Lavach

Large Animal Ophthalmology

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Dedicated to the memory
of my father

PREFACE

Veterinary ophthalmology texts contain little information about large animals. Cattle, sheep, goats, and swine have, with few exceptions, received scant attention regarding ocular disorders. Certainly this is due to the use and economic status of these animals. Additionally, however, it may be due to the fact that fewer scientific publications address ocular diseases in large animals, despite there being more ophthalmological information on equines than on other large animal species. It is an interesting historical note that veterinarians responsible for examining horses to be purchased for military purposes often examined several thousand horses each year. I doubt if any veterinary ophthalmologist today examines more than a few hundred horses in a year.

This text began as a compilation of references for students interested in large animal ophthalmology, particularly equine ophthalmology. It evolved into a rough outline that provided a summation of the referenced information. Eventually it assumed the format of a voluminous outline. Personal experiences with patients were influential in assigning importance to certain aspects of large animal ophthalmology. Discussions with students, residents, practitioners, and fellow ophthalmologists have influenced my writing. Dr. Glenn A. Severin has been especially influential as my mentor and friend. Dennis Giddings provided the excellent illustrations for this text.

I hope this information will be useful to those interested in eye diseases of large domestic animals. **The major section of the text deals with horses, so if a veterinarian encounters an eye disease in another large animal species and needs to investigate it further the logical place to turn will be Section I (pp. 1 to 298), dealing with horses.**

The entire staff of Mosby has been supportive, and they have made this text a reality. George Stamathis and Elaine Steinborn were especially helpful. George Stericker, Senior Manuscript Editor, provided the literary style that I lacked. Without his efforts, this text would be far less readable.

John Daniel Lavach

CONTENTS

PART ONE

HORSES

CHAPTER 1

Ocular therapeutics

I. Chemical Restraint

Before any treatment procedure is undertaken, the veterinarian should have a diagnosis in mind. A thorough examination is necessary for an accurate diagnosis. In the case of equine ophthalmology, sedation and/or anesthesia may be required for the examination.

A. Xylazine (Rompun 100 mg/ml)
   1. The intravenous dose of xylazine is 1.1 mg/kg bodyweight (0.25-0.5 ml/100 lb; 0.25-0.5 mg/lb).
   2. Xylazine is the most commonly used sedative in equine ophthalmology. It is an excellent analgesic and is useful in examinations, subconjunctival injections, biopsies, minor wound repairs, nasolacrimal flushes, etc. (Kalpravidh et al., 1984b).
   3. It produces analgesia for 15-30 min and sedation for 1-2 hr; however, it does not prevent an animal from being moved if necessary, which usually can be done within 30 min.
   4. Mixing the xylazine with acetylpromazine for intravenous administration (though not recommended by the manufacturer) will prolong the sedation. **Accidental intraarterial injection of this combination has been fatal.**
   5. Xylazine administered 5-6 min prior to butorphanol or morphine will enhance the sedative and analgesic action as well as reduce excitatory motor activity.
   6. Xylazine has an oxytocin-like effect on the uterus and is not recommended during the last 3 mo of pregnancy (Thurmon et al., 1985).

B. Butorphanol tartrate (Torbugesic 10 mg/ml, Stadol 2 mg/ml)
   1. The intravenous dose is 0.1 mg/kg bodyweight (5 ml/1000 lb; 0.05 mg/lb).
   2. The optimal analgesic dose has been reported to be 0.2 mg/kg; however, at this dose, side effects of shivering, ataxia, restlessness, and excitement commonly occur (Robertson et al., 1981; Kalpravidh et al., 1984a).
   3. Analgesia begins within 15 min and persists for up to 4 hr depending on dose and other drugs administered.
   4. Intravenous xylazine (1.1 mg/kg) 6 min before butorphanol (0.1 mg/kg) produces a synergistic analgesic effect (Robertson and Muir, 1983). Prior

administration of xylazine will reduce the excitatory reactions (Muir, 1982).

