Treatment of Lacrimal System Dysfunction—Preventing Basic Mechanisms in the Pathogenesis of Diseases

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Abstract

In medicine, the discovery of new knowledge has led to paradigm shifts in treatment approaches. A major discovery in the late 20th century was lacrimal system dysfunction (LSD). Lacrimal occlusion therapy (LOT) and surgical procedures to decrease tear film evaporation (rather than therapeutic drops or lubrication therapy) are necessary to obtain long-lasting benefits in patients with LSD. This paper outlines the ramifications of LSD, and discusses the possibility of updating the Delphi Panel recommendation to the National Eye Institute classification for dry eye. A call is made for controlled studies leading to standard testing and treatment protocols in the emerging new surgical specialty of Lacrimology.

Keywords

Lacrimal system dysfunction, neural-immune dysregulation, dry eye, asthma, pneumonia, lacrimal plugs, punctum plugs, autonomic nervous system, prevention, lacrimal occlusion therapy, lacrimology, parasympathetic, lacrimal excretory hyperactivity, lacrimal efficiency test, Comfortear™, Herrick, National Eye Institute, Delphi Panel

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In the history of medicine, the discovery of new knowledge has led to paradigm shifts in treatment approaches for diseases, and improvement in overall health. The following are examples:

1. In 1876, Robert Koch identified *Bacillus anthraces* as the first bacterium to cause infectious disease leading to the identification of multiple infectious diseases such as tuberculosis and syphilis (two major causes of death in the 19th century).
2. In 1912, James B Herrick identified coronary artery occlusion as the main cause of heart attacks—leading to the development of coronary bypass surgery.[1]
3. In 1939, Alexander Fleming discovered the bactericidal properties of fungi—leading to the development and use of antibiotics.
4. In 1983, Robert S Herrick described lacrimal system dysfunction (LSD) as the basic mechanism in the pathogenesis of many secondary conditions involving the eye and other body systems.[2]

In LSD, the ocular surfaces are inadequately lubricated, leading to dryness, irritation and reflex tearing. High levels of afferent impulses are generated.

In response, the brain increases parasympathetic tone to activate corrective mechanisms; however, the eyes remain irritated resulting in chronic parasympathetic overstimulation and the chronic loss of the homeostasis needed for organ systems to work together and maintain optimum health.

Diagnosis and Treatment of Lacrimal System Dysfunction

A symptoms checklist (See *Figure 1*) in conjunction with functional diagnostic tests that temporarily occlude the lacrimal excretory system (for example, the Temporary Stitch Test[2] or the Herrick Test/Lacrimal Efficiency Test™, in which dissolvable plugs are placed into all four tear drainage ducts) may be used to diagnose LSD in patients with LEH.[3]

Functional tests and treatment with LOT have proved effective in treating LSD,[4,5,6] and provide almost immediate relief from ocular dryness and irritation.[7] Functional diagnostic testing is the most critical step in determining the best method of treating patients with LSD. It decreases afferent impulses to a normal (low) level, resulting in a precipitous drop in parasympathetic tone and replacement of thick tenacious mucus with thin movable mucus throughout the respiratory system within 30 minutes. The respiratory cleansing mechanisms (sweeping cilia, sneezing, coughing, and nose blowing) rapidly expel the thick mucus along with micro-organisms and debris. This in itself eliminates many of the common congestive respiratory diseases including pneumonia (known to cause death in over 5,500 children aged under 5 years per day worldwide).[8] In pulmonary fibrosis patients, blood oxygen saturation may increase to normal levels (95–98%) and the heart rate may decrease. Some of these patients have been able to discontinue use of supplemental oxygen following functional diagnostic testing and LOT.[3]

Figure 1: Symptoms Checklist for Lacrimal System Dysfunction

Lacrimal System Dysfunction

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SYMPTOMS CHECKLIST

Patient Name (Print): _____ Date: _____

PLEASE NOTE: To ensure a proper Eye Health Examination indicate symptoms or conditions you now experience, or have experienced during the last 12 months. Provide complete answers.

EYE SYMPTOMS	Right Eye YES	Left Eye YES	SECONDARY SYMPTOMS	YES
Redness	☐	☐	Sinus Problems	☐
Dry Eye Feeling	☐	☐	Nasal Congestion	☐
Sandy or Gritty Feeling	☐	☐	Head Congestion	☐
Itching	☐	☐	Post-nasal Drip	☐
Burning	☐	☐	Chronic Bronchitis	☐
Foreign Body Sensation	☐	☐	Allergy Symptoms	☐
Constant Tearing	☐	☐	Hay Fever	☐
Occasional Tearing	☐	☐	Chronic Cold Symptoms	☐
Watery Eyes	☐	☐	Middle Ear Congestion	☐
Light Sensitivity	☐	☐	Sneezing	☐
Eye Pain or Soreness	☐	☐	Dry Mouth or Throat	☐
Sties, Chalazion	☐	☐	Headaches	☐
Fluctuating Visual Acuity	☐	☐	Asthma Symptoms	☐
"Tired" Eyes	☐	☐	Heartburn or Indigestion	☐
Contact Lens Discomfort	☐	☐	Snoring	☐
Contact Lens Solution Sensitivity	☐	☐	Sleep Apnea	☐
Mucous Discharge	☐	☐	GERD	☐

