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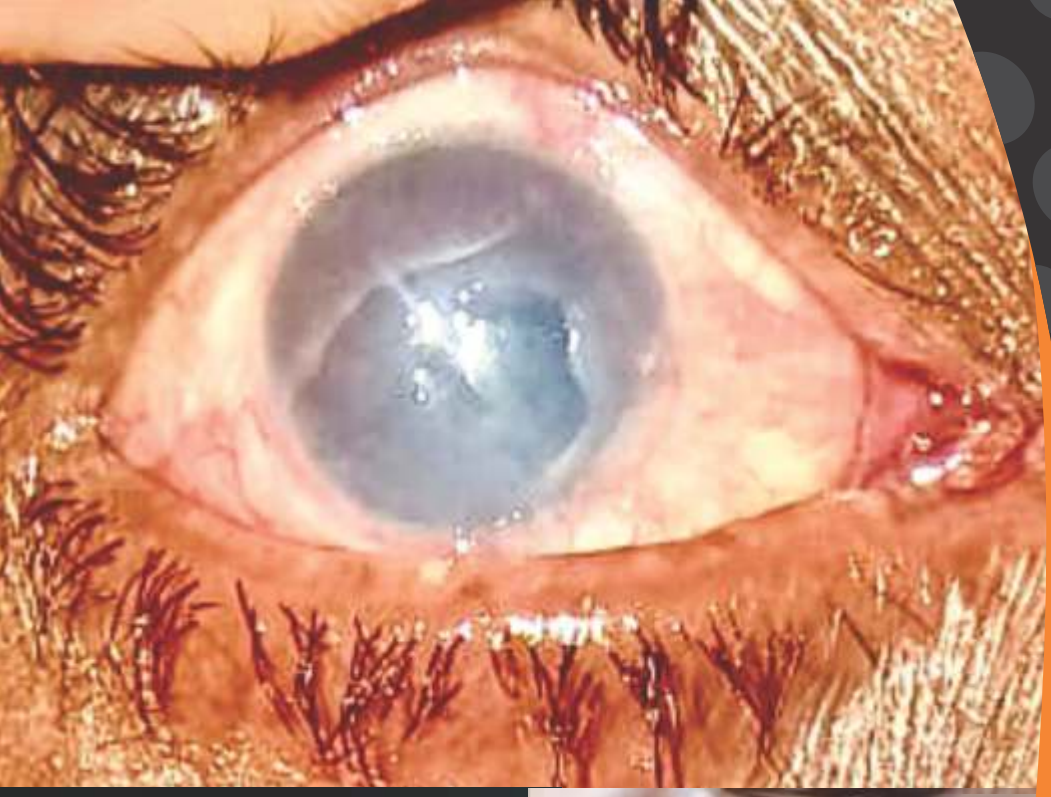

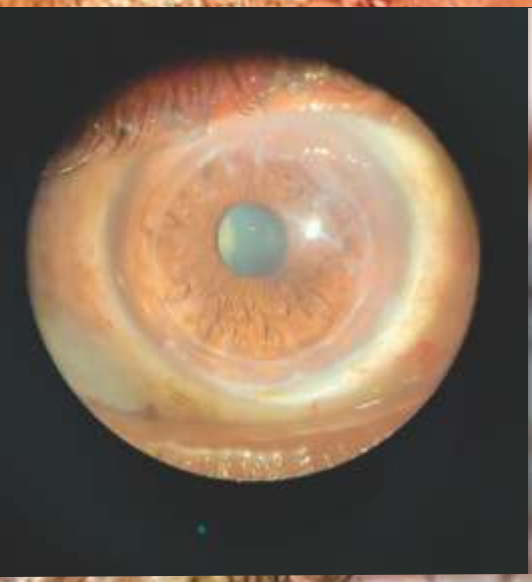

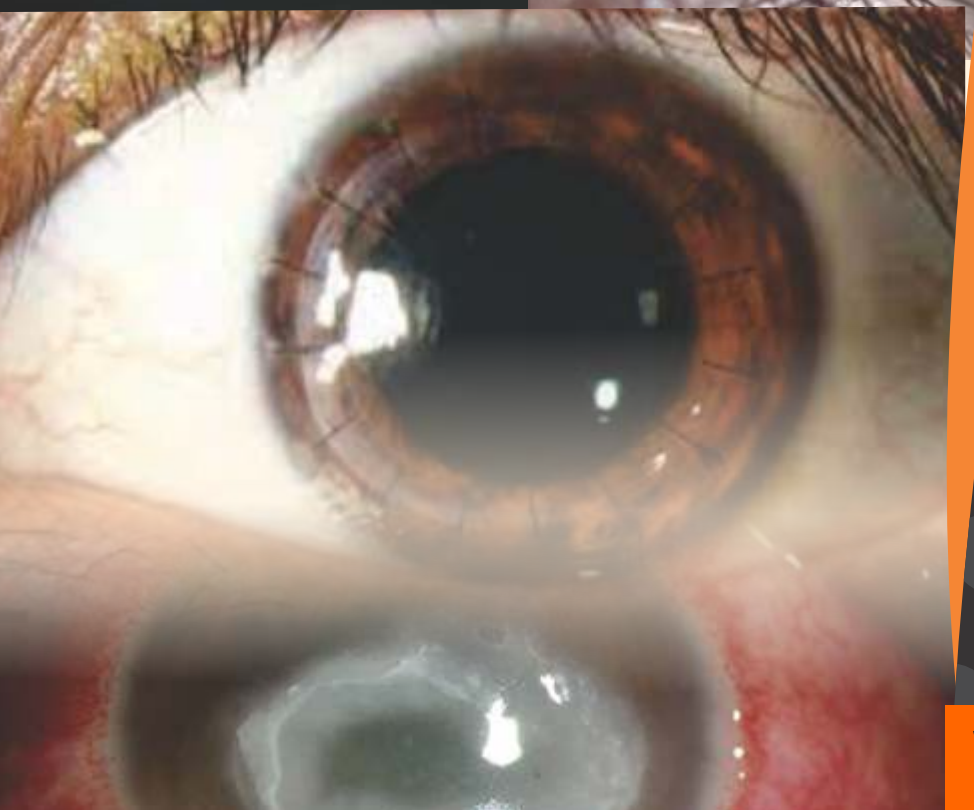

THE IDOS

NEWS & VIEWS

Official Publication of Indore Divisional Ophthalmological Society

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THE IDOS - News & Views

CONTENTS

(Volume 2, Issue 1)

"Success is not final, failure is not fatal: it is the courage to continue that counts"

- **Winston Churchill**

FROM THE EDITOR'S DESK.....

"New team and new beginning offers you new perception"

- Abuthaher

Yes, the new team is geared up to match the perceptions of all. As a step forward to what Team IDOS 2021-22 started, we have added a theme section to the journal. The first issue is focused on "CORNEA" and shall be launched during "Eye donation Fortnight 2022"

With the increasing cases of corneal blindness, it is important to emphasise on prevention, early diagnosis and management of corneal lesions.

This issue on cornea includes articles on Infectious Keratitis, Ocular Chemical Burn Amniotic Membrane Grafting, Keratoplasty, Keratoconus, Eye Banking, Pterygium, Ocular Surface Squamous Neoplasia, Open Globe Injuries etc - which will definitely benefit the residents and general ophthalmologists.

Our aim is to keep all members updated so that they can improve their clinical skills.

We wish happy reading to all.

Dr. Shweta Walia
Editor

Dr. Neetu Kori
Dr. Sumeet Agrawal
Co-Editor

Guest Editorial

Dr. Namrata Sharma

Cornea is the window of the eye and corneal clarity and morphology is the most important factor for a patient's sight or vision. As per the latest survey on blindness corneal opacities are the second commonest cause of blindness in the country after cataract. In the age group 0-49 years , it is the commonest cause of blindness. This issue covers all the corneal pathologies and their treatment which includes Corneal Degenerations and Dystrophies Simplified, Ocular Burns, Pterygium, Ocular Surface Sqamous Neoplasia, Pterygium and Open Globe Injuries. Chemical burns and open globe injuries are of utmost importance as these need to be tackled in an emergency and not only cornea specialists but all general ophthalmologists should know about the immediate management for better outcomes. Pterygium management should be known by all ophthalmologists and is one of the most simple surgery but can become challenging , if not managed well. Further this issue not only describes the tips and tricks of Penetrating Keratoplasty but also gives the pearls for corneal endothelial Keratoplasty which is one of the most evolved surgeries. Amniotic membrane grafting is a technique which is very useful in variety of ocular surface pathologies. For all those who need to know about how to establish an Eye Bank, this describes the pre-requistes for the same. Overall a must read issue for all general ophthalmologists and cornea specialists. Many congratulations to the editorial team for a stupendous effort.

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Corneal Degeneration and Dystrophy (Simplified)

Sonalee Mittal

CORNEAL DEGENERATION

Introduction :

Degenerations of the cornea are common conditions that, usually have little effect on the ocular function and vision. The normal corneal cells undergo some degenerative changes under the influence of age or some pathological conditions. Unlike corneal dystrophies, corneal degenerations are not inherited, and may be unilateral or bilateral. Degenerations tend to involve the peripheral cornea and may extend axially and overlap the limbus and conjunctiva.

CLASSIFICATION : DEPENDING UPON ETIOLOGY :

A. AGE RELATED DEGENERATIONS.

1.Arcus Senilis.

2. Vogt's White Limbal Girdle.

3.Hassall Henle Bodies.

4. Senile Marginal Furrow Degeneration.

B. PATHOLOGICAL DENENERATIONS

1.Fatty Degenerations.

2.Hyaline Degenerations.

3.Calcific Degenerations (Band Keratopathy).

4.Amyloid Degenerations.

5.Salzmann's Nodular Degenerations.

6. Spheroidal Degenerations.

7.Terriens Marginal Degenerations.

8. Pellucid Marginal Degenerations.

CLASSIFICATION DEPENDING UPON LOCATION :

A. PERIPHERAL DEGENERATIONS.

1.Arcus senilis., 2.Vogt's white limbal girdle., 3.Hassalhenle bodies., 4.Terrien's marginal degeneration., 5. Pellucid marginal degeneration. 6. Senile marginal furrow degeneration.

B. AXIAL CORNEAL DEGENERATIONS.

1.Fatty degeneration., 2. Hyaline degeneration., 3. Calcific degeneration (band keratopathy) 4. Amyloid degenerations., 5. Salzmann's nodular degenerations.

AGE RELATED CORNEAL DEGENERATIONS :

1. ARCUS SENILIS :

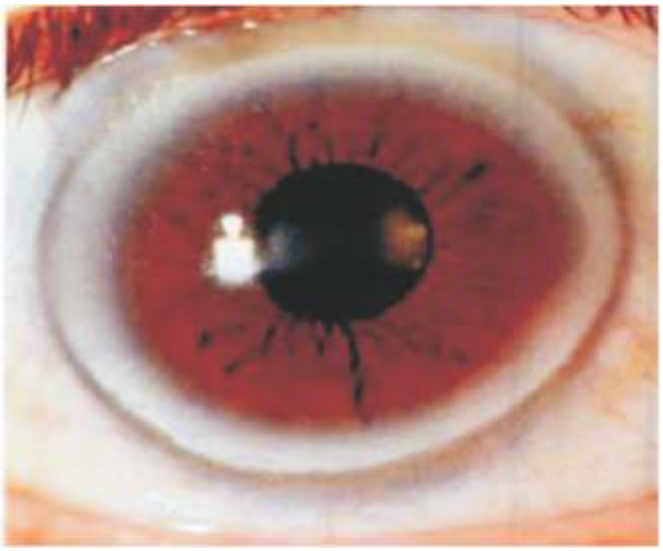
Arcus senilis also known as Gerontoxon, Corneal arcus, presents as a gray-to-white, band of peripheral corneal opacification. It begins superiorly and inferiorly at 6 and 12 o'clock positions and then progresses circumferentially to form a ring 1mm wide. Its central border is diffuse and peripheral border is sharp. This ring of opacity is separated from the limbus by a clear zone (the lucid interval of Vogt).

Stromal lipid infiltration begins in the deep stroma with progression to involve the superficial stroma. Arcus is almost always bilateral occurring in 60% of individuals between 50 to 60 years of age and in nearly all individuals above 80years.

AS is caused by leakage of lipoproteins (low density lipoproteins) from the limbal capillaries into the corneal stroma.

When AS is found in patients younger than 50 years it is termed Arcus Juvenilis . Men with juvenile arcus have increased risk for type IIa dyslipoproteinemia and cardiovascular disease.

Arcus Senilis almost always remains peripheral causing just cosmetic blemish and does not require any treatment.



ARCUS SENILIS

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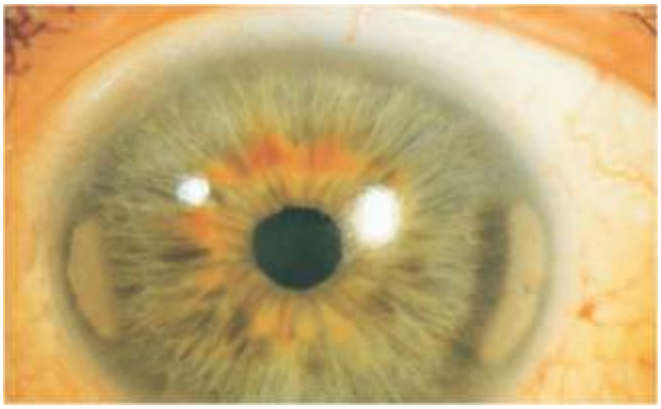
2. VOGT'S WHITE LIMBAL GIRDLE :

Vogt was the first to describe two types of limbal girdle white arc like opacities in the cornea central to the limbus in the 3 o'clock and 9 o'clock positions.

Type I is a mild early form of calcific band keratopathy, featuring a 'swiss cheese' hole pattern and a clear area separating the lesion from the limbal margin.

Type II lacks the peripheral clear zone and absence of holes and consists of fine white radial lines, located nasally more often than temporally.

Histologically, it is made up of hyperelastotic and hyaline deposits peripheral to bowman's layer, similar to those seen in pterygium and pinguecula. The prevalence of this condition increases with age to almost 100% above the age of 80 years.



3. HASSALL- HENLE BODIES :

These are drop like excrescences of hyaline material projecting into the anterior chamber around the corneal periphery. These arise from the posterior surface of Descemet's membrane.

In pathological conditions, (such as seen with Fuch's dystrophy, fleck's dystrophy, or long standing inflammatory conditions) they become larger and invade the central area and the condition is called CORNEA GUTTATA.

4. SENILE CORNEAL FURROW DEGENERATION :

It is a painless bilateral thinning of the peripheral cornea. A peripheral corneal furrow occurs between corneal arcus and the limbus in older adults. Thinning occurs due to fibrillar degeneration of the corneal stroma .

Furrow degeneration does not require any therapy, but the location and degree of thinning should be evaluated when considering location for cataract incisions.

PATHOLOGICAL DEGENERATIONS :

1.FATTY DEGENERATIONS (LIPID KERATOPATHY) :

Fatty degenerations of cornea are characterised by whitish or yellowish deposits. The fat deposits are mainly stromal, and consist of cholesterol, fatty acids, and phospholipids. Initially the fat deposits are intracellular but may become extracellular with necrosis of stromal cells. Lipid keratopathy may be Primary or Secondary.

a) Primary Lipid keratopathy : is a rare condition and occurs apparently spontaneously in a cornea that is not vascularized. Serum lipid levels are normal in such patients.

b) Secondary Lipid keratopathy : occurs in a vascularized cornea secondary to diseases such as corneal infections (herpes simplex and herpes zoster keratitis), interstitial keratitis, ocular trauma, glaucoma, and chronic iridocyclitis.

Treatment is primarily aimed at the medical control of the underlying inflammatory disease. Other options include; argon laser photocoagulation or needle cautery of the feeder vessel,(to induce slow resorption of lipid infiltrate).

2. HYALINE DEGENERATION :

It is characterized by deposition of hyaline spherules in the superficial stroma. It can be Primary or Secondary.

a) Primary hyaline degeneration : is bilateral and usually seen with granular dystrophy.

b) Secondary hyaline degeneration ; is unilateral and associated with various corneal diseases, old keratitis, trachomatous pannus and long standing glaucoma.

Treatment of the condition, when it causes visual disturbances is Keratoplasty.

3. CALCIFIC DEGENERATION (BAND SHAPE KERATOPATHY) :

It is associated with deposition of calcium salts in the bowman's membrane, epithelial basement membrane and anterior stroma.

Causes :

* Idiopathic or Primary BSK is familial.

* Ocular. Chronic anterior uveitis, chronic corneal oedema, chronic keratitis, chronic glaucoma, phthisis bulbi, silicon oil in anterior chamber.

*Metabolic : Hypercalcaemia, hyperphosphataemia, hyperuricaemia, chronic renal failure and sarcoidosis.

*Age related BSK affects otherwise healthy individuals.

Clinical Features :

It typically presents as a band shaped opacity in the interpalpebral zone with a clear interval between the ends of the band and the limbus. The condition begins at the periphery and gradually progresses towards the centre. The opacity is beneath the epithelium which is usually intact. The

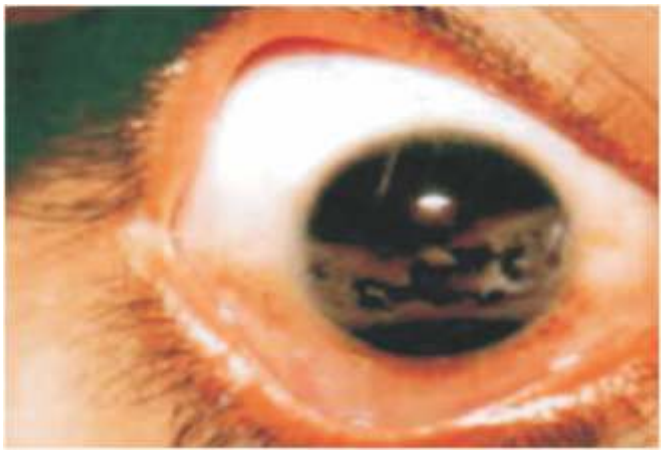
surface of the band opacity is stippled due to holes in the calcium plaques in the area of nerve channels of bowman's membrane. Advanced lesions may become nodular and elevated with considerable discomfort due to epithelial breakdown.

Treatment : Is indicated if vision is affected or the eye is uncomfortable.

*Chelation : It is chemical removal of the calcium salts. The corneal epithelium overlying the opacity and a solid layer of calcification are scraped under local anaesthesia with forceps and a scalpel blade. The cornea is then rubbed with a cotton tipped applicator dipped in a solution of 1.5 to 3.0% EDTA for about 10 to 15 minutes until all the calcium is removed. Pad and bandage is then applied for 2-3 days to allow the epithelium to regenerate.

*Phototherapeutic keratectomy (PTK) with Excimer laser is very effective in clearing the cornea .

*Lamellar Keratoplasty may be performed when the band is obscuring vision.



BAND-SHAPED KERATOPATHY

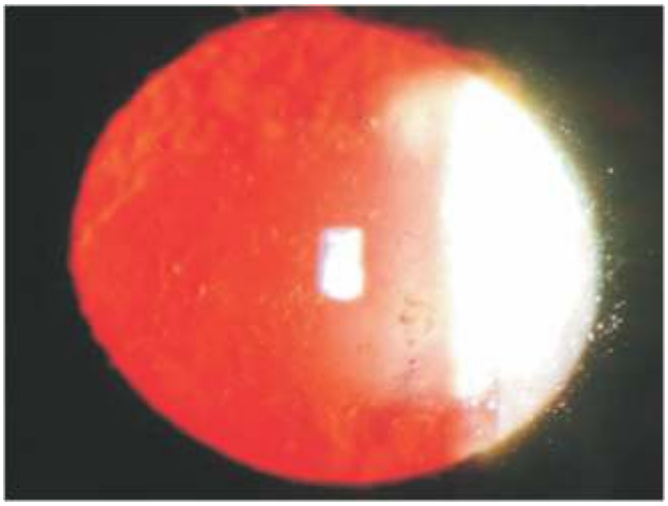
*And Treatment of the underlying causative disease.

4. AMYLOID DEGENERATION :

It is a bilateral condition characterised by non-progressive amyloid deposition within the mid and deep corneal stroma. The deposits form polymorphous and filamentous opacities in an axial distribution. There is no associated inflammation, vascularization, or altered visual acuity.

The term polymorphic amyloid degeneration was suggested by Mannis et al in 1975. Onset of disease is at 50 years of age and the amyloid deposits do not appear to progress.

The diagnosis is made by slit lamp examination, which reveals gray-white axial deep stromal opacities of the cornea. Clear, refractile,stromal filamentous opacities are evident by retroillumination.As vision is not affected , no treatment is required .



RETROILLUMINATION OF POLYMORPHIC AMYLOID DEGENERATION

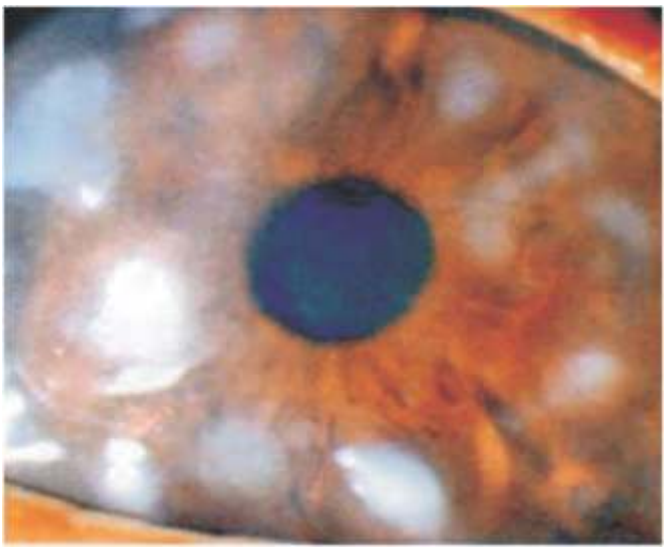
5. SALZMANN'S NODULAR DEGENERATION :

It consists of raised hyaline plaques deposited between the epithelium and bowman's membrane. It occurs in eyes with any form of chronic irritation such as trachoma, dry eyes, chronic blepharitis, recurrent attacks of phlyctenular keratitis, rosacea keratitis. More common in women and is unilateral.

*Features : Multiple bluish-white elevations (nodules) (1 to 10) arranged in a circular fashion are seen within the cornea. The base of the nodule may be associated with pannus and epithelial iron deposition.

Patient may experience discomfort due to loss of epithelium over the surface of nodules. Visual loss occurs when the nodules approach the central zone.

+Grade IFine shiny deposits present in periphery without symptoms.



SALZMANN'S NODULAR DEGENERATION

+Grade IIthe central cornea is involved and vision >20/100 (6/36)

+Grade IIIthere are large corneal nodules and vision >20/200 (6/60)

*Treatment : *.Lubrication together with control of the cause.

*Manual superficial keratectomy to peel off the lesions and surface flattened with a diamond burr.

*Adjunctive Mitomycin C applied for 10 sec. with a sponge to reduce the recurrence rates.

*Lamellar keratoplasty or Excimer laser phototherapeutic keratectomy.

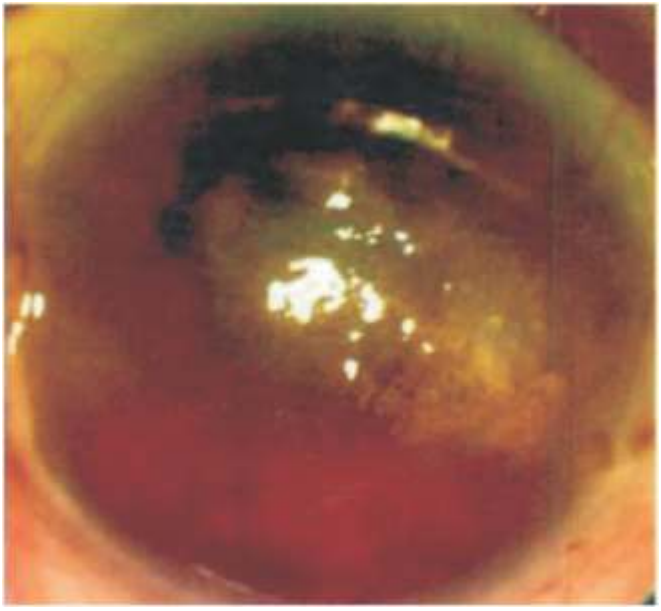
6. SPHEROIDAL DEGENERATION : (LABRADOR Keratopathy ; Climatic Droplet Keratopathy):

It typically occurs in men that work outdoors in hostile climates. Exposure to Ultraviolet rays and /or ageing are the likely cause.

*Amber coloured spheroidal granules accumulate at the level of Bowman's membrane and anterior stroma in the interpalpebral zone.

*Increasing opacification, coalescence, and central spread occurs.

*Treatment : Protection against ultraviolet rays by Sunglasses



SPHEROIDAL DEGENERATION

and Superficial Keratectomy or Lamellar Keratoplasty.

7.TERRIEN'S MARGINAL DEGENERATION :

It is non-ulcerative thinning of the marginal cornea which predominantly affects males after 40 years of age.

It mostly involves superficial peripheral cornea.

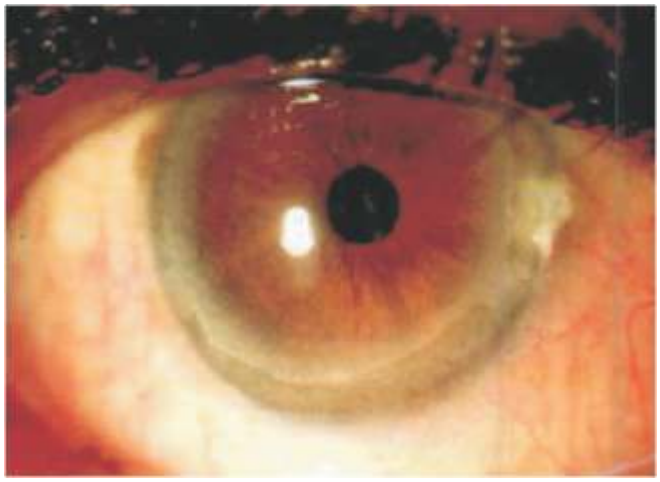
Initial lesion is asymptomatic and corneal opacification separated from the limbus by a clear zone.

The lesion progresses very slowly over many years with thinning and superficial vascularization. Dense yellowish white deposits may be seen at the sharp leading edge.

Patient experiences irritation and defective vision in advanced stages.

Complications such as Perforation and Pseudopterygium may occur.

Treatment is Nonspecific. In severe thinning a patch of corneal



TERRIEN'S MARGINAL DEGENERATION

graft may be required.

8. PELLUCID MARGINAL DEGENERATION :

The term 'pellucid marginal degeneration' was first coined in 1957 by the ophthalmologist Schalaeppi. The word 'pellucid' means clear, indicating that the cornea retain clarity in this condition.

It is characterised by a clear bilateral corneal thinning (ectasia) in the inferior and peripheral region of the cornea. The distribution of the degeneration is crescent or arcuate shaped. The cornea just above the region of thinning is of normal thickness, and may protrude anteriorly, which creates an irregular astigmatism. This is described as 'beer belly' appearance since the greatest protrusion occurs below the horizontal line (unlike keratoconus).

The inferior peripheral thinning is seen between the 4 o'clock and 8 o'clock position. It induces high against the rule astigmatism.

The gold standard diagnostic test for PMD is Corneal topography. Corneal topography may show a 'crab claw-like' appearance.

Treatment of PMD is use of Scleral Contact lens, a type of rigid gas permeable (RGP)that come in diameter of range 15.5 mm

to 18.0 mm in diameter.

Surgical treatment have lower success rates. Crescentric lamellar keratoplasty, Epikeratoplasy, and Corneal wedge/resection have been tried with variable results.

CONCLUSION :

Corneal degenerations generally result from steady deterioration of the tissues that was previously normal with subsequent loss of their functional activity. Corneal degeneration are characterised by the deposition of a specific material , stromal thinning, and vascularization. The cornea may undergo changes associated with ultraviolet light stimulation and oxidative stress that are thought to be responsible for the progression of the degenerative process.

CORNEAL DYSTROPHY

INTRODUCTION :

Corneal Dystrophies are a group of inherited, usually bilateral corneal opacifying disorder associated with decreased vision and discomfort. In corneal dystrophies, the cells have some Inborn defects due to which pathological changes may occur with passage of time leading to development of corneal haze in otherwise normal eyes that are free from inflammation or inflammation. There is no associated systemic disease.

CLASSIFICATION :

The new IC3D Classification of Corneal dystrophies based on Biomicroscopicand Histopathological features they are classified into I.Epithellial and subepithelial ; II.Bowmans layer. III.Stromal ; IV.Descemet membrane and endothelial.

I. EPITHELLIAL AND SUBEPITHELLIAL DYSTROPHIES :

It is also k/as Map-Dot-Fingerprint dystrophy.

COGAN'S Microcystic Epithelial Dystrophy. It is the most common corneal dystrophy.

Inheritance : The condition is usually sporadic.

Histology : Thickening of theBasement membrane with deposition of fibrillary protein between the Basement membrane and the Bowman layer. Basal epithelial layer hemidesmosomes are deficient, lead to their poor adhesion to basal laminar material, predisposing to recurrent erosions.

Onset : In the Second Decade. About 10% may develop recurrent erosions in the third decade.

Signs : Lesions are often best localized by Retroillumination or Scleral scatter. These include :

*Maps : Irregular islands of thickened, grey, hazy epithelium, with scalloped, circumscribed borders, affecting the central or paracentral cornea.

*Dots (Cogan) : Irregular round, oval or comma shaped, non-staining, putty grey opacities.

*Finger print lines : Parallel, curvilinear lines, usually paracentral.

*Bleb-Like Subepithelial pebbled glass pattern.

Occurrence of Bilateral Recurrent Erosions with no history of trauma suggests Basement Membrane Dystrophy.

Treatment :

EPITHELLIAL BASEMENT MEMBRANE DYSTROPHY

It is that of recurrent corneal erosions.

2. MEESMAN EPITHELIAL CORNEAL DYSTROPHY :

Also k/as Juvenile Hereditary Epithelial dystrophy.

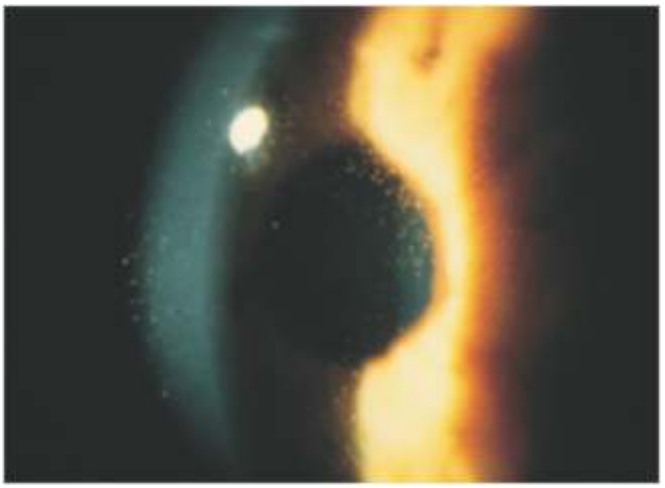
Inheritance : AD (Autosomal Dominant)

Genes involved, are Keratin K3 (KRT3) Keratin K12 (KRT12) for Stocker-Holt variant.

Genetic loci ; are 12q13 (KRT3) 17q12 (KRT12).

Histology : Irregular thickening of the Epithelial Basement membrane and intraepithelial cysts.

Symptoms : Patients are typically asymptomatic or may have painful recurrent erosions and mild visual reduction ,glare



MEESMAN EPITHELIAL CORNEAL DYSTROPHY

and light sensitivity.