C. Morphine sulfate
   1. Morphine is a controlled substance.
   2. The intravenous dose is 0.5-1 mg/kg (0.2-0.4 mg/lb) bodyweight.
   3. It is a good analgesic but has been associated with posttreatment colic.
   4. Administered alone, it may be accompanied by an excitatory phase; xylazine 5 min prior to the morphine usually suppresses this CNS activity; however, the xylazine may need to be repeated, since morphine has a longer effect (Hackett, 1976).

D. Combinations of various drugs can enhance or prolong analgesia or sedation.
   1. Xylazine 1.1 mg/kg (0.3-0.5 mg/lb) bodyweight intravenously, followed by intravenous morphine 0.15-0.35 mg/kg (0.07-0.15 mg/lb) bodyweight, will provide sedation and analgesia for 20-40 min.
      a. Alternatively, xylazine 1.1 mg/kg (0.3-0.5 mg/lb) bodyweight followed by butorphanol 0.01-0.35 mg/kg (0.005-0.15 mg/lb) bodyweight will provide sedation and analgesia for the same length of time.
   2. Xylazine 0.4-0.5 mg/lb bodyweight intravenously, followed by ketamine 1 mg/lb bodyweight intravenously, will cause the horse to become recumbent for 10-15 min.

II. Local Anesthetic Injection Techniques

A. Auriculopalpebral block (Rubin, 1964)
   1. The caudal border of the ramus of the mandible and zygomatic arch is palpated.
   2. A depression is felt caudad, but the nerve cannot be palpated.
   3. A 22-gauge 1-inch needle is inserted into the depression of the temporal portion of the zygomatic arch (Fig. 1-1) and is directed upward just caudal to the highest point of the arch.
   4. Then 5-6 ml of 2% lidocaine or other suitable anesthetic is injected.
   5. A motor paralysis of the eyelids is produced in most horses but no desensitization to pain.
   6. A few horses will have lower eyelid control when branches of the dorsal buccal nerve are present. These branches can be blocked by injecting along the facial crest.
   7. Sweating over the rostral auricular muscles often occurs.
   8. The auriculopalpebral block is currently not used as often as it once was, before the development of xylazine.

B. Palpebral, frontal, and zygomatic nerve blocks (Manning and St. Clair, 1976)
   1. Upper eyelid sensory and motor nerves
      a. The superior rim of the orbit is palpated where the supraorbital process widens (medially) to feel the supraorbital foramen.
      b. Then 2 ml of 2% lidocaine is injected through a 1-inch 22-gauge needle inserted 2 cm (¾ inch) into the foramen.
      c. As the needle is withdrawn 1 ml more is injected, and 2 ml additional is deposited in the subcutaneous tissue over the foramen.

