

NOCTURNAL LAGOPHTHALMOS

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SUMMARY

Nocturnal lagophthalmos is the inability to close the eyelids during sleep. It may be physiological but can cause significant symptoms in some patients. The spectrum of the disease ranges from minimal corneal epithelial changes, which may heal later in the daytime, to corneal ulcers after severe exposure. There are a variety of predisposing factors for lagophthalmos, which can be grouped as proptosis/eye exposure etiologies, palpebral insufficiency etiologies, and idiopathic etiology. The diagnosis is easily missed in subjects having nocturnal lagophthalmos with normal voluntary lid closure (idiopathic). A diagnosis of such cases can usually be made from a detailed history and careful slit lamp examination. A focused clinical evaluation for lagophthalmos in patients complaining of redness, dryness or eye irritation, especially after sleep, will identify most cases. The optimal treatment usually depends on the cause of lagophthalmos. It may include topical agents, lid taping at night or ocular surgery to correct lid malpositioning. This article reviews the incidence, clinical presentations, etiology, diagnosis, examination, and treatments of nocturnal lagophthalmos. [International Journal of Gerontology 2009; 3(2): 89–95]

Key Words: elderly, eye diseases, eyelids, lagophthalmos, sleep

Introduction and Incidence

Nocturnal lagophthalmos is the inability to close the eyelids during sleep. The term *lagophthalmos* is derived from the Greek *lagos*, meaning a hare, since the hare was believed to sleep with its eyes open. Nocturnal lagophthalmos with the eyes partly open during sleep is a common phenomenon, frequently observed in healthy individuals. It is a potential cause of dysfunctional tear film and exposure keratopathy. However, there are only a few published articles on this condition, many of which were published nearly half a century ago^{1–6}. Fuchs and Wu³ examined 500 Chinese medical students and found that 5% slept with their

eyes partially open, but without any resultant symptoms. Howitt and Goldstein² reported a prevalence of 1.4% in their population, also without symptoms. Mueller¹ noted that nocturnal lagophthalmos was common in people of the Amharic race in Ethiopia, and some of these developed inferior corneal scarring possibly related to this. Sturrock⁴ noted a positive family history of nocturnal lagophthalmos in 5 of 102 patients presented with corneal exposure symptoms after sleep, supporting the possibility of a genetic factor in at least some patients. In 1990, Lyons and McNab⁶ found that 13% of 40 consecutive patients had a family history of nocturnal lagophthalmos. There is an increased incidence of lagophthalmos in females and in the third decade^{4,6}. A review of the literature reveals that nocturnal lagophthalmos is a relatively common disorder and a potential cause of previously undiagnosed chronic keratitis. However, large prospective observational studies of the natural history of lagophthalmos, its incidence, prevalence, and functional impact have yet to be conducted.



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Clinical Presentations

Patients typically present with their symptoms early in the day within a few hours of waking. The symptoms consist of soreness, dryness, foreign body sensation or sharp pain in one or both eyes, often associated with watering and sometimes blurred vision. Some patients will present redness of the eye. Symptoms are most pronounced immediately after waking and tend to gradually improve during the course of the day. If damage from exposure is sufficiently severe, it may not heal during the waking hours.

Nocturnal lagophthalmos is most often accompanied by an area of epithelial disturbance located in the interpalpebral zone of the cornea. The lesion, which could be easily overlooked without the aid of a biomicroscope, consists of punctate epithelial keratopathy (Figure 1), sometimes combined with epithelial microcysts. The epithelial microcysts are visible only by retroillumination and do not take up stain⁴. The lesion is mostly in the central or lower cornea. Sometimes, the entire lower half of the cornea is involved, but in the majority of cases, there is a horizontal band across the cornea. The precise area of damage appears to be a function of exactly where the palpebral opening occurs in relation to the cornea. The most inferior portion of the cornea is often spared⁶. Severe exposure may cause melting of the lower part of the cornea. Most frequently, the melting is inferonasal, but it may be central, and any part of the lower cornea may be involved. Katz and Kaufman⁵ proposed that any unexplained ulcer in the lower cornea, in which microbiologic studies are negative and purulent exudate is not seen, is suggestive of this diagnosis.