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Figure 2: VisiPlug™ Lacrimal Plugs—Non-dissolvable and Medium-term (Six Month) Dissolvable

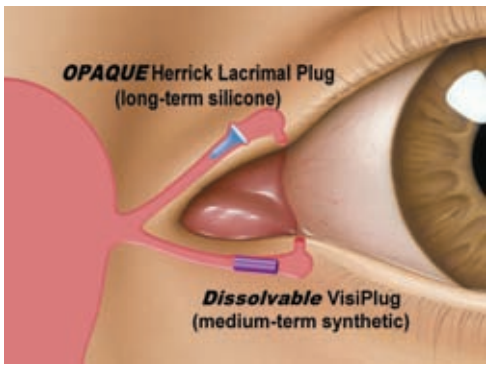


Figure 3: Comfortear™ Punctum Plug—Non-dissolvable

Chronic parasympathetic dominance increases vagal tone leading to a flood of efferent impulses being sent to multiple body systems which then fail to perform efficiently.[7] This increased vagal tone is a major factor in cardiac arrhythmias. Cardiac arrhythmias may greatly improve or completely disappear with the application of functional diagnostic tests, LOT and surgical procedures to reduce tear film evaporation.

Immune System Overstimulation

Chronic parasympathetic dominance also causes chronic overstimulation of the immune system. The combined dysregulation of the nervous system and the immune system (neuroimmune dysregulation)[9] leads to over-activation of the immune system's healing mechanisms – the inflammatory response and thickening of basement membranes. The sympathetic division of the autonomic nervous system does not fully mature until puberty, hence chronic parasympathetic overstimulation in children can result in congestive respiratory conditions (rhinitis, sinus congestion, middle ear disease, chronic cough, bronchitis, asthma, and pneumonia), which account for 65% of all new diseases seen by pediatricians. With improved competitive imbalance in the autonomic nervous system by the age of puberty, there is improvement in the overall health of children (for example, two-thirds of asthmatic children 'outgrow' their asthma).

In the anterior chamber of the eye, the inflammatory response may be a significant factor in glaucoma and cataract formation. Another chronically over-activated healing mechanism is thickening of basement membranes. This may also contribute to glaucoma, cataract formation, Fuch's corneal dystrophy (thickening of Descemet's membrane), and macular degeneration (thickening of Bruch's membrane). Both healing mechanisms may be involved in the pathogenesis of vascular diseases and hypertension, and also may be critical factors in the pathogenesis of neoplastic diseases.

Neurotransmitter Depletion

Chronic dysregulation of the autonomic nervous system and chronic parasympathetic overstimulation may lead to the depletion of neurotransmitters such as acetylcholine. Neurotransmitter depletion—in particular, acetylcholine and norepinephrine depletion—are recognized as causative factors in Alzheimer's disease and senile dementia, respectively.

