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AYURVEDIC CONCEPT OF NEURAL MECHANISM OF THE LACRIMAL FUNCTIONAL UNIT AND ITS DISRUPTION

[1]K. Sreekumar

[1]Assistant professor, Dept.of Shalakyatantra, Govt.Ayurveda College,Tripunithura, Ernakulam, Kerala.

ABSTRACT

The lacrimal functional unit (LFU) is defined as an integrated system comprising the lacrimal glands, ocular surface (cornea, conjunctiva and meibomian glands) and lids, and the sensory and motor nerves that connect them. The majority of dry eye symptoms are due to a chronic inflammation of the lacrimal functional unit resulting in a loss of tear film integrity and normal function. This leads to a reduction in the ability of the ocular surface to respond to environmental challenges. Maintenance of tear film stability is very important for the preservation of ocular surface defense mechanism. It is essential to analyze the Ayurvedic concept of neural mechanism of LFU so that effective management of ocular surface inflammations can be derived. By exploring the Ayurvedic literature, it is evident that *Tridoshas* play a vital role for the formation and regulation of the lacrimal functional unit which is necessary for the integrity of ocular surface system. In this article an attempt has been made to elaborate the role of *Tridoshas* in maintaining the proper control of the lacrimal functional unit and how it will cause diseases in conditions of vitiation.

Keywords: Lacrimal functional unit (LFU), ocular surface, *Tridoshas*

INTRODUCTION: The tear film is formed and maintained by an elaborate system – the lacrimal apparatus consisting of secretory, distributive and excretory parts. The secretory part includes the lacrimal gland, accessory lacrimal gland tissue, sebaceous glands of the eye lids, goblet cells and other mucin-secreting elements of the conjunctiva. The neural control of these organs plays a major role in the maintenance of ocular surface defense mechanism and lack of the harmony of these may leads to diseases like dry eye syndrome. It is essential to understand the Ayurvedic concept of the lacrimal functional unit so that the appropriate *Samprapthi vighatana* and management of the ocular surface diseases can be done effectively. The *Tridosha* harmony is the factor responsible for the proper neural control of the lacrimal functional unit.

AIMS AND OBJECTIVES:

- To explore the lacrimal functional unit and role of tridosha in maintaining its neural control
- To examine the role of *tridoshas* in the *samprapti* of disruption in the normal neural control of tearing.

MATERIALS AND METHODS: Available literature from the *Brihatrayee*, *Laghutrayee* and other relevant Ayurvedic texts were collected and discussed to explore the Role of *tridoshas* in the neural control of lacrimal functional unit (LFU) Relevant portions from the modern ophthalmology also were collected to explain the functions of LFU

THE LACRIMAL FUNCTIONAL UNIT (LFU)

- **Modern concept of control of Lacrimal functional unit:** The ocular surface is a unique region whose primary purpose is maintenance of

corneal clarity and vision. Conjunctival and corneal tissues require specialized support tissues to protect their delicate epithelial surfaces from environmental challenges, and to prevent pathological changes that could interfere with vision.The lacrimal glands, together with unique regions in ocular surface tissues such as the accessory lacrimal glands of the conjunctiva and the eyelids, the corneal limbus, and the meibomian glands, have crucial supportive roles. The functional theme of these tissues is secretion of tear components for maintenance of a stable, protective, and supportive tear layer which is critical for optimal functioning of the optics of the eye. Varying (but normally small) levels of bioelectric energy from ocular surface sensory nerves provide constant input into central nervous system (CNS) pathways which ultimately link changes in the ocular surface environment with tear secretory activity by these specialized support tissues. The concept of the lacrimal functional unit unifies the actions of these tissues by which the ocular surface protects and controls its own environment, and it provides a framework for understanding how the system dysfunctions in dry eye patients.

A complex of sensory, sympathetic, and parasympathetic nerves links the components of the lacrimal functional unit into a homeostatic loop with the essential role of protecting and supporting the ocular surface. Acting through areas of the CNS, the tissues are linked together by specific neural input and output pathways. The tissues and their neural components can be classified by function. For example, the cornea provides sensory input to the functional unit, whereas the lacrimal glands, despite their secretory function, contain all three types of neural tissues. Sensations arising from the cornea are always along the pain continuum, and corneal nerves are responsible for the patient's perception of discomfort in dry eye[1].

