

# AFFECTIONS OF CORNEA IN ANIMALS

## Anatomy and physiology:

- Anterior 6<sup>th</sup> part of the outer layer of the eyeball and the rest is sclera.
- The transition area between cornea and sclera is called **limbus**.
- Cornea is avascular and transparent with diameter of about 15-16mm in dogs.
- **The cornea is composed of 5 layers:**
  1. **Anterior epithelium:** The outermost layer containing several layers of squamous columnar and polyhedral cells.
  2. **Anterior limiting membrane:** Also known as '**Bowman's membrane**' and is structure less non-elastic tissue.
  3. **Stroma:** Constitutes 90% of the cornea and contains connective tissue cells and collagen fibrils which interlace, forming lamellae that are united by fixed cells and nerve fibers and lymph vessels occupy area between the lamellae.
  4. **Posterior limiting membrane:** Also known as '**Descemet's membrane**' and is structure less elastic membrane.
  5. **Posterior epithelium (Endothelium):** Innermost layer and is in contact with aqueous humor. It is composed of single layer of mesothelial cells. Posterior limiting membrane and endothelium continue with iris and ciliary body.
- The cornea being avascular, receives its nutrition from superficial marginal plexus, lacrimal secretions and aqueous humor.
- The long ciliary sensory nerve (ophthalmic) supply cornea.
- Under normal circumstances the cornea is dehydrated and when excess fluid enters cornea, it becomes opaque as corneal stroma has marked affinity for water. The endothelium and epithelium control the water content of cornea. Minimal damage of endothelium immediately results in the oedema of cornea i.e. corneal opacity.
- The cornea consists mainly of proteins with collagen in greater concentration. These proteins help to prevent the penetration of acid burns due to precipitation.
- All the layers of cornea are capable of spontaneous regeneration except Descemet's membrane which depends upon endothelium for regeneration.

## AFFECTIONS OF CORNEA:

1. **Dermoid:** Congenital embryological defect characterized by cutaneous growth with hair follicles involving cornea alone or both cornea and conjunctiva.

## Treatment:

- Superficial keratectomy with complete excision of the dermoid is done under

general anaesthesia normally at later stage of the life (3 months of age).

- Topical antibiotic ointment for 12-15 days or more postoperatively

1. **Microcornea:** Rarest congenital condition and is normally associated with microphthalmia
2. **Megalocornea:** Abnormally large cornea results from the development defects of the filtration area of the chamber angle.
3. **Coloboma:** Congenital defect in the cornea mostly seen near the limbus and is associated with scleral Coloboma.

4. **Corneal erosions:**

- Erosions of cornea result from mechanical factors or chemicals like soap.
- Lesions mostly affect the epithelium of cornea.
- Clinical signs include pain, photophobia, loss of corneal luster and blepharospasms.
- Lesions normally heal by it self.
- Protective ophthalmic antibiotic ointments with corticosteroids can be used.

6. **Keratitis:** Inflammation of cornea constituting the highest incidence of corneal diseases.

- Most common condition in certain brachycephalic breeds of dog like Pekingese, Pug, and Boston terrier because of prominent eyes.
- Etiological factors are almost same as for conjunctivitis.
- May be associated with certain systemic diseases like infectious canine hepatitis, canine distemper etc.

**Symptoms/clinical signs:** One or more of the following signs may be seen:

- **Loss of transparency:** May be partial or complete and may result from either change in the water content of cornea causing oedema or from inflammatory exudates due to leucocyte infiltration. This is also known as corneal opacity which can have three stages depending upon the severity:
  1. **Nebula:** Slight blurring (light cloudiness).
  2. **Macula :** More dense (Moderate cloudiness).
  3. **Leucoma:** Very dense (well marked opacity or cloudiness).
- **Ciliary Injection:** The circumcorneal vessels, which are derived from the anterior ciliary vessels, become engorged.
- **Vascularization:** Although avascular, but to increase its defense to the irritants in pathological conditions, there is augmentation of normal circulation (ciliary injection) and thereafter actual invasion of cornea itself with newer vessels occur. This is also known as "**Pannus**". Vascularization is seen in most of the corneal diseases. The vascularization can be **superficial vascularization** or **deep vascularization**. The superficial vessels run directly under the epithelium and are in continuation with bulbar conjunctival vessels. The deep vessels are derived from the ciliary vessels and are darker purple in color and are arranged in straight lines or

brush-like clumps.