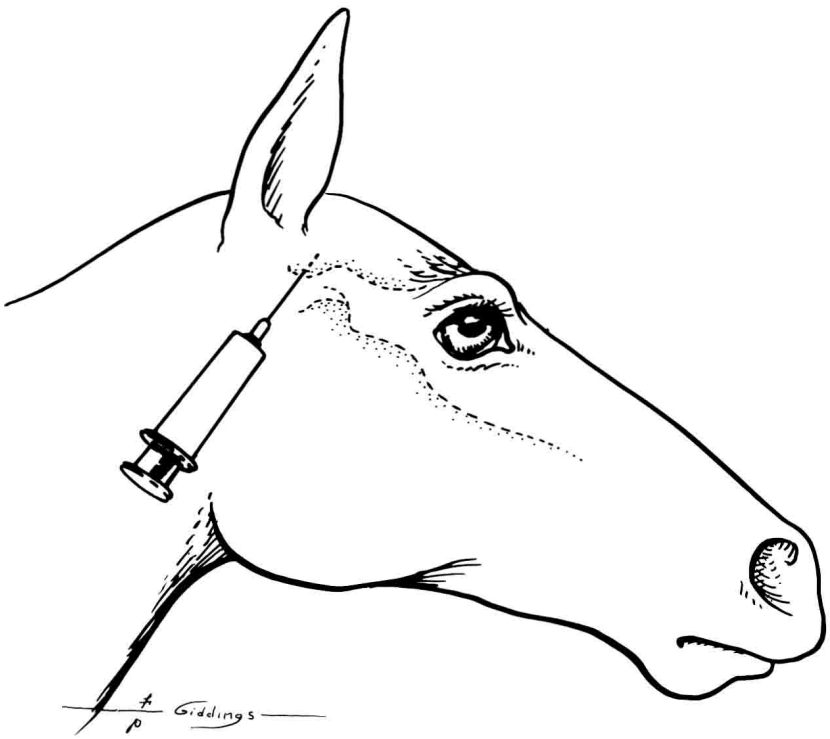

Figure 1-1. An auriculopalpebral block will reduce eyelid mobility.

   d. This technique will anesthetize the frontal nerve and the medial palpebral branch of the auriculopalpebral nerve.
2. Zygomatic nerve
   a. The index finger is placed on the ventral rim of the orbit tightly against the temporal canthus.
   b. Lidocaine (2 ml) is injected just medial to the finger in the lower eyelid and along the ventral rim of the orbit.
3. Lacrimal nerve
   a. Lidocaine (2-3 ml) is injected along the dorsal rim of the orbit just medial to the temporal canthus.
4. Infratrochlear nerve
   a. The notch in the dorsal rim of the orbit near the nasal canthus is located.
   b. Lidocaine (2-3 ml) is injected deep and slightly rostral to the notch.

C. Local anesthesia of the eyelids
1. Infiltration of local anesthetic is easily performed and provides excellent analgesia of the eyelid margin.
2. Sedation with xylazine beforehand will make the procedure easier to accomplish.
   a. With a 25-gauge ⅝-inch needle, 1-2 ml of 2% lidocaine is injected under the skin at the temporal canthus.

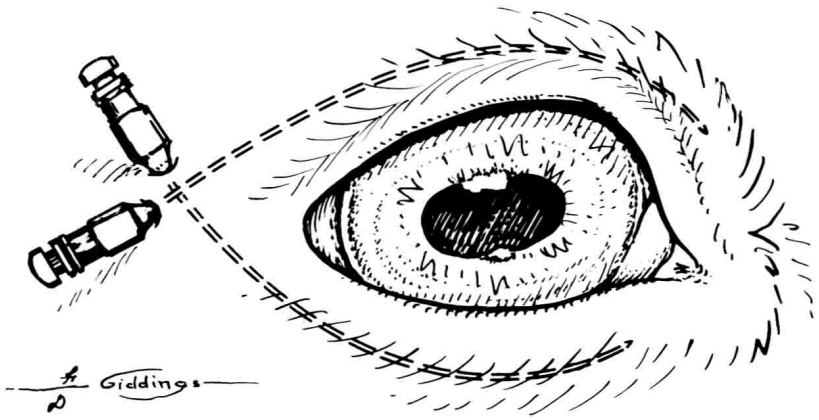

Figure 1-2. Local infiltration of 2% lidocaine into the eyelids.

3. A 25-gauge 2½-inch diamond-tip spinal needle with a stylet (Monoject) is introduced under the skin of the upper eyelid at the anesthetized canthus.
   a. It is threaded under the skin all the way to the nasal canthus, staying approximately 1 cm from the eyelid margin (Fig. 1-2).
   b. The stylet is withdrawn from the needle and a 10 ml syringe with 2% lidocaine is attached.
   c. The lidocaine is injected as the needle is being withdrawn.
4. The procedure is repeated for the lower eyelid.
5. To keep the cornea and conjunctiva from continuing to have sensation, it will be necessary to apply topical anesthetic to them.