Maintenance of a refreshed and stable tear film is essential for the proper health of ocular surface and successful visual function in diverse environments. Ocular surface health depends on a sensitive and precise lacrimal reflex and on proper operation of the lacrimal functional unit. Lacrimal functional unit comprises of the ocular surface (cornea, conjunctiva, meibomian glands), the main and accessory lacrimal glands and the neural network that connects them[2]. This functional unit controls secretion of the three major components of the tear film in a regulated fashion, incorporating feedback from environmental, endocrinological, and cortical factors. The overall purpose of the lacrimal functional unit is to maintain the clarity of the cornea and the quality of the image projected onto the retina. Retinal image quality ultimately depends on the integrity of the tear film and the health of the ocular surface. Functions of tissues in the lacrimal functional unit are integrated by sensory nerves, which carry information about the systems status to the lacrimal center in the brainstem, and are directed by autonomic secretomotor nerves[3].

ROLE OF *TRIDOSHAS* IN MAINTAINING THE LACRIMAL FUNCTIONAL UNIT:

Functions of *Vata Dosha*:

- Formation and maintenance of macro and micro channels in the eye are controlled by *Vata*. It is the stimulating factor of all *Indriyas*[4].

- It governs the touch stimulation and movements of eye including the blinking actions (*Nimesha*&*Unmesha*)[5].
- Stimulate all the reflex actions (*Vega Pravartana*) by initiating the reflex arcs consisting of sensory and autonomic nervous system[6].
- It maintains the normal circulation and the differentiation of metabolic products into advantageous and waste and excretion of waste metabolites are maintained by *Vata*.
- It controls the *Pitta* and *Kapha Doshas* to maintain the homeostasis of ocular surface[7].

- **Functions of *Pitta Dosha*:**

- The *Sneha*, *Sara* and *Drava* properties of *Pitta* helps to maintain the normal *Prabha* (luster) of ocular surface and *Mardava* (softness of ocular surface)[8].
- Proper digestion and assimilation of *Rasa Dhatu* and formation of *Rakta Dhatu* is controlled by *Pitta*[9].
- It is responsible for the local metabolism in the ocular surface, absorbs the medicines applied locally and contributes to the ocular surface defense mechanism.

- **Functions of *Kapha Dosha*:**

- *Sleshma* due to its properties imparts cohesion of *Dhatus* in the eyeball as well as stabilizes the eyeball in the orbital cavity[10].
- It mainly protects the ocular surface by providing proper lubrication. (*Udakakarmana – Kledana, Tarpana* and *Poorana*)[11].
- *Tarpaka Kapha* which is located in *Shira* does the function of *Aksha Tarpana* (Nourishment to *Indriyas*) in association with *Sneha Dhatus*[12].
- *Sleshaka Kapha* unites and lubricates all the mobile and immobile joints of the eye[13].
- The *Guru*, *Sheeta* and *Snigdha* properties of the *Kapha* protects the eye against the *Rookshata* and *Kharata* produced by *Vata* and *Ushnata* by *Pitta*[14].
- *Kapha* repairs and regenerates the *Dhatus* of eye which undergo wear and tear phenomena due to constant exposure to the irritation of external environment.
- Ocular surface immunity is the mainly contributed by *Kapha* (*Bala* and *Sthairya*)[15]. This *Prakrita Bala*(*Ojas*) is responsible for the protection of ocular surface from contaminated external atmosphere and immunity against the wide range of micro-organisms which comes in contact.

AYURVEDIC CONCEPT OF CONTROL OF LACRIMAL FUNCTIONAL UNIT:

Krishna Mandala, being the seat of *Vata Dosha* will monitor the minute changes in the ocular surface. Any change in the equilibrium of ocular surface due to exogenous or endogenous factors, will stimulate the *Prana Vayu* to act reflexly and transmit impulses to the *Shira* (seat of *Prana Vayu* and *Tarpaka Kapha*)[16]. This stimulation will initiate the *Tarpaka Kapha* to carry out its function i.e *Kledana, Tarpana* and *Poorana*. *Tarpaka Kapha* will perform its function by the help of its *Ashrayi Dhatus* (*Sneha Dhatus*)[17]to act on the ocular surface.

Pittha Dosha which has the specific seat at *Netra* and having the unique feature of *Pachana* will assimilate the *Dhatus* secreted by the *Tarpaka Kapha* and form a stable tear film and maintain the normal *Prabha* (luster) and *Mardava* (softness) of the ocular surface.

Vyana Vayu which circulates all over the body will help the normal lid movements and *Dhatu Tarpana*.

This reflex arc will help to maintain the ocular surface integrity and immunity which facilitate the proper optical function of the eye. *Prana* and *Vyana Vayu* along with *Pachaka Pitta* and *Tarpaka Kapha* are the *Doshas* involved in this reflex arc for the proper operation of Lacrimal functional unit.