- **Cellular deposits and increased protein in aqueous humor:** This develops due to involvement of iris and ciliary body. This is reflected as slight deposition or hypopyon (pus in the anterior chamber).
- **Corneal ulceration:** Deep or superficial and may be spreading or stationary. Can be detected best with *Flourescein dye* which gives green color to the ulcerated area.
- **Subjective symptoms:** These include pain, photophobia, Epiphora and blepharospasms.

### *Classification of keratitis*

#### 1. **Superficial without vascularization:**

##### a. **Superficial punctate keratitis:**

- May be unilateral but is often bilateral.
- Confines to the anterior epithelium and sub epithelial layer of cornea.
- There is coarse or faint corneal opacity.
- Corneal vascularization in long standing cases only.
- Mostly seen in Dachshunds and Poodles.
- Not a common disease.

##### **Treatment:**

- Topical corticosteroids with antibiotics are helpful but opacities regress within few months without any treatment.
- Superficial keratectomy under suitable anaesthesia to remove the affected part is successful in some cases.

##### b. **Corneal erosion syndrome:**

- Erosion of cornea occurs following trauma.
- Mostly occurs due to separation of the basement membrane.

##### **Treatment:**

- Careful stripping of the overhanging epithelial edge after staining it with Flourescein dye.
- Topical antibiotics ointments with corticosteroid.

#### 1. **Superficial with vascularization**

##### a. **Vascular keratitis (Pannus):**

- Characterized by formation of capillaries between the epithelium and the anterior limiting membrane (sub epithelial vascularization), chronic form of superficial keratitis.
- Most commonly seen in German shepherd.
- The disease begins as a grayish haze at the limbus and mostly affects both the eyes.
- Later on there is spreading of the film all over the cornea and blindness results.
- The disease is most likely immune mediated.

**Treatment:**

- Topical corticosteroid therapy 4-5 times per day for 7 days. Thereafter 3 times per day for 2 weeks and then once/day for one month.
- Subconjunctival injection of antibiotic with corticosteroid is quite helpful.
- Few clinicians have recommended superficial keratectomy for the quickest removal of the lesion.

**Complication:** Since prolonged antibiotic-steroid therapy is required, the most common complications seen are Keratoconjunctivitis and corneal ulceration.

**b. Superficial diffuse keratitis:**

- Commonly seen as a sequelae to Keratoconjunctivitis sicca.
- May be associated with exophthalmia, untreated focal infection of cornea.
- Mostly result from bacterial or fungal infection.

**Treatment:** As per the cause topical antibiotic/fungal eye ointments.

**c. Interstitial and deep keratitis:**

- Inflammation of stroma, Descemet's membrane as well as endothelium.

**Etiology:**

- Bacterial associated with abscessed teeth, gingivitis.
- Viral – Infectious canine hepatitis, canine distemper.
- Extension of superficial corneal disease.
- Extension of scleral inflammation.
- Direct traumatic injuries.
- Severe ulcerative keratitis.
- Post-vaccinal antigen-antibody reaction (hepatitis).
- Rarely fungus (Blastomycosis etc.).

**Symptoms:**

- Corneal opacity due to oedema and cellular infiltration.
- Pannus mostly seen at limbus and the vessels are directed towards the center. In untreated cases vessels become more prominent and progress in 360° brush like fashion.
- Hypopyon may be seen.
- Pain, photophobia, blepharospasms, Epiphora may be seen.

**Treatment:**

- The cause is diagnosed and treatment is adopted accordingly.
- Topical corticosteroids with antibiotics.
- Subconjunctival steroid injections are most helpful in alleviating the corneal inflammation and opacity (except if the cause is fungal).
- Systemic antibiotics as per the cause.
- Mydriatics (topical atropine) are used when associated with iritis or

iritidocyclitis to prevent anterior synechia (formation of adhesions between cornea and iris).

**Major complication:**

- Secondary glaucoma in long standing cases mostly following uveitis.
- Corneal haze with deep corneal vessels may remain permanently.
- Pigmentation of cornea.

