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OCULAR PHARMACOLOGY AND THERAPEUTICS

Selection of the suitable drug depends on:

1-The penetrating characteristics of the intact corneal epithelium and blood aqueous barrier of the drug

2-The required site of drug action within the eye

3-The convenience of application

4-The stability of the drug in the formulation and the duration of action

The choice of the route of administration of the ophthalmic drug have the same important as the choice of the drug itself

The proper choice of route of administration depends on:

1-The drug character 2-Understanding of the ocular disease and knowledge of ocular barriers.

Generally speaking, diseases of the conjunctiva, superficial cornea and eyelids may be corrected with topical or subconjunctival application, while diseases of the uveal system, anterior and posterior segments, orbit and lacrimal glands may be managed by topical, subconjunctival, retrobulbar, and systemic administration.

Routes of administration of ocular drugs are:

I- Topical administration: -

Means application of the drug in a direct contact with the surface of the cornea and conjunctiva.

The penetrating power of the drug is affected by different factors like:

1-Drug characteristics: -

A-Chemical character of the drug: -

The drug penetrates the cornea by differential solubility and not by simple diffusion.

B-Size of the molecule: -

The larger the molecule the poorer the penetration.

C- Drug concentration: -

The higher the concentration the greater the, penetration.

II-Vehicle of the drug: - The vehicle of the drug may be:

1-Drops: - Least irritating and short topical duration.

2-Ointments: - Cause some irritation and lasts longer than drops

3-Powders: - Are too much irritating.

Types of vehicles for drops and ointments are aqueous methylecellulose, hydroxyethyle cellulose, polyvinyle alcohol, and artificial mucin. After topical application, the drug may pass away with the tears to outside or to the nasolacrimal duct, or penetrate the cornea and/or conjunctiva.

Routs of administration: -

I-TOPICAL ADMINISTRATION OF DRUG: -

1-Periodic administration: -

The medication is applied to the lower conjunctival cul-de-sac by applying thumb pressure at the base of the lower eyelid for partially everting it.

2-Subpalpebral administration: -

The subpalpebral system is indicated when the case requires intensive therapy, in cases of temporary tarsorrhaphy and when the animal is difficult to treat as equine and feline. The subpalpebral system was made from silastic or polyethylene tubing. The tube is fine for small animals and somewhat strong for equine and cattle. It is placed in the superior conjunctival sac by passing it through the upper eyelid using general or local anesthesia. Two or three holes are cut in the tube and one end is connected to a bottle containing corneal lavage solution for continuous treatment or connected to a syringe for intermittent treatment and secondend is ligated.

II- SUBCONJUNCTIVAL ADMINISTRATION: -

Is the injection of the therapeutic drug subconjunctivally or beneath the Tenon's capsule. In subconjunctival injection the drug will leaks through the punctured conjunctiva into the tear fluid and then crossing the cornea. Deeper injections beneath the Tenon's capsule allow greater diffusion of the drug through the sclera into the eye. The technique of injection usually requires only topical analgesia in small animals and auriculopalpebral nerve block in large animals. Small tissue forceps is used to grasp and stabilize the bulbar conjunctiva. Tuberculine needle (25 gauge) with 1 ml syringe is inserted subconjunctivally or beneath the Tenon's capsule with the bevel up as close as possible to the lesion being treaieu. rv nui.iv.<-a-ble bleb should appear where the drug is deposited. The needle can be rotated on withdrawal to limit leakage through the conjunctival puncture.

Advantages:

1-The lipoidal epithelial barriers of the cornea and conjunctiva are by-passed.

2-High intra-ocular drug level in a short time. 3-Excellent intra-ocular absorption of the drug.

Indications:

1-Acute anterior uveitis 2-Panophthalmitis 3- Episcleritis 4-keratitis

Disadvantages:

At the seat of injection, inflammation, necrosis, haemorrhage and abscessation occasionally develop.

Injection of the drugs subconjunctivally at the base of the third eyelid is used in some schools but penetration of the globe and injection of the drug intra-ocularly by mistake is extremely serious complication. Mydriatics, antibiotics and corticosteroids are among the drugs commonly used for subconjunctival injection. The dose varies from animal to animal and as example ranged between 50-250 mg ampicillin, 250-500 mg neomycin, 250,000-1,000,000 units penicillin G and methylprednosoline 10-20 mg.