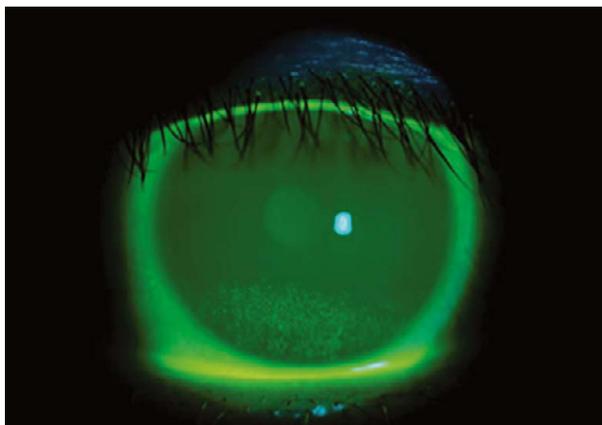


Figure 1. Characteristic staining of the corneal epithelium resulting from nocturnal lagophthalmos.

Etiology

Numerous factors may give rise to lagophthalmos (Table 1). Conceptually, Latkany et al.⁷ divided them into three main groups: (1) proptosis or excessive ocular surface exposure; (2) palpebral insufficiency arising from congenital or acquired conditions; or (3) idiopathic.

Persons with excessive ocular surface exposure or proptosis may have a bony orbit that is smaller than its orbital contents. This may be caused by congenital disease such as craniosynostosis, or acquired disease such as thyroid exophthalmos. Retrobulbar hemorrhage or tumor may also cause protrusion of the eyeball and result in corneal exposure.

Palpebral insufficiency has two important features: shortened lid height, and reduced lid muscle tonus. A patient with vertical shortening of the upper or lower eyelid may have incomplete closure with each blink and during sleep. In some cases, a normal eyeball-to-eyelid relationship may have been altered by iatrogenic causes, such as lid tightening surgery, blepharoplasty or botulinum toxin injections for essential blepharospasm. Palpebral insufficiency can also be caused by cicatricial disease altering the eyelid configuration, such as Stevens-Johnson syndrome, ocular pemphigoid, traumatic injury or chemical burn, that retracts the eyelid as a result of adhesion or symblepharon formation between the eyelid and the globe. Any disease causing seventh nerve palsy can result in the inability to close the eyelids, thus aggravating corneal exposure during

Table 1. Cause of nocturnal lagophthalmos

Proptosis/greater eye exposure
Congenital
Thyroid exophthalmos
Orbital mass (hemorrhage, tumor)
Palpebral insufficiency/shortened lid heights or reduced tonus
Congenital
Iatrogenic/post-surgery or post-Botox injection
Cicatricial
Neurogenic/seventh nerve palsy
Involutional/senile ectropion
Medication/alcohol
Myogenic (facial myopathies/dysthyroid eyelid retraction)
Central nervous disease/coma state
Idiopathic

Adapted from reference 7.

sleep. It can also be the result of an involitional process leading to ectropion and subsequent lagophthalmos. Excessive alcohol intake and hypnotic medication have been reported to cause nocturnal lagophthalmos^{4,6,8}. Drunkenness or the use of hypnotic drugs may give rise to a state similar to that seen in comatose patients who keep their eyes open, a condition often referred to as a “vegetative state”. The condition is associated with disease of the ventral mesencephalon and pons, although it can also be a sign of diffuse hemispheric disease. If the patient’s nocturnal lagophthalmos cannot be attributed to any of the above causes, it can be ascribed to an idiopathic cause⁷.

Diagnosis and Examination

Although one would expect the condition to affect all age groups equally, it occurs far less commonly in children than in adults and in older people. It appears that the decrease in tears, which occurs with aging and in patients with keratitis sicca, increases the chance of even modest corneal exposure causing substantial clinical disease. Therefore, not infrequently, corneal disease first becomes symptomatic in people in their middle or later years of life⁵.

