



AYURVEDIC AND MODERN MANAGEMENT OF CORNEAL ULCER-A JUXTAPOSE REVIEW

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ABSTRACT

A corneal ulcer is a corneal epithelial defect with underlying inflammation usually due to invasion by bacteria, fungi, viruses, or acanthamoeba. It can be initiated by mechanical trauma or nutritional deficiencies, and uncontrolled inflammation can produce corneal necrosis, alternative names of corneal ulcer include; Bacterial keratitis, fungal keratitis, acanthamoeba keratitis, herpes simplex keratitis. Symptoms are progressive conjunctiva redness, foreign body sensation, ache, photophobia, and lacrimation¹. *Acharya Sushruta* has mentioned about a *vyadi* in classification of *Krishnagat vyadhis* in *Uttar Tantra* of *Sushruta Samhita* termed as *Savarna Shukra* having clinical features similar to corneal ulcer thus, corneal ulcer is analogous to *Savarna Shukra*. This article contains descriptive information of etiopathology, diagnosis, treatment of *Savarna Shukra* or corneal ulcer according to ancient *ayurvedic* text.

Index Term- Corneal ulcer, *Savarna Shukra*, etiopathology, diagnosis, treatment, management.

INTRODUCTION

Modern science has provided characteristic and descriptive information about corneal ulcer, which includes its anatomy, physiology, pathogenesis, microbiology, pharmacology, clinical investigations, examination and treatment. While in ancient texts *Acharya Sushruta* has described corneal ulcer (*Savarna Shukra*) among *Krishnagat vyadhis* along with its causes, diagnosis and curative procedures. *Acharya Sushruta* has explained seventy-six different kinds of eye diseases and their treatment in *uttara tantra*. The *netra* execute both physiological functions *roopagrahana* and *buddhigrahana* and it is the seat of *alochaka pitta*. The shape of *netra* is *ghausthanakara* (oval shape)². *Acharya Sushruta* has described the anatomical parts of the eye consists of *mandals*, which are five in number, *sandhi* and *patala* which are six in number *Acharya Sushruta* has mentioned about four types of *Krishnagat vyadhis* in *Uttar Tantra* of *Sushruta Samhita*, their names are; *Savarna Shukra*, *Avrana Shukra*, *Pakatyaya* and *Ajaka*. Among which *Savarna Shukra* is closest related to corneal ulcer. Corneal ulceration occurs due to the host cellular and immunologic responses to the offending agent which may be bacterial, viral, and fungal or protozoa organism. Sometimes it is sterile corneal

ulceration, which may occur due to systemic dermatologic or connective tissue disease and chemical or thermal injuries. The course of events, which occur in the process of corneal ulceration, can be divided into three stages-

STAGES OF CORNEAL ULCER ³

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Stage 1: Progressive Stage

In the progressive stage, the ulcer is usually saucer shaped and is associated with gray zone of infiltration. Adhesion of the organisms is facilitated by bacterial pili and a glycocalyx envelope in bacteria such as *Pseudomonas* and *Gonococcus*. In response to this, PMNs are generated at the ulceration site. The polymorphonuclear (PMN) cells originate from the tears initially and limbal vessels consequently in response to the corneal injury. Progressive invasion of the cornea by the polymorphonuclear cells and the phagocytes increases the size of the ulceration, due to release of various lytic enzymes by the microbes. This leads to necrosis and sloughing of the epithelium, Bowman's membrane and the involved stroma. The walls of the active ulcer project due to the swelling of the lamellae by imbibitions of fluid. Ulceration may progress further by lateral extension leading to diffuse superficial ulceration or by deeper penetration of infection leading to descemetocoele formation and possibly corneal perforation

Stage 2: Regressive Stage

The termination of the progressive stage and the onset of the regressive stage is brought by the natural host defence mechanisms (humoral antibody response and cell mediated immune defences) and the anti-microbial treatment. There is an improvement in the symptomatology and clinical signs. A line of demarcation forms around the ulcer so that the margin and floor of the ulcer become more smooth and transparent. The line of demarcation consists of leukocytes that neutralize and eventually phagocytise the offending organism and the necrotic cellular debris. The digestion of the necrotic material may cause an initial enlargement of the ulcer