Signs : Characteristic lesions include .

*Multiple, tiny intraepithelial cysts of uniform size but variable density mostly in the interpalpebral area with surrounding clear epithelium, which extend towards the limbus but do not reach the limbus.

*Corneal thinning and Reduction in corneal sensations.

*In Stocker-Holt variant, the entire cornea has fine, greyish punctate epithelial opacities that stain with fluorescein and fine linear opacities that may appear in a whorl pattern.

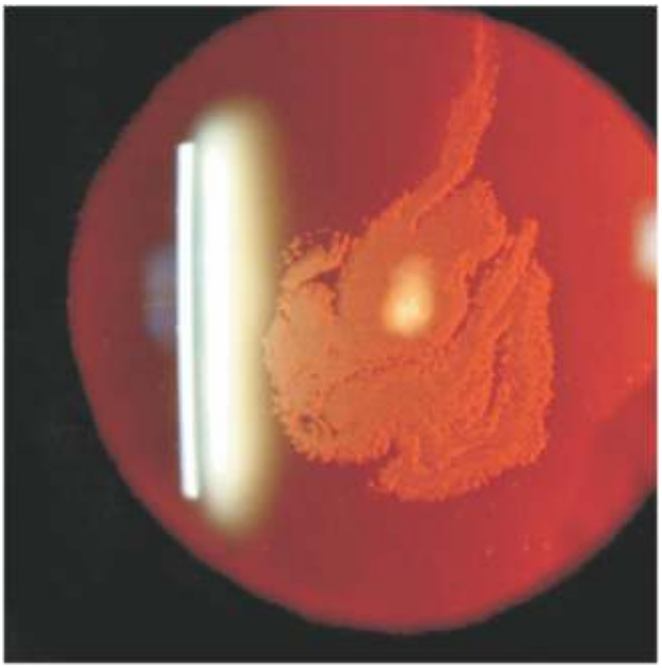
3. LISCH EPITHELIAL CORNEAL DYSTROPHY :

Also k/as Band Shaped and Whorled Microcystic Dystrophy of the corneal epithelium.

Inheritance : X-linked chromosomal dominant.

Symptoms : Usually Asymptomatic. Blurring of vision occurs if pupillary zone is involved.

Signs : Direct illumination shows Localized Grey Opacities in different patterns : Whorl-like, Radial, Band shaped, flame/ feathery shaped.



LISCH EPITHELIAL CORNEAl DYSTROPHY

Indirect Illumination shows multiple densely crowded Clear Cysts with clear surrounding epithelium.

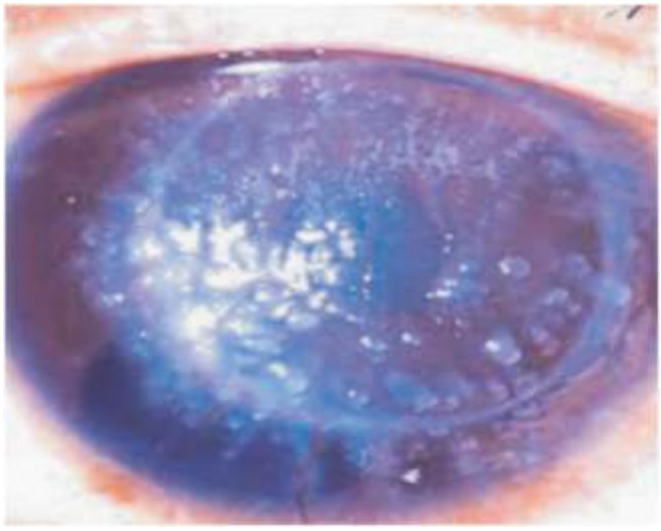
4.GELATINOUS DROP LIKE CORNEAL DYSTROPHY.(GDLD) :

Also k/as SubepithelialAmyloidosis / Primary Familial Amyloidosis. Occurs in the first decade of life and the condition is progressive.

Inheritance : AR (Autosomal Recessive).

Genetic Locus is 1p32 and Gene is Tumour Associated Calcium Signal Transducer2 (TACSTD2).

Symptoms : Significant decrease in vision, photophobia, redness and irritation.



GELATINOUS DROP LIKE CORNEAL DYSTROPHY.(GDLD)

Signs : Subepithelial lesions similar to band keratopathy, or a group of small multiple nodules in a mulberry configuration.

II. BOWMAN LAYER DYSTROPHY. :

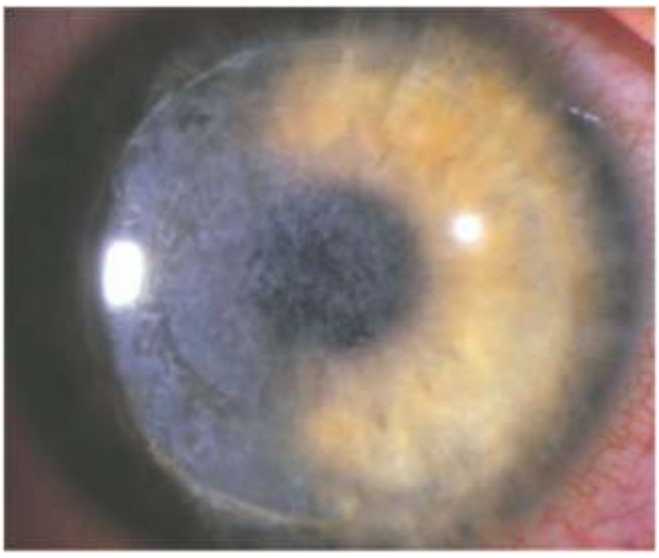
1.REIS- BUCKLERS CORNEAL DYSTROPHY :

Also k/as Corneal dystrophy of Bowman type 1 (CDB1)

Inheritance : AD (Autosomal dominant)

Genetic locus is 5q31 and gene involved is TGFB1.

Histology : Replacement of Bowmans Layer by Connective



REIS- BUCKLERS CORNEAL DYSTROPHY

Tissue Bands.

Symptoms : Vision is impaired from childhood. Recurrent Corneal erosions cause ocular discomfort and pain in the first decade. It causes slowly progressive visual deterioration.

Signs : Grey-white geographic ,sub-epithelial opacities of various density which develop at the level of Bowman layer and superficial stroma increasing with age to form a Reticular pattern. Corneal sensations may be reduced.

2.THIEL- BEHNKE CORNEAL DYSTROPHY :

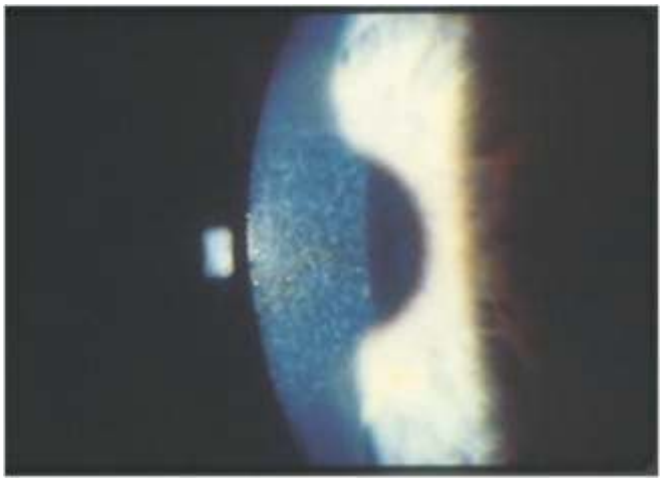
Also k/as Corneal Dystrophy of Bowman type 2 (CDB2). 0r Honey-Comb Shaped Corneal Dystrophy.

Inheritance : AD (Autosomal Dominant).

Genetic locus is 5q31 and gene involved TGFB1.

Symtoms : Recurrent corneal erosions cause discomfort and pain in the first and second decade followed by gradual visual impairement.

Signs : Symmetrical Sub-epithelial Reticular (Honey-comb) opacities predominantly involving the central cornea, which



THIEL- BEHNKE CORNEAL DYSTROPHY

are less individually defined and may progress to involve the superficial stroma.

III. STROMAL CORNEAL DYSTROPHY :

1. LATTICE CORNEAL DYSTROPHY. (TGFB1)

A. CLASSIC LATTICE CORNEAL DYSTROPHY (LCD1)

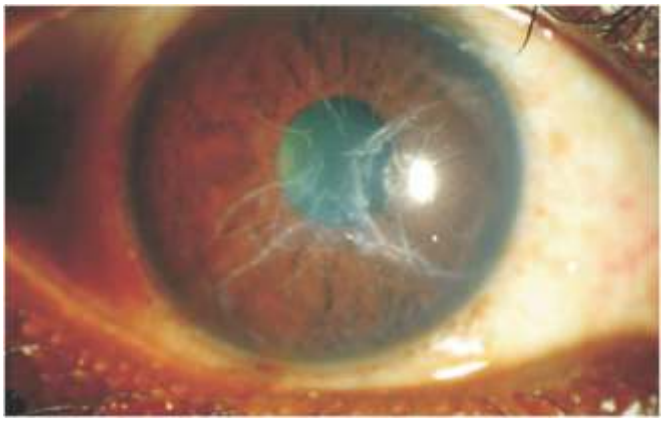
Also k/as Biber-Haab-Dimmer Dystrophy.

Inheritance : AD . Genetic locus is 5q31 and gene involved is TGFB1.

Histology : Amyloid staining with Congo Red.

Onset and Symptoms : Appears at the age of 2 years and the condition is progressive. Recurrent corneal erosions ,ocular discomfort and pain may start appearing in the 1st decade of life, Progressive clouding of cornea by the age of 20 years and a Penetrating or a Deep Lamellar Keratoplasty may be required by the age of 30- 40 years .

Signs : Refractile Anterior Stromal Dots, coalescing into fine filamentous lattice that spreads gradually, but spares the periphery.



CLASSIC LATTICE CORNEAL DYSTROPHY (LCD1)

A generalized stromal haze with reduced corneal sensation may develop.

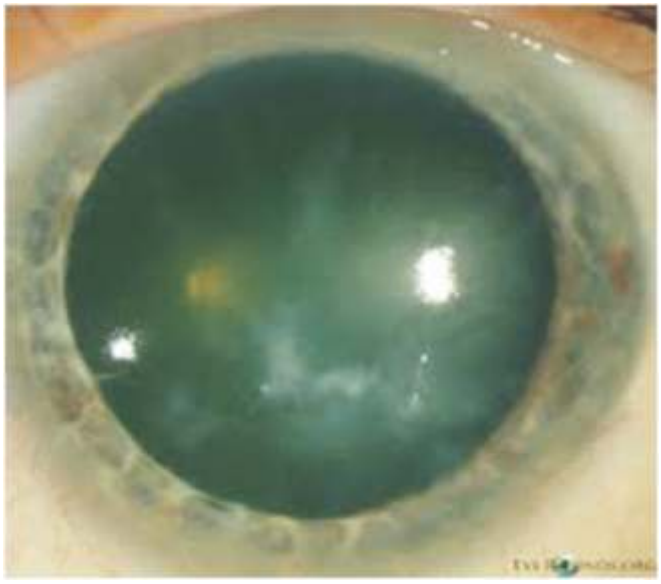
B. LATTICE CORNEAL DYSTROPHY, GELSOLIN TYPE (LCD2)

Also k/as Familial Amyloidosis of Finnish (FAF) or Meretoja Syndrome.

Inheritance : AD. Genetic locus is 9q34 and Gene involved is Gelsolin GSN.

Histology : Amyloid deposits in Corneal stroma.

Onset and Symptoms : Third &Fourth Decade of life. Slowly progressive condition, majority patients have good vision till seventh decade. Ocular irritation is main symptom ; erosions are rare.



LATTICE CORNEAL DYSTROPHY,GELSOLIN TYPE (LCD2)

Signs : Lattice lines appear in the corneal stroma ; spreading centripetally from the limbus; which are more peripheral and less numerous than type 1 .The central cornea is relatively spared. Corneal sensitivity is reduced or absent.

Systemic Features : Progressive cranial and peripheral neuropathy; mask like facies and autonomic features.

2. GRANULAR DYSTROPHY :

A. GRANULAR CORNEAL DYSTROPHY TYPE 1 (GCD1)

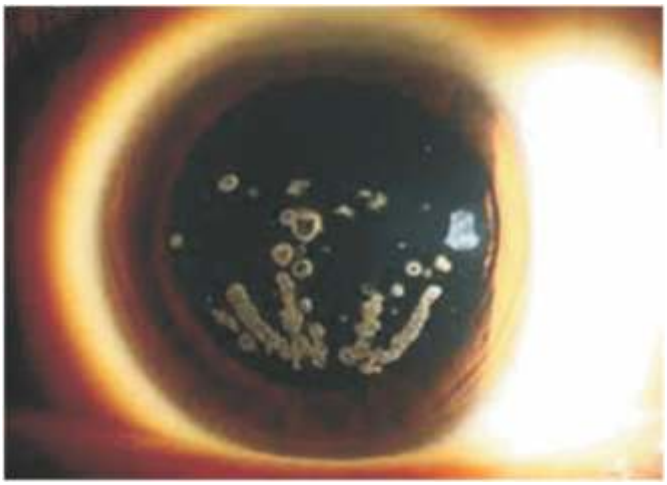
Inheritance : AD Genetic locus 5q31 and gene involved is TGFB1.

Histology : Amorphous Hyaline Deposits staining Bright Red with Masson Tri-chrome.

Onset and Symptoms : Glare and Photophobia , with Blurring as progression occurs.

Recurrent Erosions occur causing Pain, Discomfort and Watering.

Signs : Discrete White Central anterior stromal deposits resembling sugar granules or bread crumbs separated by clear stroma. There is gradual increase in number and size of deposits with deeper and outward spread ;sparing the limbus. Gradual confluence and diffuse haze lead to visual impairement. Corneal sensations are impaired.



GRANULAR CORNEAL DYSTROPHY TYPE 1 (GCD1)

Treatment :Deep Lamellar or Penetrating Keratoplasty is usually required in fifth decade.

B. GRANULAR CORNEAL DYSTROPHY TYPE2 (GCD2)

Also k/as Avellino Corneal dystrophy and Combined Granular-lattice Dystrophy.

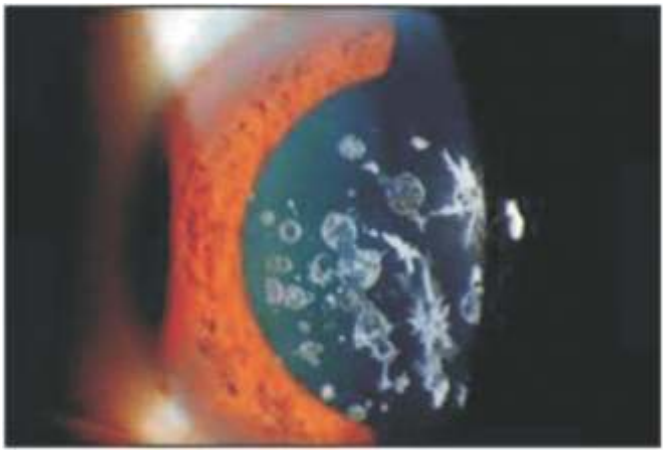
Inheritance; AD . Genetic Locus is 5q31 and gene involved is TGFB1 .

Histology ; Both Hyaline and Amorphous Deposits.

Onset and Symptoms : In First decade may be as early as 3 years. Vision decreases with age as the central axis is affected. Pain and ocular discomfort due to erosions.

Signs : Fine superficial tiny whitish dot opacities that progress to form Rings or Stellate shaped Snowflake stromal opacities appearing between superficial and mid-stroma.

Superficial translucent Bread-crumb opacities are seen in the final stage.



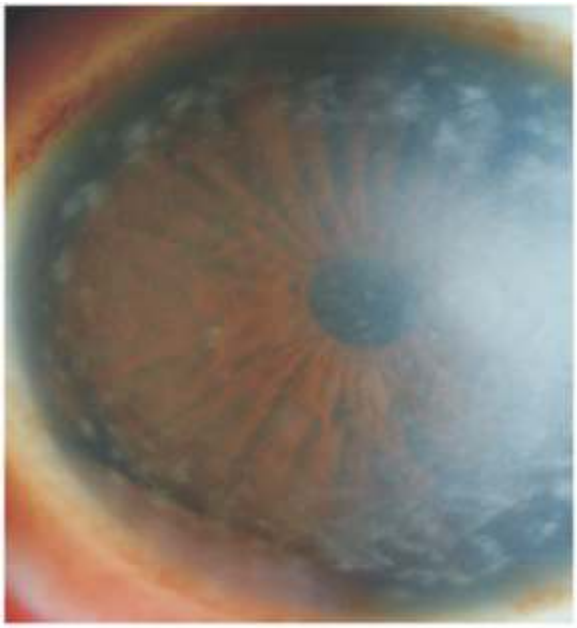
GRANULAR CORNEAL DYSTROPHY TYPE2 (GCD2)

3. MACULAR COREAL DYSTROPHY. (MCD) :

Also k/as Groenouw Corneal dystrophy or Fehr spotted dystrophy.

Inheritance : AD . Genetic Locus is 16q22 and gene involved is CHST6.

Onset and Symptoms :Early (end of 1st decade) Visual deterioration. Recurrent corneal erosions cause pain and



MACULAR COREAL DYSTROPHY (MCD)

photophobia.

Signs : Dense poorly delineated greyish white spots centrally in the anterior stroma and peripherally in the posterior stroma. There is no clear delineation between the opacities which may be elevated like macules. Progression of lesions occur causing anterior stromal haze in central cornea. Eventually

Full thickness stromal involvement occurs extendind to the limbus with no clear zone. Corneal sensations are reduced.

Treatment is Penetrating Keratoplasty.

III. DESCEMETS MEMBRANE AND ENDOTHELIAL DYSTROPHY.

1.FUCH'S ENDOTHELIAL CORNEAL DYSTROPHY.

Inheritance : AD or Sporadic . Genetic Locus is 13p.

Symptoms :

l. Stage of cornea guttata. It is characterised by the presence of Hassall-Henle type of excrescences in the central part of cornea. A gradual increase of centralguttae with peripheral spread and confluence gives rise to the so called 'beaten-metal' appearance. This stage is asymptomatic.

2. Oedematous stage or stage of endothelial decompensation (Fig. 6.27) is characterised by the occurrence of early stromal oedema and epithelial dystrophy. Patients complaint of blurring vision.

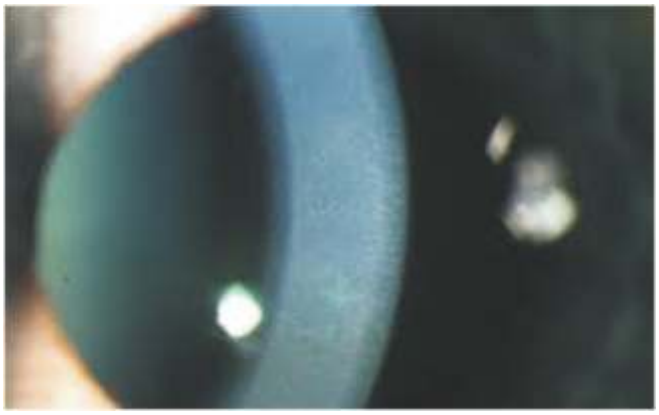
3. Stage of bullouskeratopathy. This stage follows longstanding stromal oedema and is characterised by marked epithelial oedema formation of bullae, when rupture cause pain, discomfort and irritation with associated decreased visual acuity.

4. Stage of scarring. In this stage, epithelial bullae are replaced by scar tissue and cornea becomes opaque and vascularized. The condition may sometimes be complicated by occurrence of secondary infection or glaucoma.

Specular microscopy reveals decreased endothelial cell count, increased average cell diameter, decreased hexagons and increased variation in cell size leading to Beaten-bronze appearance.

TREATMENT :

1. Hypertonic saline: (5% sodium chloride) may be of some use in early oedematous stage.
2. Warm air blown on the eyes (e.g. hair dryer) helps in reducing oedema.
3. Intraocular pressure lowering drugs, e.g. 0.5% timolol or others should be used to treat associatedocular hypertension.
4. Inbullouskeratopathystage: bandage contact lens, cycloplegics, antibiotic ointments and lubricants.
5. Posterior Lamellar keratoplasty (Descemets membrane-stripping endothelial keratoplasty- DSAEK-or-Descemets membrane endothelial keratoplasty-DMEK) and Penetrating keratoplasty is the treatment of choice when the visual acuity is markedly reduced.



FUCH'S ENDOTHELIAL CORNEAL DYSTROPHY

2. Congenital Hereditary Endothelial Dystrophy :

Onset and course. Congenital hereditary endothelial dystrophy 1(CHED1) occurs in first or second year of life. Progression of corneal clouding occurs over 1- 10 years.

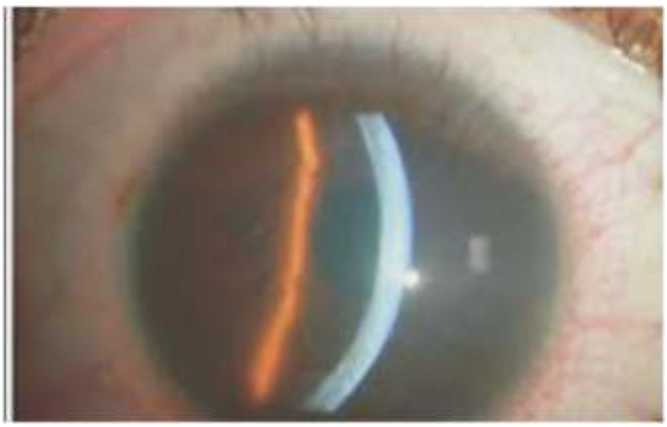
Inheritance : AD. Genetic Locus is 20p 1 1.2 q l - 1.2 (pericentromericregion) and gene is unknown.

Signs & Symptoms include:

Endothelial changes in form of moon crater-likeappearance and peau d'orange texture.(Such patients are asymptomatic).

Corneal clouding occurs as a diffuse haze to a ground-glass appearance with occasional focal grey spots causing blurred vision with photophobia and watering. Vision is characteristically worse in the morning.

Thickening of the cornea, can be 2-3 times of normal thickness.



Congenital Hereditary Endothelial DystrophyI

Subepithelial band keratopathy may be seen occasionally.

4. Congenital Hereditary Endothelial Dystrophy2 :

Also k/as Maumenee dystrophy.

Inheritance ; AR . Genetic locus is 20p 13 and thegene involved isSLC4A 11.

Signs and symptoms are similar to CHED l except:

The condition is more common and severe than CHED 1

Nystagmus is often associated.

5. X-linked Endothelial Corneal Dystrophy :

Onset and course. X-Linked endothelial cornealdystrophy (XECD) occurs congenitally and is aprogressive condition in males and non-progressive in females.

Inheritance: X-chromosomal dominant .Genetic locus is Xq25 and the gene involved isunknown.

Signs and Symptoms : Male patients have blurred vision associated with :

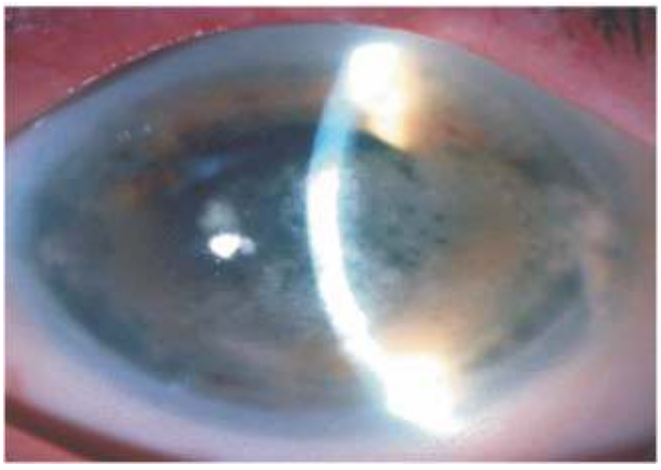
Corneal clouding since birth ranging from a diffusehaze to a ground-glass, milky appearance.

Moon crater-like endothelial changes.

Subepithelial/ band keratopathycombined withmoon crater-like endothelial changes.

Nystagmus may be associated.

Female patients are asymptomatic having only moon-crater-like endothelial changes.



X-linked Endothelial Corneal Dystrophy

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Infectious Keratitis

Trushaa Agrawal

Corneal ulceration occurs due to the host cellular and immunologic responses to the offending agent which may be bacterial, viral, fungal or protozoal organism.

Stages of corneal ulcer

Stage 1: Progressive Stage - the ulcer is saucer shaped and is associated with gray zone of infiltration . In this stage, the microbes adhere to the epithelium, release toxins and enzymes and cause tissue destruction

Stage 2: Regressive Stage - it is brought by the natural host defense mechanisms (humoral antibody response and cell mediate immune defenses) 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.

Stage 3: Healing Stage - The process of epithelialization starts to occur at this stage. The histiocytes and keratocytes convert to fibroblasts so that the scar tissue is formed.

Classification of microorganisms causing infectious keratitis

EUKARYOTES

Protozoa
- Sporozoa : *Toxoplasma*
- Amoebae: *Entamoeba, Naegleria, Acanthamoeba*
- Microsporidia

Fungi
- Mould like: *Aspergillus*
- Yeast like: *Candida*
- Dimorphic : *Histoplasma. Blastomyces, Coccidioides*
- True yeasts: *Cryptococcus*

PROKARYOTES

Filamentous bacteria
- Actinomyces, *Nocardia, Mycobacterium,* Streptomyces

True Bacteria
- Gram-positive Bacilli and Cocci
- Gram-negative Bacilli and Cocci

Spirochaetes
- *Borrelia, Treponema, Leptospira*

Mycoplasma

Rickettsiae and *Chlamydia*

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Indore

Fungal organisms causing keratitis

I. FILAMENTOUS

A. SEPTATED

1. *Nonpigmented*
- *Fusarium:* Solani, oxysporum, moniliforme, episphaeria
- *Aspergillus:* fumigatus, flavus
- *Acremonium (Cephalosporium)*
- *Paecilomyces*
- *Penicillium*

2. *Pigmented (Dematiaceous)*
- *Curvularia:* Senegelensis, verruculosa, pallescens
- *Lasiodiplodia theobromae*
- *Alternaria*
- *Cladosporium*
- *Celletotrichum*
- *Drechslera (Helminthosporuim)*

B. NONSEPTATED
- *Rhizopus (mucormycosis)*

II. YEAST
- *Candida: Albicans, parapsilosis, krusei, tropicalis*

Diagnosis of microbial keratitis

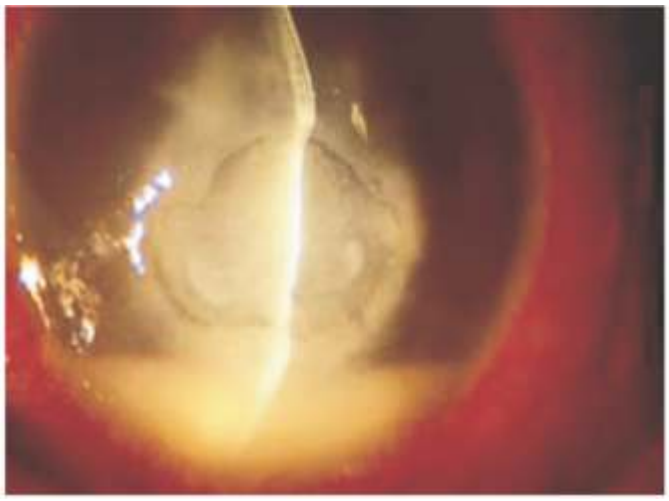
1) A detailed history should be elicited for evaluation of:
- Risk factors including contact lens use/ use of steroids
- Use of Ocular medications including antibacterials /antifungals/ antivirals
- Compliance to the antibiotic regimen previously prescribed if any

2) A good clinical examination includes a record of following parameters:
- Visual Acuity
- External examination : Status of eyelids for entropion, trichaisis, lagophthalmos
- Adnexal examination for dacryocystitis
- Slit lamp exam

Fluorescein staining

Area and density of infiltration
- Size and depth of ulceration
- Degree of stromal edema
- Scleral involvement
- AC reaction

Examine for specific features of fungal etiology: feathery margins, satellite lesions, immune rings, fixed hypopyon, dry looking infiltrates, pigmentation with some fungi



- Corneal sensation
- Documentation: drawing/ clinical photograph

Slit lamp examination of corneal ulcer

INVESTIGATIONS

OCULAR

It is recommended that in all the cases of microbial keratitis, a smear examination should be done.

All the smears should be examined under the microscope for detection of fungal hyphae using a 10% KOH wet mount preparation.

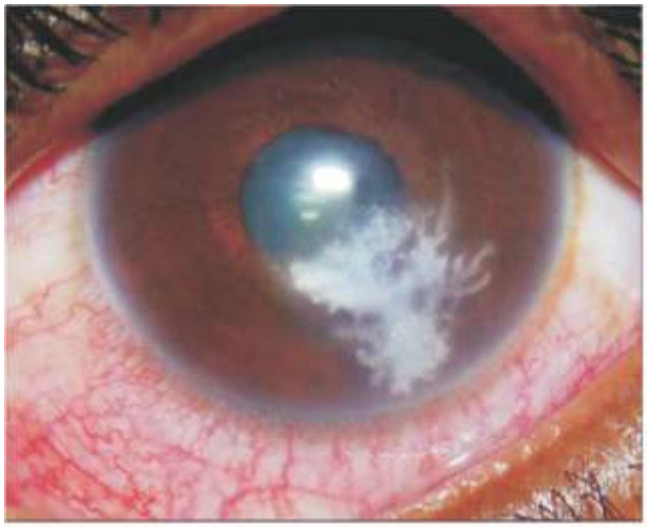
Gram staining should also be done if facilities are available.

Procedure for scraping

Scraping should be done under slit lamp/operating loupe/ operating microscope.

Instil 1-2 drops of topical anaesthetic agent.

Wait for 1 min. Keep 2 clean glass slides having 1cm circle with glass pencil on reverse side of slide.



Corneal ulcer with broad feathery infiltrate suggestive of fusarium keratitis

Scrape base and edges of corneal ulcer with flame sterilized kimura spatula or sterile 15# BP blade.

Streak over glass slide within circle: KOH, Gram stain.

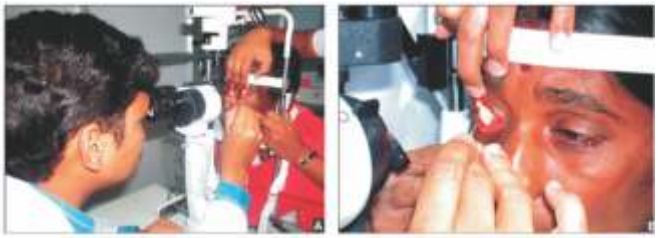
Apply KOH, cover with cover slip.

Examine under Light Microscopy (LM).

Related material like contact lens, lens casesolution should be subjected to culture if available.

CULTURE

Culture and sensitivity should be done in all cases of microbial keratitis if the facilities are available. The ideal culture media recommended for identification of pathogenic organisms include blood and chocolate agar along with Sabaroud's



Materials used for collecting specimens for corneal ulcers

Dextrose Agar (SDA). Direct plating is recommended. Conjunctival swab has no role in the microbiological workup for a patient with corneal ulcer.

ULTRASONOGRAPHY

An ultrasound examination of the eye must be conducted if there is a suspicion of endophthalmitis.

SYSTEMIC

Systemic work up should include a fasting/random blood

sugar test to rule out diabetes mellitus.

Corneal biopsy

In cases with no clinical improvement and where the smear and culture reports fail to reveal the causative pathogen, a corneal biopsy should be performed. The procedure is perfomed under topical anaesthesia under an operating microscope. A partial thickness trephination, with a dermatology punch, of the anterior corneal stroma(preferably avoiding the visual axis) is followed by enbloc resection of the tissue with a crescent blade or Bard Parker knife. The tissue should be divided into sections and subjected to smear examination, cultures and histopathological examination.