D. Retrobulbar anesthesia
   1. A retrobulbar block is a useful adjunct to general anesthesia. It will reduce the need for deeper anesthesia that often is necessary to abolish nystagmus. It also may reduce the bradyarrhythmias and hypotension associated with the oculocardiac reflex.
   2. A four-point block is commonly used (Fig. 1-3). The technique is as follows:
      a. Each quadrant of the muscle cone is injected with 5-10 ml of lidocaine through a 3-inch 20-gauge needle.
      b. The superior quadrant is injected by directing the needle through the center of the upper eyelid parallel with the globe.
      c. The temporal quadrant is injected by passing the needle through the temporal canthal skin, following the globe posteriorly.
      d. The inferior quadrant is injected by passing the needle either through the lower eyelid or directly into the conjunctiva. To avoid the optic nerve, it is necessary to stay slightly nasal.
      e. The nasal quadrant is injected by elevating the third eyelid and directing the needle through its base following the globe.
   3. Failure to inject anesthetic into the muscle cone, or injecting in front of the orbital septum, may cause the drug to migrate forward under the conjunctiva. The swollen conjunctiva will then limit corneal exposure.

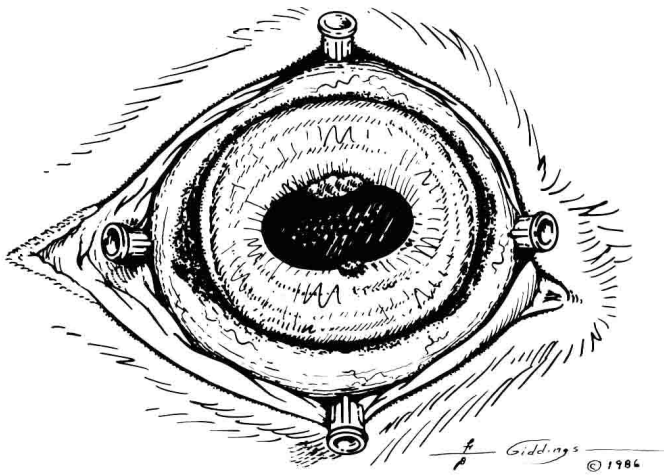

Figure 1-3. A four-point block will reduce ocular nystagmus during general anesthesia.

4. A modified Peterson block technique has been described (Raffe et al., 1986) for use in horses:
   a. An 18-gauge 10 cm needle is bent to a curvilinear shape and inserted 1 cm lateral to the temporal canthus directed toward the opposite nasal canthus (ventromedially).
   b. Lidocaine is injected as follows: 10 ml for horses weighing up to 250 kg (550 lb), 20 ml for horses weighing 250-600 kg (550-1320 lb), and 30 ml for horses weighing more than 600 kg.

III. Topical Anesthetics

A. Commonly available topical anesthetic agents (proparacaine 0.5%, tetracaine hydrochloride 0.5%, benoxinate hydrochloride 0.4%)
   1. A combination of 0.5% proparacaine and 0.25% fluorescein sodium (Fluorocaine) is available for topical use.
   2. It is convenient when topical anesthesia and fluorescein staining are necessary during an examination.

B. All topical anesthetics cause transient stinging and conjunctival hyperemia.
   1. Topical anesthetic is applied by spraying from a tuberculin syringe (without a needle) or by dropping into the conjunctival sac.
   2. Repeated applications at 30-60 sec intervals are usually necessary for three or four treatments to desensitize the cornea and conjunctiva for subconjunctival injection, etc.

C. An inflamed eye will require more topical and may not become as desensitized as a noninflamed eye. Hyperemia increases the rate of drug removal from the tissue; increased lacrimation dilutes and washes the agent away.

IV. General Anesthesia

A. Various drug combinations are suitable for inducing general anesthesia in horses (glycerol guaiacolate, ketamine, xylazine, barbiturates).
   1. The choice depends on experience and personal preference. An excellent review of anesthetic techniques has been published (Thurmon et al., 1985).

2. Ocular nystagmus is sometimes a problem when performing surgical procedures (Vesce, 1982). A retrobulbar block may be necessary.