Stage 3: Healing Stage

The process of epithelialisation starts to occur at this stage. The histiocytes and keratocytes convert to fibroblasts so that the scar tissue is formed. Vascularisation occurs towards the ulcer site, which further promotes healing as a result of influx of fibroblasts and antibodies. When the healing is complete, the vessels regress and become "ghost vessels" which may be visualized by indirect illumination. The degree of scarring from healing varies according to the depth of involvement. Bowman's membrane does not regenerate and is replaced by fibrous tissue, which over a period of time becomes less dense, especially in young patients. The process of cicatrization occurs due to regeneration of collagen and the formation of fibrous tissue. Since the newly formed fibres are not laid down in a regular manner as in normal corneal lamellae, a scar is formed which causes the light to be refracted irregularly.

Acharya Sushruth has provided with descriptive information of *Mandals* in *Sushruth Samhita* where he has mentioned *krishnagata mandal* (cornea), as the seat of corneal ulcer or *Savrana Shukra*, thus making it very important to understand the concept of *mandals*, before *Savrana Shukra* or corneal ulcer. The concept of corneal ulcer is as follows-

CONCEPT OF MANDALS

Acharya Sushruta has enumerated the anatomical parts of the eye consists of *mandals* are five in number and *sandhi* and *patala* are six in number, these are the seat for various eye related diseases. Description of *mandals* according to *Acharya Sushruta* and its relation in modern science is as following-

- 1) **Pakshma Mandala:** This is the first and outermost *mandala* of the eye formed by the *pakshma* or eyelashes. *Pakshmani* means *chakshua achadana romani*⁴. *Pakshma* are situated in lid margins called *pakshmathaya* or *pakshma sadana*. *Pakshma* is a form of *kesa* and considered as *upadhatu* of *majja* and *mala of asthi*. It serves to heighten the protection of the eye from dust and foreign bodies.
- 2) **Vartma Mandala:** The Upper and Lower eyelids together form a circular structure in front of the eyeball called as *vartma mandala*. The eyelids are mobile tissues curtains placed in front of the eyeballs. *Vartma Mandala* is also known as *Aksi Kosha* considering its protective function. There are two *tarunasthi* in the eye lids⁵ it is of elliptical space between the upper and lower eyelids. The eyelids feature a row of eyelashes along the eyelid margin. The two eyelids meet each other at medial and lateral angles (two *sandhis as kaninika and apanga*). The *nimesha-unmesha* function (blinking) is controlled by *vyana vayu*⁶. The movement of the *vartma (nimeshaunmesha)* is regulated by motor nerves are facial (orbicularis muscle), oculomotor (levator palpebrae superioris muscle) and sympathetic fibers. Sensory nerve supply is derived from branches of trigeminal nerve such as lacrimal, supraorbital and supra ocular nerves for upper lid and infraorbital nerve with infra- trochlear branch for lower lid. Each eyelid consists (from anterior to posterior) of many layers.
- 3) **Shukla Mandala:** This *mandala* is present exactly inside of the *vartam mandala* and beyond the *krishnagata mandala*. The *shukla mandala* appears white in colour. The *shukla mandala* can be allied with the scleral part of the external fibrous coat of the eyeball. Sclera forms the posterior five-sixth opaque part of the exterior fibrous tunic of the eyeball. Its entire outer surface is covered by tenon's capsule. In the anterior part it is also covered by bulbar conjunctiva. Thickness of sclera varies considerably in dissimilar individuals and with the age of the person. It is normally thinner in children than the adults and in females than the males. Sclera is thickest posteriorly (1mm) and progressively becomes thin when traced anteriorly. Lamina cribrosa is a sieve-like sclera from which fibres of optic nerve pass.
- 4) **Krishna Mandala:** The *krishana mandala* of eye (cornea) is forms one-third of the transverse extent of the eyeball. In modern perspective, cornea is forms anterior one-sixth of the outer fibrous coat of the eyeball. The *krishna mandala* can be similar with the cornea; seems as blackish because of the iris. Cornea is a transparent, avascular, watch-glass like structure. The uveal tissue constitutes the middle vascular coat of eyeball. From anterior to posterior it can be separated into three parts, namely, iris, ciliary body and choroid. Iris is the anterior most part of uveal tract. Iris is a tenuous circular disc corresponding to the diaphragm of a camera. The definitive colour of iris is contingent on the anterior limiting layer. In blue iris this layer is thin and contains few pigment cells. While in brown iris it is thick and compactly pigmented. The physical basis of eye colour is determined by the distribution and content of melanocyte cells in the uveal tract of the eye. The iris consists of several layers: the anterior limiting layer and its underlying stroma are the most important for appearance of the eye color⁷. Two primary physiological functions of the cornea are to act as a major refracting medium; and to protect the intraocular contents. The stroma of the iris contains collagenous fiber, pigment cells, sphincter pupillae muscle and dilator pupillae muscle.