ROLE OF *TRIDOSHAS* IN THE*SAMPRAPTI* OF DISRUPTION IN THE NORMAL NEURAL CONTROL OF TEARING*:* The neural mechanism of the lacrimal functional unit is maintained by the *Tridoshas* which was described in the conceptual study elaborately. The vitiated *Doshas* will cause the disruption of neural mechanism of LFU while the related *Dhatus* will cause the instability of tear film. *Acharyas* clearly mentioned that the *Kshaya* of *Kapha* and *Kaphasrayi Dhatus* especially *Rasa* will occur during the old age along with the *Vata Vriddhi*[18]. Any local or systemic pathology in which the similar *Dosha* vitiation especially *Vata-Pitta Vriddhi* can lead to the ocular surface pathology like *Vatika Jwara*, *Vatika Pandu* etc. Formation of *Ama* due to the influence of improper *Ahara* and *Vihara* will cause the disturbance of function of *Pachaka Pitta*[19] which also contributes to the Pathology.

- *Ama* formation will cause the *Srotorodha* locally (ocular surface) and systemically will cause the vitiation of *Vata* which ultimately causes the interruption of afferent neural pathways and reduction of blinking rate.
- The vitiated *Vata* itself is responsible for the interference of functioning of *Tarpaka Kapha* because of its *Pangutwa*[20] (Will not be motivated in the absence of proper stimulation of *Vata*). The *Kapha Kshaya* due to old age will cause the *Kshaya* of all types of *Kapha* including *Tarpaka Kapha*. Any of these pathology i.e. *Vata* vitiation or *Kapha Kshaya*, can lead to the disruption of *Indriya Tarpana.*
- *Pitta* vitiation mainly due to the dietary factors like *Amla Vidahi Ahara*, *Shukta* etc and environmental factors like exposure to sunlight, heat etc will ultimately lead to the initiation of inflammation in the ocular surface[21]. The affinity of *Pitta* to promote ocular surface inflammation is especially due to the *Achakshushya Pitta Prakopa Ahara Vihara* along with the tissue damage caused by the vitiated *Vata* and *Kapha* in the ocular surface.

Dry eye occurring due to corneal anaesthesia in the conditions like herpetic keratitis, refractive surgery, surgical damage to trigeminal ganglion and topical anesthetic abuse[22] are some examples of vitiated *Vata* causing afferent neurodeprivation. The aggravation of symptoms during the intake of spicy foods, exposure to heat and sunlight etc in dry eye syndrome is due to the vitiation of *Pitta.*

DISCUSSION: By reviewing the Ayurvedic literature, it is evident that the harmony of *Vata*, *Pitta* and *Kapha* are the essential for maintaining the proper neural control of tearing. *Vega pravarthana* function of *Vata*, *Indriya tarpana* role of *Kapha* and *pachana* (assimilation) function of *Pitta* are the vitals which maintain the ocular surface stability and neural control. Dry eye syndrome is a common disease which occurs due to the disruption of this lacrimal functional unit, the condition is similar to the *Shushkakshipaka* mentioned as one of the

Sarvakshigata vikara in Ayurveda.Vitiation of *Vata* mainly due to its increased *Rukshata* and *Khara*; *Pitta* due to its aggravated *Teekshnat*a and *Ushnata* along with the involvenent of *Rasa* and *Rakta Dhatus* will ultimately leads to the utmost manifestion of the disease *Sushkakshipaka*

The etiological factors responsible for *Vata-Pitta & Rakta* vitiation will lead to *Kaphakshaya* and will initiate the pathology. *Vata* provocating factors like *Ruksha,Laghu Gunas, Katu Rasa, Vega Dharana, Ratrijagarana, Ativyayama, Shoka, Utkandha, Grishma Kala* and *Vriddhavastha*[23] are the some common *Nidanas* of *Shushkakshipaka.* These factors also create a vulnerable atmosphere for the provocation of *Pitta* and *Rakta*. One should consider the causative factors of *Rakta Dushti* like *Vidahi Annapana, Atapanala Sevana*[24] etc in the pathophysiology of *Shushkakshipaka* because the vitiation of *Rakta* alone can disturb the stability of tear film.

CONCLUSION: Ocular surface health depends on a sensitive and precise lacrimal reflex and on proper operation of the lacrimal functional unit. Lacrimal functional unit comprised of the ocular surface, the main and accessory lacrimal glands, and the neural network that connects them. Any factors which are responsible for the *Vata-Pitta* vitiation or *Kapha kshaya* will lead to the interruption of harmony of lacrimal functional unit. *Shushkakshipaka* is a disease which closely resembles the dry eye syndrome in modern ophthalmology occurring due to the instability of tear film. By maintaining the *Tridosha* harmony in ocular surface, the health of eye as well as the chance of inflammations of the ocular surface can be prevented.

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Corresponding Author: Dr.K. Sreekumar Assistant professor, Dept. of Shalakyatantra, Govt. Ayurveda College, Tripunithura, Ernakulam, Kerala.
Email: drsreekumarmsayu@yahoo.co.in

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