III- RETROBULBAR INJECTION: -

Local analgesic solutions are often injected around the muscles behind the globe for exenteration of the orbital cavity in cattle. A 5-6 cm needle is used for injection of the anesthetic solution at four sites adjacent to the globe at 3, 6, 9 & 12 O'clock. In equine the retrobulbar injection is performed through the supra-orbital fossa. Antibiotics are sometimes injected by this route for intra-ocular infections, retro-bulbar cellulites or abscess, as the sclera does not act as a barrier for drug penetration as does the cornea.

IV- INTRAOCULAR INJECTION (INTRACAMERAL): -

Injection of the drug into the anteriorchamber through the limbus is indicated during surgery to control hemorrhage or pupil size and in the management of intra-ocular inflammatory disease. The procedure is performed under aseptic condition. During intra-ocular surgery sterile saline can be used to irrigate blood and fibrin out the eye. Mydriatics and miotics can be used during surgery.

V-INTRAVITREAL INJECTION: -

The anatomical barriers of ocular tissues and the characteristics of the vitreous body are responsible for poor penetration of drugs into the vitreous humour. Direct injection into the vitreous is one method for attaining high concentration of the drug. 22-25 gauge needle (one-two cm length) with 1 ml syringe is

inserted at the ora lineata 6 mm posterior to limbus in dog and 12 mm. in cattle or equine and directed towards the posterior pole of the eye.

Indication:

Diffuse posterior segment inflammatory disease.

VI-PARENTERAL ADMINISTRATION (SYSTEMIC): -

Oral, intravenous, and intramuscular routes are used for treatment diseases of the posterior and anterior segment of the globe, orbit, sclera and eyelids.

Ophthalmic therapeutic agents

I-CLEANSING SOLUTIONS - EYE WASHES - COLLYRIA: -

The use of tap water as eyewash is not recommended, and the eyewash is used for flushing the conjunctival sac and removal of ocular discharae, foreign bodies and irritants. Cleansing solution should be bland and used worm or at room temperature. Application is accomplished by eyedropper, soft-rubber bulb syringe or plastic irrigating bottle.

1-Normal saline solution 2-B.S.S. (Balanced salt solution) 3-Boric acid solution 2%

II-ASTRINGENTS: -

Astringents are locally acting protein precipitants, and they are occasionally used in various forms of conjunctivitis. The most frequent drugs used as astringents are:

1-Zinc sulphate: -

Zinc sulphate solution (0.2 - 0.25%) and ointment (0.5%) have mild astringent and antiseptic properties. It is used for mild nonspecific conjunctivitis and is often combined with vasoconstrictor and antihistaminic drugs.

2-Silver nitrate: -

Silver nitrate solution (1%) is brushed to the everted eyelids and conjunctiva in various forms of conjunctivitis. The ability of silver ions to kill microorganisms is the bases for their ophthalmic use. It is very irritating drug and its use in veterinary ophthalmology is completely outmoded.

3-Copper sulfate: -

It is used for the removal of lymphoid follicles in chronic follicular conjunctivitis. It is chiefly used in crystal form. The palpebral and bulbar surfaces of the nictitating membrane may be rubbed lightly with the crystal and the eye immediately flooded with normal saline solution.

4-Yellow mercuric oxide (Golden eye ointment): -

This is an outmoded agent once used for its antiseptic properties. It is employed in an ointment (1-3%) and usefull for blepharitis, chronic conjunctivitis and superficial punctate keratitis.

III-CAUTERANTS: -

Cauterants are severe protein-precipitating agents that cause tissue destruction and are used to remove tissues. Surgical removal is accomplishes the same result and does not leave necrotic debris. The following preparations are commonly used as cauterant

1-Carbolic acid (phenol): -

Is used for cauterization of corneal ulcer. It is safely used for producing corneal sloughs because the corneal protein is quickly precipitated by the acid. This precipitate in turn acts as a barrier for further penetration of acid into deeper layers of the cornea.

2-Tincture of iodine: -

Iodine is a milder cauterant than phenol used for corneal ulcers and erosive lesions. Tincture (3-7%) of iodine or alcoholic potassium iodide solution may be

used. The use of Tr. for treatment of superficial corneal erosion in dogs has been replaced by surgical superficial keratectomy.

3-Trichloroacetic acid: -

Trichloroacetic acid 25% solution is a powerful cauterant used for corneal ulcer and fistulae.