- 5) **Drishti Mandala:** The *drishti mandala* can be similar with the pupil and lens. Acharya Susruta has described the diameter of *drishti mandala* (pupil) of eye is one-seventh and one-ninth part of *krishna mandala* (cornea) and the distance between right and left *drishti mandala* (interpupillary) are four fingers. Serving the function of dristi or vision.

CAUSES OF CORNEAL ULCER⁸

Most cases of corneal ulcer are due to a bacterial infection that invades the cornea often. Besides bacterial infection, other causes of corneal ulcers are fungi and parasites, which are as follows:

- 1) **Acanthamoeba:** These common parasites can enter the eye and cause acanthamoeba keratitis, a very serious eye infection that can result in permanent scarring of the cornea and vision loss, acanthamoeba microorganisms are commonly found in tap water, swimming pools, hot tubs and other water sources. Contact lens wearers who fail to remove their lenses before swimming significantly increase their risk for a corneal ulcer from acanthamoeba keratitis.
- 2) **Ocular herpes:** Another cause of corneal ulcer is a herpes simplex virus infection (ocular herpes), which can damage the exterior and sometimes even deeper layers of the eye's surface.
- 3) **Other causes:** Corneal ulcers can be caused by dry eyes, eye allergies and widespread general infection. Immune system disorders and inflammatory diseases such as multiple sclerosis and psoriasis also can lead to corneal ulcers.



Ring Infiltrate in acanthamoeba corneal ulcer



Ring infiltrate in fungal corneal ulcer

INVESTIGATION

Systemic investigation should be done in cases of sterile corneal ulcers. Systemic investigations in cases of peripheral ulcerative keratitis include laboratory tests, which should focus on the systemic diseases. This includes a hemogram in cases of immuno compromised individuals and blood sugar examination in suspected cases of diabetics. A complete blood count including esr, urine analysis, blood urea, nitrogen and creatinine. IgM rheumatoid factor, which is positive in cases of Rheumatoid arthritis, scleroderma, polyarteritis nodosa, wegner's granulomatosis, systemic lupus erythematosus, sarcoidosis should also be sent for. Circulating antibodies such as ANA (>90%), anti-DNA (70%) are positive in systemic lupus erythematosus. Angiotensin converting enzyme (ACE) is elevated in sarcoidosis and antineutrophil cytoplasmic antibodies (ANCA) are present in 96 % cases of Wegner's granulomatosis. Hepatitis B surface antigen is sent for in suspected cases of polyarteritis nodosa and fluorescent treponemal antibody absorption (FTA-ABS) in suspected cases of syphilis.