Confocal microscopy is particularly useful for demonstrating the cyst and trophozoite forms of Acanthamoeba in suspected cases. Presence of hyphae in cases of filamentous fungi and pseudohyphae in cases of Candida keratitis can also be sometimes demonstrated on confocal microscopy.

Fluoroquinolones (FQ)	Fortified drops
Cheaper	More expensive
Readily available	Need to be prepared
Stable	Preferable to refrigerate
Shelf-life of a month	Shelf-life of one week
Less toxic	More toxic
Gram-positive coverage poor with old generation	Better

Management

If the smear examination reveals gram positive or gram negative organisms, combination therapy with broad spectrum fortified antibiotics should be started. The same regimen should be given in patients when no organism is seen on the smear or a smear examination is not possible.

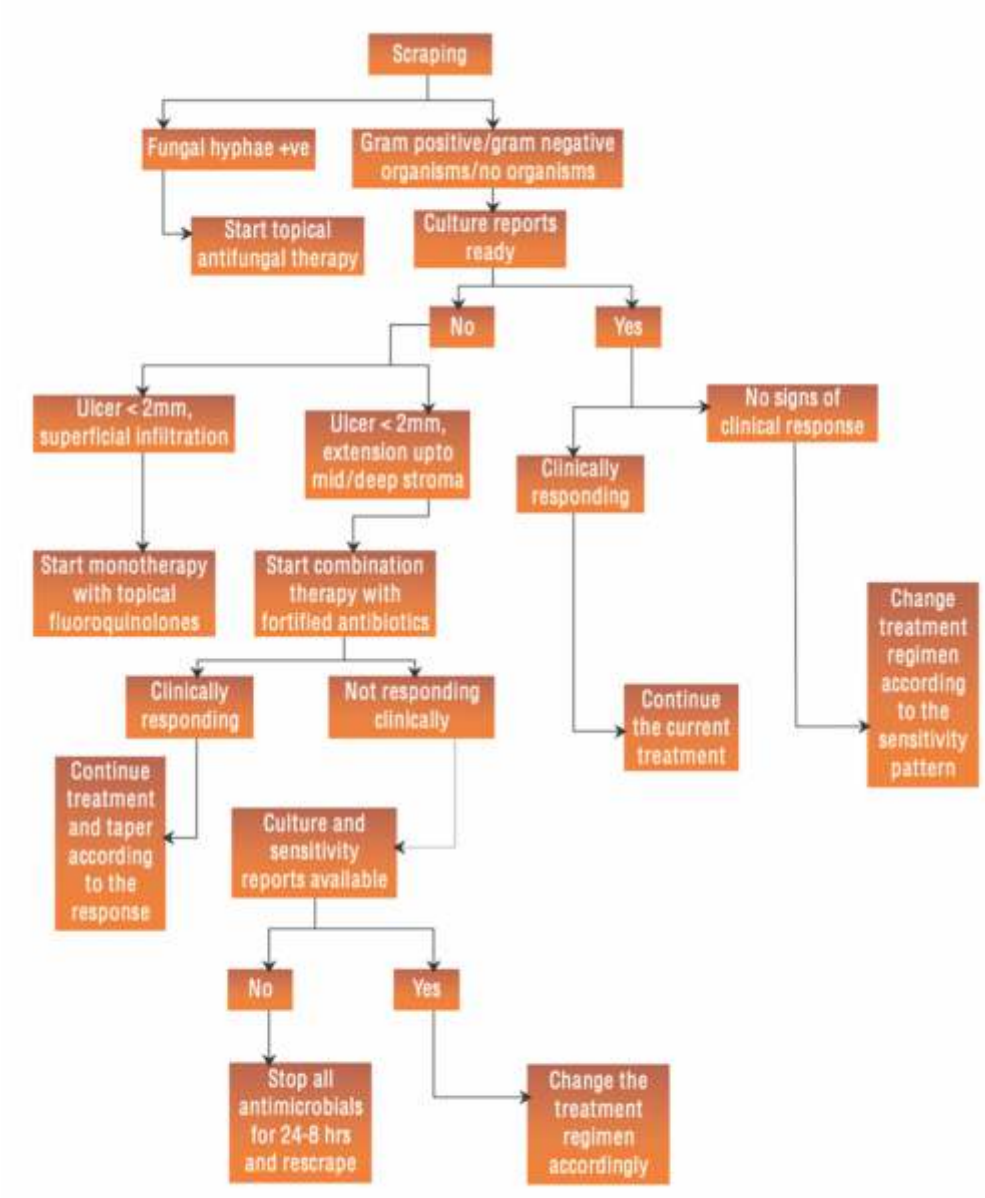
The treatment may include any of the following combinations of antibiotics.

- Conc. Cefazolin 5 % + Conc. Tobramycin 1.3 %
- Conc. Cefazolin 5 % + Conc. Gentamicin 1.3 %
- Conc.Cefazolin5%+Ciprofloxacin 0.3%

Dosage

Initial loading dose is every 5 minutes for an hour followed by 1 hourly round the clock. If a positive clinical response is seen at 24-48 hrs, the dose can be tapered to 2 hourly. Further tapering of the dose should be done subsequently depending on the clinical response of the patient.

Monotherapy with fourth generation flouroquinolones (commercially available moxifloxacin 0.5% or gatifloxacin 0.3% can be considered in cases where the ulcer is small (<3mm), involves the superficial layers of the cornea, and the visual axis is spared. The choice of flouroquinolone antibiotic should be guided by the sensitivity pattern prevalent in the region.



Adjunctive therapy

Cycloplegics and analgesics should be added to relieve ciliary spasm and associated pain. Anti-glaucoma medication can be added in the treatment regimen if indicated.

There is no role of topical anti-inflammatory medications in the management of corneal ulcer.

Subconjunctival antibioticsare associated with pain, redness, patient apprehension, risk of globe perforation and failure to provide enhanced corneal levels of antibiotic compared to drops. They are no longer advisable for routine management of corneal infections. Oral or parenteral antibiotics have been shown to be of no benefitand are indicated only in ulcers with perforation, scleral involvement or endophthalmitis.

Recommended oral antibiotics include Tablet ciprofloxacin 500 mg twice a day or Tab. levofloxacin 750 mg once a day.

Role of steroids in the management of microbial keratitis

Along with the combination therapy, it may decrease the amount of inflammation and reduce chances of scarring. The prerequisites for starting the patient on steroid therapy include:

- The case should be a proven bacterial keratitis identified in culture. Fungal infection should have been ruled out.
- The ulcer should be stabilized with antibiotic treatment for the first 48 hours or till epithelium heals.
- The patient should be admitted and evaluated every day.

1% prednisolone phosphate should be given for three weeks in a tapering dose under the cover of 1 hourly instillation of topical antibiotics. The dosage schedule is four times a day for the first week, twice a day for the next week and once a day for the last week.

Agent	Route	Dose/concentration
Polyenes		
Amphotericin B	Topical	0.075-0.3% (0.15% usually)
	Intracameral	5-10 µg
Natamycin	Topical	5%
Imidazoles		
Clotrimazole	Topical	1%
Econazole	Topical	2%
Miconazole	Topical	1%
Ketoconazole	Topical	2%
	Oral	400 mg/day
Triazoles		
Fluconazole	Topical	0.2%
	Oral	200 mg/day
Itraconazole	Topical	1%
	Oral	200 mg/day
Voriconazole	Topical	0.1-1%
	Oral	400 mg/day
Pyrimidines		
Flucytosine	Topical	2%
	Oral	50-150 mg/kg/day

Organism	Antibiotic	Topical Concentration	Subconjunctival Dose
No organism identified or multiple types of organisms	Cefazolin or vancomycin with	25–50 mg/ml	100 or 25 mg in 0.5 ml
	Tobramycin or gentamicin or	9–14 mg/ml	20 mg in 0.5 ml
	Fluoroquinolones*	Various†	
Gram-positive cocci	Cefazolin	50 mg/ml	100 mg in 0.5 ml
	Vancomycin‡	10–50 mg/ml	25 mg in 0.5 ml
	Bacitracin‡	10,000 IU	
	Fluoroquinolones*	Various†	
Gram-negative rods	Tobramycin or gentamicin	9–14 mg/ml	20 mg in 0.5 ml
	Ceftazidime	50 mg/ml	100 mg in 0.5 ml
	Fluoroquinolones	Various†	
Gram-negative cocci§	Ceftriaxone	50 mg/ml	100 mg in 0.5 ml
	Ceftazidime	50 mg/ml	100 mg in 0.5 ml
	Fluoroquinolones	Various†	
Gram-positive rods (Nontuberculous mycobacteria)	Amikacin	20–40 mg/ml	20 mg in 0.5 ml
	Clarithromycin	10 mg/ml	
	Azithromycin‖	10 mg/ml	
	Fluoroquinolones	Various†	
Gram-positive rods (*Nocardia*)	Sulfacetamide	100 mg/ml	
	Amikacin	20–40 mg/ml	20 mg in 0.5 ml
	Trimethoprim/sulfamethoxazole: trimethoprim	16 mg/ml	
	sulfamethoxazole	80 mg/ml	

Modified with permission from the American Academy of Ophthalmology Basic and Clinical Science Course Subcommittee. Basic Clinical and Science Course. External Disease and Cornea: Section 8, 2017–2018. Table 10-6. San Francisco: American Academy of Ophthalmology, 2017.

Atypical mycobacterial keratitis and post lasik infectious keratitis

The traditional drug of choice for the treatment of mycobacterial keratitis has been the aminoglycoside amikacin. However, the non-response rate to amikacin may be as high as 60%, likely due to poor penetration through intact epithelium. Ciprofloxacin could be used for isolates resistant to amikacin.Topical and oral macrolides, such as clarithromycin (10-40 mg/ml) and azithromycin (2 mg/ml) are also effective in these cases

Management of fungal Keratitis

Natamycin 5% suspension is the first choice for treatment of filamentous fungal keratitis. Surface debridement helps to remove slough and reduce load of infection. It also enhances the drug penetration. Drops are used every half to one hourly initially and tapered as per the clinical response. Response to treatment in fungal infections is very slow and complete resolution often may require 4-8 weeks of treatment.

Amphotericin B is particularly effective

against yeasts but less effective against filamentous fungi; it is therefore the first agent of choice against yeasts.

Voriconazole has the broadest spectrum of the azole antifungals and has good intraocular penetration after oral administration.Voriconazole is a new, promising therapy for fungal keratitis that is refractory to standard antifungal agents. It is used orally 200 mg twice daily and as drops (0.1-1%)

Indications for starting oral antifungals in cases of fungal keratitis include:

1. Large ulcers
2. Severe deep keratitis
3. Scleritis
4. Post Keratoplasty
5. Endophthalmitis
6. Patients with diabetes mellitus
7. Immunosuppressed individuals

Recommended oral antifungals include ketoconazole (200mg bd)/ fluconazole (200mg bd)/ itraconazole (100mg bd)/ voriconazole (200mg bd) for 4-6 weeks. All the patients being started on oral antifungal therapy should be monitored for hepatotoxicity. A baseline liver function test report should be followed by repetition of these tests every 2 weeks

Patient should be regularly followed up every 24 hrs till there is improvement in signs and symptoms.

Signs of improvement include:

- Reduced pain, discharge, eyelid, edema, congestion
- Consolidation, sharper demarcation of stromal infiltrate
- Decreased density of stromal infiltrate
- Reduced stromal edema, endothelial inflammatory plaque
- Reduced anterior chamber cells or hypopyon
- Initial re-epithelialization
- Cessation of progressive corneal thinning

Adjuvant therapeutic measures

1.Intracameral injections in cases with proven fungal etiology. They can be considered in situations like:

- Ulcers non-responsive to medical therapy
- Thick hypopyon
- Endothelial exudates
- Deep anterior chamber exudates

The recommended antifungals and their dosage for the above therapy are as follows:

- Amphotericin B: 5-7.5 g /0.1ml
- Voriconazole: 50 mg/0.1 ml

2. Debridement involves surgical removal of corneal epithelium without injury to the basement membrane. In cases of microbial keratitis, this procedure should be used to enhance penetration of drugs especially antifungals.
3. Tarsorrhaphy should be employed in cases of corneal exposure and neuroparalytic keratitis.
4. Tissue adhesives can be used in cases with a small perforation. The bed should be dry and free of epithelial cells. Adequate time should be given for complete drying of the adhesive.
5. Patch grafts and penetrating keratoplasty should be considered for larger perforations.

Approach to non healing infectious corneal ulcers

Any corneal ulcer not responding to appropriate treatment over a period of 2-3 weeks could be labelled as a non-healing ulcer. It could be infectious, sterile, immune mediated or due to a combination of these processes. There could be associated ocular or systemic problems contributing to the ulcerative process

- Wrong line of therapy
- inadequate therapy
- Drug resistance
- Drug toxicity

Infectious keratitis is one of the major causes of avoidable blindness.

Management of infectious keratitis has evolved over the past decades with the advent of newer and improved rapid diagnostic modalities such as PCR and Confocal microscopy. Standard guidelines, though available, are often not adhered to resulting in progressive ulceration. Emergence of drug resistance and availability of newer antimicrobials has made it essential for us to update our knowledge and change our treatment guidelines.

Appropriate management could reduce the incidence of severe visual loss and restrict corneal damage.

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Dry Eye Disease

Arpit Sharma

Abstract :

The Definition and Classification Subcommittee of TFOS DEWS II arrived at a revised, evidence-based definition of dry eye and a classification scheme consistent with the collective current understanding of DED. Previous definitions and classification schemes for dry eye formed the starting point, and revisions were made to address perceived shortcomings, in the context of the latest knowledge derived from the current literature. The Diagnostic Methodology Subcommittee of TFOS DEWS II set out to first identify tests used to diagnose and monitor dry eye disease from a comprehensive review of the academic literature, with a particular emphasis on changes since the original Tear Film and Ocular Surface Society Dry Eye Workshop. TFOS DEWS II Management and Therapy Report summarizes the management and therapeutic options for treating dry eye disease. The goals of this committee were to review appropriate methods for the management of dry eye disease and recommend a strategy for their clinical application, based on an evidence-based review of the literature.

Introduction :

The diagnosis of dry eye and its treatment has long been approached somewhat subjectively. Even more so, it's an ocular ailment that hasn't always been treated with enough gravity given the impact this disease can have on the people who live with it. The last three decades have seen the awareness of dry eye disease (DED) rise considerably around the world. Through the mutual efforts of many organizations, much has been learned about the basis and impact of this disease in the continued attempt to improve clinical care for affected individuals.

Definition of Dry Eye Disease :

The first definition of dry eye, published in 1995 on the basis of consensus from the NEI/Industry working group on Clinical Trials in Dry Eye,1 was as follows :

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"Dry eye is a disorder of the tear film due to tear deficiency or excessive tear evaporation which causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular discomfort".[1]

The 2007 International Dry Eye Workshop (DEWS),[2] sponsored by the Tear Film and Ocular Surface Society (TFOS) began by reviewing the definition of dry eye disease that was adopted by the 1995 National Eye Institute (NEI)/Industry Dry Eye Workshop and decided to update this definition to take account of new knowledge about the roles of tear hyperosmolarity and ocular surface inflammation as follows:

"Dry eye is a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface".[2]

Acknowledging the role that neurosensory abnormalities play in the etiology of the disease was also considered worthy of inclusion within the definition, in light of the expanding literature in this area. This process led to the refined TFOS DEWS II global dry eye definition,[3] as follows:

"Dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological role".[3]

Classification of Dry Eye Disease :

Dry eye classification schemes serve to guide diagnosis and ultimately improve patient care through appropriate treatment. The NEI/Industry Report (Fig. 1),[1] identified the two primary categories of dry eye as tear deficient and evaporative, and proposed, in sub-classification, a range of intrinsic and extrinsic etiological factors believed to contribute to dry eye development within these categories.

Although the 1995 NEI/Industry Dry Eye Workshop classification has served as a useful and durable scheme for over a decade, it does not reflect newer knowledge on

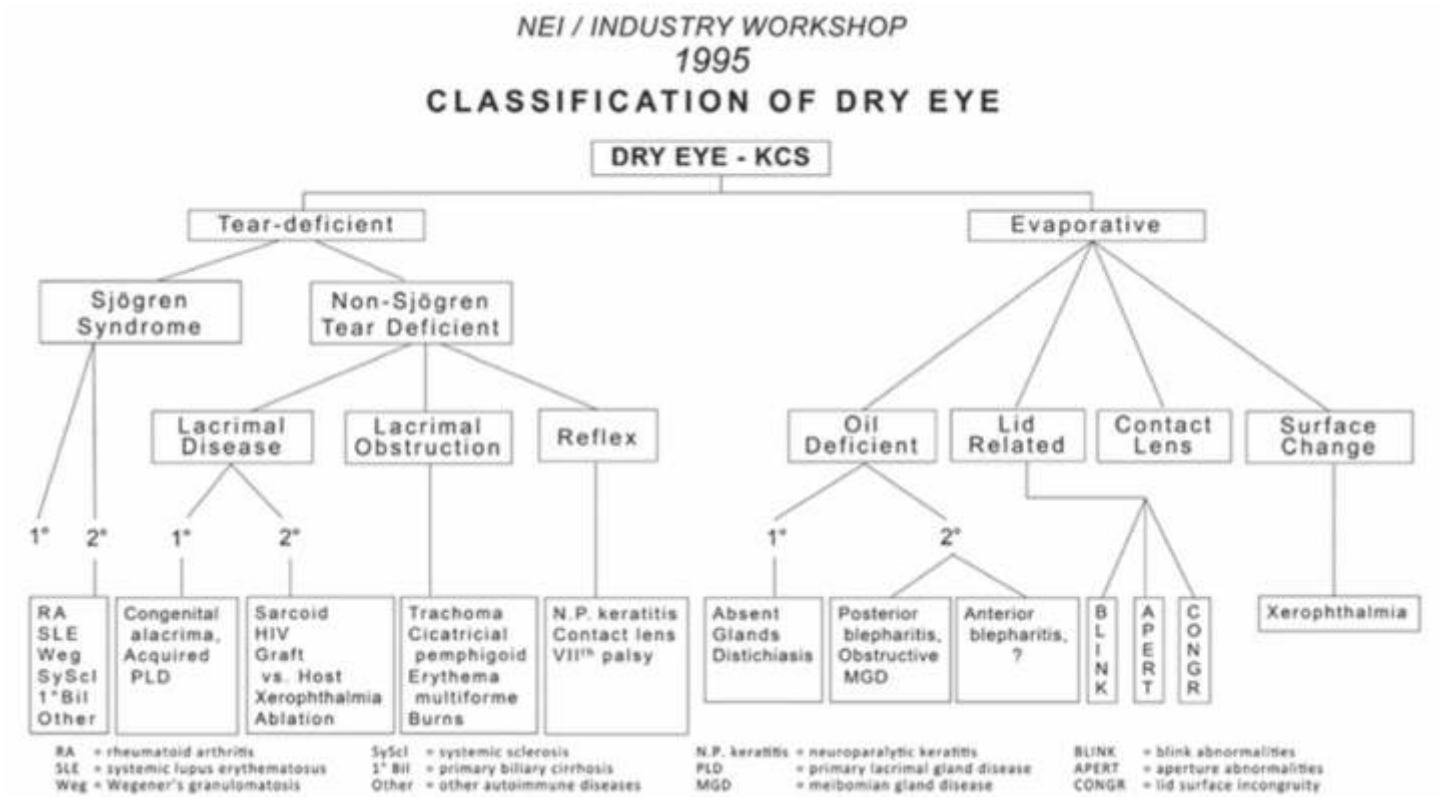

Figure 1. The 1995 Classification of dry eye

pathophysiological mechanisms, effects on vision, and the clinical value of an assessment of disease severity. To address this, DEWS based the revised classification scheme on the updated Triple Classification published in 2005,[4] and the report of the Delphi Panel published in 2006.[5] A three-part classification system was developed. The first part is etiopathogenic and illustrates the multiple causes of dry eye.4 The second is mechanistic and shows how each cause of dry eye may act through a common pathway, and that any form of dry eye can interact with and exacerbate other forms of dry eye as part of a vicious circle.[4] The third is a scheme based on the severity of dry eye disease, which is expected to provide a rational basis for therapy.[5]

The classification scheme presented by the TFOS DEWS 2007 report (Fig. 2) retained the two primary categories, aqueous deficient and evaporative, although 'tear deficient' was redefined more specifically as 'aqueous deficient'.[2] Once again, possible disease etiologies were listed in a sub-classification.

In TFOS DEWS II reports, a detailed description of the terminology is provided to clarify the decision-making behind the development of the classification scheme (Fig. 3).[6] The upper portion of the figure 3 represents a clinical decision algorithm, beginning with the assessment of symptoms, and followed by review for signs of ocular surface disease. DED exhibits both symptoms and signs, and can be differentiated from other ocular surface disease with the use of triaging questions and ancillary testing.[7] It is to this DED group that diagnostic subtyping,[7] and conventional dry eye management strategies apply.[8] Symptomatic patients without demonstrable clinical signs do not fall into the DED group, but are differentiated into pre-clinical dry eye or neuropathic pain (non-ocular surface disease). Conversely, asymptomatic patients exhibiting signs are differentiated into patients with poor corneal sensitivity, or those with prodromal signs, who are at risk of developing manifest DED with time or provocation, for example following ophthalmic surgery.[9] The lower portion of Fig. 3 represents the etiological classification of DED, and highlights the two predominant and non-mutually exclusive categories; aqueous deficient dry eye (ADDE) and evaporative dry eye (EDE).[2] Epidemiological and clinical evidence suggest that the preponderance of DED is evaporative in nature,10 which is reflected in a greater proportion of Fig. 3 devoted to EDE than ADDE. While it is possible that ADDE can occur without obvious signs of EDE and vice versa, as DED progresses, it is increasingly likely that characteristics of both ADDE and EDE will become evident.[11] ADDE describes conditions affecting lacrimal gland function.

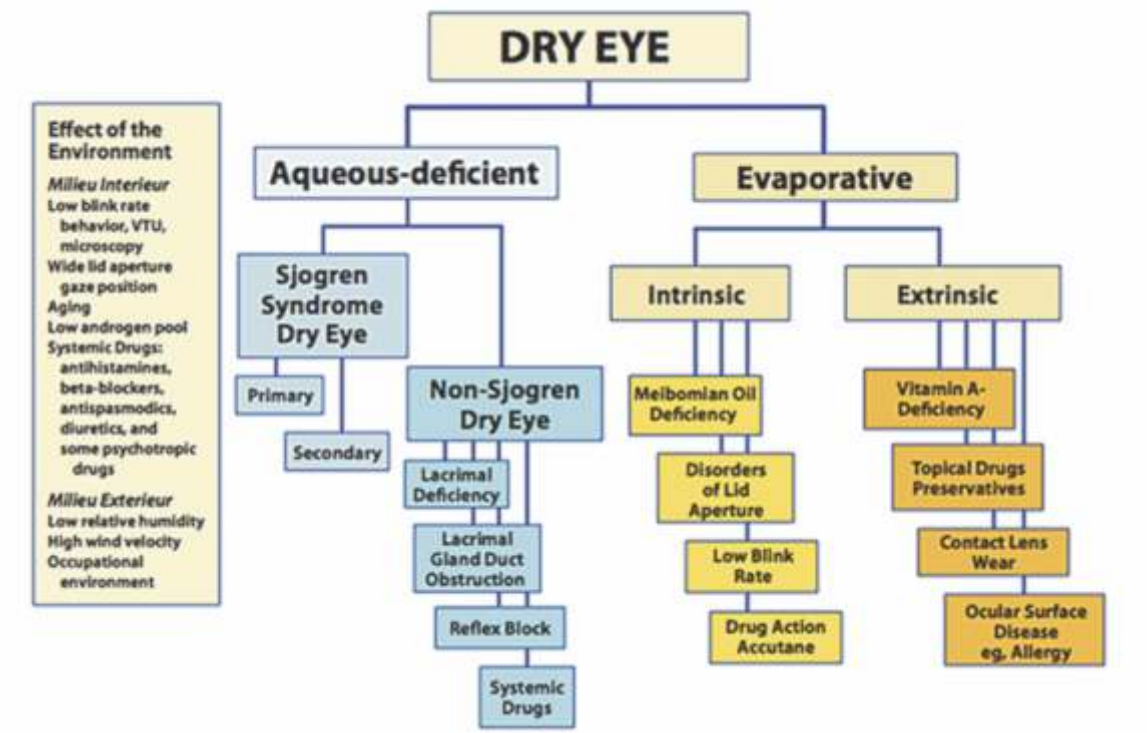

Figure 2. Dry eye classification from the 2007 DEWS Report

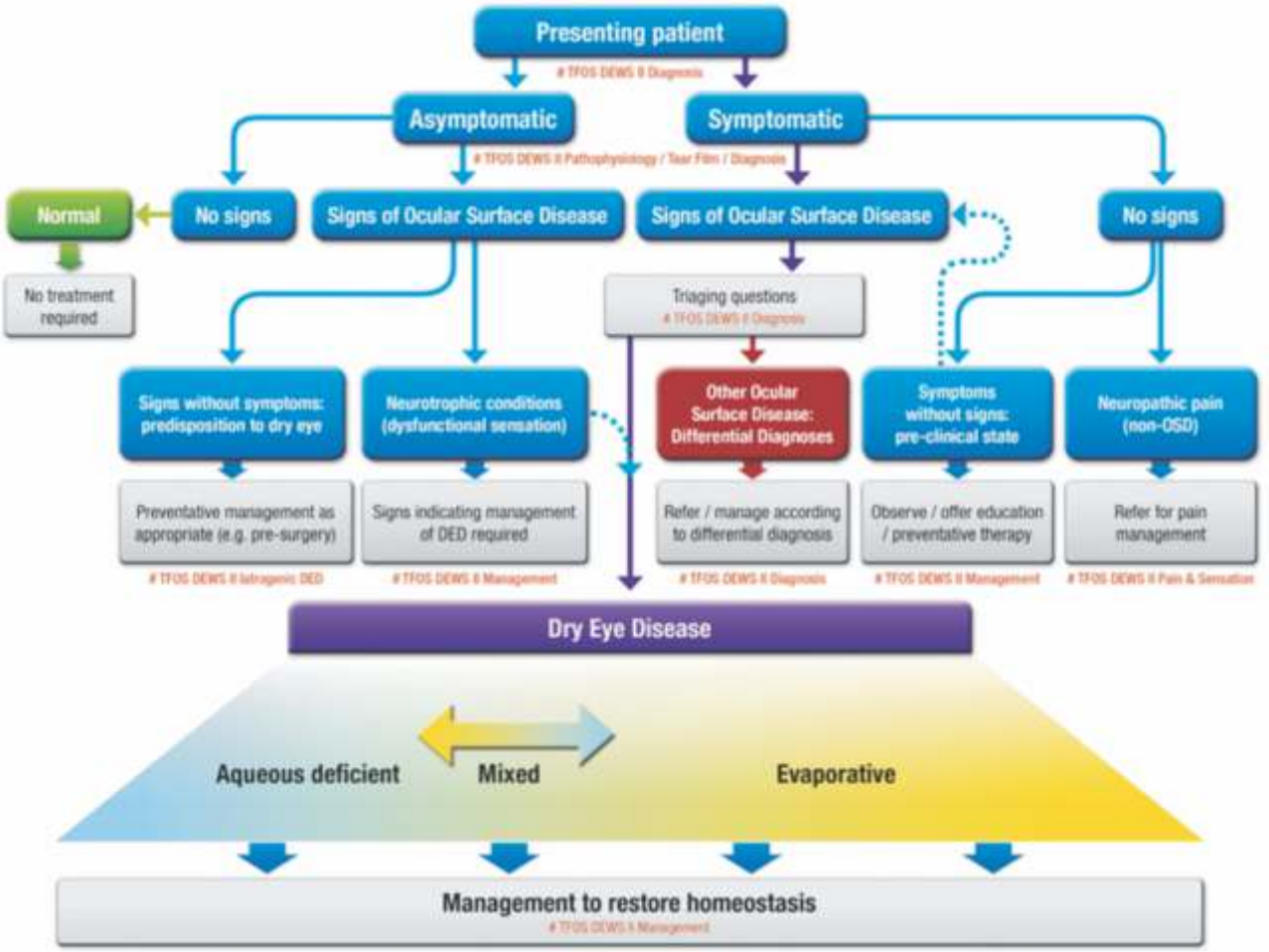

Figure 3. Classification of DED according to TFOS DEWS II reports

EDE is recognized to include both lid-related (e.g. Meibomian gland dysfunction(MGD) and blink-related) and ocular surface-related (e.g. mucin and contact lens-related) causes.

Diagnosis of Dry Eye Disease :

Symptoms :

As in the previous TFOS DEWS definition of DED1, the current TFOS DEWS II definition for DED describes the presence of ocular surface symptoms and other signs of DED.[6] Although the relationship between symptoms and signs of DED is not linear and varies across individuals and types of DED,[14] the ability to accurately quantify ocular surface symptoms is an important screening tool that can assist in establishing the medical necessity for additional DED evaluation. It is also critical for monitoring the progression of the condition and response to treatments. In this regard, symptom measurements are very similar to clinical signs of DED. It is therefore recommended that a validated symptom questionnaire be administered at the beginning of the patient interaction.

Multiple questionnaires are used to measure the frequency and severity of symptoms of DED,[7] as Dry Eye Questionnaire (DEQ), 5-Item Dry Eye Questionnaire (DEQ-5), Dry Eye-Related Quality-ofLife Score (DEQS), Impact of Dry Eye on Everyday Life (IDEEL), McMonnies' Questionnaire (MQ), Ocular Comfort Index (OCI and OCI-C), Ocular Surface Disease Index (OSDI), Symptom Assessment in Dry Eye (SANDE), and Standard Patient Evaluation of Eye Dryness (SPEED).[7]

In general, the OSDI is the most widely used questionnaire for DED. The OSDI measures frequency of symptoms, environmental triggers and vision related quality of life. Many other questionnaires have established concurrent validity against the OSDI in recent publications. The consensus view of the committee was to use the OSDI due to its strong establishment in the field or the DEQ-5 due to its short length and discriminative ability.[12]

Visual Disturbance :

Visual disturbance can be assessed by using OSDI, DEQ-5,Impact of Dry Eye on Everyday Living (IDEEL), National Eye Institute's Visual Function Questionnaire (NEI VFQ-25). Dry Eye-Related Quality-of-Life Score (DEQS), Computer-vision symptom scale (CVSS17).[7] Functional testslike Early Treatment Diabetic Retinopathy Study (ETDRS) and

How severe is the eye discomfort?	•Unless severe, dry eye presents with signs of irritation such as dryness and grittiness rather than 'pain'. If pain is present, investigate for signs of trauma / infection /ulceration.
Do you have any mouth dryness or enlarged glands?	•*Trigger for Sjogren syndrome investigation*
How long have your symptoms lasted & was there any triggering event?	•Dry eye is a chronic condition, present from morning to evening but generally worse at the end of the day, so if sudden onset or linked with an event, examine for trauma / infection / ulceration.
Is your vision affected and does it clear on blinking?	•Vision is generally impaired with prolonged staring, but should largely recover after a blink; a reduction in vision which does not improve with blinking, particularly with sudden onset, requires an urgent ophthalmic examination.
Are the symptoms or any redness much worse in one eye than the other?	•Dry eye is generally a bilateral condition, so if symptoms or redness are much greater in one eye than the other, detailed eye examination is required to exclude trauma & infection
Do the eyes itch, are they swollen, crusty or have they given off any discharge?	•Itching is usually associated with allergies while a mucopurulent discharge is associated with ocular infection
Do you wear contact lenses?	•Contact lenses can induce dry eye signs and symptoms and appropriate management strategies should be employed by the contact lens prescriber.
Have you been diagnosed with any general health conditions (including recent respiratory infections) or are you taking any medications?	•Patients should be advised to mention their symptoms to the health professionals managing their condition, as modified treatment may minimise or alleviate their dry eye.