4-Silver nitrate sticks:

It is a dangerous cauterizing agent. It must be neutralized by sodium chloride solution to precipitate the silver as silver chloride. Without neutralization it will react with the cornea and leads to irreversible damage.

IV- MYDRIATICS AND CYCLOPLEGICS: -

Mydriatics:

They are agents that produce dilatation of the pupil

Cyloplegics:

They are agents that cause paralysis of the ciliary body with resulting dilatation of the pupil.

Thus cycloplegics acts as mydriatics but a mydriatic does not necessarily cause cycloplegia. Two groups of these drugs recognized.

1- Parasympatholytic drugs (Anticholinergic drugs): -

These drugs produce dilatation of the pupil and cyclopiegia. The most common drugs of this group are atropine, tropicamide, and scopolamine.

A-Atropine: -

Atropine sulfate in solution or ointment (1-4%) is one of the most important and useful drug in veterinary ophthalmology.

Indications:

1-Ophthalmoscopic examination. 2-Deep keratitis and corneal ulceration

3-Iritis, cyclitis and anterior uveitis (to relieve painful spasm by paralising ciliary muscle)

4-Sialogogue (promote salivary secretion) when applied to the oral cavity or reaching it via the nasolacrimal duct.

Atropine is not frequently used as a mydriatic for examination because its action last for 24 hours to some days. It is contraindicated in breeds susceptible to glaucoma, in cases of lens luxation and in animals with keratitis sicca.

B-Tropicamide (1% solution): -

It is a fast acting drug of short duration used to induce mydriasis for intraocular ophthalmoscopy. A maximum mydriasis is obtained within 20-30 minutes and the pupil will return to normal within several hours.

C-Scopolamine (0.3-0.5%): - Sometimes it is used before intra-ocular surgery.

2- Sympathomimetic drugs: -

The common drugs in this group are adrenaline and phenylephrine. They do not cause cycloplegia and their effect is upon the dilator muscle of the iris.

A-Adrenaline (Epinephrine): -

Indications:

1-To break down recent synechia (5-10% used as mydriatic without cycloplegia)

2-As vasoconstrictor (It stimulates contraction of vascular smooth muscle, resulting in vasoconstriction. This effect is used to control conjunctival and scleral hemorrhage by topical application of 1:1000 solution)

3-To slow down the process of absorption of drugs (When mixed with penicillin & lignocaine)

B-Phenylepherine: -

It is used as mydriatic in 10% solution for ophthalmoscopy and in the treatment of minor allergic and inflammatory conjunctival disorders.

V- MIOTICS: -

Miotics diminish the size of the pupil, producing tonic contraction of the iris and ciliary muscle and reduce intra-ocular pressure.

1-Direct acting miotics: -

Cholinergic drugs which stimulate the effect of acetylcholine as pilocarpine, acetylcholine and carbacol.

2-Indirect acting miotics: -

Anticholinesterases drugs, which prevent the hydrolysis of acetylcholine by the enzyme cholinesterase such as phospholine iodide, fluoropryl, humorsol and eserine.

Indications:

1-Topical instillation of 0.5-6% solutions of these drugs results in an increased outflow of aqueous in glaucomatous eye

2- Stimulate secretory glands (lacrimator) in case of keratoconjunctivitis sicca:.

3-As miotics after application of mydriasis

VI-LOCAL ANESTHETICS OR ANALGESICS: -

A number of diagnostic and surgical procedures can be performed in veterinary ophthalmology under effect of local anesthesia. Instillation of topical anesthetic is used for minor diagnostic and surgical processes that requires superficial

manipulation of the cornea and conjunctiva such as; tonometry, gonioscopy, foreign body removal, suture removal, conjunctival follicles removal, conjunctival scraping and corneal ulcer cauterization. More detailed surgical procedures such as; third eyelid flap, conjunctival flap, repair of eyelid laceration and removal of eyelid neoplasms can be achieved with nerve block and local tissue infiltration. Tranquilization may be essential to facilitate instillation of topical anesthetics, nerve block and local infiltration.

1-Topical anesthetics: -

A number of topical anesthetics are available and variations among them depend on

1-Time of onset 2-Duration of action 3-Stability 4-Local toxicity

5-Systemic toxicity 6-Degree of resistance to growth of organisms

The mechanism of action of topical anesthetics involves a reversible blockage of conduction through the nerve fibers. The duration of action depends on the length of time it remains bound to the nerve protein. Nearly, all topical anesthetic inhibit corneal epithelial healing in variable degrees. Topical anesthetics cause marked inhibition of corneal epithelial healing are

1-Cocaine 2% 2-Cornacaine 2%.