CLINICAL INVESTIGATIONS⁹

The clinical investigations include the estimation of the intraocular pressure and posterior segment evaluation by ultrasonography to rule out any evidence of concomitant endophthalmitis. Tonopen can be used to measure intraocular pressure in cases of non-perforated corneal ulcers. Digital estimation of the intraocular pressure may also be done to rule out secondary glaucoma. The intraocular pressure will be low in cases of perforated corneal ulcers. Ultrasonography scan should be done to evaluate the status of the posterior segment in cases of corneal ulcers where endophthalmitis is suspected.

CORNEAL SCRAPING

Corneal scraping is the most valuable specimen in cases of corneal ulcer and its examination is the main stay in the diagnosis and subsequent management. Anaesthesia corneal scraping is performed under topical anaesthesia preferably after instillation of two drops of 0.5 % proparacaine in the lower fornix of the affected eye. Topical 0.5 % proparacaine is least bactericidal as compared to other anaesthetic agents such as tetracaine and xylocaine. Proparacaine provides adequate anaesthesia within one minute and does not cause intense stinging on first installation. General anaesthesia and sedation may be required in children, uncooperative adults or mentally impaired patients. Instruments corneal scraping is obtained using a Kimura's spatula. The other instruments for corneal scraping are 26-gauge needle, Bard Parker blade -57, hypodermic needle, surgical blade no. - 15 and calcium alginate swab. The platinum spatula has been traditionally used for corneal scraping. It is rapidly sterilized with a Bunsen burner and cools rapidly between scrapings. A modified platinum spatula is also available with a rounded flexible tip, which is modified with a honing stone to create a narrow tapered roughened edge to enhance removal of corneal material. We routinely use a 23-gauge needle to scrap the ulcer. It is easier to get good quantity of corneal scrapings due to the sharpness of this instrument. However extreme caution is need in cases of dry and deep ulcers especially thin corneas. Care should be taken not to rub the cornea against the superior flange especially while applying the speculum. The scraping may be done under a slit lamp or under an operating microscope. Under direct illumination, the ulcer is inspected. Any mucous or debris on and around the ulcer is carefully cleaned with a sterile swab stick. Then, using a Kimura Spatula or a Bard Parker Knife or a 23-gauge needle, the leading edges and base of the ulcer are scraped. Streptococci pneumoniae is more readily found at the edge of the ulcer whereas moraxella is more likely to be present at the ulcer base. Since the material obtained from corneal scraping may not be adequate, it should be directly inoculated into the culture media rather than placing it first into the transport media. Care should be taken to ensure that the instrument is moved in one direction only. Multiple scrapings must be obtained to enhance the yield of the organisms. One should be careful not to touch the eyelids or the lashes while collecting the sample to avoid contamination. More recently, calcium alginate swabs moistened with trypticase provides another method of collecting corneal specimens. Studies have demonstrated higher yield of bacteria as well as fungi when this method was used as compared to the platinum spatulas.

Potassium hydro-oxide wet mount preparation

The scraped material is spread out as thinly as possible with the help of spatula on the slide. One drop of 10 % KOH solution is put on the scrapings and a slide cover is placed. The slide is examined under a microscope. The KOH helps in loosening the corneal stromal lamellae and exposing more fungal filaments. It also stains the filaments in a very light yellow colour. 10 % KOH mount examined by conventional microscope is a useful test in helping identification of fungi and acanthamoeba. The test has high sensitivity (92%) and a high specificity (96%).

SEROLOGICAL INVESTIGATIONS

A variety of DNA probe assays are available for the confirmation of the results of the culture and for direct detection of the organisms. The expensive molecular microbiologic tests however, should not replace the time tested culture and staining techniques, the efficacy of which have a proven track record. Such serological test may be divided into three categories. Which are target amplification systems such as polymerase chain reaction (PCR), cell sustaining sequence replication or strand displacement amplification, probe amplification systems which include ligase chain reaction (LCR), signal amplification in which the signal generated from each probe is increased by using compound probes or branched chain technology. These techniques detect whether DNA and RNA from a particular organism is present but do not detect the viability of the organism, the advantages of PCR include greater speed than culture methods (up to 4 hours) and the ability to analyze specimens far from where they are collected. The cost of PCR to diagnose infections generally exceeds that of conventional culture methods, a factor that currently limits its widespread use, 16S rDNA typing has been used as a rapid alternative to culture for identifying pathogens in patients with bacterial keratitis, whereas 18s ribosome gene is used to detect fungal kerati.

