7. Orchard, L.N. and J.A. Stern, 1991. Blinks as an index of cognitive activity during reading. Integ. Physiol. Behav. Sci., 26: 108-116.
8. Karson, C.N., 1988. Physiology of Normal and Abnormal Blinking. Adv. Neurol., 49: 25-37.
9. Hall, A., 1945. The origin and purpose of blinking. Br. J. Ophthalmol., 29: 445-467.
10. Lemp, M.A. and D. Wolfley, 1998. Adler's Physiology of the Eye. St Louis, Mosby., pp: 19.
11. Ousler, G. and M.B. Abelson, 2001. An inside look at the NEI dry eye meeting. Review of Ophthalmol., 8: 82-84.
12. Yolton, D.P., R.L. Yolton, R. Lopez, B. Bogner, R. Stevens and D. Rao, 1994. The effects of gender and birth control pill use on spontaneous blink rates. J. Am. Optomol. Assoc., 65: 763-70.
13. Al-Abdulmunem, M., 1999. Relation between tear break-up time and spontaneous blink rate. Intl. Contact Lens Clin., 6: 117-120.
14. Yap, M., 1991. Tear break-up time is related to blink frequency. Acta Ophthalmol., 69: 92-94.
15. Cho, P., P. Cheung, K. Leung, V. Ma and V. Lee, 1997. Effect of reading on non-invasive tear break-up time and inter-blink interval. Clin. Exp. Optomol., 80: 62-68.
16. Tsubota, K., H. Seiichiro, Y. Okusawa, F. Egami, T. Ohtsuki and K. Nakamori, 1996. Quantitative videographic analysis of blinking in normal subjects and patients with dry eye. Arch Ophthalmol., 114: 715-720.
17. Liu, D. and O.G. Strasior, 1983. Lower eyelid laxity and ocular symptoms. Am. J. Ophthalmol., l 95: 545-550.
18. Colin, J.R., C. Beard and I. Wood, 1978. Experimental and clinical data on the insertion of the levator palpebrae superioris muscle. Am. J. Ophthalmol., 85: 792-796.
19. Linberg, J.V. and S.A. McCormick, 1986. Primary acquired nasolacrimal duct obstruction: A clinicopathologic report and biopsy technique. Ophthalmolog, 93: 1055-1060.
20. Henderson, J.W. and W.A. Prough, 1950. Influence of age and sex on flow of tears. Arch Ophthalmol., 43: 224-227.
21. Jordan, D.R., 1978. Dacryoadenitis, Dacryocystitis and Canaliculitis, Chapter 57 In: Cornea-Cornea and external diseases: Clinical diagnosis and management (St. Louis, Mosby), pp: 687-693.
22. Romano, A., E. Segal and M. Blumenthal, 1978. Canaliculitis with isolation of Pityrosporum Pachydermatis. Br. J. Ophthalmol., 62: 732-734.
23. Tost, F., R. Bruder and S. Clemens, 2000. Clinical diagnosis of Chronic Canaliculitis by 20-MHz Ultrasound. Ophthalmologica, 214: 433-436.
24. Jones, L.T. and J.L. Wobig, 1976. Surgery of the Eyelids and Lacrimal System. Birmingham, A L, Aesculapius.
25. Gupta, P.D. and K. Pushkala, 2005. Human Syndromes, Oxford and IBH Publishers, New Delhi, India.
26. Hauser, W.A., W.E. Karnes, J. Annis and L.T. Kurland, 1971. Incidence and prognosis of Bell's palsy in the population of Rochester, Minnesota. Mayo Clin. Proc., 46: 258-264.
27. Adour, K.K., F.M. Byl, R.L. Hilsinger Jr., Z.M. Kahn and M.I. Sheldon, 1978. The true nature of Bell's palsy: Analysis of 1,000 consecutive patients. Laryngoscope, 88: 787-801.
28. Katusic, S.K., C.M. Beard, W.C. Wiederholt, E.J. Bergstralh and L.T. Kurland, 1986. Incidence, clinical features and prognosis in Bell's palsy, Rochester, Minnesota 1968-1982. Ann. Neurol., 20: 622-627.
29. Peitersen, E., 1982. The natural history of Bell's palsy. Am. J. Otol., 4: 107-111.
30. Adour, K.K. and J. Wingerd, 1974. Idiopathic facial paralysis (Bell's palsy): Factors affecting severity and outcome in 446 patients. Neurology, 24: 1112-1116.
31. Diamant, H., T. Ekstrand and A. Wiberg, 1972. Prognosis of idiopathic Bell's palsy. Arch Otolaryngol., 95: 431-433.
32. Cawthorne, T. and T. Wilson, 1963. Indications for intratemporal facial nerve surgery. Arch Otolaryngol., 78: 429-434.

33. Campbell, E.D.R., R.P. Hickey, K.H. Nixon and A.T. Richardson, 1962. Value of nerve-excitability measurements in prognosis of facial palsy. Br. Med. J., 2: 7-10.
34. Richardson, A.T., 1963. Electrodiagnosis of facial palsies. Ann. Otol. Rhinol. Laryngol., 72: 569-580.
35. Mutsch, M., W. Zhou and P. Rhodes *et al*., 2004. Use of the inactivated intranasal influenza vaccine and the risk of Bell's palsy in Switzerland. New Engl. J. Med., 350: 896-903.