B. Xylazine should not be used in neonates since it enhances depression and may cause a bradydysrhythmia.
   1. It must never be used in mares during the last 3 mo of pregnancy.
   2. A report of the oculocardiac reflex (Short and Rebhun, 1980) in an 8 mo old foal described a decreased heart rate and asystole when the eye was manipulated.

C. Corneal sensation may not be abolished with certain general anesthetic combinations, and a topical anesthetic may be needed to augment the anesthesia (Hillidge et al., 1973).

V. Topical Antibiotics

A. Chloramphenicol (Chloromycetin 1% ointment, Ophthochlor 0.5% solution, Ophthocort ointment with polymyxin B and hydrocortisone, Chloromyxin ointment with polymyxin B, Bemacol 1% ointment, Chlorasol 0.5% solution, Chlorasone ointment with prednisone, Chloricol 1% ointment, Chloroptic 0.5% solution, Chloroptic-P ointment with prednisolone acetate, Vetrachloracin 1% ointment, Chloromycetin sodium succinate injectable [1 g])
   1. Chloramphenicol is available as an ointment, solution, or injectable, or in combination with other antibiotics and/or corticosteroids.
   2. It is a broad-spectrum bacteriostatic agent.
   3. Biphasic solubility allows it to penetrate the cornea even when the corneal epithelium is intact. This is an important advantage of chloramphenicol and makes it the choice of antibiotic for penetration into the eye.
   4. It is not permitted in horses intended for food, however, since tissue levels in horse meat could cause death in sensitized persons.

B. Bacitracin
   1. Bacitracin is an effective drug for use against gram-positive organisms, spirochetes, gonococci, and actinomycetes but not against gram-negative bacteria.
   2. It may be suitable for penicillin-resistant staphylococci.
   3. It does not penetrate the corneal epithelium.
   4. A potent topical ophthalmic solution is prepared as follows: add 3 ml of artificial tears to each of three vials of bacitracin (50,000 units each); then mix the three vials together with the remaining 6 ml of tears; the final concentration will be 10,000 units/ml.
   5. Bacitracin is often combined with neomycin and polymyxin B.

C. Neomycin
   1. Neomycin is bactericidal against many staphylococci and gram-negative organisms, but not against *Pseudomonas*.
   2. However, localized hypersensitivity can develop with prolonged use and may contribute to inflammation.
   3. Thus, any keratoconjunctivitis that continues or worsens despite what appears to be adequate therapy should cause the veterinarian to consider a drug reaction.
   4. Neomycin will not penetrate the cornea unless the epithelium is missing.

D. Polymyxin B
   1. This time-honored antibiotic is effective against most gram-positive cocci and gram-negatives, including some strains of *Pseudomonas*.
   2. It often is combined with neomycin and bacitracin.

E. Bacitracin, neomycin, and polymyxin B preparations (Anaprime solutions [neomycin, polymyxin B, and flumethasone]), Neobacimyx ointment, Neobacimyx-H ointment with hydrocortisone, Neo-Corticin ointment [neomycin, sulfacetamide, and hydrocortisone], Neomide ointment [neomycin and sulfacetamide], Mycitracin ointment, Neo-Delta-Cortef suspension [neomycin and prednisolone acetate], Neo-Predef ointment [neomycin and isoflupredone], Vetropolycin ointment, Vetropolycin-HC ointment with hydrocortisone, Trioptic-P ointment, Trioptic-S ointment with hydrocortisone, Neosporin ointment and solution, Cortisporin suspension [polymyxin B, neomycin, and hydrocortisone], Polysporin ointment [polymyxin B and bacitracin])
   1. The combination drugs are excellent for the initial treatment of low-grade keratitis and conjunctivitis.
   2. However, corneal penetration through intact epithelium is poor. The preparations with corticosteroids should not be used if corneal ulcers are present.