Recommended Approach to Treatment

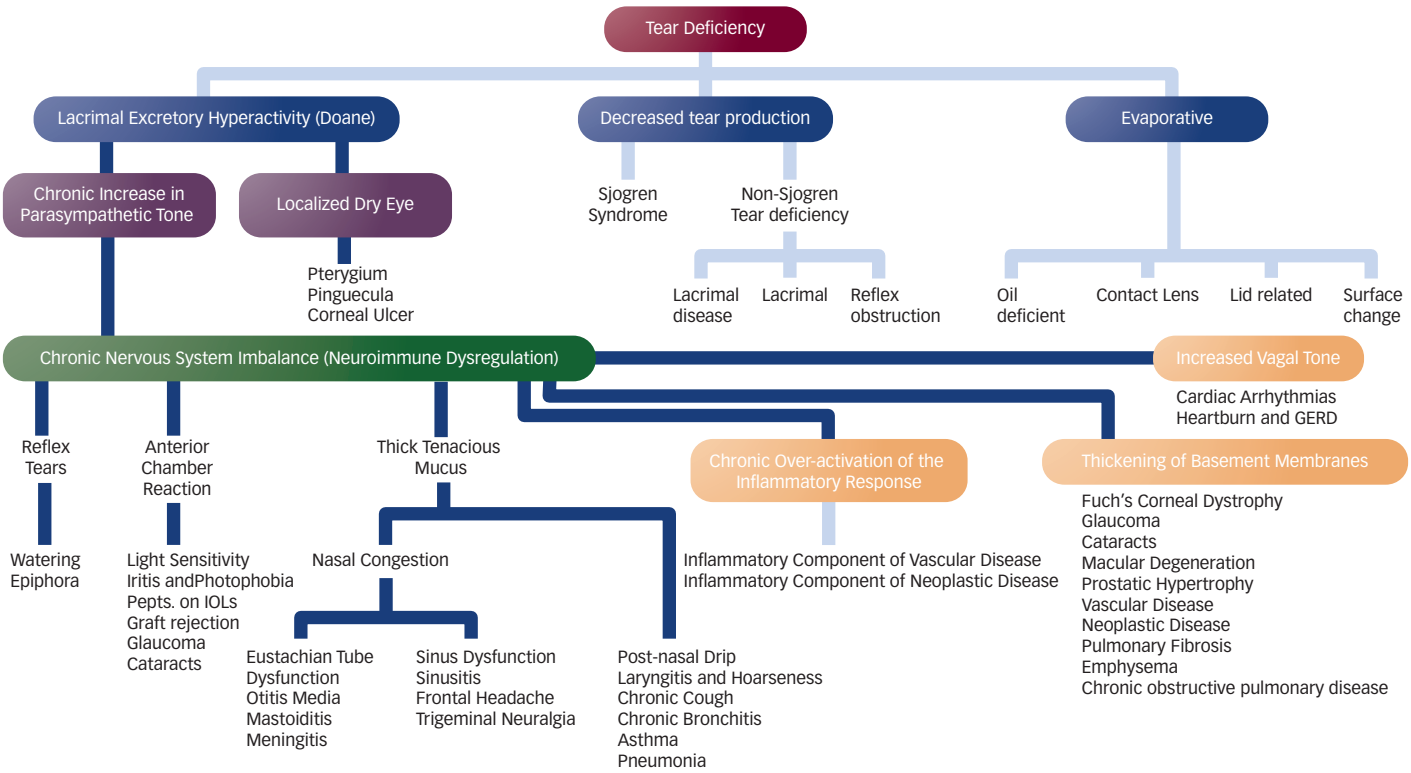
Starting with the symptoms checklist followed by functional testing and LOT, clinicians will develop a strong conviction about the benefits of LOT and surgical procedures to decrease tear film evaporation. These result in elimination and cure of diseases—compared to prescribing therapeutic drops or lubrication therapy (which offers only symptomatic relief but no possibility of cure). Effective use of LOT involves occlusion of the upper canaliculi first, using either radio wave microcautery or non-dissolvable or long-term dissolvable lacrimal (see *Figure 2*)[10] or punctum plugs (see *Figure 3*).[5,6] In severe cases, complete closure of all four canaliculi may be necessary. In addition, surgical procedures to decrease tear film evaporation may be necessary to lower afferent signals to normal low levels and to stop dysregulation and dysfunction.

Revisions to the National Eye Institute Classification of Dry Eye Disease

The National Eye Institute (NEI) classified dry eye disease (DED) based on two factors—tear evaporation and decreased tear production—identified by the Delphi panel chaired by Michael Lemp, MD.[11,12] In addition, Robert Herrick, MD, proposes the addition of a third factor—lacrimal excretory hyperactivity (LEH) (see *Figure 4*)—to the classification criteria. Evidence for LEH was reported by Marshall Doane, PhD, who conclusively demonstrated that the lacrimal excretory pump is 10–20 times too active in most people.[13]

This author recommends that the next periodic update to the 2007 Delphi panel's guidelines[11] includes functional diagnostic testing to simulate

Figure 4: Classification of Lacrimal System Dysfunction



Includes National Eye Institute (NEI)/Industry Workshop 1995 dry eye classification—with modifications (additions) linked by dark lines. IOL = intraocular lenses; GERD = gastroesophageal reflux disease.`

curative treatments. This will make it possible to eliminate LSD as the basic mechanism in the pathogenesis of dry eye disease and numerous other diseases. With the addition of LEH to the NEI classification of DED, it is further proposed that this title be changed to 'Classification of Lacrimal System Dysfunction'.

Summary and Conclusions

LSD is the basic mechanism in the pathogenesis of common diseases, some of them devastating diseases occurring both in childhood and later life, including keratoconjunctivitis sicca, corneal ulceration or erosion, recurrent herpes simplex keratitis, unexplained decreased visual acuity, with the rule astigmatism, rhinitis and rinorrhea, sinusitis or sinus congestion, frontal headaches, otitis media, hayfever, post-nasal drip, hoarseness, chronic cough, chronic bronchitis, asthma and pneumonia. Patients undergoing treatment for LSD may also report improvement in heartburn, gastroesophageal reflux disease, bladder control, cardiac arrhythmias, pulmonary fibrosis, emphysema, and chronic obstructive pulmonary disease.

Any truly effective treatment for ocular dryness and irritation requires the prevention or elimination of LSD, which—according to Hamano[4]–is easily tested for and corrected through functional testing, LOT, and surgical procedures to reduce tear film evaporation. Use of these procedures are vital to achieve effective treatment for many diseases; their use may reduce or eliminate the use of potentially harmful systemic medications, while delaying or preventing potentially serious secondary diseases.

Hippocrates stated: 'There are in fact two things, science and opinion; the former begets knowledge, the latter ignorance.' To fully understand and prevent LSD, definitive studies must be conducted which produce irrefutable, objective, measurable evidence to establish lacrimology—the study of the lacrimal system and its effects on the body—as an urgently needed and exciting new surgical specialty in evidence-based medicine. Furthermore, Behrens and colleagues explain that: 'By establishing these definitions and classification of DED, we believe clinicians will be better able to determine the level of DED, as well as the best treatment course for their patients.'[14] ■

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