The lagophthalmos diagnosis begins with observing the patient, paying particular attention to the eyelid aperture and inferior scleral show, and the patient’s ability to reach full appositional closure with each blink. An incomplete blink can help to detect nocturnal lagophthalmos; if a patient does not achieve full closure during each blink, they most likely do not fully close their eyelids at night. During this observation, the patient should be questioned about difficulties in sleeping, dry eyes, any eye pain or watering upon awakening. They should be asked about a history of Bell’s palsy or any eyelid surgery, and about a personal or family history of sleeping with the eyes open.

After distance observation, a slit lamp examination should be performed using a low light intensity with a fine slit beam in order to limit any additional voluntary closure of the eyelids. Particular attention should be given to how the eyelids appose each other upon closure. We can then ask the patient to gently close both eyes. In patients having corneal exposure at bedtime, the lid on the most involved side frequently begins to fasciculate after a few seconds, and exposure of the cornea can often be observed. In a substantial

number of patients, lid closure initially occurs, but within a minute or two, the lids open sufficiently wide for a diagnosis to be made. Latkany et al.⁷ proposed a classification system of nocturnal lagophthalmos. Type I is obvious lagophthalmos with a clear lack of palpebral closure, and should not pose a difficulty for diagnosis. Type II is obscure lagophthalmos caused by eyelashes. Upper and lower lashes, especially if they are thick, obstruct each other and prevent full closure. The obstruction may also prevent the examiner from viewing the lid position. If the eyelids appear to be touching, the upper eyelids can be gently lifted with a warm finger in order to remove the eyelashes from view. If the patient does actually fully close the eyelids, then upper and lower eyelids should be stuck together somewhere near their meibomian gland orifices. If not, the examiner should look for a less obvious opening. Type III is obscure (overhang) lagophthalmos, and it is the most difficult to diagnose. In direct view, the upper lid anterior and inferior to the top of the lower lid appear to be fully closed. However, a small gap may exist just beneath the overhanging lid. If the eye is grossly viewed from below, a small gap may be apparent between the upper and lower eyelid through the eyelashes, or just beneath the overhanging upper eyelid. It requires experience and a high level of suspicion to diagnose both types of obscure lagophthalmos. Additionally, we would like to add a fourth type of lagophthalmos. It looks normal under any kind of examination but still shows typical corneal lesions. This type may be the result of poor lid muscle tonus after sleep.

The position of the corneal lesions, such as scarring, vascularization or punctate keratitis either in the lower cornea or in a band across the cornea, is the most definite diagnostic sign to be considered. Other ocular surface findings, which can be associated with lagophthalmos, include chemosis, conjunctival injection in the interpalpebral zone, and conjunctivochalasis.

Before an anesthetic drop is administered, it is important to test the corneal sensation. Some degree of corneal anesthesia over the lesion is common, but this is not useful in aiding diagnosis, since any chronic keratitis can be associated with a relative desensitization of the cornea. However, it is still important to test the corneal sensation. Patients with lagophthalmos are more likely to develop infections and thinning from corneal abrasions when corneal sensation is impaired. Thus, treatment of a patient with decreased corneal sensation should be preventative and aggressive.

Corneal punctate keratopathy can easily be missed during a cursory eye examination. A small amount of fluorescein should be instilled into the inferior cul-de-sac to detect punctate erosions on the inferior cornea. The examiner should not instill too much fluorescein, because excess fluorescein on the ocular surface may obscure the lesions. In addition to corneal staining, a horizontal collection of gray epithelial microcysts across the inferior cornea is also characteristic of lagophthalmos⁴. Other staining agents, like lissamine green and rose bengal, can help evaluate devitalized cells in the exposed conjunctival surface.

An evaluation for dry eyes should also be performed to help determine the best method of treatment. Dry eyes could exacerbate the symptoms of nocturnal lagophthalmos, and nocturnal lagophthalmos can also worsen dry eyes with excessive exposure during sleep. The examiner should also look for evidence of blepharitis and meibomian gland dysfunction, since both will further compromise the tear film and worsen the lagophthalmos.