F. Gentamicin solution, ointment, injectable, and combinations (Gentocin solution and ointment, Gentocin Durafilm solution with betamethasone, Optivet solution and ointment, Optivet Duracoat solution with betamethasone, Genoptic solution and ointment, Garamycin solution and ointment, Gentavet injectable 50 mg/ml, Gentocin injectable 50 mg/ml)
   1. Gentamicin is a potent bactericidal agent against many gram-negative organisms, including *Proteus* and some strains of *Pseudomonas*. It also is effective against certain resistant strains of *Staphylococcus*.
   2. The injectable preparations may be useful when higher concentrations are necessary for topical anesthesia or subconjunctival injection. A potent topical is prepared by adding 1.5 ml of injectable gentamicin (50 mg/ml) to 5 ml of the ophthalmic solution.

G. Tobramycin solution, ointment, and injectable preparations (Tobrex 0.3% solution and ointment, Nebcin [80 mg/2 ml ampule injectable])
   1. Tobramycin is an aminoglycoside that is related to neomycin, kanamycin, and gentamicin.
   2. It has fewer resistant organisms than do the other available aminoglycosides.
   3. Its spectrum of activity is broad and it is the **drug of choice** for *Pseudomonas* corneal ulcers.
   4. The injectable preparations are useful for subconjunctival injections and when higher concentrations are needed. The injectable form may be diluted with artificial tears.

H. Tetracycline, chlortetracycline, and oxytetracycline ointment, suspension, and combinations (Achromycin 1% suspension and ointment [tetracycline], Aureomycin 1% ointment [chlortetracycline], Terramycin ointment [with polymyxin B])

1. The tetracyclines have a broad spectrum of antimicrobial action against rickettsiae, chlamydiae, and mycoplasmas; however, many resistant strains are encountered.
2. They may be useful in low-grade nonspecific conjunctival infections.
3. They are less expensive than the newer antibiotics and may be useful for treating outbreaks of keratoconjunctivitis in large numbers of horses.

I. Nitrofurazone solution, ointment, and powder (Furacin 0.2% dressing ointment, Furacin soluble powder, Nitrofurazone 0.2% dressing, Nitrofurazone 0.2% solution)
   1. The nitrofurazones are adequate for topical application in superficial infections, burns, and abrasions; however, they are not useful in *Pseudomonas* infections.
   2. They are well tolerated by the eye and often are incorporated under bandages. Old or contaminated wounds may be packed with nitrofurans for 6-24 hr prior to surgical debridement.

J. Amikacin
   1. Amikacin has the broadest antimicrobial activity in its class, with a unique resistance to the aminoglycoside-inactivating enzymes.
   2. It is especially useful in resistant *Pseudomonas* infections.
   3. A topical preparation is not available commercially, but a 100 mg/ml concentration can be prepared and used topically.

VI. Systemic Antibiotics

A. Chloramphenicol (Chloromycetin, Chloricol)
   1. Chloramphenicol is indicated when the eyelids, eye, or orbit have been injured or are involved with an infectious process.
   2. It also is useful in the initial treatment of uveitis.
   3. It has the greatest penetration of any systemic antibiotic through the blood-aqueous barrier in noninflamed eyes and is the drug of choice for intraocular infections in most species.
      a. Horses may not achieve adequate blood levels with an injection of 25 mg/kg (Brown et al., 1984).
      b. Knight (1975) recommends using oral chloramphenicol (25-50 mg/kg) every 6 hr.

B. Procaine penicillin, trimethoprim-sulfadiazine, and ampicillin
   1. Most antibiotics and sulfonamides will penetrate into the eye if uveitis is present.
   2. Broad-spectrum antibiotics are administered when periocular or orbital tissues are injured or infected.

C. Potassium penicillin
   1. Potassium penicillin is available in 1,000,000 or 5,000,000 IU sizes.
   2. The addition of 1,000,000 IU to a liter of saline or Ringer's lactate provides a good solution for irrigation of the conjunctival sac, especially just prior to surgery.
   3. Potassium penicillin is also useful for irrigating the orbit after enucleation, when panophthalmitis has been present, or when a silicone prosthesis is implanted. Concentrations of 100,000 IU/ml have been used in these situations, with total doses varying between 100,000 and 1,000,000 IU depending on severity.