Those causing slight delay are

1-Lignocaine 4% 2-Pontocaine (Tetracaine®) 4%

3-Proparacaine (Ophthaine®) 2%

Those causing no delay are

1-Lidocaine 2% (Xylocaine®) 2-Metycaine 2%. (Piperocaine®)

One drop for each eye is instilled and then a second drop is applied after 1-2 minutes. Corneal anesthesia occurs in a less than one minute and conjunctiva takes a longer time.

Considerations on use topical anesthetics

1-Local anesthetics should not be used therapeutically or included in any therapeutic preparation

2-Most of them are toxic to normal corneal epithelium and inhibit corneal regeneration

3-Bacterial samples should be taken before application of topical anesthetics as the latter and the preservative they contain will kill the bacteria in conjunctival sac.

4-Topical anesthetics are unsuitable for local infiltration.

5-Some of them is extremely toxic (5 ml of 2% pontocaine solution is fatal human dose).

2-Injectable anesthetics: -

Local infiltration and nerve block (regional anesthesia) are useful in veterinary ophthalmology for examination and minor surgical procedures especially in large animals. The most common injectable anesthetics are Lidocaine 1-2% (Xylocaine®) and Procaine1% (Novocaine®).

VII-ANTIBIOTICS: -

Antibiotics are the most commonly used drugs in veterinary ophthalmology. Unfortunately, misuse of antibiotics is nearly as great as its benefits. Antibiotics are prescribed before specific diagnosis has been established. Before application of antibiotics, the clinician should be certain that the condition is infection and not inflammation due to trauma, foreign body, mechanical or chemical irritation, allergy, contact sensitivity and degenerative or metabolic disease. In external infection of the eye, a smear should be prepared before application of antibiotics.

Gram's stain allows differentiation between cases of infection and allergy. Giemsa stain can demonstrate viral, chaladial, and mycoplasmal inclusions within epithelial cells and will permit differentiation of white blood cells. In acute severe and chronic infect cases, culture and sensitivity test should be performed. Antibiotics may be administered until the results of the sensitivity test is determined

Selection of antibiotics depends on: -

1-The nature of the offending organism and its sensitivity to the antibiotic

2-The spectrum of activity of the available drugs

3-The penetrating properties of the antibiotic into the eye through the intact corneal epithelium and blood-aqueous barrier

4-The pharmacologic, pharmaceutic and toxic properties of the avail antibiotic

The ideal basis for selection of antibiotic is the identification of the responsible organism and its antibiotic sensitivity. Combination of different antibiotics may be synergistic and not antagonistic at therapeutic levels. The advantage of combination include the ability to provide more broad spectrum coverage than one antibiotic, to provide sensitivity to another antibiotic if the organism develop resistance to one and to permit sub-toxic dose if one of them is highly toxic.

The important common antibiotics are: -

1-Antibiotics which cannot penetrate the intact corneal epithelium and blood-aqueous barrier are penicillins and its derivatives except ampicillin, streptomycin, auromycm and terramycin. Intraocular penetration of these drugs is very poor even if they injected subconjunctivally. Also they cannot cross the blood-aqueous barrier unless administered in massive doses. These drugs can be used for superficial eye disease.

2-Antibiotics which have the power of penetration of the intact corneal epithelium and cross the blood-aqueous barrier are chloramphenicol, neomycin, bacitracin and gentamycin. Chloramphenicol is a broad-spectrum antibiotic,

effective against a wide variety of gram-positive & gram-negative organisms, rickettsia, spirochaetes and chalamydia and is one of the most effective drugs for ocular infection. Chloramphenicol can applied topically, subconjunctivally, intravenously and orally. Neomycin, bacitracin and gentamycin are broad-spectrum antibiotics effective for the treatment of superficial ocular infections. The reports concerning penetration of intact cornea and blood-aqueous barrier are conflicting but it appears that they can attain a therapeutic level in the aqueous if injected subconjunctivally or systematically.