36. Keane, J.R., 1994. Bilateral seventh nerve palsy: Analysis of 43 cases and review of the literature. Neurology, 44: 1198-1202.
37. Skuza, B.H., 1971. Clinical features of the aging eye. J. Am. Optomol. Assoc., 42: 1038.
38. Millidot, M., 1977. The influence of age on the sensitivity of the cornea. Invest Ophthalmol., 16: 240.
39. Dayal, Y. *et al*., 1968. Distichiasis, its genesis and repair. Orient Arch Ophthalmol., 6: 14-19.
40. Scheie, H.G. and D.M. Albert, 1966. Distichiasis and trichiasis: Origin and management. Am. J. Ophthalmol., 61: 718-722.
41. MacKeen, D.L., H.W. Roth and M.G. Doane, 1996. Ocular drug delivery by the lid. Invest Ophthal. Vis Sci., ARVO Poster, 362-B274.
42. Hart, D.E., M. Simko and E. Harris, 1996. The moisture chamber for the dry eye patient. J. Am. Optomol. Assoc., 65: 517-522.
43. Gilbard, J.P., 2000. Dry eye disorders in Principles and Practice of Ophthamology V 2. Albert, D.M., Jakobiec FA (Eds.), Philadelphia.
44. Bartley, G.B. and J.C. Lowry, 1992. Argon laser treatment of trichiasis. Am. J. Ophthalmol., 113: 71-74.
45. Sahni, J. and D. Clark, 2001. Argon laser and trichiasis: A helpful tip. Br. J. Ophthalmol., 85: 761.
46. Sharif, K.W., A.F. Arafat and W.C. Wykes, 1999. The treatment of recurrent trichiasis with argon laser photocoagulation. Eye, 5: 591-595.
47. Ghabrial, R., I.C. Francis and M.B. Kappagoda, 1994. Autologous blood facilitation of lid laser treatment. Aust. NZ. J. Ophthalmol., 22: 218.
48. Lemp, M.A., 1995. Report of the National Eye Institute/Industry Workshop on clinical trials in dry eyes. CLAO J., 21: 221-32.
49. Sullivan, D.A. and M.E. Stern *et al*., 2002. Lacrimal Gland, Tear Film and Dry Eye Syndromes 3. Basic Science and Clinical Relevance. Plenum Press, New York.
50. Shimazaki, J., M. Sakata and K. Tsubota, 1995. Ocular surface changes and discomfort in patients with meibomian gland dysfunction. Arch Ophthal., 113: 1266-1270.
51. Schaumberg, D.A., J.E. Buring, D.A. Sullivan and M.R. Dana, 2001. Hormone replacement therapy and the prevalence of dry eye syndrome. JAMA., 286: 2114-2119.
52. Caffery, B., D. Richter and T. Simpson *et al*. 1996. The prevalence of dry eye in contact lens wearers: Part 2 of the Canadian dry eye epidemiology study (CANDEES). Invest Ophthalmol Vis Sci., 37: S72.
53. Rocha, E.M., L.A. Wickham and L.A. da Silveira *et al*., 2000. Identification of androgen receptor protein and 5alpha-reductase mRNA in human ocular tissues. Br. J. Ophthalmol., 84: 76-84.
54. Auw-Haedrich, C. and N. Feltgen, 2003. Estrogen receptor expression in meibomian glands and its correlation with age and dry-eye parameters. Graefes Arch Clin. Exp. Ophthalmol., 241: 705-709.
55. Wickham, L.A., J. Gao and I. Toda *et al*., 2000. Identification of androgen, estrogen and progesterone receptor mRNAs in the eye. Acta Ophthalmol. Scand., 78: 146-53.
56. Krenzer, K.L. and M.R. Dana *et al*., 2000. Effect of androgen deficiency on the human meibomian gland and ocular surface. J. Clin. Endocr. Metab., 85: 4874-4882.
57. Sullivan, D.A., A. Bélanger and J.M. Cermak *et al*., 2000. Are women with Sjögren's syndrome androgen deficient? Invest Ophthalmol. Vis Sci., 41: S1453.
58. Mathers, W.D., D. Stovall and J.A. Lane *et al*., 1998. Menopause and tear function: The influence of prolactin and sex hormones on human tear production. Cornea, 17: 353-358.
59. Sullivan, D.A. and M.R. Allansmith, 1987. Hormonal influence on the secretory immune system of the eye: Endocrine interactions in the control of IgA and secretory component levels in tears of rats. Immunology, 60: 337-343.
60. Sullivan, D.A., R.S. Kelleher, J.P. Vaerman and L.E. Hann, 1990. Androgen regulation of secretory component synthesis by lacrimal gland acinar cells *in vitro*. J. Immunol., 145: 4238-4244.
61. Varma, R., J.M. Tielsch and H.A. Quigley *et al*., 1994. Race-, age-, gender- and refractive error-related differences in the normal optic disc. Arch Ophthalmol., 112: 1068-1076.
62. Madia, F., V. Liberati, G. de Feo and G. Marcozzi, 2001. Variations of lacrimal fluid peroxidase activity in female and male rats. Ophthalmic Res., 33: 176-179.
63. Smith, J.A., S. Vitale and G.F. Reed *et al*., 2004. Dry eye signs and symptoms in women with premature ovarian failure. Arch Ophthalmol., 122: 151-156.