Figure 4. Initial questions for the differential diagnosis of DED

Lighthouse near vision charts are also used.[13]

Tear Film Stability :

Impaired tear film stability has been one of the fundamental diagnostic criteria for diagnosing abnormality of the tear film and many ways of evaluating tear film stability have been described.[15] Measurement of the tear breakup time with a noninvasive technique (NIBUT) is considered preferable to the Fluorescein breakup time (FBUT), for Tear film stability.[16]

Tear Volume :

Although not mentioned directly within the definition of DED, the tear film volume is important for ocular surface health and its loss of homeostasis (aqueous deficiency) may be at the same time a key pathogenic mechanism and a diagnostic sign in DED patients, independent of evaporative dry eye. Meniscometry (tear meniscus assessment), Phenol red thread test, Schirmer test are some of the tests used.[6]

Tear Film Composition :

Hyperosmolarity of the tear film on the ocular surface causes a significant increase in interferon gamma, in the absence of large increases from other Th1, Th2 and Th17 cytokines, which can induce epithelial cell apoptosis through the JAK/STAT signaling pathway to induce cell death.[17] Tear osmolarity has been demonstrated to have the highest correlation to disease severity of clinical DED tests.[18]

Damage to Ocular Surface :

The most frequently used dyes are sodium fluorescein, rose bengal, and lissamine green. The clinical appearance of fluorescein staining occurs whenever viable cells experience a compromise to their integrity such as a disruption in superficial cell tight junctions or defective glycocalyx.[19] It is suggested that there is some weak background fluorescence of healthy corneal epithelial cells. Rose bengal stains ocular surface epithelial cells that are unprotected by mucin or glycocalyx, as well as dead or degenerated cells. However, it

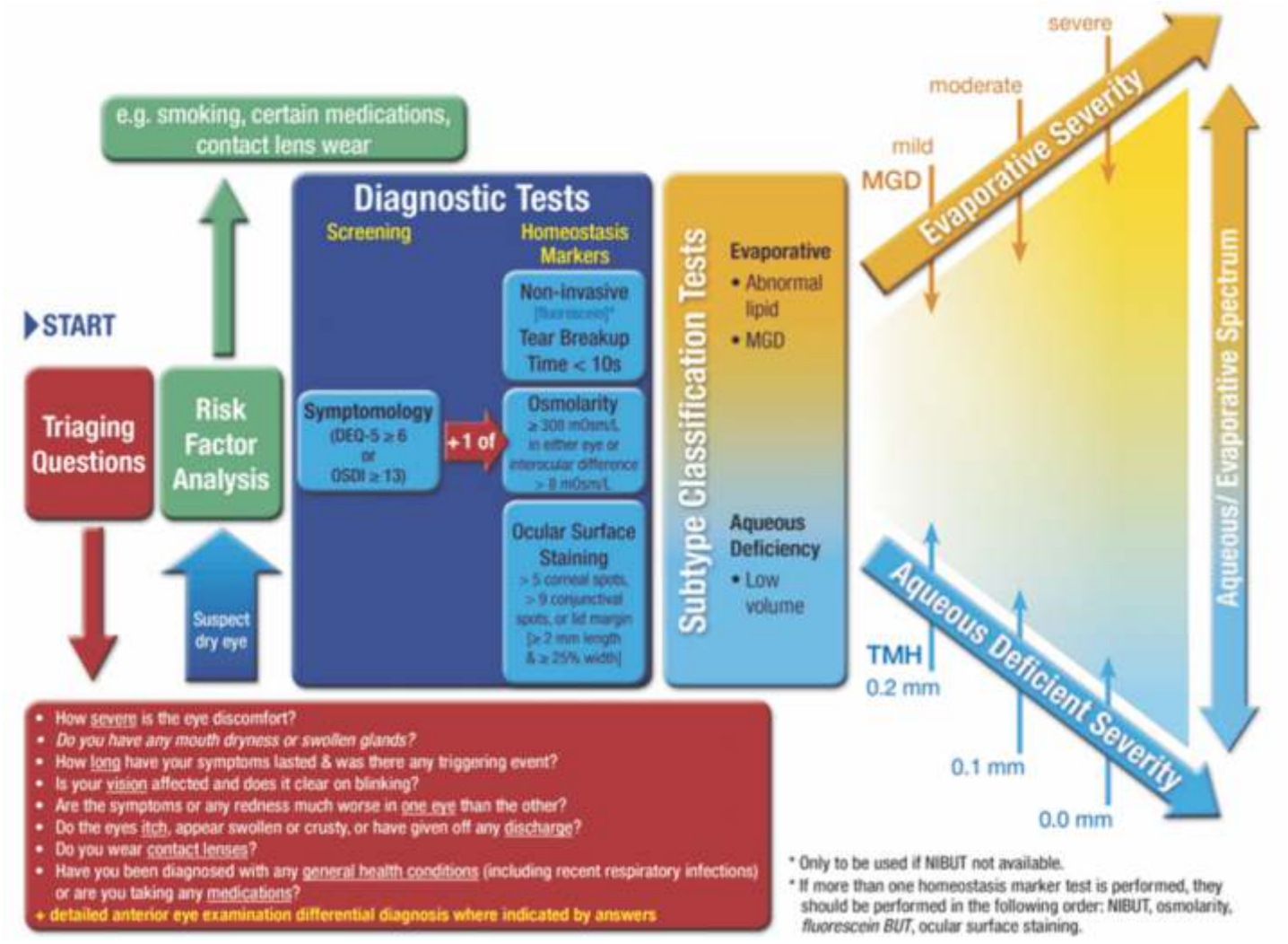

Figure5. DED diagnostic test battery

stings on instillation and induces reflex tearing. In addition, it has been shown to suppress human corneal epithelial cell viability in vitro. On the other hand, lissamine green is less toxic to the ocular surface and consequently is as well tolerated as fluorescein; it stains epithelial cells only if the cell membrane is damaged (a vital dye), irrespective of the presence of mucin, whereas rose bengal, because of its cytotoxicity, produces staining irrespective of the state of cell health, once mucin is absent; therefore lissamine green has largely replaced the use of rose bengal in evaluating ocular surface disorders.[19]

Inflammation of the Ocular Surface :

Inflammation is a recognized component of the pathophysiological mechanism of DED,[6] and has been proposed to offer a stable indicator of DED severity.[20] The most common clinical sign that is suggestive of ocular surface inflammation is conjunctival redness.[21] Other markers of inflammation arematrix metalloproteinases, cytokines (such as Th1, Th2, Th17, tumor necrosis factor alfa, interferon gamma, IL 1 beta, IL 6), chemokines (such as CXCL9, -10, -11, and CXCR3), andocular surface immune markers (HLA-DR expression, a Class-II MHC antigen).[7]

Eyelid Aspects :

Important eye lid aspects are anterior blepharitis and demodex blepharitis, Posterior Lid wiper epitheliopathy (LWE), Meibography, Meibomian gland expressibility/duct assessment and Dynamic Blink/lid closure analysis. The normal spontaneous blink rate is reported to occur from 10 to 15 blinks per minute.[7,22]

Differential Diagnosis and Comorbidities of Dry Eye Disease :

Based on the conditions that can mimic the signs and symptoms of DED, administering a series of questions (Figure 4) will aid in the differential diagnosis.[23]

The differential diagnosis of DED include: allergic conjunctivitis, viral conjunctivitis, bacterial conjunctivitis, anterior blepharitis,Demodex, Parasitic infections (chlamidia or trachoma), punctate epithelial keratopathy, conjunctivochalasis, sub-epithelial scarring, fornix foreshortening, cicatricial entropion/trichiasis, filamentary and other keratitis, and keratopathies, rheumatological conditions (rheumatoid arthritis, Sjogren syndrome,

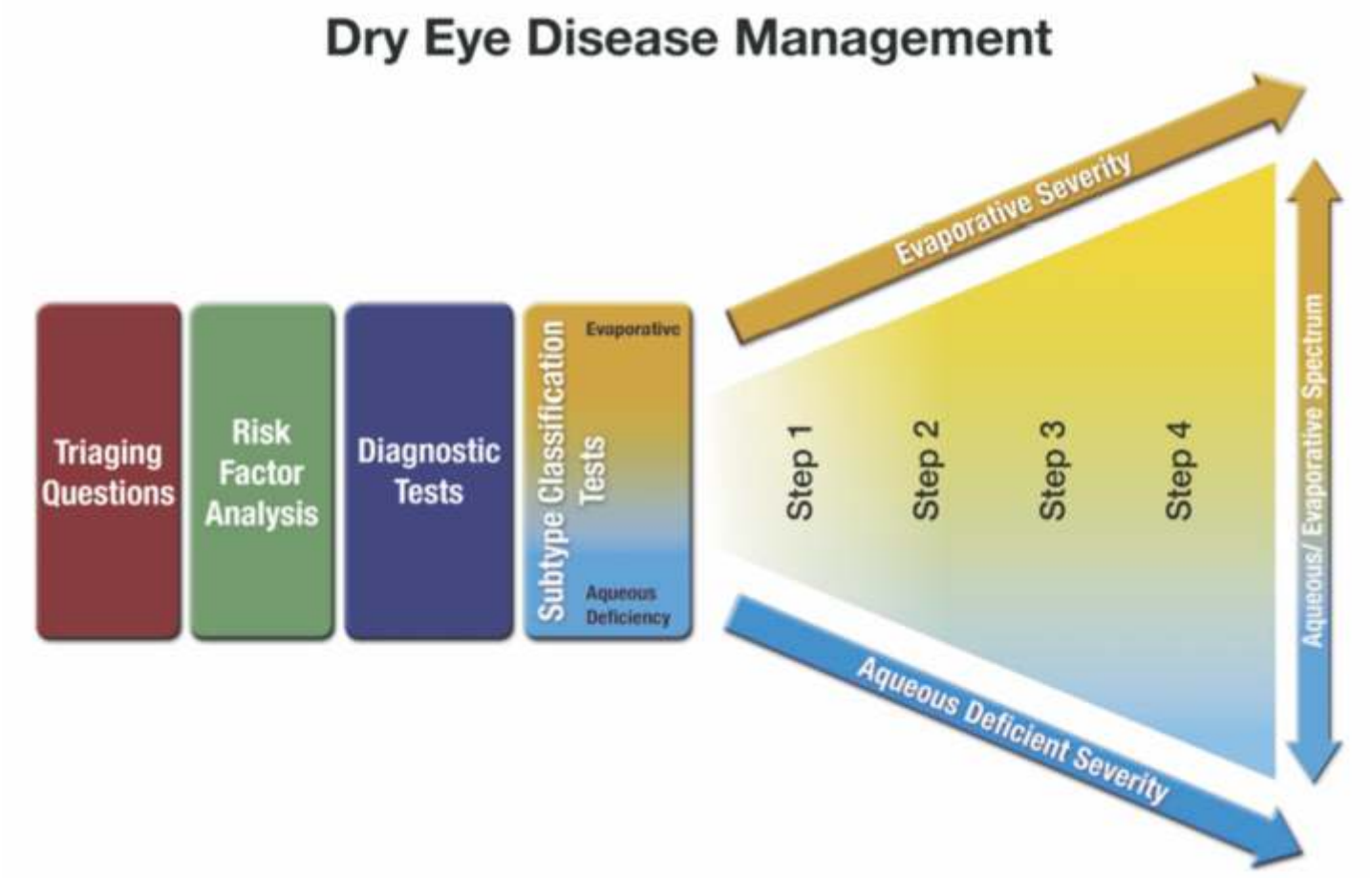

Figure. 6. Diagrammatic representation of the process associated with the management of DED

seronegative spondyloarthropathy, and antineutrophil cytoplasmic antibody-associated vasculitis), lid related disease such as chalazion or infectious hordeolum, visual asthenopia, graft versus host disease (GVHD), contact lenses, psychological factors (anxiety and depression have also been reported with increased frequency in DED patients in a variety of studies.[7]

Clinical Protocol for Dry Eye Diagnostic Test Battery :

Figure 5 illustrated the DED diagnostic test battery. The screening DEQ-5 or OSDI confirms that a patient might have DED and triggers diagnostic testing of non-invasive breakup time, osmolarity (measured prior to breakup time if FBUT used) and ocular surface staining with fluorescein and lissamine green (observing the cornea, conjunctiva and eyelid margin). On initial diagnosis, it is important to exclude conditions that can mimic DED with the aid of the triaging questions and to assess the risk factors which may inform management options.[24]

Marked symptoms in the absence of clinically observable signs might suggest an element of neuropathic pain. DED is a subset of OSD; signs alone may still warrant management to prevent DED manifestation and to optimise the optical corneal surface such as prior to refractive surgery or contact lens wear.[6] MGD features,[25] lipid thickness/dynamics, and tear volume assessment, and their severity inform the subtype classification of DED as predominantly evaporative or predominantly aqueous deficient which helps inform the management of DED. In accordance with the recommendations of the MGD Workshop (2011),[25] MILD MGD is indicated by a secretion grade 4-7, an expressibility grade of 1 and an amorphous/color fringe lipid pattern. MODERATE MGD is indicated by meibomian gland orifice plugging, lid margin vascularity, a secretion grade 8- 12, an expressibility grade of 2 and a meshwork or wave (flow) lipid pattern. SEVERE MGD is indicated by lid margin meibomian gland orifice drop-out or displacement, a secretion grade 13, an expressibility grade of 3 and an absent, globular or abnormal color fringe lipid pattern. Videos of these diagnostic and sub-classification techniques are available on the TFOS website. Sjogren syndrome should be suspected if the DEQ-5 score is > 12. Further testing will help identify treatment mechanisms worthy of targeting, but are beyond the scope of this Diagnostic Methodology report.[7]

Dry Eye Disease Management :

The management of DED is complicated due to its multifactorial etiology. Expanding upon the simple credo that "diagnosis precedes therapy" means that clinicians must make their best efforts to identify the degree to which EDE (likely related to MGD), ADDE and/or other ocular surface conditions are contributing to the patient's presentation. This aspect of determining the major causative factors behind the DED is critical to appropriate management. Figure 6 presents, diagrammatically, an approach to the management of DED.[8]

Staged management & treatment recommendations for DED.

Step 1 :

- Education regarding the condition, its management, treatment and prognosis
- Modification of local environment
- Education regarding potential dietary modifications (including oral essential fatty acid supplementation)
- Identification and potential modification/elimination of offending systemic and topical medications
- Ocular lubricants of various types (if MGD is present, then consider lipidcontaining supplements)
- Lid hygiene and warm compresses of various types

Step 2: If above options are inadequate consider:

- Non-preserved ocular lubricants to minimize preservative-induced toxicity
- Tea tree oil treatment for Demodex (if present)
- Tear conservation
- Punctal occlusion
- Moisture chamber spectacles/goggles
- Overnight treatments (such as ointment or moisture chamber devices)
- In-office, physical heating and expression of the meibomian glands (including device-assisted therapies, such as LipiFlow)
- In-office intense pulsed light therapy for MGD
- Prescription drugs to manage DED
- Topical antibiotic or antibiotic/steroid combination applied to the lid margins for anterior blepharitis (if present)
- Topical corticosteroid (limited-duration)
- Topical secretagogues
- Topical non-glucocorticoid immunomodulatory drugs (such as cyclosporine)
- Topical LFA-1 antagonist drugs (such as lifitegrast)
- Oral macrolide or tetracycline antibiotics

Step 3: If above options are inadequate consider:

- Oral secretagogues
- Autologous/allogeneic serum eye drops
- Therapeutic contact lens options
- Soft bandage lenses
- Rigid scleral lenses

Step 4: If above options are inadequate consider:

- Topical corticosteroid for longer duration
- Amniotic membrane grafts
- Surgical punctal occlusion
- Other surgical approaches (eg tarsorrhaphy, salivary gland transplantation).

Future Directions :

The understanding of DED could be further enhanced through continued research, including prospective analysis of the natural history study of dry eye, including treated and untreated DED for each of the disease main subtypes, and those where either symptoms or signs are absent, plus a more detailed understanding of the relationship between DED and other overlapping or masquerading conditions. The field has evolved considerably over this span of time, and the next ten years promise to be as notable for the next generation of dry eye clinicians and scientists.

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Pterygium: A Comprehensive Review

Palak Agrawal

Pterygium is a very common entity which we see quite frequently in our OPDs on a daily basis. Knowledge of certain things regarding it will help us in better categorizing pterygium and better management of such cases.

What is pterygium ?

Pterygium is a ocular surface disorder. It is characterized by proliferation, inflammatory infiltrates, fibrosis, angiogenes is and extracellular matrix breakdown. It is derived from the Greek word 'pteryx' which means wings. It is a wing shaped encroachment on the cornea by the conjunctival tissue in the interpalpebral region. (figure no. 1)

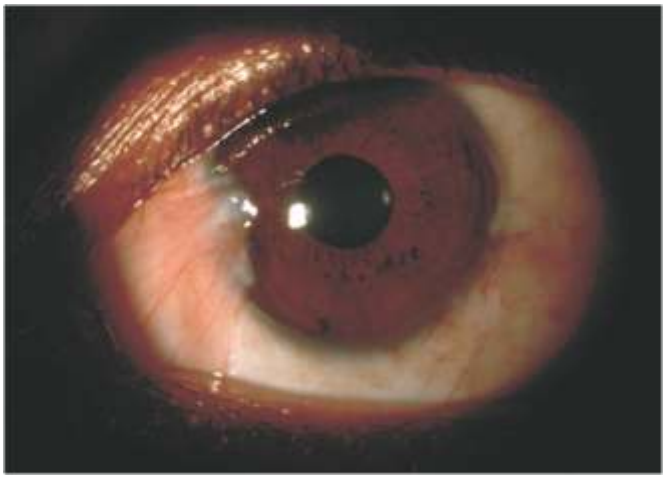

Figure 1

Epidemiology ?

It is more common in tropics than temperate latitudes. Hot and humid regions of within 30 degree latitude, popularly known as 'pterygium belt'; has higher tendency of development of pterygium.[1]

Risk factors :[2]

1. Increased UV light exposure
2. Aggravated by microtrauma and chronic inflammation from environmental factors

Etiopathogenesis :

The etiology of pterygium is not fully understood. Exposure to UV radiation is most widely accepted factor in its etiopathogenesis.[3]

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Symptoms :[4,5]

1. Mostly asymptomatic
2. Sometimes irritation, foreign body sensation and grittiness is present due to associated dellen formation
3. Contact lens wearers develop symptoms earlier due to edge lift
4. Vision may be affected (due to induced astigmatism or encroachment of visual axis)
5. Affects cosmesis

Signs :[6,7]

1. Wing shaped conjunctival tissue slowly encroaching the cornea, commonly seen in the nasal region. In some cases it can be double headed. (figure no. 2)
2. Parts of a pterygium seen are: body, head and cap.
3. Stockers line may be seen. It is actually deposition of iron at the leading edge of pterygium which develops due to pooling of tears.
4. Fuch's islets: these are small discrete white flecks consisting of clusters of pterygial cells are often present at its advancing edge.

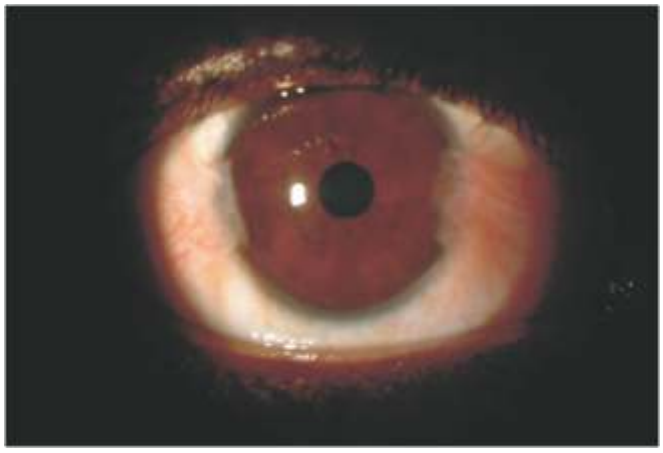

Figure 2

Pearls :[4,7][8]

1. Presence of Stockers line indicate chronicity and a stable position.
2. Pseudopterygium can be differentiated from true pterygium

a. by its location which can away from the horizontal
b. its attachment to the cornea which is firm only at its apex
c. its non-progressive nature
d. a probe can be passed under it

3. Pterygium is more common on the nasal side due to increased actinic exposure in this region secondary to ultraviolet light reflection from the nose.
4. Pterygium most commonly induces with the rule astigmatism followed by against the rule astigmatism and then oblique astigmatism. Induced astigmatism is due to the tractional forces of its contractile elements which leads to mechanical distortion and flattening of the cornea.

Grading of Pterygium :[9]

Tan's grading system :

Grade 1 : clear episcleral vessels are visible beneath the pterygium: Transparent form

Grade 2 : partial obscuration of episcleral vessels seen: Intermediate form

Grade 3 : total obscuration of episcleral vessels: Fleshy form

Grading of recurrent pterygium :

Grade 1- Normal

Grade 2- fine episcleral vessels

Grade 3- Conjunctival recurrence

Grade 4- Corneal recurrence

Differential Diagnosis:

1. Pseudopterygium
2. Limbal dermoid
3. Phlyctenular conjunctivitis
4. OSSN
5. Conjunctival lymphoma
6. Nodular episcleritis/ scleritis

Indications of treatment :

1. Significant astigmatism
2. Proximity/ encroachment of visual axis
3. Atypical appearance such as possible dysplasia
4. Cosmetic concerns

Treatment :[10][11]

The main aim of the surgery is to remove the pterygium and prevent its recurrence. Excision of pterygium can be done by avulsion technique or by superficial keratectomy.

Excision is followed by closure. Various methods of closure are :

1. Bare scleral excision- Most traditional method, has high rates recurrence (around 80%).
2. Simple conjunctival closure
3. Sliding conjunctival flaps
4. Conjunctival autografts (CAU)- most widely accepted technique in recent times.
5. Conjunctival limbal autografts (CLAU)
6. AMT

Method to reduce recurrence:

With autograft-

1. CAU (Conjunctival autograft)- currently widely accepted method to decrease the rate of recurrence.
2. CLAU (Conjunctival limbal autograft)
3. Rotational autografts
4. Buccal mucus membrane
5. AMT- used in cases of wider pterygium or double heads. It has anti-inflammatory effects and prevents neovascularization.[12]
6. PERFECT technique (Pterygium Extended Removal Followed by Extended Conjunctival Transplant): it reduces the recurrence rates along with improved cosmesis and reduced scarring
7. Mini-SLET[14] It requires less tissue than the conventional conjunctival autograft, leaving healthy conjunctiva for future use and also offers the advantage of epithelial stem cells, thus reducing the rate of recurrence.

Without covering the defect-

1. Beta irradiation
2. MMC: for intra-operative and post-operative use
3. 5 FU
4. Thiotepa
5. Cyclosporin A
6. Daunorubicin

Others-

1. Yag laser treatment
2. Fibrin glue (Tissel, Baxter, Reliseal)- shorter operation time and lower recurrence rates
3. Adequate post operative steroid

Complications of pterygium surgery :

Intraoperative-

1. Bleeding

2. Medial rectus injury
3. Corneal/scleral thinning
4. Related to graft: Reversal, loss of graft orientation

Postoperative-

1. Recurrence Most common complication
2. Corneal/scleral necrosis
3. Pyogenic granuloma
4. Persistent epithelial defect
5. Dellen formation
6. Related to Mitomycin C: poor epithelial healing, superficial punctate keratitis, late-onset scleral ulceration, endophthalmitis

Conclusion :

Thus, pterygium is not a trivial condition and hence a careful assessment should be done to decide the need for surgery and prevent its recurrence. Pterygium excision with conjunctival autograft with fibrin glue offers a low recurrence rate and a good cosmetic outcome.

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"For me, becoming isn't about arriving somewhere or achieving a certain aim. I see it instead as forward motion, a means of evolving, a way to reach continuously toward a better self. The journey doesn't end."

Michelle Obama

Thinking Outside The Cone - Innovations in Keratoconus

Shruti Kochar

Introduction :

Keratoconus (KC) is a progressive localized ectatic disease of the cornea. An undetected Keratoconus can be a risk factor for Post-Refractive Surgery ectasia. Early diagnosis is the key to preventing the disease from progressing to a stage where corneal transplantation becomes a necessity. There is an increasing focus on early detection and research has been done to identify therapeutic strategies that can prevent progression. This article aims to highlight innovations and cutting-edge knowledge on the latest developments in etio-pathogenesis, imaging and advances in treatment of keratoconus.

Etio-pathogenesis beyond the textbooks :

Various factors like atopy, eye rubbing and hard contact lenses have been associated with keratoconus but specific molecular mechanisms involved in the pathogenesis are not fully elucidated. The etiology of keratoconus is still poorly understood. Although environmental factors have been involved in KC pathogenesis, strong underlining genetic susceptibility has been proven. Some of the associated genes are LOX, VSX1, miR184, DOCK9, SOD1, TGFBI, COL5A1, COL4A3, COL4A4, WNT10A, SOD1, IL1B, IL1A. [1]

Traditionally, keratoconus is described as non-inflammatory. However, there are various reports that suggest that pathogenesis can involve inflammatory mediators and matrix degrading proteins. Tears of KC patients exhibit higher levels of proinflammatory cytokines, cell adhesion molecules, and matrix metalloproteinases (MMPs).[2] Recently, various inflammatory factors, such as IL6, TNFα, MMP9, cathepsins, etc., have been shown to be elevated in the tears of KC patients, suggesting a deregulation of underlying molecular pathways. Structural deformity of the KC cornea may be dependent on reduced expressions of collagens and LOX, as well as on elevated MMP9 by the corneal epithelium. [3]

Tear biomarkers for keratoconus- Every tear has a tale :

Expanding knowledge of the tear proteome and metabolome opened new avenues to study keratoconus and to identify probable prognostic or diagnostic biomarkers for the disease. Disease specific molecular signature from tear fluid analysis can help in decoding the etiology of the disease and to help in prognosis. In addition, tear fluid can serve as an optimal source of molecular targets for treating ocular disease condition.

Modern Indices for Screening - novel determinants :

Most indices perform well for screening frank Keratoconus. But the challenge is to detect the disease at early stage. Corneal tomography is the gold standard. Tomography based devices are the Pentacam, Orbscan and Galilei. However, the values and indices obtained from different instruments are rarely interchangeable as these instruments use different methods to depict corneal surfaces. Newer modalities involve the evaluation of Bowman's layer and biomechanics of cornea.

The additional information available from anterior segment tomographic devices has led to the development of screening programs like the Belin-Ambrosio Enhanced Ectasia Display (BAD) available on Pentacam. It displays the elevation data against the commonly used best-fit-sphere (BFS) and uses a newly developed reference surface called the “Enhanced Reference Surface.”

Several new classification systems for keratoconus have been proposed. The newly described ABCD keratoconus grading system uses the anterior and posterior radius of curvature taken from the 3-mm zone centered on the thinnest point (“A” for anterior, “B” for back surface) and the corneal thickness at the thinnest point (“C” for corneal thickness) as well as best corrected distance visual acuity (“D” for distance visual acuity). This new classification/grading system has advantages over the older Amsler-Krumeich classification in that it recognizes the importance of the posterior corneal surface and each component are individually graded. “Belin ABCD” grading system has been incorporated in the OCULUS Pentacam software.[4]

SCORE Analyser uses combination of Placido topography (Orbscan-IIz) and corneal elevation.[5] Positive score (> 0) is predictive of keratoconus suspect, while a negative score (< 0) is predictive of a normal cornea.

Galilei uses Best fit toric asphere which is closer to true corneal shape and can pick up subtle change in corneal surface

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irregulaties.[6] It gives Keratoconus prediction index (KPI), which is based on anterior surface measurements. It predicts percentage probability of keratoconus. Cone Location and Magnitude Index (CLMI) provides a robust index that can detect the presence or absence of a keratoconic pattern in anterior corneal topography maps and is independent of a specific platform. In addition, CLMI finds the location and curvature magnitude of the cone present in corneal topographic maps.[7]

SMADJA Decision Making Tree is a classifier that shows good performance for discriminating between normal corneas and forme fruste keratoconus dual Scheimpflug analyzer. Asphericity Asymmetry Index (AAI) is calculated by absolute summation of maximum elevation and maximum depression in the 6-mm zone on BFTA map. Cut off value of 21.5 µm and the corneal volume at 30.8 mm,[3] as the two most discriminant variables among the parameters incorporated.[8]

Percentage Tissue Altered (PTA) is calculated through the sum of flap thickness (FT) plus the ablation depth (AD) divided by the preoperative central corneal thickness (CCT). [PTA = (FT + AD)/CCT]. PTA greater than 40 percent was significant risk factor for ectasia in eyes with pre-operative normal topography.[9]

Corneal biomechanics: Is it important?

Biomechanical destabilization of the cornea may take place ahead of the topographic evidence of keratoconus. Keratoconic eyes show a weaker stress versus strain response along with a more disorganized collagen network. Corneal Hysteresis (CH) and Corneal Resistance Factor (CRF) measurements from Ocular Response Analyzer (ORA) are reduced in KC eyes with greater decrease as KC severity increases. [10] Parameters from Corvis ST like Highest Corneal Deflection Amplitude (HCDA) are worsened in patients with Keratoconus and can be useful for the detection of such cases.[11] The cornea is stiffened post collagen cross linking (CXL) and the Young's modulus has been found to be increased by up to 300 %.[12] Therefore, a knowledge of biomechanics can be a predictor of response after crosslinking.

Recently, using Brillouin microscopy, corneal stiffness has been found to be increased significantly by both epi – on and epi – off modalities of CXL and showed that the mechanical loss in keratoconus is primarily concentrated in corneal protrusion.[13] With further research, it is likely to lead to a customized management of keratoconus targeting the biomechanically weaker areas in keratoconus.

Bowman's layer- Neglected so far :

Bowman's layer may help in stromal wound healing and recovery of corneal transparency. If damaged, sub-basal nerve regeneration is delayed.[14] It does play a role in the pathogenesis of keratoconus and may be involved in the pathway for haze. Local alterations to Bowman's layer due to injury, eye rubbing, structural defects, etc. may trigger a focal, cone specific degenerative process. Consequently, deregulated local epithelial molecular factors drive changes that could cause the focal thinning and protrusion.[15]

In a recent study the irregularity of the Bowman's layer in keratoconus and forme fruste keratoconus eyes was evaluated. Subjects underwent high resolution OCT imaging (Bioptigen) and corneal tomography (Pentacam). Using a proprietary algorithm Bowman's roughness index (BRI) was calculated. BRI was defined as the sum of the enclosed areas between segmented edge and a smooth 3rd order polynomial fit to the edge. BRI was significantly reduced in FFKC and KC eyes. It improved the detection of FFKC but not KC eyes.

Keratoconus and the corneal nerves :

There is significant reduction in sub-basal nerve fiber density and length in affected eyes of patients with unilateral keratoconus compared to the fellow unaffected and control eyes. Unaffected eyes also showed significant changes in the sub-basal nerve plexus compared to controls even though their topographies were comparable.[16] This suggests a potential role of confocal microscopy in early detection of corneal nerve changes may therefore be used as imaging markers to aid in early diagnosis of keratoconus.

Epithelium – The great confounder :

Current topographers help in detection of patients who are at risk of ectasia, however they cannot compensate for the masking effect of epithelium which tends to smoothen out irregularities and give a false impression that topography is normal than it is. Epithelium- Bowman's interface is the level where the disease process starts. Topography at the level of Epithelial Bowman interface may help in the early detection of disease and more accurate profile in patients undergoing cross-linking procedures.[17]

Is the potential of OCT fully utilized?