VIII-ANTIVIRAL DRUGS: -

Viruses are obligate intracellular parasites that utelize the metabolic processes of the host's cells. The location of the virus and intimate relationship to the host make effective therapy difficult. Idoxuridine (IDU) is chemically very similar to thymidine, one of the constituents of nucleic acid. IDU substitutes for thymidine in DNA synthesis and thus inhibits the action of the virus. IDU is available in 1% solution and 0.5% ointment and is applied 5-6 times daily as ointment and every two hours as solution for maximal effect. Antiviral drugs are used for treatment of herps keratoconjunctivitis, follicular conjunctivitis and superficial punctate keratitis in dogs and cats.

IX-ANTIFUNGAL AGENTS: -

Important ocular and adnexal fungal innfections are present in three groups of diseases:

1-Infection of the skin of the eyelids "blepharodermatomycosis"

2-Mycotic keratitis following corneal injuries by foreign vegetable objects

3-Intraocular infection leads to mycotic endophthalmitis

Any non-specific corneal ulcer associated with corneal opacity that does not respond to antibiotic therapy should be scraped, stained and cultured for possible mycotic involvement. Superficial keratectomy of infected corneal tissues is often as effective as drug therapy and should be combined with it. Topical antimycotics are nystatin, amphotercin B, natamycin, flucytosine and imidazole

compounds. Parenteral antimycotics include amphotercin B and 5-fluorocytosine.

X-SULPHONAMIDES: -

Sulphonamides have largely been replaced by antibiotics but still useful for minor infection. They are bacteriostatic and act by blocking utilization of para-aminobenzoic acid by bacteria. Purulent exudate that contains para-aminobenzoic acid interferes, with the action of sulfonamides. Sulfa drugs are effective against gram-positive and some gram-negative organisms, and in higher concentration, against some viruses, fungi and toxoplasma. Sulfacetamide is used for topical instillation as it penetrates the cornea best. High concentration is recommended, 10-30% solution and 6%, 12% and 15% ointments. These drugs have a tendancy to retard healing of corneal epithelium. Parenterally, sulfapyridine and sulfadiazine readily achieve therapeutic level after penetration of the blood aqueous barrier. Systemic use of sulfonamide is indicated in cases of bovine keratoconjunctivitis due to moraxella bovis and ocular -toxoplasmosis. Local anaesthetics inhibit the effectiveness of sulfas because topical anaesthetics are esters of para-aminobenzoic acid. The major advantagess of sulphonamide are low cost and low allergenicity.

XI-CORTICOSTEROIDS: -

Perhaps the greatest usefulness of corticosteroids in veterinary medicine only lies in, the field of ophthalmology. Corticosteriods are the most misused agent in veterinary ophthalmology. They are among the most useful and powerful drugs with specific properties that should be understood and with equally important indications and contraindications. Steroids do not affect the causative agents but rather the tissue response to those agents. They do not have antibiotic or chemotherpeutic effect.

The ocular, effects of corticosteroids are:

1-Suppress the inflammatory process by decreasing capillary dilatation, capillary permeability, exudation and the migration of the phagocytes to the site of inflammation.

2-Suppress scar formation of the cornea by inhibition of the process of collagen formation and reduction of the fibroblast activity

3-Suppress neovascularization (capillary proliferation) of the cornea

4-Suppress hypersensitivity reactions by inhibiting release of histamine from sensitized mast cell

The effect of corticosteroids as anti-inflammatory drugs is non- specific. The inflammatory process is inhibited whether the cause is mechanical, chemical or immunological. Large doses of corticosteriods may produce suppression of antibody formation owing to the ability of these drugs to destroy lymphocytes, which produce antibodies. Corticosteriods inhibit the formation of fibroblasts in corneal stroma and granulation tissue formation in the eye. They retard epithelial and endothelial regeneration of the cornea, thus delaying the normal wound hfealing process. Melanin deposition is minimized and topical usage may decrease pigmentation already present.

Corticosteroids have the power of penetration the intact corneal epithelium and blood-aqueous barrier than do most other classes of ophthalmic drugs. The highest concentrations of the drug after topical administration in the eye are in the cornea and conjunctiva. However, all parts of the eye contain some of the preparation. The power of penetration to the cornea is determined by both differential solubility of the drug tissue factors. The epithelium of the cornea is lipophilic, presenting a barrier to penetration of water-soluble preparations. The stroma is hydrophilic, water soluble steroid can penetrate the cornea readily in absence of epithelium. The corticosteroids should possess biphasic polarity. That is, it should be both fat and water-soluble. Acetate derivatives are biphasic while succinate and phosphate are hydrophilic..