**d. Ulcerative keratitis:** The most common corneal disease condition of dogs where there is loss of corneal substance with or without corneal inflammation.

- The corneal ulcers may be **atonic** or **inflammatory**.
- **Atonic:** Due to nutritional deficiency or in old age.
- **Inflammatory:** Due to inflammation of cornea and is known as ulcerative keratitis. **Etiology:**
  - **Mechanical:** Due to presence of aberrant cilia, entropion, foreign bodies etc causing trauma of cornea.
  - **Infectious:** bacterial/viral/Mycotic.
  - **Exposure:** Exophthalmia.
  - **Secondary to KCS.**
  - **Degenerative:** Chronic irritation.
  - **Burns.**

**Classification:**

1. **Simple ulcer:** A superficial ulcer involving only the epithelium of cornea. Mostly the damaged epithelium regenerates rapidly in few days.
2. **Deep ulcer:** Extend upto the Descemet's membrane and sometimes there is complete perforation of the cornea. Marked infection is normally present and there may be involvement of uvea. With pus in the anterior chamber.
3. **Serpent or dendritic ulcer:** Usually associated with some systemic viral infection and such ulcers branch like a tree. Not a common occurrence.
4. **Nutritional ulcer:** develops due to avitaminosis A.
5. **Neuroparalytic ulcer:** This type of ulcerative keratitis develops due to trigeminal nerve lesion causing some sensory loss to the cornea. The cornea usually looks dull, lusterless, insensitive and the condition may be confused with KCS.

**Diagnosis:** Apply Flourescein dye, gives green color to the ulcer.

**Clinical signs:**

- Pain, photophobia, blepharospasms, rubbing of affected eye.
- Pain is more in superficial ulcers.
- Serous to muco-purulent discharge.
- Pannus formation.

**Treatment/management:**

- As per the cause (bacterial/viral/Mycotic).
- Elimination of the possible cause (Entropion, aberrant cilia, foreign body etc.).
- Cauterization of ulcerative area with 0.5-1% silver nitrate, 7% tincture of iodine with the help of a tooth pick after applying a cotton plug. May be done by touching the ulcerative area with hot needle. However may lead to perforation. Always perform thorough flushing (NSS or 2% boric acid) after cauterization.
- Superficial keratectomy (removal of damaged epithelium) is very helpful. Done under topical anaesthesia.
- Use topical antibiotic solutions every 4 hr.
- Use of topical calomel has given good results in slow healing ulcers.
- Provide dark environment. Can be achieved by proper bandaging or by third eyelid/conjunctival flaps.
- Use systemic vitamin A preparations for early regeneration of the epithelium.
- 1% topical atropine is indicated if there is involvement of iris to prevent anterior synechia.
- Paracentesis of anterior chamber is done when hypopyon. Done under suitable anaesthesia using No.11 BP blade and making a nick at 6 'O' clock position 2mm from the limbus. This helps in the escape of the fluid from the anterior chamber.
- *Use of topical steroids is contraindicated in the management of corneal ulcers.*

### Complications:

- **Descemetocele:** Protrusion of Descemet's membrane through ruptured cornea.
- **Corneal fistulation:** There is complete rupture of the cornea and the opening enters the anterior chamber.
- **Anterior synechia:** There is formation of adhesions between the cornea and the iris.
- **Iris prolapse:** Iris protrudes out through the ruptured cornea, may be partial or complete.
- **Staphyloma:** When the prolapsed iris is covered with a fibrin film and a layer of epithelium is formed over it.
- **Ectasia:** It is the protrusion of cornea itself through the ruptured cornea; mostly develop due to softening of the cornea following interstitial keratitis.

e. **Keratoconjunctivitis sicca:** Inflammation of cornea as well as conjunctiva due

to deficiency of aqueous part of the tears and the precorneal tear film.

- Commonly known as 'Dry Eye'.
- Any breed can be affected.

### **Etiology:**

§ Canine distemper.

§ Corneal and conjunctival injuries.

§ Associated with chronic blepharitis/conjunctivitis.

§ May be drug induced, following use of anaesthesia or topical atropine.

§ Associated with drug toxicity e.g. phenazopyridine, sulfonamides.