OCT topography is a novel non-invasive method to analyze the Epithelium- Bowman's interface in normal and keratoconic eyes. It is a non-invasive method for “virtual de-epithelization” using OCT, where no physical removal of epithelium is required. This tool can be useful for preoperative planning of trans-epithelial procedures and customized corneal. Combining Tomography and OCT based indices increases sensitivity and specificity of FFKC detection.[18]

Bespoke Corneal cross-linking :

There is evidence now that keratoconus is a localized biomechanical disorder of the cornea. Thus, addressing the local disorder instead of the entire cornea could possibly

reduce the amount of ultraviolet (UVA) energy delivered to the stroma. Biomechanical modeling of corneal crosslinking has shown that selective CXL of the cone area may result in greater topographic flattening as compared to entire cornea.[19] This approach is exciting as it has the potential to deliver better therapeutic effect than the standard protocol with minimal collateral damage.

Bowman's layer transplantation :

Melles at al. recently described a new technique where an isolated Bowman's layer is transplanted into a mid-stromal manually dissected corneal pocket in patients with an advanced (Stage III-IV) keratoconus.[20] This is a new and interesting approach that could have its indication for that advanced keratoconus unsuitable for corneal collagen crosslinking or intracorneal ring segments and intolerant to contact lenses, but without visually significant corneal scars. In such cases, Bowman's transplant could avoid or postpone the necessity of keratoplasty.

Conclusions :

At the light of this review we can conclude that there is still much to understand about the disease. Moreover, the constant aim of basic and clinical research today is to identify the best strategies to halt the disease progression and restore the vision in keratoconus patients with the maximum safety. The future expected advances in trans-epithelial crosslinking, gene therapy nanotechnology, and regenerative medicine predicts an exciting future in this field.

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Ocular Surface squamous neoplasia : A review

Ankit Deokar

Ocular surface squamous neoplasia (OSSN) is a term that comprises of precancerous and cancerous epithelial lesions of the conjunctiva and cornea. The spectrum includes dysplasia, conjunctival intraepithelial neoplasia (CIN), and invasive squamous cell carcinoma (SCC). It was earlier termed as intraepithelialepitheliomaor Bowens disease. The term ocular surface squamous neoplasia (OSSN) which included mild, moderate, and severe dysplasia, carcinoma in situ, and invasive squamous cell carcinoma (SCC) was first proposed by Lee and Hirst in 1995. Dysplasia and carcinoma in situ constitute the term Conjunctival Intraepithelial Neoplasia and are premalignant conditions whereas squamous cell carcinoma represents its progression into malignancy.[1,2]

Lee and Hirst's grading of OSSN:

I. Benign dysplasia Papilloma
Pseudotheliomatous hyperplasia
Benign hereditary intraepithelial dyskeratosis

II. Preinvasive OSSN
Conjunctival/corneal carcinoma in situ(CIN)

III. Invasive OSSN
Squamous cell carcinoma
Mucoepidermoid carcinoma

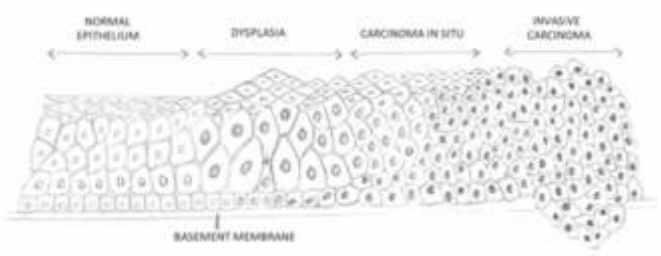

Fig-1: Spectrum of epithelial dysplastic changes

Proposed theories of etiopathogenesis of OSSN :

1) Ocular surface DNA damage is probably mainly caused by solar UV radiation (UVR), although.[3]
2) HPV is also hypothesized with supportive evidence to play
3) HIV increases the oncogenic action of other viruses and a study from Botswana reported multiple oncogenic viruses (EBV, HPV, KSHV, HSV1/2 and CMV) in cases of OSSN and pterygium.[4]
4) Vitamin A deficiency :

- Compromises the integrity of the surface epitheli um creating micro-abrasions for HPV entry
- It leads to cell-mediated immunodeficiency, and dysregulation of stem cell differentiation.[5]

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Table 1	Risk Factors associated with OSSN
1.	Exposure to ultraviolet-B radiation.
2.	Infection with human papilloma virus 16.
3.	Exposure to petroleum products.
4.	Heavy cigarette smoking.
5.	Chemicals such as trifluridine, Arsenic, Beryllium Ocular surface injury
6.	Vitamin A deficiency
7.	Defective DNA repair in Xeroderma. Pigmentosum
8.	HIV

Classification of OSSN:

The Morphological classification of OSSN:

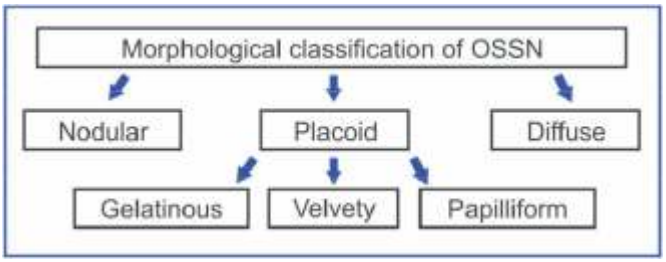

Fig-2

1) The Nodular type grows rapidly with a high incidence of metastasis to adjacent lymph nodes.

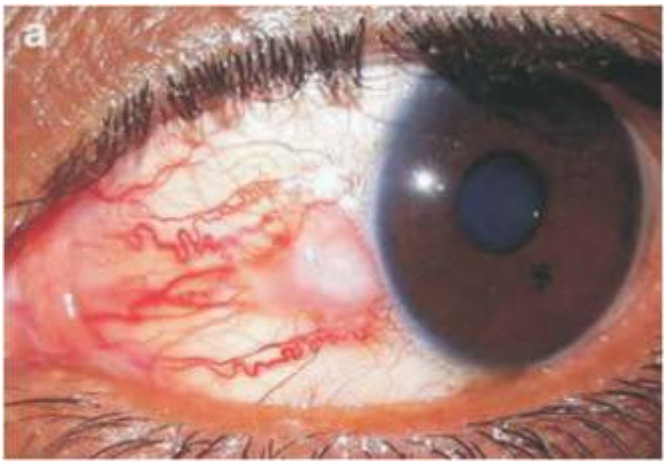

Fig-3

2) The placoidtype are relatively long standing and less aggressive sub-type compared to the nodular type. It is further sub-divided into 3 different patterns of presentation:

· Gelatinous- Circumscribed gelatinous lesions are the most common.

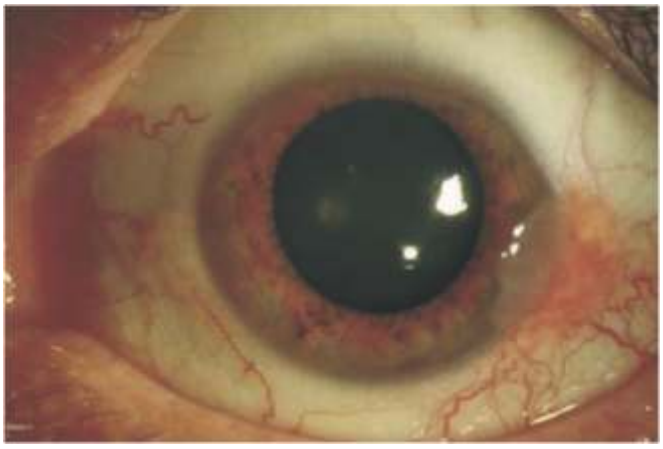

Fig-4

· Leukoplakic- These are usually pre invasive

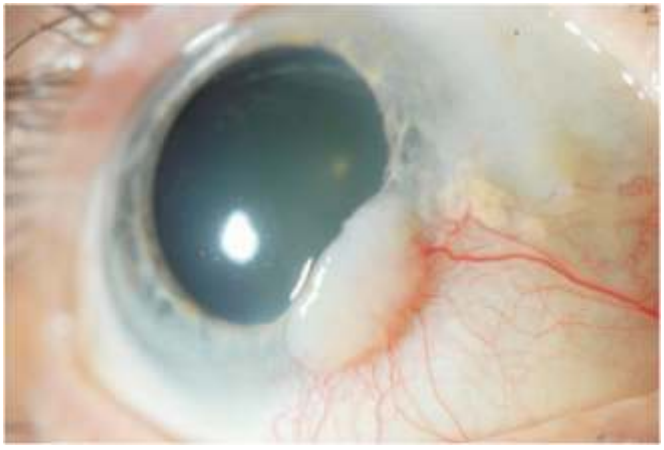

Fig-5

· Papilliform-They are exophytic, strawberry like, with a stippled red appearance corresponding to its fibro vascular core. They are clinically benign

3) The Diffuse type: The least common and in the early stages presents as persistent redness of the conjunctiva. They are masquerades of chronic conjunctivitis. It is clinical challenge to differentiate between benign and malignant lesions in these cases.

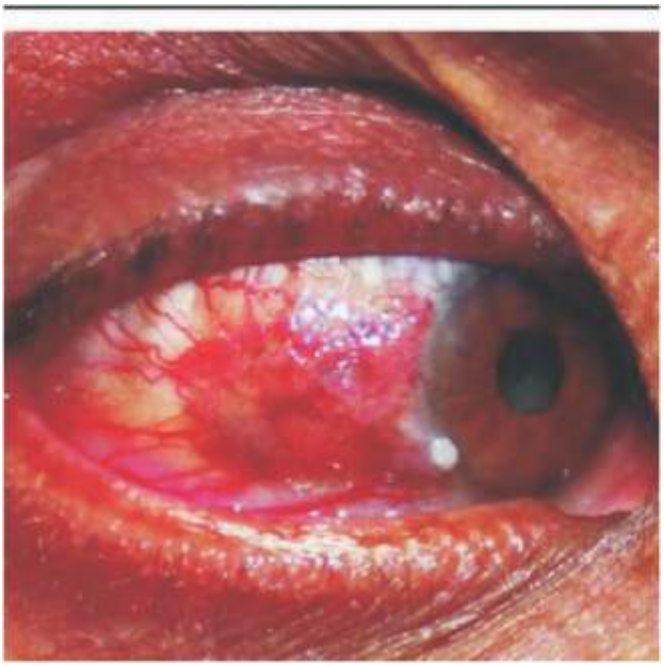

Fig-6

Histologically OSSN can be mild, moderate, severe or CIN grade 1, CIN grade 2 and CIN grade 3. When dysplasia involves the lower one third of the epithelium it is called mild, dysplasia extending into the middle third is called moderate or CIN grade 2 and when the dysplasia involves the full thickness of the epithelium it is called severe or CIN grade 3.[6,7]

Clinical features of OSSN:

· Ocular surface squamous neoplasia is mostly unilateral and is seen in middle aged older male patients.
· Bilaterality it is associated with immunosuppression.
· Redness and ocular irritation are presenting complaints
· Vision is usually unaffected unless it encroaches the center of the cornea.
· It appears as fleshy or nodular, sessile minimally elevated lesion.
· Corneal OSSN lesions are usually pre invasive, with a mottled, ground glass sheet appearance. They have sharply defined borders while the convex leading-edge spreads in an arc away from the limbus and often white dots are present over the grey epithelium. They are usually avascular. These lesions are typically indolent, slow growing and prone for recurrence.[6,7]

Diagnosis of OSSN:

On contrary to other malignancies, the treatment protocol of OSSN does not compulsorily mandate a histopathological diagnosis before starting of treatment. Only in clinically

doubtful cases and diffuse type of lesions is an incision biopsy done first. Given that local lesions can removed without much morbidity or vision loss, the usual protocol is to directly go for excision biopsy after clinical diagnosis.

For all practical purposes the lesion is treated as malignant until proven otherwise by histopathology.Rose Bengal staining of the lesion one of the best indicators of a high possibility that the lesion is OSSN.[8]

Non- invasive methods that can aid in the diagnosis of OSSN are:

Table-2

Exfoliative cytology	In vivo confocal microscopy	AS OCT
• Impression cytology using cellulose acetate paper (CAP) is as simple and inexpensive diagnostic technique • Cannot assist in the grading of epithelial dysplasia neither it can exclude micro-invasive growth, which requires a full thickness examination of the involved tissue	• In experienced hands ,reliable in predicting the grade of dysplasia • In addition, cytological examination can differentiate between invasive and in situ tumors.	• Noninvasive, non-contact and can be used for the initial diagnosis of OSSN, the detection of OSSN in the presence of concomitant ocular surface disease, and during the follow up of patients on topical treatments for OSSN

Differentiation between malignant and non-malignant conjunctival lesions

Table -3

Non-malignant Lesions	Malignant Lesions
Mobile lesion	Immobile lesion
Slow growing lesions over months and years	Usually increases in size rapidly
Does not bleed on touch	Bleeds on touch
Keratin pearls not present	Keratin pearls can be present, diagnostic of OSSN
Feeder vessels may or may not be present	Multiple prominent feeder vessels with telangiectasia
Symptoms are less severe or absent, eye will look quiet	Ocular symptoms of pain, redness, foreign body sensation will be severe
No distant or regional metastasis	Distant metastasis or regional metastasis to lymph nodes may be present
Might not show pigmentation	Darkly pigmented severe lesion

It is important to rule out the lesions listed below before making a clinical diagnosis of OSSN.[8,9]Below is Table -4 showing the differentials to be kept in mind

The treatment of OSSN includes:

1) Surgical excision : Complete surgical excision using the"NO TOUCH" technique is the treatment of choice in suspicious malignant lesions covering less than/equal to 3 clock hours at the limbus and not encroaching onto the centre of the cornea. Excision ofhigher clock hour involvement can lead to LSCD(Limbal stem cell deficiency). AMG following surgical excision of OSSN is effective for reconstruction of the conjunctival and corneal surface.

Table-4 Differential diagnosis of OSSN:

Actinic disease
Pannus
Vitamin A deficiency
Benign intraepithelial dyskeratosis
Pinguecula
Pterygium
Pyogenic granuloma
Pseudoepitheliomatous hyperplasia
Keratoacanthoma
Malignant melanoma and nevi

2) Topical chemotherapy including immunotherapy :
Drugs like Mitomycin-C (MMC), Interferon alpha, 5 Fluorouracil (5FU) is an effective modality of treatment for OSSN.[10,11]

The indications for using topical chemotherapy for treating OSSN is summarized in table-5:

Table-5	The indications for use of chemotherapeutic agents are:
1)	>3 quadrants of conjunctival involvement
2)	>180 degree of limbal involvement
3)	Clear corneal extension encroaching onto the pupillary axis
4)	Positive margin after excision
5)	Patient not fit for surgery

Topical interferon therapy:

In 1994 Maskin was the first to report to report the use of topical interferon (IFN alpha-2b) in a multi-focal limbal OSSN. Karp reported complete resolution in five cases of OSSN measuring 4 clock hours of the limbus.

Mitomycin-C (MMC) & 5-Flurouracil (5FU):

- Topical 5FU was first reported for the treatment of premalignant lesions of the cornea, conjunctiva, and eyelid in 1986. Since then, several studies evaluated 5FU as a primary agent for OSSN, with a high frequency of resolution (average 91%, range 82%-100%).
- Conjunctival intraepithelial neoplasia and milder forms of

Squamous Cell Carcinoma can be treated with topical MMC (0.020.04%). [10,11]

Table-6

Drugs	Dosage	Mechanism of action	Type	Side effects
Interferon	1MIU/ml, topical and intralesional, 4 times daily	Immune related inhibition of IL-10, stimulates IL-2 and IFN gamma mRNA. Antiviral Antiproliferative	Type 1 interferon	1. Flu like symptoms 2. Fever/Myalgia 3. Follicular conjunctivitis 4. Superficial punctate keratitis
5 Fluorouracil	1% topical, 4 cycles, 4 times daily for 1week, then 3 weeks off	Inhibits production and incorporation of thymidine into DNA thereby preventing RNA synthesis	Pyrimidine analogue	1. Eyelid erythema 2. Conjunctivalhyperaemia
Mitomycin-C	0.02-0.04%, 4 times daily, for 4 weeks then 2 weeks off	Under anaerobic conditions it generates free radicals leading to cytotoxicity, lipid peroxidation and inhibition of DNA and protein synthesis which prevents cell migration and extracellular matrix formation.	Alkylating agent	1.Conjunctival hyperaemia 2. Blepharospasm 3. Corneal punctate erosion 4. Punctal stenosis 5. Limbal stem cell deficiency

Topical or subconjunctival anti-VEGF:

- Studies conclude that topical bevacizumab is effective as a neoadjuvant therapy combined with surgical excision for the treatment of OSSN. It may be used as debulking agent before surgery Topical treatment also seems superior to subconjunctival administration, especially for the treatment of the corneal portion of the tumor.[12]
- If there is a patient with recurrent or refractory OSSN and when HPV is confirmed on PCR, the anti-viral drug cidofovir has shown very promising results.

3) Radiotherapy :Naseripour et al treated patients with recurrent conjunctival squamous cell carcinoma effectively with Ruthenium-106 plaque radiotherapys. Though extremely effective, it causes significant ocular surface damage and dry eye, which is often permanent.[13]

A new clinical based classification as well as treatment modality has been proposed by Meel Retal[10].The classification is mentioned in table 7

Newer Advances:

p16INK4a over expression is useful to segregate high-risk patients with OSSN presenting at an advancedstage. Once identified, these patients can be advised more aggressive treatment modalities. Sunlight-induced epigenetic alteration in p16INK4a plays an important role in the pathogenesis of OSSN.[14] In a study done by Dilip Kumar Mishra et al, it is stated that stem cells expressing p63, c-Kit, ABCG2, and CD44 have a role in the progression of OSSN.[15]

Conclusion:

While surgical excision has traditionally been the gold-standard treatment for OSSN, topical chemotherapies are now available as valuable and effective alternatives. These medical treatments offer the advantage of treating the entire ocular

Table-7: New clinical classification

Grade	Limbal involvement (clockhours)	Maximal basal diameter(mm)	Treatment
Grade 1: OSSN with no invasion into ocular coats clinically and on imaging (ultrasound bio-microscopy)			
A	Less than equal to 3 clock hours	Less than equal to 5 mm	Surgical excision with margin control
B	>3 to < 6 clock hours	>5 to < 15 mm	Immunotherapy or immunoreduction
C	More than equal to 6 clock hours	More than equal to 15 mm	Immuno-reduction
Grade 2: OSSN with invasion into ocular coats on imaging (ultrasound bio-microscopy)			
	Any	Any	Excision + lamellar sclerectomy or Keratectomy + cryotherapy
Grade 3: OSSN with intraocular invasion			
	Any	Any	Enucleation
Grade 4: OSSN with intra-orbital extension (confirmed by CT scan or MRI)			
	Any	Any	Orbital Exenteration

surface and can avoid some of the unfavourablesequelae associated with surgery. However, their various side effect profiles, need for compliance and financial implications should be taken into account by the patient and physician. AS-OCT technology can complement both medical and surgical treatments. With the modern surgical techniques, the local recurrence rate is less than 5% and regional metastasis is also less than 2%. OSSN generally has a good prognosis except in

Tables-8: The treatment protocol

Suspected OSSN 1-3 Clock Hours

Excision biopsy with 2mm clear margins and cryotherapy with amniotic membrane grafting

Margins positive

Topical chemotherapy with Interferon/MMC with 3 monthly review till tumor resolves

Margins negative

3 monthly review and evaluation for tumour recurrence

Suspected OSSN 3-6 Clock Hours

Incision biopsy to evaluate invasiveness

PRE-INVASIVE

Start topical chemotherapy with Interferon/MMC

Monthly follow up to evaluate tumor resolution-if resolves completely,then follow up every 3 months

INVASIVE

Start topical chemotherapy to achieve reduction in size.Onceachieved,surgical excision of residual tumour with clear margins and cryotherapy to base and margins

Monthly follow up for evaluation

Suspected OSSN >6 Clock Hours

Incision biopsy to rule out invasion

PRE-INVASIVE

Start topical chemotherapy with monthly follow up until complete resolution

INVASIVE

Start topical chemotherapy,if complete resolution occurs then monthly follow up till one year

If partial resolution-enucleation/exenteration depending on ocular coats

mucoepidermoid or spindle cell variants and in immune suppressed patients

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Ocular Chemical Burn Pathophysiology and Management Strategy-A Review

Prateek Tiwari

ABSTRACT :

Ocular chemical burn is an acute emergency which threatens sight and life. Various chemicals have been implicated. Alkali injury being more common than acid with the former being more severe because of greater penetration in the tissues due to saponification of the cell membranes. Injuries caused due to alcohols are superficial and generally result in epithelial sloughing. The injury results in damage to various extraocular and intraocular tissues ranging from mild to extremely severe. Final outcome is determined by the type of injurious agent, duration of exposure,nature of the treatment and its swiftness.The management principles include assessment of damage, control of inflammation, facilitating healing, controlling intraocular pressure and prevention of sequelae. Long term complications can be addressed by various surgical techniques.Management of intra-ocular pressure is often missed. Overall management requires multi disciplinary approach.

INTRODUCTION :

Ocular chemical burns are absolute ophthalmic emergencies. There are very few ophthalmic emergencies and out of them absolute are fewer. Ocular chemical injury remains one such emergency. Chemical burns can range from mild to severe, where mild burns can be easily managed while severe may require extensive treatment.[1]

EPIDEMIOLOGY :

Ocular burns constitute nearly 22% of all ocular injuries.[2,3] It's more common in lower socioeconomic status.[2] However, even in higher socio-economic strata it's not uncommon.

The incidence is higher in men but women are affected much earlier.[4] Young males working in industry constitute the bulk of the cases. Children in the age group 1-2 years are affected twice as much as adults.[2]

Majority of chemical burns are from Alkali where Ammonia and Lime are the most common offending agents.[4] Acids and alcohols also constitute a significant number,where injuries due to alcohols are milder and easily manageable. Sulfuric acid is the most common agent for acid. This is most commonly found in industrial cleansers and batteries.[5]

Centre for Sight, Indore

PATHOPHYSIOLOGY :

Common alkali are ammonia, ammonium hydroxide (which are found in cleaning solutions and fertilizers)sodium hydroxide in caustic soda and drain cleaners, calcium hydroxide in plaster and cement.

Magnesium hydroxide which is present in fireworks,can cause devastating injuries due to the thermal as well as the chemical effect.Lime, which is one of the most common forms of alkali injury, leads to formation of calcium salts after penetrating the cell membrane.These precipitate and form deposits, which prevent further penetration and damage. However, retained lime particles in the fornices can act as a reservoir of the alkali and cause severe damage if not identified and removed promptly.[67]

Alkali injury are more severe than acid injury. They work by different mechanisms.

Acids- work by causing coagulative necrosis. They also interact with the water contents of the tear film and tissue to produce heat which leads to additional charring of the corneal and conjunctival epithelium. Ultimately it leads to tissue coagulation and collagen shrinkage.[3]

Tissue surface proteins are neutralized by acid. Thus they aren't able to penetrate deeper. One exception to this is hydrofluoric acid which may rapidly pass though cell membranes and enter the anterior chamber of the eye. It causes tissue damage by two mechanisms- corrosive burn by the free hydrogen ions and chemical burn by tissue penetration of the fluoride ions.

Common acids associated- sulphuric acid which is present in car batteries, hydrochloric acid in swimming pool disinfectant, nitric acid in dyes and acetic acid in vinegars.

Alkalis- work by causing liquefactive necrosis.

Alkali saponifies the fatty acids(they are lipophilic) enclosed in the superficial cell membranes. Once the function of the cell membrane is disturbed, cell death ensues and the insulating agent more efficiently reaches the underlying connective tissue where the matrix proteoglycans are readily hydrolysed leaving collagen fibrils especially susceptible to enzymatic degradation. [3]

After reaching Anterior Chamber it results in shortening of collagen fibers- destroys Trabecular meshwork and hence

Roper Hall Classification for Ocular Surface Burns

Grade	Prognosis	Cornea	Conjunctiva/Limbus
I	Good	Corneal epithelial damage	No limbal ischemia
II	Good	Corneal haze, iris details visible	<1/3 limbal ischemia
III	Guarded	Total epithelial loss, stromal haze, iris details obscured	1/3-1/2 limbal ischemia
IV	Poor	Cornea opaque, iris and pupil obscured	>1/2 limbal ischemia

Dua Classification for Ocular Surface Burns

Grade	Prognosis	Clinical findings	Conjunctiva Involvement	Analogue Scale*
I	Very good	0 clock hours of limbal involvement	0%	0/0%
II	Good	< 3 clock hours of limbal involvement	< 30%	0.1-3/1-29.9%
III	Good	Between 3-6 clock hours of limbal involvement	30-50%	3.1-6/31-50%
IV	Good to guarded	Between 6-9 clock hours of limbal involvement	50-75%	6.1-9/51-75
V	Guarded to poor	Between 9 and 12 clock hours of limbal involvement	75-100%	9.1-11.9/75.1-99.9%
VI	Very poor	Total limbus (12 clock hours) involved	Total conjunctiva (100%) involved	12/100%

*The analogue scale records the amount of limbal involvement in clock hours of affected limbus/percentage of conjunctival involvement. The conjunctival involvement should be calculated only for the bulbar conjunctiva, up to including the conjunctival fornices.

Figure A (Above) B (Below)

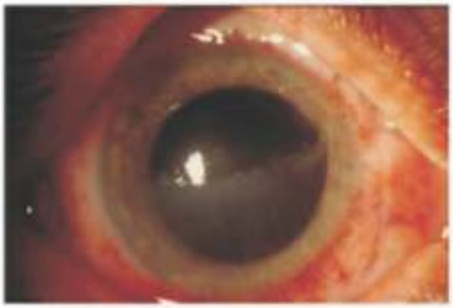

Figure C (Above)

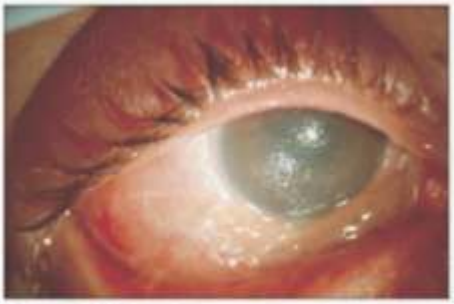

Figure D (Above)

Image Legend

Figure A – Acute Grade II burn. **Figure B-** Grade II burn one week after presentation. **Figure C-** Acute grade III burn with corneal haze. Involvement of approximately 6 clock hours. **Figure D-** Acute grade IV burn (Roper Hall) and grade VI (Dua). Images courtesy of Dr. Kathryn Colby and Dr. James Chodosh (Massachusetts Eye and Ear Infirmary).

obstructing outflow and increasing IOP.[8]

In long run it leaves the scar tissue leading to Glaucoma in the long term.

Chemical injury results in severe drop in glucose and ascorbate in the aqueous humor due to damage to the ciliary epithelium which leads to retarded collagen synthesis, which in turn can cause irreversible hypotony and phthisis specially with prolonged elevated aqueous pH levels of > 11.5.[9]

Retinal damage is unlikely to be caused by the direct effect of the chemical agent. Usually the anterior segment tissues act as a barrier in the path of the day chemical. All chemical changes are restricted to the cornea and the anterior chamber where they cause profound uveal inflammation and release of pro-inflammatory cytokines.[10]

Chemicals are not the only determinants of damage. Other factors include temperature, the force of the impact, concentration of the chemical (higher the concentration, higher is the impact) and duration of the exposure and surface area affected.[1,8]

Depending on the degree of penetration,all structures of the eye can be involved.

In cornea, epithelium, stroma, nerves can be affected along with surrounding conjunctiva, Tenon's capsule, episclera and sclera. Deep penetration can lead to damage to the iris and lens. Limbal ischaemia can result into subsequent limbal stem cell deficiency. Damage to the ciliary body can result in hypotony while damage to the trabecular meshwork can result in increase in intraocular pressure.

GRADING AND STAGING :

Grading should be documented at the very first ophthalmic examination. However, it's not always possible to do it accurately in the first instance due to acute discomfort of the patient. However, it should be revised on every visit.

Grading systems combine the corneal, limbal and conjunctival changes to prognosticate the clinical condition and are very useful to acquire a general idea of the interventions that may be recommended in later stages.

Roper Hall gave the grading based on amount of corneal damage and amount of limbal ischemia.[11] Subsequently, Joseph in a publication showed that grade 4 Roper Hall don't have such a bad outcome.[12] Hence, Dua came up with the classification in which he proposed six grades where grade 4 Roper Hall was further divided into three grades.

According to Dua's classification limbal ischemia is not the sole determinant of LSCD and total epithelium loss may occur in presence of apparently insignificant ischaemia with poor outcomes. [12]

Dua classification also provides an analog scale that is more flexible and allows for combining features of the different grades which is more compatible with real clinical situations.[12]

MANAGEMENT :

Management strategies are based not only on the severity of the burn but also on the stage at which the condition is being evaluated. This staging was described by Culley.[13]

Immediate(Pre-hospital) :

Patients suffering from chemical injury often present in the emergency department. Immediate treatment involves starting irrigation with any available clean solution as soon as possible. Initial history taking and irrigation should be performed simultaneously.[8] During irrigation, the superior and inferior conjunctival fornices should be examined and any particulate matter removed with moistened cotton buds. If needed, the patient should be taken up in the OT where double eversion of the lid and further exploration of the chemical in the fornices should be done.

Irrigation with hypertonic amphoteric solutions may be more beneficial (though hypertonic solutions cause more discomfort in comparison to isotonic solutions). Diphoterine is amphoteric meaning it can neutralize both acids and alkali and is hypertonic. In a 30-year longitudinal study published by Wiesner et al, it was shown that pre-hospital rinsing of the ocular surface with Previn (an amphoteric polyvalent agent) followed by secondary rinsing in the hospital setting reduced the severity of chemical burns in comparison to all solutions.[14]

Acute/Inside Hospital(<7 days) :

Within 12-24 hour of chemical burn, polymorphonuclear leukocytes infiltrate the periphery of the cornea. These cells release collagenase which cleave and scavenge damaged collagen fibrils.

However, if the chemical burn is severe there is a second wave of influx of PMN, which occurs at day 7 and peaks between day 14-21 and persists as long as the epithelial defect remains. [13,15]

Treatment is aimed at quelling inflammation and encouraging growth. Frequent topical corticosteroids should be used irrespective of the epithelial defect for at least seven days. Start topical antibiotic (preservative-free formula is preferred).

Early reparative day 8-21- The epithelium proliferates. Collagenase activity peaks. Chronic inflammation supersedes acute inflammation leading to stromal hyperplasia and scar formation.[16] Treatment is aimed at maximizing the collagen synthesis and minimizing the collagenase activity. Continue corticosteroids even if epithelialization has been completed. Start frequent preservative-free artificial tears and continue throughout treatment. Check IOP; start IOP lowering medications if elevated IOP is detected.Start systemic tetracyclines and oral vitamin C.

Consider Amniotic membrane trasplantation (alternatively: PROKERA) in grades IV-VI Dua classification preferably in the first week. [17]

Consider Tenoplasty if scleral melting or ischemia is noted (more common in grades V-VI Dua classification). In the presence of non-healing epithelial defects, steroids should be tapered after 10-14 days.[18]

Late reparative after day 21- In this phase changes secondary to host repair and regeneration or lack thereof are manifest, including fibrovascular pannus, deep corneal vascularisation, dry eye, neurotrophic keratopathy, persistent epithelial defect, and/or perforation. Here the aim is to prepare the eye for further surgical interventions once the inflammation subsides. Treatment is directed at correction of complications: Previous treatments are continued until stable ocular surface is ensured.[4]

PROMOTION OF EPITHELIALIZATION :

Maintaining an intact epithelium is very important to prevent the digestive enzymes reaching the stroma. However the challenge lies in minimizing the inflammation and collagenase activity.Liberal use of artificial tears.