Eye position during sleep is probably the most difficult to assess and the hardest to predict as an etiologic factor in nocturnal lagophthalmos. This may be the reason why some patients with obvious lagophthalmos do not have symptoms or signs of exposure keratopathy. Sir Charles Bell⁹ described in 1823 the upward rotation of the eyes during forced eyelid closure, a movement now called Bell's phenomenon, and implied that this occurred during sleep. Hall¹⁰ examined the position of the eyes in 234 sleeping subjects and found that the eyes rotated upward in only 42%, were straight ahead in 44%, and deviated to the side or downward in a few. Hall was able to show that there is no such thing as a normal position for the eyes during sleep, and the position of the eyes may vary in the same individual on subsequent nights. In addition, the eyes move rapidly and widely during phases of rapid eye movement sleep, a normal stage of sleep that occurs several times per night. Francis and Loughhead¹¹ examined 508 consecutive patients for Bell's phenomenon, and found that it varied in both direction and amplitude. Bell's phenomenon also tends to diminish with age¹². Despite these variations in eye position during sleep, in theory, an absent or diminished Bell's phenomenon would still make an eye more susceptible to symptomatic nocturnal lagophthalmos. However, the testing of Bell's phenomenon with gentle or forced lid closure is not predictive of the position of the eye

during sleep. Some other advanced test of sleep pattern in nocturnal lagophthalmos will be needed in the future.

Other Considerations

Association with sleep

Lagophthalmic patients tend to be poor sleepers. Poor sleep quality is especially common in older patients. The added level of dryness and increased frequency of blepharitis with poorer quality tears in middle-aged and older adults may account for the higher incidence of symptomatic nocturnal lagophthalmos in older patients. However, further research may help determine the role that nocturnal lagophthalmos and quality and quantity of sleep have with each other⁸.

Surgical precautions

Patients with nocturnal lagophthalmos may be asymptomatic prior to surgical procedure but become symptomatic after certain types of surgery. Caution should be applied in the preoperative evaluation of the lagophthalmic patient contemplating refractive surgery, blepharoplasty or botulinum A toxin injection. Patients with known dry eye syndrome or clear exposure-related signs and symptoms may benefit from evaluation by a corneal and external disease specialist. Surgical candidacy could be withheld until a full evaluation is made, with full understanding of the risks and benefits of surgery, including the potential risk of chronic symptoms⁹.

Treatment

For treatment of nocturnal lagophthalmos, we should try to find the causes first (Table 1). If the cause is known, resulting from either proptosis or palpebral insufficiency, correcting the cause either surgically or medically usually minimizes the symptoms of corneal exposure. If it is idiopathic or the patient cannot undergo the surgery, a more natural approach or medical approach could be used. The options include a natural approach, medical approach, and surgical procedures (Table 2).

Natural approach

The natural approach to manage the ocular surface problems associated with nocturnal lagophthalmos consists

Table 2. *Treatment options for nocturnal lagophthalmos*

Natural approach	
Environmental changes	
Behavior modifications	
Lid hygiene	
Taping the eyelids/external lid weights	
Medical approach	
Artificial tears	
Ointments	
Anti-inflammatory agents	
Tetracyclines	
Surgical approach	
Tarsorrhaphy	
Surgical correction of mechanical causes	
Gold/platinum weight implantations	

of environmental changes, behavior modifications, lid hygiene, dietary changes, and taping of the eyelids.

Avoiding or relocating away from lower humidity environments may provide a benefit. Any stream of dry air, such as a vent or heating or cooling device, should be redirected away from the eyes. Also, having a humidifier may be of help in dry environments.

Some behavior modifications, such as learning to blink completely and increasing blink rates, may help. Using moisture chamber goggles in certain environments may provide an additional benefit. Hypnotherapy has been reported to be effective against nocturnal lagophthalmos¹³. Avoiding overconsumption of alcohol may also decrease the chance of symptomatic nocturnal lagophthalmos.