Methods of corticosteroid application and indications are:

<u>1-Topical and subconjunctival injections: -</u>

These methods offer numerous advantages over systemic administration. The main important one is the high local concentration for long periods of time with

minimal systemic side effect. Hydrocortisone solution 2% and acetate ointment 1 1/2%, prednisolone 0.25% and dexamethasone solution 0.1% are among the most common corticosteriods used for topical and subconjunctival injections.

Indications:

1-Blepharitis 2-Non-pyogenic conjunctivitis 3-Episcleritis 4-Iritis 5-Following intraocular surgery

6-Superficial keratitis (vascularization, pannus and exuberant granulation tissue).

2-Systemic administration: -

Most types of corticosteroids penetrate the blood-aqueous barrier. Commonly used drugs are prednisolone, methyl prednisolone & dexamethasone.

Indications:

1-Interstitual keratitis 2-Anterior and posterior uveitis 3-Episcleritis 4-Optic neuritis 5-Retinal detachment

XII-ANTIHISTAMINES: -

Histamine antagonists are used to prevent immediate hypersensitivity reaction by preventing histamine formation within the mast cells, preventing its release from the mast cells, competing with it at the site of action and blocking its effect on the receptor cells. This group of drugs is little used in ocular therapy. Systemic antihistamines may be useful than topical one. Antistine (Antolazine 0.5%) solution is very effective topically to relieve the eye changes seen with allergic reactions. Premedication with systemic antihistamine 20-30 minutes before intraocular surgery will reduce fibrin formation during operations. Oral administration can be used in elective surgery such as cataract e.g. chlorpheniramine maleate 12 mg, 2-4 hours before surgery in dogs.

XIII-DRUGS USED FOR TREATMENT OF GLAUCOMA: -

1-Carbonic anhydrase inhibitors: -

The enzyme carbonic anhydrase is present in the ciliary body and is associated with aqueous production. Inhibition by carbonic anhydrase inhibitors reduces aqueous humour production, resulting in decreased intraocular pressure. The production of aqueous, humour by the ciliary body may be decreased by more than one-half. Carbonic anhydrase inhibitors are used for the treatment of most types of glaucoma. These drugs reduce the formation of aqueous humour. They are often combined with other antiglaucoma drugs that improve the outflow of aqueous humour. These drugs are administered orally or intravenously daily in 3 divided doses.

Examples:

1-Acetazolamide (Diamox) 10-20 mg/kg b.w

2-Methazol amide (Neptazane) 5 mg/kg b.w.

3-Ethoxzolamide (Ehamide) 5 mg/kg b.w.

4-Dichlorphenamide (Daranide) 2 mg/kg b.w.

2-Osmotic diuretics:

Osmotic diuretics are used frequently in veterinary ophthalmology to reduce intraocular pressure. The osmotic agents act by increasing the osmotic concentration of blood perfusing the eye, thus drawing fluid from the eye (aqueous and vitreous) directly into the blood stream.

Indications:

1-Acute glaucoma 2-Prior to intraocular surgery 3-Clearing of corneal edema

4-Traumatic proptosis of the globe to reduce swollen tissues in order to reposition the globe back into the orbit

Examples:

1-Mannitol: -

It is a vegetable sugar, penetrates the eye poorly, is not metabolized and is rapidly excreted by the kidney. Mannitol is administered intravenously in a dose of 1-5 ml/kg b.w. 20% solution in small animals. It causes rapid decrease in intraocular pressure within one hour. Mannitol is beneficial immediately prior to intraocular surgery at a lower dosage level and provides the surgeon with a soft globe.

2-Glycerol: -

It is administered orally in small animals in a dose of 1-2 ml/kg. Glycerol is effective in lowering intraocular pressure. It penetrates the eye poorly and remains extracellular.

3-Urea: -

It is administered intravenously in a dose of 1-2 gram/kg b.w. 30% solution. Urea is markedly lower intraocular pressure. It penetrates eye readily and is not metabolized and rapidly excreted in urine. Extravascular injection of urea causes sloughing of tissues and phlebitis. It is rarely used since mannitol and glycerol are' available.

4-Topical sodium chloride (Na Cl) 5% ointment: -

It is used in corneal edema

XIV-VITAMINS: -

Various vitamins have been advocated for their supposed therapeutic efficacy in the treatment of ocular disorders of animals. In the absence of a specific vitamin, there is little to be gained from such local therapy.