Using tetracyclines like doxycycline can inhibit metallo-proteinase and can thus prevent the enzymatic proteolysis of the stroma.[19] Supplementing ascorbate from outside in the form of vitamin C supplements may improve collagen synthesis. [20]

Medications like N-acetyl-cysteine[21], biological medications[22,23] (PRP, serum, amniotic membrane extracts) have been tried although with limited success.

Currently, it is recommended that all eyes with grades III to VI

Dua's classification receive at least one type of biological eye drops every 2 hours for a month starting in the acute stage and continued with slow taper until the inflammation has completely resolved.

MINIMIZING INFLAMMATION :

Inflammation management is the cornerstone of the Ocular Injury patients. On one hand it brings the resources for activating the repair mechanisms; on the other hand these mechanisms may go uncontrolled and result in further damage. The balance between these two potentials of the same mechanisms determines the efficiency of the healing process.

Frequent administration of topical steroids (prednisolone acetate 1% or Dexamethasone 0.1% every 2 hours) is recommended in the acute stage. It should be tapered in the early reparative stage in order to avoid complications.[25] They may be continued thereafter, if the epithelial defects have been healed, but the inflammation is still a concern. [26]

Progesterone derivatives inhibit collagenase activity in addition to having anti-inflammatory activity. However, firm evidence in human subjects is lacking.

Sodium citrate is a potent inhibitor of collagenase and leukocyte migration. Its mechanism of action is related to the chelation of calcium ions. Brodovsky et al reported that topical citrate administration was associated with better outcomes in patients with a guarded prognosis.[27,28]

Currently, frequent administration of topical 10% citrate is recommended in the acute stage of chemical burns.[24]

The effectiveness of topical or systemic nonsteroidal anti-inflammatory medications, whether as adjuvants to corticosteroids or as corticosteroid-sparing agents, needs to be explored.

MEASURES TO PREVENT COMPLICATIONS :

Irrespective of the stage of the disease, its imperative to look for complications. Its important to monitor epithelial defects consistently and add prophylactic broad spectrum topical antibiotics in acute stage and thereafter until re epithelialization has been completed. Any stromal infiltration should be noted and sent for culture and sensitivity, until the report comes, empirical treatment should be started.

Measure IOP rise. IOP rise is generally due to chemical induced disruption of trabecular meshwork or contracture of the sclera. Aggressive use of the corticosteroids can also raise the IOP. Elevated IOP can be managed by topical anti-glaucoma medications, however epithelial toxicity should be monitored. The higher the initial grading, higher the chance of glaucoma.[29,30]

Addition of cycloplegics help in relieving pain and prevent synechiae formation.

Surgical Management :

Surgical management is usually needed for higher grades (generally grades III to VI Dua's classification), it should not be considered longitudinal to medical management. Instead, at any stage of the chemical burn, surgical interventions may be recommended to accelerate the healing process and to reduce the burden of complications.

Amniotic Membrane Transplantation (AMT) :

The AMT is very popular in current clinical practice and many authors recommend it immediately in the acute stage of grades III to VI Dua's classification. Though a recent RCT did not demonstrate any additional benefit of AMT in severe (grade IV Roper-Hall or grade V-VI Dua) chemical burns. It is also less predictable in grades IV to VI Dua's classification. Persistent epithelial defect may remain and may require repeat AMT.

Amniotic membrane acts as a biological sponge and to remove inflammatory mediators from the ocular surface. It also expedites the healing of the damaged epithelium, reduces pain.[8]

It can be transplanted as single or multiple layers and with stromal side up or down. It may be sutured or attached with fibrin glue onto ocular surface. Its not necessary to place a bandage contact lens(BCL), it can be left uncovered. However, the results are not predictable-it may take several months to get a smooth epithelialized surface. AMT has been shown to fail in some studies.[31]

Tenonplasty :

In cases with severe chemical burns where limbal vasculature is significantly compromised, tenoplasty or tenonplasty remains a logical approach.

This may be sutured alone or combined with AMT or may be augmented with tissue adhesives. [18]

The goal of the procedure is to get ischaemic limbus with healthy connective tissue which can help in reducing the anterior segment necrosis and corneoscleral ulceration and melting.

Debridement of Necrotic Tissue :

Necrotic tissue act as a source of instability for tissue, devitalised tissues should be removed. [24]

Limbal Stem-Cell Transplantation (LSCT) :

LSCT is an option when the corneal conjunctivalization is total

or center-involving.[8,32]

To be done when inflammation has been perfectly controlled. Correction of structural abnormalities such as symblepharon or cicatricial entropion and/or ectropion take priority over LSCT.[33] For unilateral LSCD,the healthy eye can be used to acquire conjunctival limbal autograft for CLAU or stem cells can be transferred from the healthy eye as in Simple Linebal Epthetial all Trasplant, the technique originally described by Dr Sangwan.[34]

If bilateral but asymmetric involvement is the case, cultivated limbal epithelial transplantation (CLET)[35] or Allo SLET[33] is an option. When bilateral LSCD is severe and symmetric, limbal stem-cells can be harvested from allograft donors either as living-related conjunctival limbal allograft (lr-CLAL) or keratolimbal allograft (KLAL).[36]

All allografts need systemic immunosuppression and a multidisciplinary medical team if rejection and side effects are to be prevented. [37]

Keratoplasty and Keratoprosthesis :

Both PK and DALK are acceptable depending on the depth of the scars. DALK is a better option due to less chances of rejection.[38] Simultaneous placement of amniotic membrane can be considered depending on the possibility of getting a PED. Keratoplasty should not be scheduled if LSCT is anticipated.[39] Delay keratoplasty for at least three months after LSCT.[40]

Large corneo-scleral grafts are preferable because they may provide limbal stem cells in addition to tectonic support.[4]1If multiple failed keratoplasties are encountered then its better to go for keratoprosthesis.[42]

In wet eyes- Boston type 1 K-Pro should be considered while in extremely dry eyes or surface keratinisation or select cases with non functional lids, Boston type 2 or osteo-odonto-keratoprosthesis OOKP may be recommended.[43]

For corneal perforations- cyanoacrylate and fibrin glue can be used.

CONCLUSION :

An ocular chemical burn is an ophthalmic emergency. Immediate treatment is of vital importance at the site of the accident. Management is based on achieving complete epithelialization, controlling inflammation and minimising and managing the complications. Initiation of early and frequent topical steroids irrespective of epithelial defect is of vital importance. Similarly, placing early amniotic membrane reduces inflammation, supports stroma and provides a bed for expansion of epithelial tissue. Limbal stem cell deficiency can be managed later when inflammation has settled. Keratoplasty can be done to improve visual outcomes.

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Open Globe Injuries
Evaluation and Initial Management

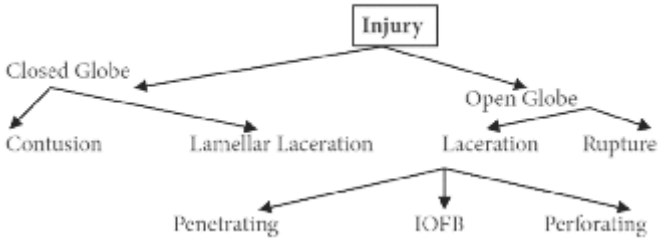
Aanchal Mehta Agarwal[1], Ashutosh Agarwal[2]

Ocular trauma is a major cause of uniocular blindness in India, with incidence rates ranging from 4.5% to 7.5%.[1,3] Occupational eye injuries remain the most common cause of ocular injuries in the Indian rural population and are caused mainly due to agriculture-related work, carpentry, chiseling, and hammering.[3,4]

Assessment :

Classification

The Birmingham Eye Trauma Terminology (BETT)



Open globe injury classification

TYPE

A	Rupture
B	Penetrating
C	Intraocular foreign Body
D	Perforating
E	Mixed

Grade	**Visual Acuity**
1	>20/40
2	20/50 to 20/100
3	19/100 to 5/200
4	4/200 to light perception
5	No light perception

PUPIL (affected eye)

Positive RAPD +

Negative RAPD -

ZONE

I	Isolated to cornea (including corneo- scleral limbus)
II	Limbus to 5mm posterior into the sclera
III	Posterior to anterior 5mm of sclera

History :

A properly elicited history tells us about the time since injury, type of injury, open or closed globe, mode of injury, nature of the penetrating material and the associated medico legal aspects.

Ophthalmic Evaluation :

A complete ocular examination, including diffuse light examination; slit lamp examination and fundus examination whenever possible.

Best corrected visual acuity and relative afferent pupillary defect are the most significant prognostic factors on presentation.

Signs such as diffuse chemosis; massive sub-conjunctival hemorrhage; corneal laceration, asymmetrical depth of anterior chamber; low intraocular pressure; “uveal show” under the conjunctiva suggesting scleral rupture; hemorrhagic choroidal detachment etc especially in combination should make one think of and actively search for a scleral rupture which may be trying to escape detection owing to the intact conjunctiva or chemosis above it or due to its posterior location.

Seidel's test helps in the detection of occult penetrating corneal injury.

If the initial examination still fails to exclude a rupture or a hidden full thickness scleral wound, then do not hesitate to explore in the OT.

Evaluation of posterior segment in open globe injuries

Possible injuries

Vitreous hemorrhage / incarceration

Retinal tear / dialysis / retinal detachment

Retained intraocular foreign body

Traumatic endophthalmitis

In case of a scleral tear, the media may sometimes be clear to

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allow a screening of the vitreous and the retina. Vitreous hemorrhage, vitreous incarceration into the wound, retinal tears / detachment is common with scleral injuries.

Imaging Techniques :

The B Scan Ultrasound is very useful to evaluate posterior segment structures, but it's use in open globe injury on presentation is limited due to the contact of the probe with the cornea or lid.

CT Scan is the imaging modality of choice if we are suspecting an open globe injury. Especially in cases of occult globe rupture; detect IOFBs; gives an idea of the orbital pathologies like retrobulbar hemorrhage; orbital wall fractures.

MRI, is severely limited by the fact that it can't be used when we are suspecting a metallic foreign body.

Early Management and Planning the Surgery :

Initial medical treatment includes mainly broad spectrum intravenous antibiotics. Tetanus toxoid intramuscular injection is given. Analgesics can be given for symptomatic relief. Preservative free topical antibiotics can be given.

The primary repair is done within 6 hours. Interventions like IOFB removal is done as a primary procedure. IOFBs without much risk of endophthalmitis; repair of retinal detachment etc can be done as a second planned procedure.

Anaesthesia :

General Anesthesia is usually preferred as local anesthesia can increase retrobulbar pressure which can aggravate prolapse of intraocular tissues.

Simple full thickness corneal lacerations :

It involves when the wound doesn't have iris and vitreous incarceration along with sparing of lens from the injury, and the wound doesn't extend over the limbus.

Any perforations less than 2 mm can be managed with cyanoacrylate glue and BCL.

Full thickness Non Self -Sealing Corneal Wounds :

These require primary repair using 10-0 nylon sutures.

Principles of Surgical repair of Corneal Lacerations :

Important aspect in restoration of ocular surface includes formation of limbus, proper apposition of wound margins, removal of any foreign material in the wound. The idea is that apposition of the edges of the laceration with properly placed sutures should first happen at these land marks. (Figure 1)

Basic Suturing Technique :

Ideally a round suture loop should be placed in a single plane so that the 2 edges will have a layer to layer apposition. Suture passes should be around 1.5 to 2 mm length in total i.e. 0.75 to 1 mm on either side. The depth of the sutures should be 85-90% of full thickness.

Full thickness corneal lacerations generally have one of the following 2 anatomical configurations-

- A vertical (perpendicular) laceration

- An oblique (shelved or beveled) laceration

The 2 types require 2 slightly different approaches. In vertical lacerations the suture entry and exit sites should be equidistant from the wound margins so that the corneal suture is centered over the wound (Figure 2).

In bevelled or shelved lacerations,bites equidistant from the anterior aspect of the wound margin would lead to wound overriding and tissue distortion. To prevent this care should be taken to ensure that the suture is centered on the posterior aspect of the wound margin. This means that the suture entry and exit sites will be displaced with respect to the anterior aspect of the laceration but will be equidistant with respect to the posterior aspect.(Figure 3)

Various factors which are responsible for wound apposition include the effects of suturing methods done on the tissue including compression, torquing, splinting, tissue eversion and inversion.

Compression Factors :

The area of compression is directly proportional to the length of the suture. There is a formation of diamond shaped zone of compression around every interrupted suture. Adequate wound closure is achieved when these compression zones overlap with each other on either sides.

Tightening of the suture will cause compression of the tissues, but if correctly done there will not be any eversion or inversion of the edges.

Running Sutures :

This type of suturing is done in sharp edged wounds. The advantage is that it provides a uniform zone of compression which helps in wound apposition. However, the disadvantages are :

- Large zone of compression and thus excessive flattening of the cornea.
- Misalignment of wound edges due to suture induced edge slippage.
- Straightening of curvilinear incisions.
- Rippling of corneal surface if sutures are not placed in the same depth or full thickness.

Rowsey-Hay's Technique of Corneal Suturing[5] :

The periphery of the wound is closed with long tight compressive suture bites. This results in flattening of the periphery and compensatory steepening of the corneal centre. The centre is then closed with short, spaced, minimally compressive suture bites.

Corneal laceration with iris incarceration :

Corneal wound is sutured after separating iris from the posterior surface of the wound by sweeping with help of iris repositer and reconstructing the anterior chamber. Air is injected to maintain the anterior chamber.

If iris prolapse is present then the prolapsed tissue is removed. It is important to resect the prolapsed tissue within 24 hours to prevent any infection and epithelial ingrowth. Viability of the iris tissue is checked and if non viable then iris abscission is done.

Stellate Wounds :

These wounds may require a combination of sutures and tissue adhesive, and sometimes, a patch graft for a proper closure. A purse string technique has been proposed by Eisner6.

Loss of Tissue :

When tissue loss exceeds 5 mm in diameter, a corneal patch graft is usually required.

Scleral and Corneoscleral Injuries :

Scleral wounds especially ruptures can sometimes be missed since they can be hidden by the intact conjunctiva and /or large subconjunctival hematoma. In case of any doubts globe exploration should be done. Special attention is given to areas of muscle insertions as it is a common site for rupture.

Full thickness scleral wounds are generally apposed with interrupted sutures with 7-0 vicryl suture.

- If the limbus is involved then first suturing to reconstruct limbus should be done. Scleral wounds are closed from anterior to posterior direction.
- Involvement of any prolapsed tissue in the suture is to be avoided. Any such tissue must be reposited back or abscised away, before passing the suture. Vitreous is amputated at the scleral surface.
- In cases where the scleral wound extends through or under an extra ocular muscle, an assistant can retract the muscle to aid in exposure.
- The main point to be remembered about suturing is to suture the limbus first, then cornea and then sclera.[7]

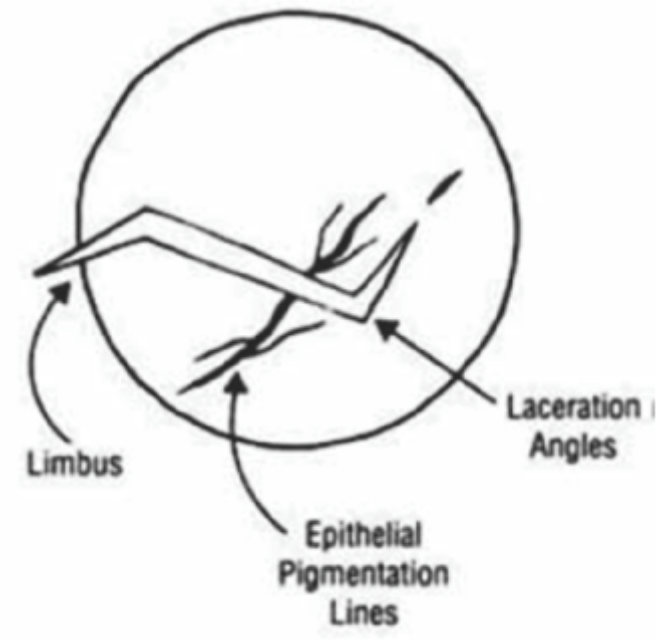

Figure 1: Corneal landmarks that facilitate anatomic realignment: the limbus, epithelial pigmentation lines (e.g. iron lines), and stellate wound edges/angles of the wound.

Post Operative Management :

- Broad spectrum antibiotics topically - like gatifloxacin 0.3%. If wound seems to be infected then fortified cefazolin 5% and tobramycin 1.3% can be added
- Systemic antibiotics are to be continued
- Cycloplegic drugs twice to three times a day
- Anti glaucoma drugs if IOP is high

Intraocular Foreign Body :

IOFB is mostly metallic.[8] They are usually generated during chisel hammering, drilling, gunshot, or bomb blast. Since they are sharp, about 2/3rd of IOFBs are found in the posterior segment.

Ocular damage with iron foreign body results in siderosis bulbi. It is a pigmentary, degenerative process due to chronic retention of an iron IOFB. An inflammatory reaction to a copper foreign body results in chalcosis. Organic foreign bodies such as animal hairs, insect parts, thorn, and vegetable matter are contaminated and cause fulminant endophthalmitis.

Slit-lamp examination is a must. Careful examination should be done to look for conjunctival laceration, hemorrhage, and entry site of IOFB. Pigment under the conjunctiva may indicate uveal prolapse and possible entry site.

Iris should be inspected for transillumination defects The entry wound of the cornea and iris may help in localizing the foreign body. The lens should be evaluated for focal opacity,

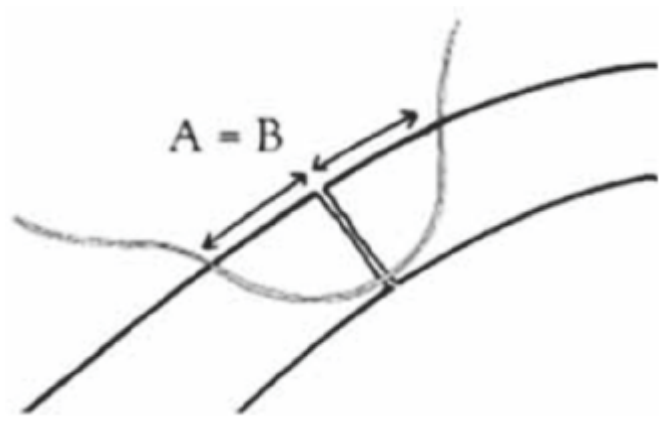

Figure 2 : The distance from the wound margin to the entry site (A) is the same as the distance from the wound margin to the exit site (B)

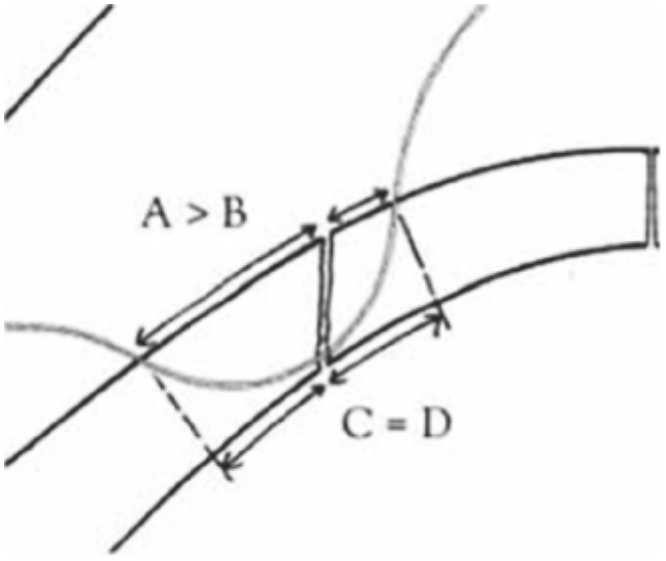

Figure 3: Suturing of a shelved laceration. The distance from the anterior margin of the wound to the suture entry site (A) is not equal to that from the same point to the suture exit site (B). But what matters here is the distance from the entry and exit sites to the posterior margin of the wound (C&D), which is equal (C=D)

cataractous changes, capsule rupture, and phacodonesis.

X-ray of orbits (anteroposterior and lateral view) can detect metallic foreign bodies but cannot detect radiolucent objects like wood or glass. USG B scan is a cheap and useful investigation to detect metallic foreign bodies. The metallic body appears as a hyperechoic structure with acoustic shadowing and a high spike on A-scan. Aluminum, steel, and bottle glass usually show a flashlight artifact, a focused and narrow ring-down artifact. Lead, windshield glass, copper, and silver usually show a headlight artifact which is a broad and dense artifact. A glass foreign body can appear as a hyperechoic lesion with a back shadow, or it can show a comet tail (reverberation) artifact. The wooden foreign body usually appears as a hyperechoic structure.

CT (computed tomography) scan can accurately detect the number, size, shape, and location of a foreign body. The CT can give the exact relation of ocular coats with the IOFB, as IOFBs, which are deeply buried in the ocular coats, may be difficult or impossible to remove surgically.

MRI (magnetic resonance imaging) can detect organic and glass objects with greater sensitivity. MRI is contraindicated in the metallic foreign body as it can dislodge it and cause further damage.

Tetanus toxoid (intramuscular) injection should be given. Broad-spectrum intravenous antibiotics may be considered as prophylaxis against endophthalmitis. Endophthalmitis is a dreaded complication and is associated with 7 to 13% of IOFB cases.[9]

IOFB in the anterior chamber: After primary repair of the cornea/sclera, the anterior chamber should be formed with viscoelastic solutions. Any exudates or hyphema should be washed. Small IOFB can be removed with viscoexpression or an intraocular magnet. If it is immobile due to surrounding fibrosis, then the IOFB should be removed with forceps.

The IOFB should not be removed through the entry wound.[10] A separate incision should be made for its removal. The anterior chamber aspirate can be sent for microbiological evaluation if there evidence of infection. If the anterior lens capsule is ruptured, lens aspiration should be done and anterior vitrectomy should be kept ready.

Posterior segment IOFB : Vitreous surgery provides excellent visualization and allows the removal of hemorrhage and exudates. Three standard scleral ports are made. Lensectomy is done if the lens is cataractous. If possible, the anterior capsular rim should be preserved to enable a ciliary sulcus intraocular lens implantation. Then core vitrectomy is done. A posterior vitreous detachment is induced. The IOFB is localized. The adhesions and fibrous capsules around it are excised. It is mobilized and brought over the retinal surface. Its shape and size are determined. Accordingly, the decision is taken to remove it through the anterior or pars plana route. If the IOFB is large, it is better to remove it through the anterior route through a corneoscleral tunnel. A large IOFB requires a large pars plana incision which increases the chances of retinal incarceration, vitreous prolapse, and retinal detachment.[11] A small IOFB can be safely taken out through the pars plana. The IOFB, once freed from the surrounding adhesions, can be taken out with the help of an intraocular magnet or intravitreal forceps. PFCL (perfluorocarbon liquids) can be injected over the macula to protect it in the event of a fall of the IOFB in the

process of extraction.

The site of impaction should be laser barraged. The retinal periphery should be inspected for additional breaks. If retinal detachment is present, a complete vitrectomy should be done, followed by fluid air exchange, endolaser photocoagulation, and silicone oil tamponade. If the retina is attached, then the retinal break should be laser barraged. The scleral ports are closed tightly.

Post-traumatic endophthalmitis accounts for one-third of all infectious endophthalmitis cases irrespective of the cause.

Causative organisms are most often gram-positive, including Staphylococcus, Bacillus, Streptococcus, and Enterococcus species; 10% 15% are due to gram-negative organisms including Pseudomonas aeruginosa and some species of Enterobacteriaceae; 10-30% are polymicrobial. High incidence of Bacillus infections are seen in the setting of IOFB or soil contaminated wounds. Candida species, Aspergillus and Fusarium are fungal entities that have been identified in chronic indolent cases.

Factors that may increase the risk of infection in open globe eyes include:

- Delayed primary repair of open globe injury by greater than 24 hours
- Retained intraocular foreign body
- Contaminated injury with soil, rural or organic matter
- Ruptured lens capsule
- Large wound size
- Vitreous prolapse through the open globe wound

It can be difficult to diagnose early infection immediately after open globe injury due to trauma-related ocular tissue disruption and inflammation.

Signs :

- Anterior chamber reaction with hypopyon +/- fibrin membranes
- Vitritis identified on clinical examination of B-scan ultrasonography
- Purulent discharge
- Corneal edema
- Eyelid edema
- Severe conjunctival injection with chemosis
- Possible periorbital erythema and proptosis
- Possible decrease in motility

Symptoms :

Increasing pain with hypopyon and vitritis suggests an infection until proven otherwise. Bacterial infections, the most common cause, typically have a relatively rapid onset and progression to panophthalmitis with severe pain and inflammation. Bacillus endophthalmitis is classically associated with very fast (within hours) onset of severe inflammation and is associated with poor outcome. On the other hand, fungal infection after open globe injury may not present acutely. These should be suspected in tree branch or vegetable matter injuries.

Gram stain, KOH preparation of vitreous sample and blood and chocolate agar should be plated. Samples should be cultured on Sabouraud's dextrose for fungal organisms. Only 70% of vitreous cultures usually yield positive results. PCR assays of vitreous for identification of bacterial and fungal strains should be considered.

Medical Therapy :

- Empiric intravitreal vancomycin 1 mg/0.1 mL and ceftazidime 2.25 mg/0.1 mL injections in cases where emergency pars plana vitrectomy cannot be performed. If vitrectomy is performed, consider injection intravitreal antibiotics at the conclusion of the case.
- Systemic broad spectrum antibiotics can be used including Inj. vancomycin 1 g 12h and ceftazidime 1g 8h. Systemic voriconazole (200mg bid) is recommended intravenously for fungal infections.
- Topical fortified vancomycin (50 mg/mL) with ceftazidime (100 mg/mL) every hour.

Medical Follow up :

- Once hypopyon resolves and vitritis improves, the antibiotics are switched to oral and the patient is discharged from the hospital. Oral fluoroquinolones (e.g. ciprofloxacin 750 mg q12hr) are widely used for bacterial infections and oral voriconazole (200 mg bid) for fungal infections. Culture results and sensitivities, once available, can be used to narrow antibiotic therapy.
- Semiweekly to weekly follow-ups with B-scans are performed until the infection fully resolves.

Surgical Follow up :

- Daily follow-up until marked improvement of infection noted. If no improvement is seen in 48-72 hours, repeated intravitreal antibiotic injection can be considered.
- Secondary procedures are common to address retinal detachment, proliferative vitreoretinopathy, vitreous hemorrhage, choroidal detachment, and cataract. Corneal opacification (due to laceration, suture repair, and scarring) may limit visualization of the posterior segment. In such cases, combined penetrating keratoplasty/ temporary keratoplasty are options.

Conclusion :

Open globe injuries are a major cause of visual morbidity so, urgent and appropriate measures are necessary in these cases to improve the visual outcome. Appropriate imaging should be done to look for IOFB and early treatment is the key. The patients should be adequately counselled regarding the prognosis of IOFB and the importance of long-term follow up.

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Amniotic Membrance Transplantation

Shreya Thatte[1], Ankita Dubey[2]

Introduction :

Normal ocular surface comprises of conjunctival and corneal epithelium in addition to tear film. Impairment to these cells owing to any reason can lead to ocular surface disorder (OSD). OSDs encompass a wide range of pathologies from minor epithelial erosions to major vision threatening conditions that can disrupt the entire ocular surface. Each case represents different etiology and has an individualized challenge demanding combinations of multiple medical and surgical strategies. Amniotic membrane has multiple properties, therefore has been deemed useful in overcoming such diverse situations.[1]

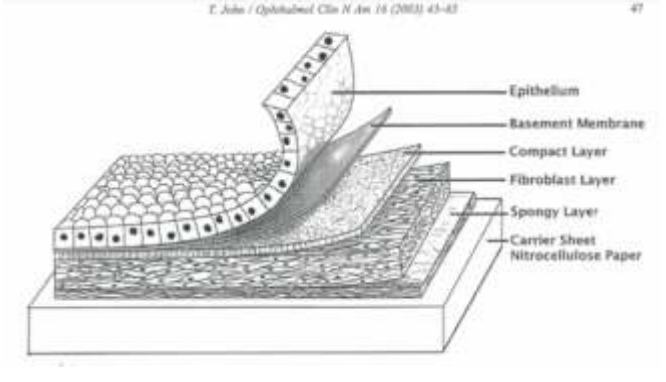
History and Evolution :

De Roth used fetal membranes for the very first time on the ocular surface in 1940.[2,3,4] Sorsby and Symons first used Human Amniotic Membrane (HAM) in 1946 and in 1993 Batle and Perdomo introduced Human Amniotic Membrane Transplantation.[5,6]

In 1995, Kim and Tseng published their observations of effectiveness in rabbits.[7] John et al first used Human Amniotic Membrane Transplantation (HAMT) in Toxic Epidermal Necrolysis and showed good visual preservation.[8]

Structure of Amniotic Membrane :

The human AM is the innermost layer of the placenta.



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Histologically the amnion is a 0.02 mm to 0.05 mm thick five-layered membrane, composed of three basic layers. 1) Epithelial monolayer 2) Thick basement membrane 3) Avascular, hypocellular stromal matrix.

The epithelium consists of a single layer of cuboidal cells with a large number of microvilli on the apical surface. The basement membrane is a thin layer composed of a network of reticular fibers. The compact layer contributes to the tensile strength of the membrane. The fibroblast layer is the thickest layer of the AM made up of a loose fibroblast network. The outermost layer of the amnion is the spongy layer.[3]

Physiology and possible Mechanism of Action of amniotic membrane :

Specific properties of AM can be attributed to special biological factors.