If the patient has concomitant external eye disease such as blepharitis or meibomian gland dysfunction, emphasizing lid hygiene may contribute to a more stable and healthier tear film. It will also reduce the quantity of bacteria and waste products on the eyelid surface, thus decreasing the chances of symptoms⁷.

Diets high in omega-3 fatty acids and low in omega-6 fatty acids may result in higher anti-inflammatory cytokines and lower destructive cytokines, such as tumor necrosis factor^{14,15}. A lower omega-3 fatty acid intake has been reported to be associated with a higher incidence of dry eyes. Foods high in omega-3 fatty acids include cold-water fish such as salmon, tuna, cod and mackerel, green leafy vegetables, flaxseed, and walnuts. Further research is needed to evaluate the benefit of omega-3 fatty acid oral supplements in treating dry eye, blepharitis, and lagophthalmos.



Figure 2. Eyelid taping with a paper tape on a patient's left eyelid during sleep.



Figure 3. External eyelid weight applied on a patient's upper eyelid.

Taping the eyelid closed with a paper tape during sleep has proven to be helpful for some patients. The tape is first applied to the cheek and the cheek is pulled up, thereby, closing the eye by pulling up the lower lid through pressure on the cheek only. The tape is then attached to the forehead (Figure 2)⁵. Some ointment can be applied to the eye in conjunction with taping the lids.

However, some patients may not tolerate the tape on their periorbital skin because of sensitivity to the tape adhesives; while some female patients may not comply with this treatment because they worry about pulling away eyelashes while removing the tape. Some other patients may not tolerate this method, because they find the tape sensation unpleasant. External lid weights (Figure 3) have been proven to be helpful in the treatment of corneal exposure in patients with facial nerve palsy^{16,17}. In a minority of patients, a bandage

contact lens may provide some temporary protection for initial healing or in cases of prolonged exposure⁵.

Medical approach

Using ophthalmic ointment at night and artificial tears during the day are the most simple and effective ways to treat nocturnal lagophthalmos. Ophthalmic ointment at night can be combined with lid taping or external lid weights to get a better and faster response. A wide variety of tear supplements with different ingredients are available, with and without preservatives. For regular use, preservative-free tears are preferred. Artificial tears increase tear clearance, therefore decreasing inflammatory mediators. If the patient has coexistent external eye disease such as blepharitis or rosacea, oral treatment with tetracycline and nonsteroidal anti-inflammatory drugs may help decrease the eyelid inflammation and improve the tear film. Since an inflamed lid margin may induce an ectropion and secondary lagophthalmos, treating the coexistent external eye disease can lessen their symptoms.

If the cause of nocturnal lagophthalmos is seventh nerve palsy, it is important to first determine the etiology. An acute presentation of a seventh nerve palsy requires consultation with a neurologist. If the palsy is believed to be temporary and corneal exposure is severe, botulinum A toxin injection has proven to be useful in cases of temporary lagophthalmos, as it induces a protective ptosis which, on average, lasts for over 12 weeks and has no permanent adverse effects¹⁸.

Surgical approach

If the patient has a retrobulbar hemorrhage or tumor, a drainage or removal procedure may be necessary to correct lagophthalmos. If the cause is thyroid exophthalmos, an orbital decompression can be performed after the condition has been stabilized for 3 months. In symblepharon-induced lid retraction, the symblepharon may need to be released and the fornix reconstructed with mucosal or amniotic membrane grafting. If the problem results from insufficient lid height, either skin grafting or a tarsal graft may be needed. Furthermore, a temporary or permanent tarsorrhaphy is another effective way to treat corneal exposure unresponsive to the medical approach. Aside from the occasional unacceptable cosmetic result, the procedure is usually quick and reversible and has few complications.

Gold weight implantation is another option for patients with permanent facial nerve palsy. Because gold weight implantation carries a 90% success rate and can be easily removed, it can be performed even with temporary facial nerve palsy. In general, gold weight implantation is well tolerated and effective; however, it can produce blurry vision from corneal astigmatism and bulging of the implant, so a flexible platinum chain may be a better alternative.

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