1-Vitamin A: - It plays an important role in the physiology of vision. Vitamin A deficiency causes deterioration of the retina specially rods. Fortunately, they can

regenerate with 2-4 months of vitamin A administration. Also vit. A is essential for the normal life of the epithelial cells. In absence of this vitamin the epithelial cells degenerate and atrophy and the basal cells proliferate resulting in keratinization and keratomalacia.

2-Vitamin C: - It is essential for proper maintenance of intercellular cement substances. In vitamin C difficiency the endothelial cells of the capillaries fail to produce cement substance resulting in capillary haemorrhage.

3-Riboflavin (Vit. B): - Vit. B deficiency is characterized by superficial vascularization and ulceration of the cornea.

Multi vitamin therapy may be useful if systemic vitamin deficiency disorders are suspected.

XV-ENZYMES: - Enzymes preparations are rarely used. in veterinary ophthalmology.

1-Fibrinolysin: -

This enzyme is used to remove clotted blood from the anterior chamber in traumatic hyphema. Most of such clots are resorbed spontaneously in 7-10 days. This enzyme acts on fresh clots and should be considered for use in extensive haemorrhage.

2-Alpha chymotrypsin: -

Trypsin is useful for absorption of intraocular debris in cases of hypopyon. Alpha chymotrypsin (Alfapsin) is a proteolytic enzyme used for removal of the lens by intracapsular extraction in cases of cataract. It is used in human but may be of little value in animals as the zonules are considerably more resistant to enzymatic digestion.

XVI-OPHTHALMIC STAINS: -

Ophthalmic stains are used commonly as a diagnostic aids in diseases of anterior and posterior segment and nasolacrimal system.

1-Fluorescein dyes: -

Fluorescein is available as solution of 0.5-2.0%. Filter paper stripe impregnated with fluorescein may be placed in the conjunctival sac until moistened by tears. It is readily soluble in water produces a bright green fluorescent colour.

Uses:

1-An indicator dye for corneal epithelial defects. After instillation of flourescein, the excess in gently removed from the eye with normal saline. Normal intact corneal epithelium has a high lipid content and does not retain the water-soluble dye. When the epithelium disrubted, fluorescein rapidly penetrates the corneal stroma, resulting in an intense green fluorescence. The fluorescein-impregnated strips are more useful because they are more convenient and sterile.

2-Detection of the patency of the nasolacrimal duct. A fluorescein strip is placed in the lower conjunctival sac until adequate moistening occurs. The head may be lowered to aid drainage of tears through the excretory part of the lacrimal system. Within 1-5 minutes, the fluorescein usually appears at the external naries.

3-Diagnostic aid for detection of the lesions of the retinal and uveal vasculature. A sterile aqueous solution of sodium fluorescein 5-10% in water injection is used for fluorescein angiography studies. 25 mg/kg of 10% fluorescein appears most satisfactory for angiography in the dog. Fluorescein does not cross the blood-retinal barrier and the fluorescence of the dye is rapidly observed at high dilutions with suitable filter.

2-Rose Bengal: -

It stains devitalized cells and their nuclei of the cornea and conjunctiva as well as mucous, readily retaining the intensely red stain. Rose bengal is used almost in cases of keratoconjunctivitis sicca. One drop of 0.5% solution is instilled and after one minute, excessive stain is flushed from the eye with saline. In mild cases, a minute punctate staining is clear. In severe cases, retention is extensive.

XVII-ARTIFICIAL TEARS: -

In general, aqueous solutions as normal saline are unsuitable for tear replacement because these hydrophilic solutions do not adhere to the lipophilic corneal epithelium. Viscous agents, bind the solution to the epithelium. They are indicated in cases of keratoconjunctivitis sicca, exposure keratitis and as cushioning solution during gonioscopy as well as an ophthalmic vehicle.

Examples:

1-Methylcellulose 0.5-1.0% solution

2-Poly vinyl e alcohol 1.4%

XVIII-NON-SPECIFIC PROTEIN THERAPY: -

Foreign proteins stimulate formation of antibodies thus increasing the natural resistance against invading bacteria. It is indicated in cases of corneal ulcers, uveitis and some cases of purulent conjunctivitis. As steroids create a therapeutic response superior to foreign protein therapy, the latter is seldom used anymore.