§ Senility.

§ Congenital absence of or malfunction of the secreting glands has been recorded in some breeds of dog e.g. Chihuahuas, Yorkshire terriers, Miniature pinchers.

§ Intoxications like belladonna poisoning and botulism also reduce tear production by direct action on the secretory cells of the lacrimal glands.

§ Hypothyroidism.

§ Underlying autoimmune disease in some breeds like bulldogs.

§ Surgically induced when lacrimal gland and gland of third eyelid are removed.

§ Vitamin A deficiency (more in human beings).

### **Clinical signs:**

#### **Acute**

§ The conjunctiva becomes red, thick and velvety (conjunctival hyperemia).

§ There is sticky and ropy discharge.

§ Corneal Vascularization.

§ Corneal ulceration.

§ Dry nostril on the affected side may be present.

§ Blepharospasms.

§ Cornea appears dull and irregular.

§ Associated staphyloma and iris prolapse may be seen.

#### **Chronic:**

§ Mild conjunctivitis with minimal corneal changes.

§ Sometimes severe conjunctivitis with pannus formation.

§ Hyperemia and Chemosis of conjunctiva.

§ Mucoid to mucopurulent discharge.

§ Corneal opacity.

§ Sometimes only superficial corneal vascularization (Pannus).

### **Diagnosis:**

- Modified Schirmer's Tear Test: Value less than 5mm is indicative of KCS.

- Corneo-conjunctival cytology: Neutrophils with devitalized epithelium is observed.

### **Treatment:**

#### **Medicinal:**

§ **Artificial tear therapy:** It is must and continued till the normal secretions of the lacrimal glands are restored. Frequent instillations are required. 0.5% - 1% methyl cellulose; 0.5% hydroxyl ethyl cellulose; 0.5% hydroxyl propyl methyl cellulose.

§ Topical antibiotics 4-6 times daily to prevent infection. If no corneal ulceration, topical antibiotics with corticosteroids are more beneficial.

§ Topical 5-10% acetylcysteine is helpful as mucolytic substance.

§ **Cholinergic drugs:** Used to stimulate the lacrimal glands for normal tear production.

**a) Pilocarpine:** 0.25-4%. Can be used orally but toxic and unpalatable.

Use topically, 1-2 drops twice daily, for 3 to 4 weeks to see the positive effect.

0.25 - 0.5% used for 2-4 kg weight.

0.5 - 2% for 5-10kg wt.

2-4% for dogs above 10kg wt.

#### **Surgical:**

§ Normally indicated when after one month of medicinal therapy there is inadequate tear production.

§ Under suitable anaesthetic technique go for parotid duct transpositioning.

§ If there are corneal ulcers, provide dark environment by TEF (third eyelid flap).

### **f. Other affections of cornea:**

#### **(1) Tumors of cornea:**

- Rarely seen.
- Normally secondary extensions
- Common are epithelioma, dermoids.

#### **(2) Foreign bodies of cornea:**

- Mostly thorns, awns, flakes of paint or metal adhering to the cornea
- Cause pain, photophobia and excessive lacrimation.
- Unnoticed FBs may lead to development of corneal ulceration, Pannus formation and corneal opacity.
- The FBs are removed with the help of a forceps under topical anaesthesia. However deep embedded FBs are removed under general anaesthesia after performing keratomy. Care is taken not to perforate the cornea.



- Postoperative topical antibiotics with corticosteroid if no ulceration.
- Drop of atropine daily is helpful in early regeneration of the damaged epithelium.

**(3) Wounds of cornea:**

- The wounds may be non-penetrating or penetrating.
- The non-penetrating types of wounds heal rapidly unless infected. However such wounds are very painful.
- Treatment includes topical atropine and antibiotics.
- Penetrating wounds are normally associated with iris prolapse.
- Treatment of such wounds include third eyelid flap (TEF) after instillation of topical atropine ant antibiotics.
- Only extensive corneal ulcerations will require suturing of the wounded cornea.

**(4) Burns of cornea:**

- Mostly caused by lime particles, plaster or chemicals.
- Treatment includes thorough washing of the affected eye with NSS or tap water immediately followed by topical atropine and antibiotic.