1. Re-epithelisation : AM provides superior substrate for migration of epithelial cells,[9] reinforces adhesion of basal epithelial cells,[10,11] promotes epithelial differentiation[12-15] and prevents apoptosis of epithelial cells.[16,17,18] The cytokines like Nerve Growth Factor (NGF), Epidermal Growth Factor (EGF), Keratocyte Growth Factor (KGF) and Hepatocyte Growth Factor (HGF)[19,20] are workable in preserved AM[21] and approximately 50% of the epithelial cells of AM cryopreserved for months can still be viable.[22]

2. Reduce Scarring : Amniotic Membrane matrix uniquely suppresses transforming growth factor β (TGF β) signalling and prevents myofibroblast differentiation of normal fibroblast, resulting in reduction of fibroblasts and scarring.[23,24]

3. Anti-Inflammatory : Acute inflammation is reduced by certain cytokines, suppressing IL1 α and IL 1 β upregulation and the rapid apoptosis of polymorphonuclear neutrophils.[25,26,27]

4. Prevent Angiogenesis : Fresh human amniotic epithelial and mesenchymal cells express potent anti-angiogenic agents, IL1 receptor antagonist, all four matrix metalloproteinase inhibitors, collagen XVIII, IL10 and thrombospondin 1.[21]

5. Immune Privileged Tissue : AMT does not require administration of systemic immunosuppressive therapy to prevent rejection[22,28] as it expresses HLA-G, a non-classic MHC Class 1 molecule in cytotrophoblaston the feto-maternal

interface, that protects the fetus from maternal cellular immunity.[22,29]

6. High Tensile Strength : The compact layer of the avascular connective tissue is the strongest layer of AM and provides it significant tensile strength.[30]

7. Antimicrobial and Antiviral Properties : Amniotic membrane has antimicrobial properties[31] as matrix of AM secretes elafin and secretory leucocyte protienase inhibitor, both of which have antimicrobial action and cystatin E, the analogue of cysteine proteinase inhibitor, which exhibits antiviral properties by inhibiting viral replication and altering the intracellular proteolytic processing of viral proteins.[32,33,34,35,36,37]

8. Nerve Regeneration : A high and therapeutic level of Nerve Growth Factor (NGF)[19] promotes subepithelial nerve regeneration in patients after keratoplasty.[38]

PROCURATION and PRESERVATION OF AMNIOTIC MEMBRANE :

DONOR SELECTION

- Safety criteria considered for AM transplantation has to be more stringent as compared to organ transplantation.
- Donors at risk of having HIV (human immunodeficiency virus), HBV (hepatitis B virus), HCV (hepatitis C virus), syphilis and CJD (Creutzfeldt-Jakob disease) are rendered unsuitable and must be excluded.
- It is recommended that the maternal donor should undergo repeat serological screening after 6 months (to cover the window period for transmission of communicable diseases).[39]

PROCURATION :

- The AM should be obtained under all aseptic precautions only after elective caesarian section.[39] Placenta obtained after vaginal delivery is not used for this purpose because of the potential for contamination with bacteria from the vaginal tract.
- The obstetrician must place the placenta in a sterile stainless steel 12-inch diameter basin, preferably covered with a sterile lid.[40]

PROCESSING :

- In the clean atmosphere of the operating room or the clean laminar flow workbench, the placenta is cleaned under sterile conditions with balanced salt solution containing a cocktail of antibiotics (50 µg/ml penicillin, 50 µg/ml streptomycin, 100 µg/ml of neomycin as well as 2.5 µg/ml of amphotericin B) thus covering both gram positive and gram negative bacteria as well as fungi.[7] The amnion is then separated from the chorion by blunt dissection.
- The AM can then be used as fresh (without preservation) or as preserved, either by means of cryopreservation (cryopreserved human amniotic membrane, C-HAM) or in a freeze-dried form (dry human amniotic membrane, FD-HAM).[40]

FRESH versus PRESERVED AM :

- The epithelial cells in both fresh and preserved AM are nonviable.[41]Both the tissues are known to be equally efficacious in ophthalmic surgeries.[42]
- Hypothermic conditions for Fresh AM can be provided by refrigeration equipment, from +4°C to +8°C and does not require specialized cryoequipment, thus simplifying short term preservation of a material.[43]
- However, with fresh unpreserved membrane there is an increased risk of communicable diseases in recipients as the mandatory post-donation retesting 6 months later is not done.[42,44]

PRINCIPLES OF SURGERY :

- The main objectives of AMT are ocular surface reconstruction, promotion of epithelialisation, providing symptomatic relief and reducing inflammation. There are three basic principles upon which the final technique is individualized.[44]

1) Inlay or graft technique: It is meant to act as a scaffold for the epithelial cells, which then merges with the host tissue.[45] The AM is secured with its basement membrane or epithelial side up to allow migration of the surrounding epithelial cells on the membrane.
2) Overlay or patch technique: AM is used as a biological contact lens to protect the healing surface defect beneath.[46,47] The membrane is secured with its epithelial side up and it either falls off or is removed.
3) Filling-in or layered technique: In this technique the entire depth of an ulcer crater is filled with small pieces of AM trimmed to the size of the defect.[48] A larger graft is sutured to the edges of the defect in an inlay fashion and an additional patch may help in preserving the deeper layers for a longer duration.[49]

AMT ORIENTATION :

The preferred surgical orientation of the AM on the ocular surface is with the epithelial side up. The stromal surface can be identified by the presence of vitreous-like strands that can be raised with a sponge.[50]

RECONSTRUCTION OF CORNEAL SURFACE :

Non-absorbable suture is used to anchor AMGs to the cornea. A single sheet of AM may be applied as an inlay graft or overlay patch and anchored to the superficial cornea with multiple interrupted/continuous 10-0 nylon monofilament sutures. The size of the graft should be at least 1 mm larger than the defect. The suture knots must be cut short and knots buried in corneal tissue.[3,44]

CONJUNCTIVAL SURFACE RECONSTRUCTION :

The essence of the surgical technique is in adequate dissection and removal of pathological subconjunctival tissue. Vicryl sutures 8-0 or 9-0 or 10-0 are used to anchor AM to the conjunctiva.

In fornix reconstruction to anchor a sheet of AM to the fornix two sets of double armed 4-0 chromic catgut sutures are passed from the AM surface through the fornix.[51,52]

OCULAR SURFACE RECONSTRUCTION :

Extensive ocular surface damage seen in severe grades of chemical injury, Stevens Johnson syndrome (SJS) and ocular cicatricial pemphigoid warrants sequential surface reconstruction. It is important to ensure that all fibrotic tissue is meticulously dissected and removed from the corneal and conjunctival surfaces. A large sheet of AM is placed on the ocular surface and anchored to fornices using multiple interrupted 10-0 vicryl sutures. A continuous encircling 10-0 nylon suture is used to anchor the membrane at the limbus or the peripheral 360^0 cornea.[44]

INDICATIONS OF AMT IN OCULAR SURGERY :

- Conjunctival surface reconstruction
- Pterygium surgery
- Chemical burns
- Cicatrizing conjunctivitis
- Ocular surface squamous neoplasia (OSSN)
- Leaking blebs
- Filtering surgery
- Symblepharon release
- Fornix formation
- Socket reconstruction
- Conjunctivochalasis
- Entropion correction
- Corneal surface reconstruction
- PEDs
- Non-healing stromal ulcers
- Partial LSCD
- Total LSCD
- Bullous keratopathy
- Band keratopathy
- Scleral melt

POST-OPERATIVE COMPLICATIONS :

Post operative complications are very minimal. In literature few complications like infection, dislocation of membrane and early disintegration of the membrane are observed. They are mainly a result of loose or broken sutures, hemorrhage under the membrane or may be problems during processing losing its beneficial effects. To overcome these problems, Tseng et al have devised Prokera which comprises AM attached to a soft contact lens-sized conformer for easy insertion.[53]

LIMITATIONS :

AMT is proved to be effective in ocular surface reconstruction, but it has some limitations. It has shown good stability and healing in corneal perforations less than 3 mm. In corneal perforations more than 3mm AM is helpful only in reducing inflammation and deferring keratoplasty. It is incapable of providing tectonic support. In partial limbal stem cell loss AM is effective but in extensive stem cell loss it is ineffective in replacing stem cells. In these cases, stem cell transplantation is required along with AMT. Successful results of AMT is seen with moist ocular surface, but in severe dry eyes and extensive surface keratinization, AMT fails. Mechanical factors like lid margin pathologies in the form of extensive trichiasis, dystrichiasis, entropion and lid margin keratinization limits healing and graft retention, hence these factors need to be corrected prior to AMT.[3,54]

FUTURE PROSPECTS :

Further non-surgical innovations such as Amniotic Membrane Extract AMX and Prokera have made access to amnion easier than ever before. AMX is a topical application of amniotic membrane extracts.

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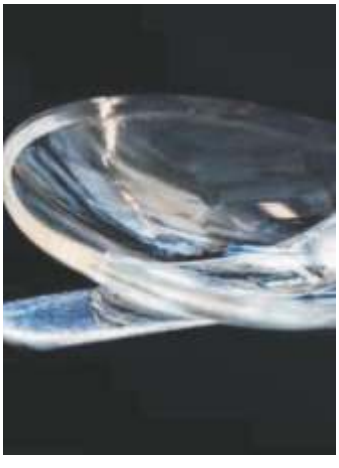
PEEP INS



Researchers have developed an implant made of collagen protein from pig's skin, which resembles the human cornea. In a pilot study, the implant restored vision to 20 people with diseased corneas, most of whom were blind prior to receiving the implant. The study was jointly led by researchers at Linköping University (LiU) and LinkoCare Life Sciences AB, Sweden. The promising results bring hope to those suffering from corneal blindness and low vision by providing a bioengineered implant as an alternative to the transplantation of donated human corneas, which are scarce in countries where the need for them is greatest.

Establishing An Eye Bank

Vijay Bhaisare[1], Shweta Walia[2]

Eye banks recover, prepare and deliver donated eyes for cornea transplants and research. "Recovery" refers to the retrieval of organs or tissues from a deceased organ donor.[1] Recovery is currently the preferred term; although "harvesting" and "procurement" have been used in the past, they are considered inappropriate, harsh, and potentially inaccurate.[2][3] Eye banks are regulated and part of the local health system; they may be attached to a hospital or housed in a separate building.

When an organ/tissue donor dies, consent for donation is obtained either from a donor registry or from the donor's next of kin. An eye bank technician is then dispatched to the hospital, funeral home, or medical examiner's office to recover the donor's eyes. The recovery occurs within hours of the death of the donor. The entire eye (enucleated), or only the cornea is excised in-situ and placed in storage media - Short-term storage media include moist chambers and McCarey-Kaufman (MK) medium which allow for 24 h and 72 hour of storage duration, respectively, Intermediate-term storage media include Optisol-GS, Cornisol, Eusol-C, and Life 4°C, which allow for 10-14 days of corneal tissue storage, Long-term storage media comprise of organ culture medium with 1-month storage period, glycerine with 1 year, and the cryopreservation technique with indefinite duration of corneal storage. The eye tissue is then transported to the eye bank for examination and preparation.

Functions of Eye Bank :

- Provide a round-the-clock public response system regarding Eye Donation Queries over the telephone
- Conduct public awareness programs on eye donation
- Co-ordinate with donor families and hospital patients to motivate eye donation under the Hospital Cornea Retrieval Program (HCRP)
- To recover corneal tissues from Cadavers/Brain dead persons
- To process, preserve and evaluate the collected tissue
- To distribute the corneal tissue in an equitable manner for Keratoplasty
- To ensure safe transportation of tissue to the Keratoplasty Center

Components of Eye Bank :

It has an administrative and medical components. The entire operation is supervised by a Medical Director, who is usually a well qualified corneal surgeon assisted by an Administrator and other staff on the administrative aspects and trained technicians on the medical issues.

The administrative section is responsible for public awareness programmes, liaison with government, local voluntary and other health care agencies and fund raising.

The medical section deals with the entire technical operation of the eye bank. Tissue harvesting, evaluation, preservation and distribution represent these activities. Each of these should be carried out following medical standards of highest quality. Any deviation from accepted medical standards can result in devastating complications. By definition, only organisations with the above structure and functions are "Eye Banks" and all other are mere "Cornea Collection Centres"

Starting up :

The steps to be taken can be grouped into the following categories :

1. Licensing : The legislation Human Organs Transplantation Act (HOTA) '94 was passed by the Central Government in August 1994 .State Organ and Tissue Transplant Organisation (SOTTO), Madhya Pradesh , office is at MGM medical College, Indore. The official email id and contact number are sotto.madhyapradesh@gmail.com and 0731 2527383 respectively . Any organization willing to start eye bank needs to duly fill Form 15 (https://notto.gov.in/WriteReadData/Portal/images/FORM15.pdf) and submit it along with a bank cheque or draft of 10,000 INR to the SOTTO office.

2. Conceptualization / Organizing : A Committee headed by a knowledgeable person, preferably a corneal surgeon, involving influential local business persons, religious leaders, social workers and social work organization must be formed .

One of the first decisions to be made is whether to set up an Eye Bank (EB), or an Eye Donation Centre (EDC), which is affiliated, to a local Eye Bank.

The next decision is 'Location' - Should it be a free separate

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unit or should it be within the premises of an existing hospital or other institutions. The latter location may save some costs, but wherever be the location, it is recommended that it SHOULD NOT BE POSITIONED within the operating radius of any existing EB or EDC.

The other basic inputs which are perhaps the most important -

(1) Permanent long-term supply pool of doctors (min. MBBS qualification as per HOTA '94) for performing surgical eye removal reliably on a 24 hour basis

(2) Social workers to motivate eye donation amongst the public and local hospital wards

1. Drapes, torch, loupe
2. Disposable Syringes (5 ml-1, 10 ml - 1) with disposable needles (21 G & spinal needle) with 2 test tubes or plain vials to collect blood sample.
3. Conjunctival Scissors
4. Corneal scissors (Right & Left)
5. Fixation forceps
6. Iris forceps
7. Spring or Wire Speculum
8. Bard Parker handle with sterile surgical blade (no. 11 or 15)

	Human Resources	
	Eye Banks	**Eye Donation Centre**
Panel of Ophthalmic Surgeons	1 statutory	-
Medical Director	1 statutory	1 desired
Eye Bank Manager	1 statutory	1 desired
Eye Bank Technicians	1 statutory	1 statutory
Social Worker-cum-Health Educator	1 statutory	1 statutory
Driver-cum-Projectionist	2 statutory	1 statutory

Infrastructure	Physical	
	Eye Bank	**Eye Donation Centre**
Space	600 sft.	300 sft.
Slit Lamp	2,00,000	----
Refrigerator	25,000	25,000
Four Wheeler	3,35,000	----
Two Wheeler	----	35,000 (Preferable)
Laminar Flow Hood	2,00,000	----
6 sets of instruments	10,000	10,000
Telephone	6,000 (2)	3,000 (1)
Furniture	1,00,000	15,000
Serological Equipment	3,00,000	----
Autoclave	1,00,000	15,000 (Should have access)
Specular Microscope	12,00,000	----
Total	**24,76,000**	**1,03,000**

3. Funding / Asset building : Following tables give an estimate of infrastructure that is needed to establish EB or EDC

Recovery Instruments Adequate sterile instruments must be available to provide for aseptic retrieval of whole eye or corneas.

Corneal excision set

Enucleation set

1. Torch
2. Disposable Syringes (5 ml-1, 10 ml - 1) with disposable needles (21 G & spinal needle) with 2 test tubes or plain vials to collect blood sample.
3. Conjunctival Scissors

4. Fixation forceps
5. Artery forceps
6. Muscle hook
7. Enucleating spoon
8. Strabismus Scissor
9. Wire or Spring Speculum
10. Bard Parker Handle with sterile surgical blade (no. 11 or 15)

Proper Biomedical Waste Management, Facility for HIV, Hepatitis B and C, Syphilis, COVID-19 testing, record maintenance facility and arrangement for registration of pledges/ donors and maintenance of utilization report should be available.

4. Staffing / Training

Board of Directors- All EBs need to have a board of directors or equivalent committee composed of medical professionals and other professionals who could contribute to the smooth functioning of the organization.

Eye Bank Manager (1) will be responsible for managing the entire operations of the eye bank.

Medical Director (MD) (1) must be an Ophthalmologist who has completed a corneal fellowship or who has demonstrated expertise in external eye disease, corneal surgery, research or teaching in cornea and/or external disease or has an experience in corneal transplantation. If the eye bank does not have such a person it should have a consulting relationship with an ophthalmologist who satisfies the above criteria. All policies and procedures of each eye bank shall be under the supervision of the MD. The Medical Director shall undergo regular continuing education in Eye Banking and related issue. The eye bank shall provide written documentation of such attendance at the time of the eye bank site inspection. A newly appointed medical director shall attend an eye banking symposium/ training within one year of appointment. An eye bank shall have three months to replace a medical director who has resigned.

Eye Bank Technician (2) shall be responsible for the entire activities of eye banking such as retrieval, processing, evaluation, documentation, distribution of tissue and maintenance of the laboratory, instruments and equipment. He / She shall be Higher Secondary or 12th pass qualified with Science or Higher Secondary education with experience in a diagnostic or similar lab or experience in operation theatre procedures. He / she shall undergo training and qualify from designated training centers for Eye Bank Technicians. Training locations are defined in the Transplantation of Human Organs and Tissues Rules, 2014, (Published in Gazette of India, 27 March 2014) (2014 THOTA Rules), as a, “registered, authorized, and functional eye bank or government medical college.”

Eye Donation Counselor (EDC) (2) - He/She shall be responsible for counseling the families at Hospitals and coordinate with eye bank and hospital for retrieval of cornea. He/She shall also be responsible for awareness campaigns regarding Eye Donation, both within the hospital and outside the hospital. Trained Eye Bank Technicians trained in counselling can also perform these duties if the situation warrants.

It is essential that eye bank personnel are abreast of the latest developments in eye banking and corneal transplantation. Each eye bank shall ensure that their personnel are adequately trained and their skills are constantly upgraded. Eye Bank Technicianand Eye Bank Managershall undergo a refresher training module at an eye bank at least once a year.

Training Period for initial recruitment:

EB Technician

- Training period-4-8 weeks depending upon the Eye Bank's volume.
- Each technician should able to perform 15 Enucleationsand Lab excisions and/or 15 in-situ excisions within the time frame.

Eye Donation Counsellor :

· On job Training period 1 month in local language.

· This training period would include both in-house (1 week) and in the field (3 weeks) training components in following aspects: Ocular anatomy (Theory and demonstration). Corneal anatomy and physiology (Theory & demonstration) Corneal blindness (Theory). Corneal transplantation (Theory and Video demonstration). Eye bank and its level of operation (Theory). Corneal excision (Theory & demonstration). Grief counselling (Theory).

If the Eye Bank is being set up by a voluntary organization registered under Societies Registration Act 1860 ,the Government of India offers non-recurring and recurring grants under National Program for Control of Blindness (NPCB) .

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Tips & Tricks of Penetrating Keratoplasty

Sachin Arya

Corneal transplantation has become a very successful procedure due to advances in eye banking, corneal surgery and postoperative treatment.

Proper evaluation of donor cornea is critical to the success of corneal transplantation. Attention must be paid to the cause of death and ocular condition as several general and ocular diseases constitute contraindications for donor corneal usage. Death to enucleation time should be noted. Gross examination and slit lamp biomicroscopy are mandatory for the evaluation of the donor eye while specular microscopy adds another useful dimension to information regarding donor cornea. Specular microscopy of endothelium is a more precise way of evaluating donor cornea. An endothelial count of more than 1500 cells/mm is considered empirically adequate to cover for almost 50% cell loss following corneal transplantation.

BIOMICROSCOPIC EXAMINATION This is the single most important step in the evaluation of donor corneas to assess their viability.

The moist chamber stored tissue is to be examined as early as possible before the corneal edema increases. The tissue is to be thawed to room temperature for the endothelium to function and deturgesce the cornea. All handling of the globe should be done with sterile instruments/cotton tipped applicators. A low magnification is to be used initially to scan the globe for gross abnormalities with a wide slit beam held at 45°. A systemic examination of the anterior segment from the corneal epithelium to the lens is to be carried out with a slit. Epithelial microscytic oedema, defects and debris are to be looked for. Epithelial oedema is indicative of poor endothelial function. Epithelial oedema has to be carefully differentiated from surface irregularity of the epithelium by oblique illumination or retro-illumination techniques.

The corneal stroma is screened for opacities, infiltration, edema and Descemet's folds

For penetrating keratoplasty, no additional preparation is needed after the tissue has been procured. The tissue is sent directly to the surgeon for transplantation . The surgeon can then punch the tissue to the desired size intraoperatively.

DESCRIPTION OF TECHNIQUE

1. Mark the center of the host cornea with a Sinskey hook. Use calipers to measure the corneal diameter to determine the appropriate size for donor trephine.
2. Trephinate the host cornea to approximately 90% depth.
3. Create a paracentesis in the trephination groove or the corneal periphery, and inject viscoelastic into the anterior chamber to preserve anterior chamber depth and stability
4. After using a blade to enter the eye through the trephination groove, resect the host cornea tissue using curved corneal scissors.
5. Trephinate the donor tissue, typically aiming for 0.25 or 0.5 mm larger than the planned host trephination depending on the pathology.
6. In cases of cataractous lens, first remove the cataract cautiously and followed by thorough cortex removal under low irrigation flow , implant intraocular lens (preferably three piece) in the bag.
7. In cases of therapeutic penetrating keratoplasty, thorough removal of infiltrate from anterior chamber, pupillary area, behind the iris and preserve the lens as much as possible. Thorough cleaning of host bed with antibiotics.
8. In cases of dilated and irregular pupil, plan for pupilloplasty to minimize suture related post op astigmatism and photophobia.
9. Peripheral iridectomy should be performed in every case.
10. Secure the donor graft to the host corneal tissue using interrupted and/or running 10-0 nylon equidistant sutures with the help of radial keratotomy marker. Sutures should be taken at 90 % depth of cornea.
11. Rotate the sutures to bury the knots, assess the astigmatism using an intraoperative keratometer, and consider placing additional sutures to reduce astigmatic error.
12. Topical steroid drops and topical antibiotics are continued for month. Topical cycloplegic are given till iritis settled.

The decision to remove sutures in a corneal transplant is is primarily based on clinical judgement. Loose sutures need to be removed as they contribute to immunologic stimulus leading to graft rejection and infection. The timing of suture removal may vary depending on the preoperative pathology and age of the patient. In children, suture removal may be required sometimes as early as one week and in adults with avascular host disease, one may delay suture removal for 12 to 18 months in the absence of other indications. Our preferred method is to cut interrupted sutures at the curve of the suture with a disposable 26-gauge hypodermic needle under slitlamp magnification. The suture is cut on the host cornea and gently teased to facilitate grasping with forceps. With running 10-0

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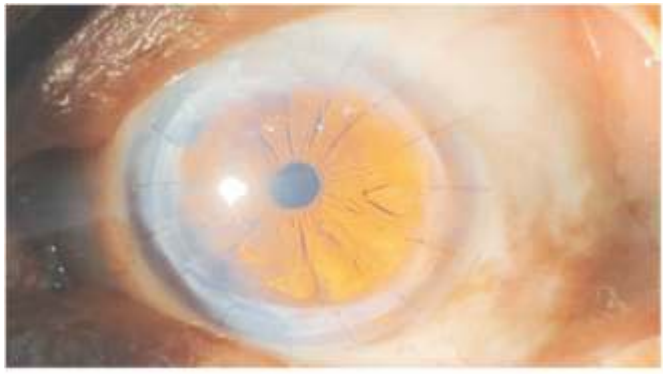

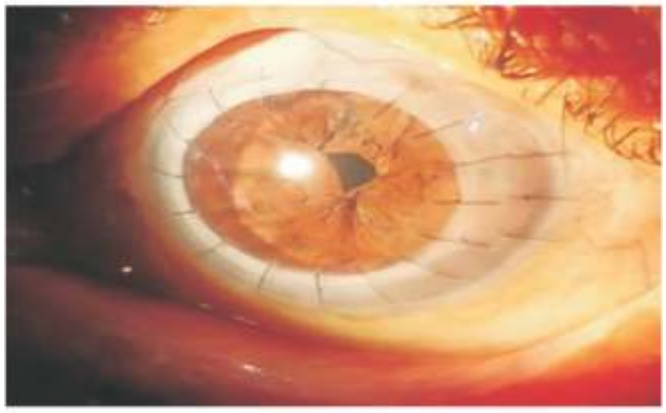

nylon sutures every other loop in the host cornea is first cut, leaving an intact loop that is also grasped in the host tissue and pulled peripherally. It is important that topical antibiotics are instilled for 3 days and the eye is examined 24 to 48 hours after suture removal for epithelial defect, wound override or dehiscence. The dosage of topical steroids should be increased immediately after suture removal and tapered over a 2 to 4 week period.

ADVANTAGES

Minimizing postoperative astigmatism by proper technique of suturing, assessing intraoperative astigmatism with hand held keratometer and pupilloplasty in cases of dilated and irregular pupil.

By thorough removal of infiltrate from anterior chamber, behind the iris , wash the host bed with intracameral antibiotics.

Compulsory peripheral iridectomy in each case lessens the risk of secondary glaucoma.

DISCUSSION

Perforating keratoplasty (PK) has made history as the cornerstone of corneal graft techniques, and as of today, it is still one of the most versatile and adoptable surgical strategy for the treatment of most corneal diseases.[1] Penetrating keratoplasty is an effective treatment for selected corneal disorders, however, appropriate preoperative preparation, operative technique, and postoperative care influence long term outcomes.

Factors affecting postoperative astigmatism are represented mainly by healing processes and the adopted suturing technique.[25] Over the years, several suture techniques have been proposed for this procedure. This has led to a search for the best technique in terms of risk-benefit ratio. Currently, the mainly used techniques are represented by interrupted suture (INT), single running suture (SRS) and double running sutures (DRS).

The fact that the interrupted suture technique leads to increased postoperative astigmatism compared to single running suture or double running suture techniques is widely described in the current literature.[6-8] However, a comparison between the single running and double running suture technique is still controversial. Assil et al state that the double running suture technique induces less astigmatism and leads to faster visual rehabilitation and a steeper cornea.[9]

AUTHOR EXPERIENCE

The better the trephination the easier watertight wound closure is achieved .Inadequately high suture tension to achieve watertight wound closure may deteriorate the regularity of the topography after PKP and delay visual recovery

Typically, keratoconus corneas are larger than Fuchs' dystrophy corneas. Graft size has to be judged by the microsurgeon individually in every single case before recipient trephination to achieve the best compromise between immunologic purposes and optical quality .Donor trephination from the endothelial side results in a smaller donor button than trephine size and convergent cut angles ("undercut") .Recipient trephination results in larger openings than trephine size and divergent cut angles .This discrepancy makes a donor "oversize" of =0.25 mm necessary .Same size grafts are feasible if the donor is created by means of an artificial anterior chamber from the epithelial side . Undersizing the graft for simultaneous correction of myopia in keratoconus is not recommended (watertight wound! irregular astigmatism!)

Major intraoperative determinants for high/ irregular astigmatism after suture removal include : 1. Decentration (donor and/or recipient trephination) 2. "Vertical tilt" (incongruent cut angles between donor and host) 3."Horizontal torsion" (horizontal discrepancy of donor and host shape or asymmetric suturing second cardinal suture!)

Iris reconstruction should be performed in eyes with substantial pupil abnormalities at the time of penetrating

keratoplasty. Pupilloplasty significantly improves graft survival and renders the pupil cosmetically acceptable and may improve visual outcome.10

Full-thickness corneal transplantation in the pediatric population is more challenging and has a higher complication rate than in adults. Careful preoperative, intraoperative, and postoperative protocols for pediatric penetrating keratoplasty (PK) are essential in reducing the risk of surgical complications in children.

CONCLUSION

Proper trephination ,Equidistant suturing, thorough wash of host bed with antibiotics in case of therapeutic keratoplasty , pupilloplasty in required cases, peripheral iridectomy in every case increases the surgical and visual outcome of penetrating keratoplasty.

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Pearls for Corneal Endothelial Keratoplasty

Prashant Bhartiya

Endothelial keratoplasty (EK) has taken over centrestage because of its obvious advantages of faster wound healing, better structural stability, lesser rejection rates and also, faster visual rehabilitation. EK has been constantly evolving and therefore the technique is being refined regularly. This article discusses a few important pearls for EK as the experience with the technique is increasing.

Types of Endothelial Keratoplasty :

1. DSEK (Descemets Stripping EK, manual preparation of the Donor)
2. DSAEK (Descemets Stripping Automated EK, Microkeratome assisted preparation of the Donor)
3. UT-DSEK/ DSAEK (Ultra-Thin DSAEK, Double pass or double dissection of Donor)
4. DMEK (Descemets Membrane EK)

Essential Steps in EK :

1. Descemets Stripping: Removal of the diseased endothelium and Descemets membrane (DM) complex by stripping
2. Donor Preparation: Preparing or harvesting the donor lenticule or DM along with the endothelium
3. Donor insertion and Placement: Inserting the Donor lenticule or DM into the anterior chamber, unfolding and centration of graft
4. Air injection: Attaching the graft to the host stroma with air

Patient Selection :

The usual indications for EK are -

1. Pseudophakic/ Aphakic Bullous keratopathy (PBK/ABK)
2. Fuchs Endothelial Dystrophy (FED)
3. Failed Corneal Grafts
4. Endothelitis / Toxic Anterior Shock Syndrome (TASS)
5. Iridocorneal endothelial Syndrome (ICE) / Congenital Hereditary Endothelial Dystrophy (CHED)

EK is indicated in corneal endothelial dysfunction where the host stroma is not scared/opacified. Certain ocular & systemic issues need to be ruled out before selecting a patient for EK.

Most important ocular feature to be noted is the health of the corneal stroma. Past history of ulceration leading to scarring can lead to poor visual out comes. Other ocular features which can prejudice the success of an EK are shallow AC (less than 2mm), presence of an AC IOL or a mal-positioned IOL, absence of an intact lens iris diaphragm like a large iris defect communicating the anterior chamber with posterior chamber.

Systemically, in addition to a medical fitness for surgery under local or general anaesthesia, the ability to lay down supine for prolonged periods needs to be ascertained.

Pearls for stripping the DM :

1. Use side port rather than main port for stripping (with narrow inner entry)
2. Mark the circumference with an 8.0 mm trephine to guide the reverse sinskey
3. Do not disturb stroma, avoid excessive pressure over stroma as indicated by whitening.
4. Try to complete the circumferential scoring in a single circular movement.
5. Strip in a well-maintained chamber

a. AC Maintainer: can cause too much flow

b. Air: gives good contrast but needs repeated refilling

c. Viscoelastic: good chamber stability but needs to be removed thoroughly before graft insertion

6. Diameter of stripped area should be larger than donor size in DMEK as DM will not stickon DM.

Role of Peripheral Iridotomy (PI) :

An inferior PI, to prevent pupillary block, is a useful step in all cases, especially so in DMEK, where a relatively full anterior chamber fill with air is required. PI can be done manually with a small peripheral entry and a pick& snip with toothed forceps and vannas scissors (parallel to the limbus) at 6 o'clock and sutured. Alternatively, a vitrector from the main port or the superior side port can be used.

Wound Architecture :

Main tunnel : Preferably temporal. Although clear corneal tunnels can be made, a relatively posterior groove and tunnel is preferable.

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Side ports : As long as possible with small width (to ensure better watertightness) and peripheral entry into AC to avoid nudging the graft while entering.

Donor Preparation :

1. Donor Characteristics

a. Age : Avoid tissues from donors less than 40 years for EK. Prefer older donor for DMEK as DM is more adherent in younger donors.

b. Cell counts : at least 2200cells/mm2 for DSEK and 2500cells/mm2 or more for DMEK.

c. Peripheral scleral rim : at least 3mm wideand regular rim is needed for fitting in the artificial anterior chamber (AAC). This is not needed for DMEK

d. Diabetesin the Donor : Avoid for DMEK as possibility of adhesions are high

2. Preferably prepare donor first for EK and have a backup tissue for PK if required.
3. DSEK

a. Do not over-pressurize the AAC, this increases chance of perforations

b. A small air bubble in AAC helps in better judgement of the depth of dissection

c. Initial groove of 400 microns for tissues in cornesol/optisol and of 450 microns for tissues in MK medium.

d. Dissect in a single direction and upto the limbus for a uniform interface.

e. Definitely place a mark on the donor lenticule before punching it.

4. DMEK

a. Stain the DM with trypan blue multiple times for better visibility

b. Stamp and mark before stripping completely.

c. Use the SCUBA (Submerged Cornea Using Backgrounds Away) technique to avoid tears due to surface tension.

d. Do not disturb the stroma (use blunt dissectors)

e. Separate the DM circumferentially for 360° from the stroma before starting to strip

Donor Insertion :

· DSEK

1. For quick and easy insertion use needle or forceps to directly place graft
2. For more controlled insertion use the suture pull through technique or Busin's glide along with intraocular forceps.
3. Essential to close or remove the AC maintainer just before releasing the graft inside the AC, otherwise the graft may be expelled out
4. Immediately suture the main tunnel after insertion
5. Fill with BSS to centre and open any folds

· DMEK

1. Short bursts of fluid through the cartridge to push the donor DM into the AC
2. Always keep an eye on the main tunnel to prevent loss
3. Remove the AC Maintainer before inserting
4. Close the wound immediately after insertion

Graft Unfolding and Centring :

DSEK : Inflate the AC with BSS, Place cannula between the taco fold, depress posterior lip to shallow the AC and then fill air to open up graft from below. Roll and tapping of cannula over the cornea can help in centration of graft.