DIAGNOSIS

Ayurved concept of investigation includes *Ashta Vida Pariksha*, in which *Druk Pariksha* mainly is done for corneal ulcer; it mainly includes complete inspection of all the *sanghis, mandals, and patals*, after complete inspection its analyzed that which *dosha* among *vata, pitta, khapa*. On determination of the *dosha* according to the *prakruti* of the patient, further steps of treatment are taken.

While according to modern science diagnosis of corneal ulcer is done by direct observation under magnified view of slit lamp revealing the ulcer on the cornea. Herpes simplex ulcers show a typical dendrite pattern of staining. Rose-Bengal dye is also used for supra-vital staining purposes, but it may be very irritating to the eyes. The descemet's membrane will bulge forward and after staining will appear as a dark circle with a green boundary, because it does not absorb the stain. Doing a corneal scraping and examining under the microscope with stains like Gram's and Potassium hydroxide preparation may reveal the bacteria and fungi respectively. Microbiological culture tests may be necessary to isolate the causative organisms for some cases. Other tests that may be necessary include a Schirmer's test for keratoconjunctivitis sicca and an analysis of facial nerve function for facial nerve paralysis.

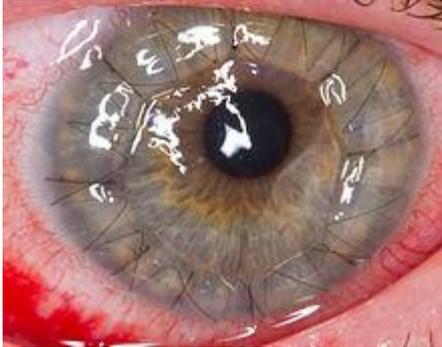
TREATMENT

Ayurveda provides with a wide range of medicines depending upon *Bala, Agni, Prakruti, Desh, Kaal* and *Vaay* of the individual thus presenting a different set of medicine and different route of medicine accordingly. *Ayurved* comprises of both *Sanshaman* and *Sanshodana* form of treatment former is generally administered by *ayurvedic aushadis* while the later is generally administered by *kriyakalpa*, depending upon the *dosha* and its severity, mode of treatment is chosen. Some of the common drugs used in corneal ulcer include- *Pindikanjan, Manhashila Anjan, Amalki Rasayana, Saaptamruth Loha, Shadhang Gugglu*.

Modern science mainly coddles with antiviral, antifungal, antibiotic eye drops, as determined by investigation medication is administered accordingly. Conventional improvement in corneal ulcer is seen within two to three weeks on giving the treatment to the patient although time period might increase in some cases. Also there might be some cases where the ulcer is mature and medications do not play significant role in those cases corneal surgery is done called keratoplasty.

Keratoplasty (Corneal transplantation)¹⁰

Corneal transplantation, also known as corneal grafting, is a surgical procedure where a damaged or diseased cornea is replaced by donated corneal tissue (the graft). When the entire cornea is replaced it is known as penetrating keratoplasty and when only part of the cornea is replaced it is known as lamellar keratoplasty. Keratoplasty simply means surgery to the cornea. The graft is taken from a recently deceased individual with no known diseases or other factors that may affect the chance of survival of the donated tissue or the health of the recipient.



Cornea transplant after one day surgery



Replacement of entire cornea

CONCLUSION

Pertinently though both *Ayurvedic* science and medical science have their own means of administration of *Savarna Shukra* or corneal ulcers both do treat the ailment, only factor which separated the two is the ancient and modern mode of drug administration. The result could be better if the patient is given both forms of mediations depending upon his *Prakruti* and chronicity, but that is a subject to further research upon.

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