DMEK : Various fluid wave patterns are created by different manoeuvres to help in unfolding and centring the DM.

i. Tap with cannula on top (centre)

ii. Fluid egress from side port

iii. Fluid gush into the AC from side port

iv. 2 cannulas : one to press and hold DM between cornea and iris and the other cannula to tap to unfold with fluid wave.

v. Use small air bubble under the DM as a third hand

Confirm Orientation :

i. Use of Marks (S/F/P)

ii. Double ring sign with air in DSEK

iii. Direction of double scroll in DMEK

Air Injection :

i. Place sutures on all large wounds

ii. Try to obtain a complete air fill in a steady fashion.

iii. Use bud at side port to trap air

iv. DSEK : After 10 to 15 minutes of complete air fill, pupil is dilated fully and air is left filling at least two thirds of the AC.

v. DMEK: Near total air fill, left for at least 2 hours and may not be deflated at all unless causing pupillary block.

Post operative issues :

1. Positioning: important for the patient to lay down supine for at least 2 hours post operatively and then maintained for 24 to 48 hours with breaks only for toilets or food.
2. Pupillary block: Intraocular pressure rise may occur if there is a pupillary block. This can be relieved with full pupillary dilation, mannitol and supine positioning. If not, thenburping some air out from the side port may be

necessary.

3. Re-bubbling: Need for re-bubbling is usually more in DMEK rather than DSEK. Use of Venting incisions in DSEK can help in removing fluid from interface especially if air is not staying in for long enough. Preoperative counselling must include discussions on need for re-surgery.

Selecting DSEK vs DMEK :

DSEK has a flatter learning curve for graft preparation, insertion and positioning. Since the donor lenticule is thicker, its handling and visibility is better even through relatively hazy corneas. DMEK gives an advantage of quicker recovery and is more likely to get a visual acuity of 6/9 or better when compared to DSEK. Theoretically, DMEK has less chances of graft rejection.

DSEK is to be preferred over DMEK in patients where the air bubble cannot stay in the anterior chamber for long (deficient lens-iris diaphragm in large iris defect, aphakia, distorted IOL) or presence of a glaucoma shunt or a trabeculectomy) or if the patient is unable to maintain a supine position for long (patients with spine/neck problems or back pain).

Good patient selection and preoperative counselling along with a standardized intraoperative technique and good post operative monitoring should ensure a successful EK.

Retionopathy of Prematurity : Review of Epidemiology & Classification

Dipty Shah[1], Pratik Mahajan[2]

Abstract :

Retinopathy of prematurity (ROP) is among the most common causes of childhood blindness. Three phases of ROP epidemics have been observed worldwide since ROP was first described in the 1940s. Despite advances in neonatal care, the occurrence of ROP and associated visual impairment has been increasing and remains difficult to control. Conventional treatment options for preventing ROP progression include retinal ablation using cryotherapy or laser therapy. With the emergence of anti-vascular endothelial growth factor (anti-VEGF) treatment for ocular diseases, the efficacy and safety of anti-VEGF therapy for ROP have recently been actively discussed. In the advanced stage of ROP with retinal detachment, surgical treatment including scleral buckling or vitrectomy is needed to maintain or induce retinal attachment. At this stage, the visual outcome is usually poor despite successful anatomical retinal attachment. Therefore, preventing ROP progression by timely screening examinations and treatment remains the most important part of ROP management

Introduction :

Retinopathy of prematurity (ROP) is a leading cause of childhood vision loss worldwide.[1] Approximately 32,300 infants worldwide are diagnosed with irreversible vision impairment due to ROP annually, of which approximately 20,000 become blind or severely visually impaired.[2] Despite significant advances in neonatal care, the worldwide number of infants with ROP has been increasing as the survival rate of premature babies has increased. While much progress has been made in research into the pathophysiology and treatment of ROP over the past few decades, its occurrence and the resulting blindness remain problematic.

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To prevent the acquired childhood blindness caused by ROP, it is important to understand its epidemiology and develop appropriate treatment plans. This review addresses recent epidemiology and treatment strategies for ROP.

Epidemiology :

Since it was first described in 1942,[3,4] ROP has become recognized as the primary cause of childhood blindness. Historically, there have been global tri-phasic epidemic periods of ROP and ROP-induced blindness.[5]

1. Three phases of ROP "epidemics" :

The first epidemic was observed in the late 1940s and early 1950s, when ROP occurred due to unrestricted oxygen use without adequate monitoring.[3,4] The second epidemic started in the late 1960s and early 1970s when the survival of smaller, less mature infants increased with numerous advances in neonatal care in industrialized countries with well-developed neonatal units. Advances in technology to control the environmental conditions of premature infants have improved the survival of extremely premature infants. In the early 1990s, it became apparent that an epidemic of ROP blindness was emerging in middle-income countries with developing neonatal intensive care, referred to as the third epidemic .

The incidence of ROP in India is reported to vary between 38 – 51.9 % in low birth weight infants.[1-3] Out of the approximate 26 million annual live births in India, approximately 8.7% of newborns in India are < 2000 grams[4] in weight.[6] This would imply that almost 2 million newborns are at risk for developing ROP. ROP evolves over 4-5 weeks after birth. This relatively slow evolution gives a small window of opportunity to effectively conduct retinal examinations and timely interventions to improve visual outcome and avoid irreversible blindness due to retinal detachment from progressive untreated ROP.

Pathophysiology :

The development and progression of ROP are characterized by abnormal neovascularization, which typically occurs in 2 postnatal phases.[7] In the first phase, immediately after birth up to 32 weeks' postmenstrual age, normal vascular growth in the retina stops due to hyperoxia, which is referred to as

"oxygen toxicity."[8] In premature infants, even room air leads to a hyperoxic environment compared to the intrauterine environment;[9] moreover, oxygen supplement in cases with respiratory distress worsens this hyperoxia. Hyperoxia causes both cessation of retinal vessel growth and partial regression of existing vessels in this phase.[10] The second phase follows with hypoxia-induced pathological vasoproliferation.[8] Incomplete vascularization causes the retina to become hypoxic, leading to the release of various angiogenic factors including VEGF and erythropoietin and subsequently to neovascularization, leading to intraocular fibrosis and retinal detachment.[7,8]

Classification :

Now, a third revision, the International Classification of Retinopathy of Prematurity, Third Edition (ICROP3), is required for several reasons. First, certain components of the ICROP are subjective and open to interpretation. Second, innovations in ophthalmic imaging have occurred. Third, introduction of anti–vascular endothelial growth factor (VEGF) therapy has presented new challenges associated with recognition of clinical features characteristic of post-treatment regression and reactivation.

Each eye should be classified using the following examination parameters, defined in this article: zone, plus disease, stage, and extent. If aggressive ROP (A-ROP) is present, it should be noted.

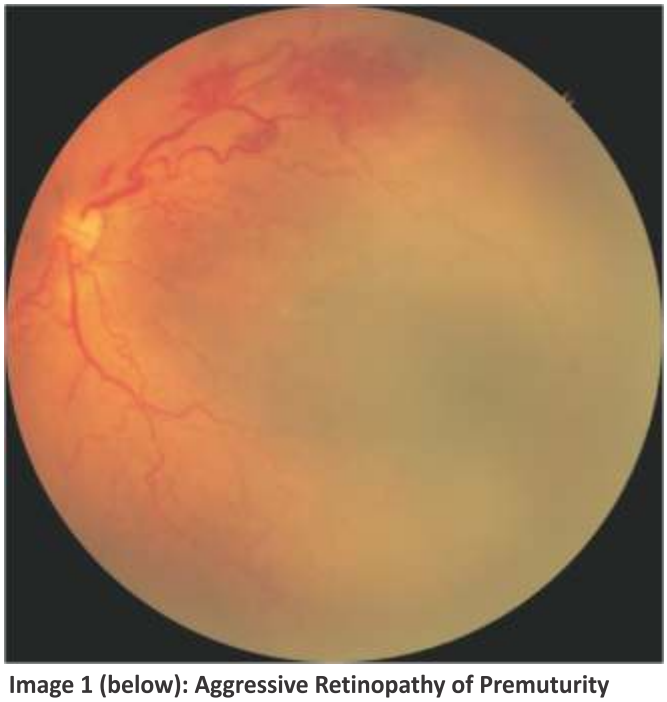

Image 1 (below): Aggressive Retinopathy of Premuturity (AROP) in a 1200 g baby .Image Courtsey: Macretina Hospital

Location of Vascularization : Zone

Retinal vascularization commences around the thirteenth week of gestation, proceeding centrifugally from the peripapillary region to the peripheral retina, which is fully vascularized by approximately term.

The location of retinal vascularization provides an indication of infant maturity and risk of ROP developing. The developing vasculature is lobular and closer to the optic disc nasally than temporally, but as a practical matter, the state of vascularization (i.e., the zone) is recorded as circles with the optic disc at the center.

Three concentric retinal zones are centered on the disc and extend to the ora serrata (Fig 1). The location of the most posterior retinal vascularization or ROP lesion denotes the zone for the eye. The most posterior region, zone I, is defined by a circle with radius twice the estimated distance from the optic disc center to the foveal center. Zone II is a ring-shaped region extending nasally from the outer limit of zone I to the nasal ora serrata and with a similar distance temporally, superiorly, and inferiorly. The committee defined a region of 2 disc diameters peripheral to the zone I border as posterior zone II to indicate potentially more worrisome disease than ROP in the more peripheral zone II .

The committee introduced the term notch to describe an incursion by the ROP lesion of 1 to 2 clock hours along the horizontal meridian into a more posterior zone than the remainder of the retinopathy. When present, this should be

Image 2 (below): Notch as defined in ICROP-3 .Image Courtesy: Macretina Hospital

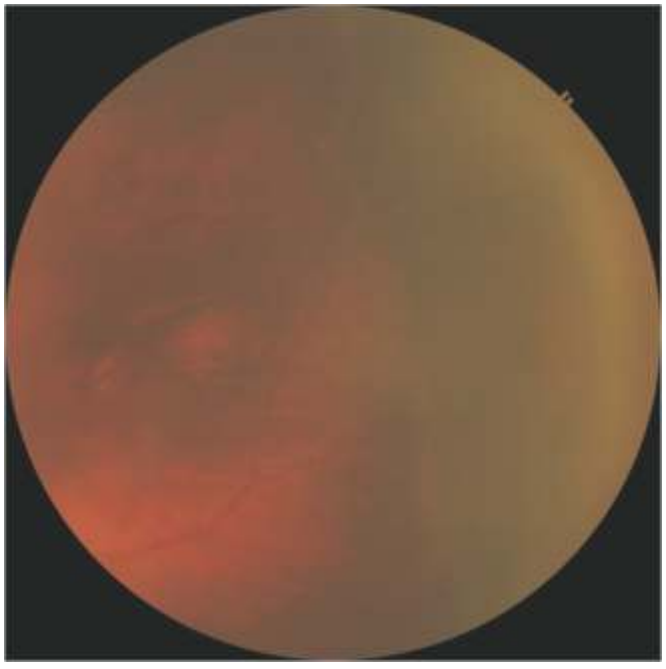

Image 3 (below) Stage2 ROP Image Courtesy: Macretina Hospital

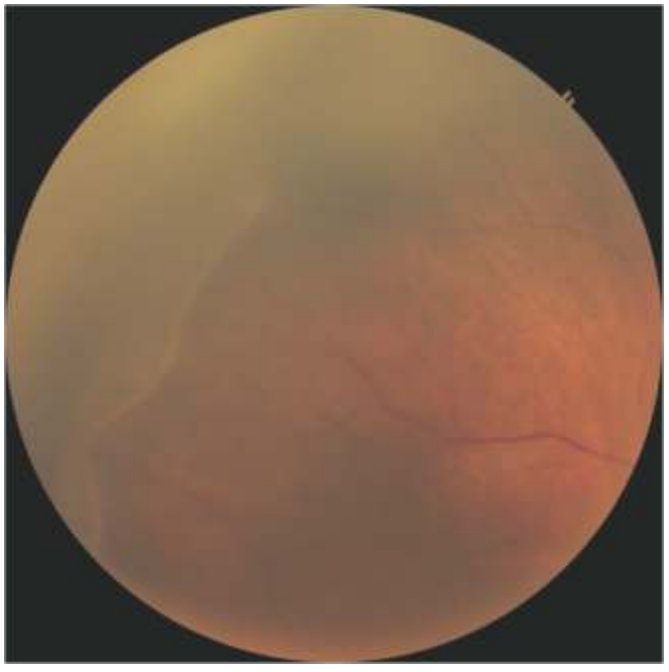

Image 4: below Stage 3 ROP.Image Courtesy: Macretina Hospital

recorded by the most posterior zone of retinal vascularization with the qualifier "secondary to notch" [Image 2]. For example, ROP in zone II in most places, but with a temporal notch extending into zone I, should be noted as "zone I secondary to notch," thereby distinguishing it from an eye in which most disease is present in zone I.

Zone III is the residual crescent of peripheral retina that extends beyond zone II.

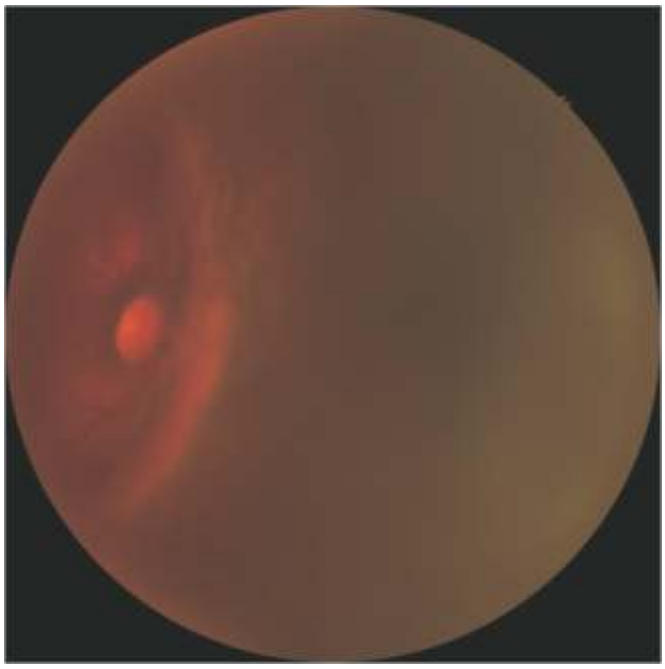

Image 5 (below): Stage 4a ROP .Image Courtesy: Macretina Hospital

Practically, the temporal extent of zone I may be estimated using a 28-diopter (D) lens. For example, by placing the nasal edge of the optic disc at one edge of the view, the limit of zone I is approximately at the temporal edge of the view

Plus and Preplus Disease :

In the ICROP 2005, preplus disease was defined to represent retinal vascular dilation and tortuosity that is abnormal, but insufficient for plus disease.

Of note, the original ICROP description of plus disease in 1984 included features of vascular engorgement of the iris, poor pupillary dilation, and peripheral retinal vascular engorgement with vitreous haze, which are now recognized as signs of advanced disease but are not necessary for plus disease diagnosis.

The committee recommends that the plus disease spectrum be determined from vessels within zone I, rather than from only vessels within the field of narrow-angle photographs and rather than from the number of quadrants of abnormality .

The terms preplus and plus should continue to be used, but the committee emphasizes that these terms represent a continuous spectrum of retinal vascular changes.

Stage of Acute Disease (Stages 1–3) :

In the developing premature infant, the retina is vascularized incompletely .When no ROP lesion is present, the Committee suggests using the term incomplete vascularization, accompanied by the zone of vascularization (e.g., "incomplete

vascularization into zone II"), rather than using terms such as no ROP or immature retina. When acute ROP vascular features develop at the junction of vascularized and avascular retina, the term stage is used to describe the appearance. If more than 1 ROP stage is present in the same eye, the eye is classified by the most severe stage.

Stage 1: Demarcation Line

The demarcation line is a thin structure at the vascular–avascular juncture, which is relatively flat and white, lies within the plane of the retina, and may be associated with abnormal branching of vessels posterior to the line. Dilatation and tortuosity of peripheral retinal vessels at the vascular–avascular juncture alone are insufficient for diagnosis of stage 1 disease.

Stage 2: Ridge

The hallmark of stage 2 ROP is a ridge with width and height that evolve from the demarcation line . The ridge may vary in height and its color may appear to range from white to pink. Small isolated tufts of neovascular tissue lying on the surface of the retina, commonly called popcorn, can be seen posterior to the ridge but do not constitute stage 3 disease.[Image 3].

Stage 3: ExtraretinalNeovascular Proliferation

In stage 3 ROP, extra retinal neovascular proliferation extends from the ridge into the vitreous and is continuous with the posterior aspect of the ridge, causing a ragged appearance as proliferation becomes more extensive.[Image 4]

Aggressive Retinopathy of Prematurity :

Aggressive-posterior ROP was added to the ICROP in 2005 to describe a severe, rapidly progressive form of ROP located in zone I or posterior zone II.

Previously known as Rush Disease, it may have been the florid acute ROP seen in the 1940s.[1]

The Committee recommends use of the new term aggressive retinopathy of prematurity (A-ROP) to replace aggressive-posterior ROP .[Image 1]

The hallmark of A-ROP is rapid development of pathologic neovascularization and severe plus disease without progression being observed through the typical stages of ROP.

Retinal Detachment (Stages 4 and 5) :

Acute disease and its regression are not always demarcated clearly. This is particularly apparent in retinal detachment, where both may occur simultaneously.

Stage 4: Partial Retinal Detachment

Stage 4 describes partial retinal detachment, which either spares [stage 4A][Image 5]or involves [stage 4B] the fovea.

Stage 5: Total Retinal Detachment

Total retinal detachment is designated as stage 5. The Committee now recommends that total detachment be sub categorized into 3 configurations:

stage 5A, in which the optic disc is visible by ophthalmoscopy, suggesting open-funnel detachment; stage 5B, in which the optic disc is not visible secondary to retrolental fibrovascular tissue or closed-funnel detachment and stage 5C, in which findings of stage 5B are accompanied by anterior segment abnormalities (e.g., anterior lens displacement, marked anterior chamber shallowing, iridocapsular adhesions, capsule-endothelial adhesion with central corneal opacification, or a combination thereof; suggesting a closed-funnel configuration).

Extent :

Extent of disease is classified using 30° sectors with boundaries along clock-hour positions.

Regression, Reactivation, and Long-Term Sequelae

Regression

Patterns of acute-phase regression in ROP differ between spontaneous regression and those occurring after treatment.

The first visible signs of regression are typically vascular and tend to occur more rapidly after anti-VEGF therapy (as early as 1–3 days) than after laser photocoagulation (approximately 7–14 days) or during spontaneous regression

These signs include decreased plus disease, where components of vascular dilation and tortuosity may become uncoupled (e.g., after anti-VEGF injection, reduced vessel dilatation can occur before reduced tortuosity, which may or may not occur), and vascularization into peripheral a vascular retina, which can occur spontaneously or after anti-VEGF treatment. Other clinical signs of regression include involution of tunica vasculosalentis, better pupillary dilation, greater media clarity, and resolution of intraretinal hemorrhages.

Regression of the ROP lesion is characterized by thinning and whitening of neovascular tissue. After spontaneous or treatment-induced regression, vascularization into the peripheral avascular retina can be complete or incomplete, the latter being termed persistent avascular retina. Persistent avascular retina should be described by its location (e.g., posterior zone II) and extent (e.g., nasal).

Reactivation :

Signs of reactivation range from development of a new self-

limiting demarcation line to reactivated stage 3 with plus disease.

Vascular changes in ROP reactivation include recurrent vascular dilation, tortuosity, or both, similar to acute-phase preplus or plus disease. Extra retinal new vessels can occur and may be relatively delicate compared with those of acute ROP, making them difficult to visualize. Hemorrhages can occur around fronds of extraretinal vessels. Alternatively, extra retinal vessels may appear as a fibrovascular ridge, which may progress to fibrosis, contraction, and tractional detachment.

Documentation of reactivation should specify presence and location(s) of new ROP features, noted by zone and stage using the modifier reactivated.

Long-Term Sequelae :

- Late tractional, rhegmatogenous, or, rarely, exudative retinal detachments
- Retinoschisis
- Persistent avascular retina -Avascular retina is prone to retinal thinning, holes, and lattice-like changes and may be associated with retinal detachments later in life.
- Macular anomalies including smaller foveal avascular zone and blunting or absence of the foveal depression
- Retinal vascular changes - These may include persistent tortuosity, straightening of the vascular arcades with macular dragging, and falciform retinal fold. Abnormal nondichotomous retinal vessel branching, circumferential interconnecting vascular arcades, and telangiectatic vessels occur frequently. Vitreous hemorrhage may occur.
- Glaucoma - Eyes with history of ROP can demonstrate secondary angle-closure glaucoma later in life.

Conclusion :

Understanding of disease pathophysiologic features and clinical management of ROP have evolved with advances in science, technology, and the art of medicine. Since the ICROP publication in 2005, some specific advances have involved neonatal care, anti-VEGF therapy, ophthalmic imaging, machine learning, and pediatric vitreoretinal surgery. This article updates ROP classification in response to those advances by integrating review of evidence-based literature with expert consensus opinion. The ICROP3 has maintained many existing classification metrics, while refining and adding others such as revised classification metrics (e.g., posterior zone II, notch, subcategorization of stage 5, and recognition of a continuous spectrum of vascular abnormality while maintaining the terms preplus disease and plus disease), the definition of A-ROP to replace aggressive-posterior ROP, and the definition of nomenclature representing ROP regression and reactivation. These principles will provide a foundation for improving research and clinical care in the future.

Nevertheless, the ICROP3 simply marks a point in the journey toward improving ROP care and outcomes. We hope this will lead to increased understanding of acute-phase ROP, its regression, and its reactivation. Areas in need of additional research include methods for quantifying vascular changes, including rate of disease progression; characterizing clinical findings using other imaging methods (e.g., fluorescein angiography, OCT); understanding long-term risks of Peripherel Avascular Retina; and elucidating signs and timing of ROP reactivation. Further collaboration with other caregivers and investigators will improve the quality and standardization of ROP care worldwide.

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We hereby declare that the consent of the parents have been taken for the use of retina images for academic and research purposes .The anonymity of the babies have maintained.

Fuchs Uveitis Syndrome

Deepanshu Agrawal[1], Shirali Gokharu[2]

Abstract :

Fuchs Uveitis Syndrome is considered a low grade, chronic uveitis which is usually asymptomatic or there might be complaints of blurring of vision or floaters. Patient typically presents with a 'white eye'. Fuchs Uveitis Syndrome is an under diagnosed entity. This low grade inflammation usually persists, even after treatment with topical steroids and that's how these patients keep getting treated commonly. However, the ideal measure is to observe these patients and treatment is only when surgery is required for either cataract or medically uncontrolled glaucoma.

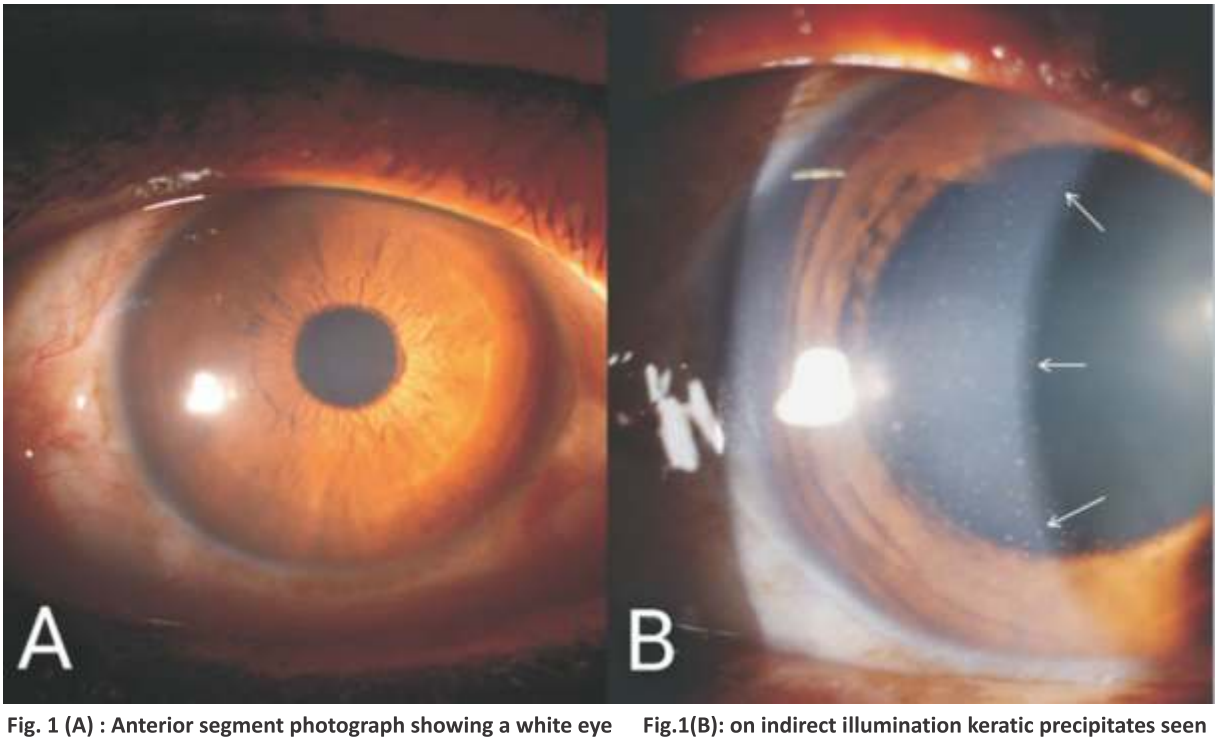

Fig. 1 (A) : Anterior segment photograph showing a white eye with no congestion and cornea under direct illumination

Fig.1(B): on indirect illumination keratic precipitates seen diffusely present over endothelium (white arrows)

A 45-year-old gentleman presented with complaints of blurring of vision in the right eye (OD) since 6 months. There was no prior history of trauma,pain or redness (Figure 1A). Best corrected visual acuity 20/20, N6 and IO was 12 mm Hg in OD. There were stellate keratic precipitates diffusely present over endothelium; (Figure 1B) anterior chamber reaction was grade 1+, with no posterior synechiae and a clear lens. Few freely mobile membranes in the vitreous cavity were noted; rest of the fundus appeared clinically unremarkable. Patient was diagnosed to have Fuchs Uveitis, based on clinical features.

Fuchs Uveitis Syndrome is a chronic, unilateral, low grade inflammation, predominantly involving the anterior uvea and vitreous.[1] Patient usually has no typical symptoms of pain and redness and often presents with complaints of blurred vision or floaters. There can be associated vitreous membranes, with normal retina and choroid. These patients be counselled for just observation and regular follow ups as this low grade inflammation persists despite treatment.[1] Surgical treatment can be catered if there is any evidence of significant cataract or medically uncontrolled glaucoma. Implantation of an intraocular lens is a justified procedure as it does not constitute an additional risk.[1,2]

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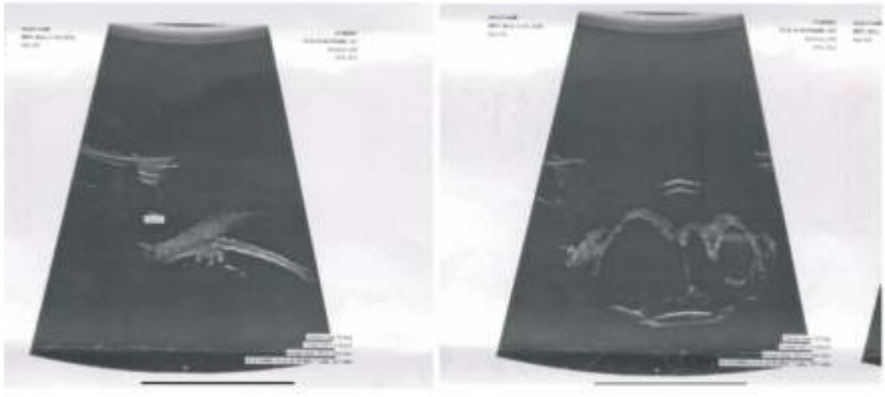
Photo Essay
A Case of Recurrent Iris Cyst

Prateek Tiwari

CASE REPORT :

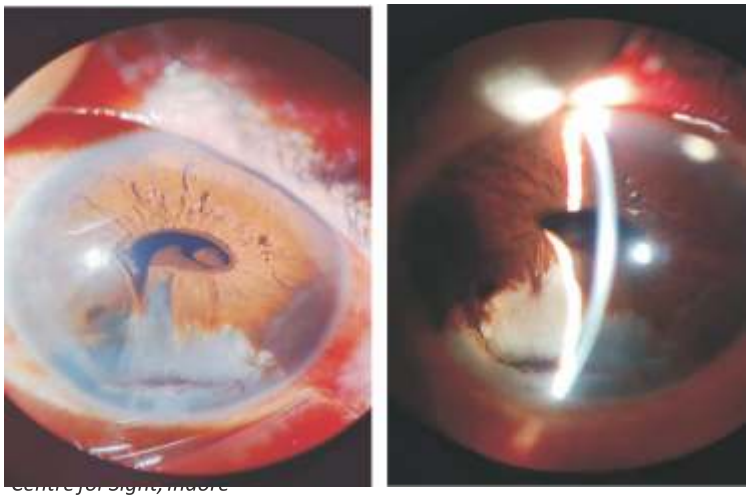


A 43 year old male referred with the complaint of glare, diminution of vision in his right eye after trauma from the last two years. On examination his best corrected visual acuity(BCVA) was 6/6(p) along with a translucent loss of iris pigments from 5 o'clock to 8 o'clock and ovalisation of pupil. The intraocular pressure(IOP) was normal. The pupillary reflexes were present in both the eyes and fundus examination was normal. Normal NCCT head and orbit ruled out any bony injury or intraocular foreign body. He underwent cyst excision and alcohol injection twice in his 1 right eye elsewhere.

The ultrasound biomicroscopic imaging(UBM) shows a well defined cystic mass arising from the iris stroma with multiple septae. Irido-corneal touch was noted from 3-9 o'clock. Pupillary extension was noted but there was no extension into the posterior cham ber.

Patient was given the option of brown tinted contact lenses and was asked to follow up 6 monthly to keep a check on IOP. Patient refused contact lenses and was lost to follow up.

An iris cyst is an epithelial-lined space that involves a layer of the iris. A primary iris cyst does not have a recognisable etiology. A secondary iris cyst has a recognizable etiology, such as surgical or nonsurgical trauma.[4]



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Iris cysts that are stable and not causing symptoms or secondary complications require no treatment but should be followed regularly. Iris cysts that involve the visual axis, particularly in children at risk for amblyopia, necessitate intervention.[5] Surgical management involves Argon laser photocoagulation of the cyst epithelium which results in halting of the production of cystic fluid contents. Nd-YAG photodisruption results in laser cystotomy. Cyst aspiration with injection of sclerosing agent is a promising treatment with low recurrence rates.However,if the recurrence occurs then the process can be repeated.[6]

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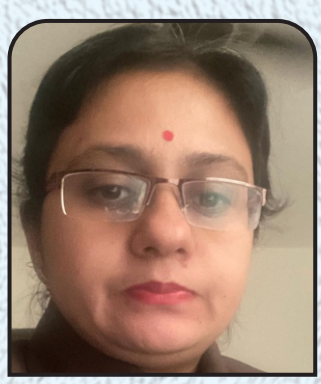

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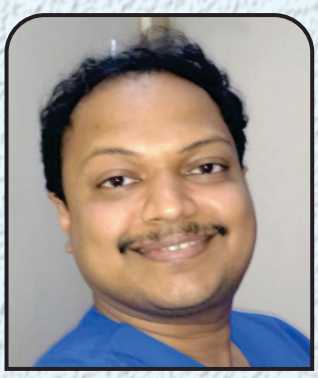

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