

Clinical Commentary

Anaerobic keratitis

C. E. Plummer

Departments of Large and Small Animal Clinical Sciences, University of Florida College of Veterinary Medicine, Gainesville, Florida, USA.

Keywords: horse; cornea; keratitis; anaerobic keratitis; corneal ulcer; chloramphenicol

Ulcerative keratitis complicated by the presence and proliferation of anaerobic pathogens is, fortunately, uncommon in domestic animals. In human patients, however, anaerobic ocular infections are being increasingly recognised as serious disease entities (Brook 2001). It has long been accepted that traumatically induced cases of anaerobic endophthalmitis have dire consequences for vision and globe retention, but more recently, cases of keratitis as a result of anaerobic or mixed bacterial infections that progress and threaten the integrity of the globe have been diagnosed in man (Perry *et al.* 1982; Brook 2001; Hsu *et al.* 2008). This is especially true with the recent increase in refractive corneal surgeries and the use of topical antibiotics and anti-inflammatory agents that change the resident flora of the ocular surface, alter its innate immune response and tip the balance in favour of the anaerobes (Ferrer *et al.* 2004). In veterinary patients, most cases of ulcerative keratitis that have an anaerobic bacterial infection have some other sort of ocular abnormality such as a traumatic injury or the presence of a foreign body, a chronic or pre-existing corneal disease or history of therapy with topical antibiotics targeting aerobic bacteria.

Anaerobes are not generally considered a significant portion of the native flora of the normal ocular surface of horses; however, their true frequency is difficult to determine because of the inconsistent use of methods adequate to detect, isolate and identify their presence (Andrew *et al.* 2003). Anaerobic organisms are often difficult to isolate from infected sites due to their fastidious nature and their slow growth in culture. A recent study that employed appropriate methods to sample and support the isolation and growth of anaerobes in culture documented their presence in 12.9% of cases of ulcerative keratitis in equine patients (Ledbetter *et al.* 2008), a frequency that approximates to the present author's clinical experience. Pure isolates of anaerobic bacteria from equine corneal ulcers are rarely observed; most tend to occur within a mixed population that includes aerobic bacteria, fungus or both. When the presence of anaerobes is observed, the affected ulcers often began as uncomplicated corneal

wounds that perhaps failed to heal as quickly as anticipated despite appropriate treatment with a broad-spectrum antimicrobial protocol. Often, these indolent ulcers will rapidly worsen and be accompanied by a significant amount of anterior uveitis. If aerobic culture of a wound fails to yield an isolate or reveals scant growth in an ulcer with significant cellular infiltrate and an infected appearance, anaerobic culture should be considered. This is especially true if the ulcer has been long-standing, if there is pre-existing ocular disease such as keratitis, keratoconjunctivitis sicca or chronic uveitis, particularly such that has required the application of topical corticosteroids or if the eye has recently undergone surgery.

Anaerobic keratitis in man may assume many different clinical forms, including nonulcerative conjunctivitis and keratitis, stromal abscesses, superficial, indolent corneal ulcers and stromal ulcerations of variable depths and loss of stromal rigidity (**Figs 1 and 2**). Some cases of human anaerobic keratitis have been observed to develop gaseous bullae, resembling fluid-filled bullae, in the subepithelial space (Ferrer *et al.* 2004). Most documented cases of anaerobic keratitis in the horse are significant ulcerative lesions with stromal digestion, necrosis and cellular infiltration (Rebhum *et al.* 1999; Ledbetter *et al.* 2008; Johns 2009). There may be other clinical manifestations of anaerobic infection in the horse cornea that have not yet been attributed to anaerobic organisms.

The incidence of anaerobic infections in the horse cornea may also be masked since many of the broad spectrum antimicrobial medications used in routine therapy of corneal ulcers are effective against anaerobes. Chloramphenicol is a particularly useful antibiotic against anaerobes and may address the problem before it is diagnosed. It is not unreasonable to consider that there may be a rise in the numbers and severity of anaerobic keratitis in domestic animals in the future because of the rising incidence in human cases and increasing resistance of anaerobic bacteria to traditional antimicrobial agents. While most anaerobes are still sensitive to chloramphenicol, occasional resistance has been noted. Most anaerobes are relatively resistant to fluoroquinolones, sulphonamides

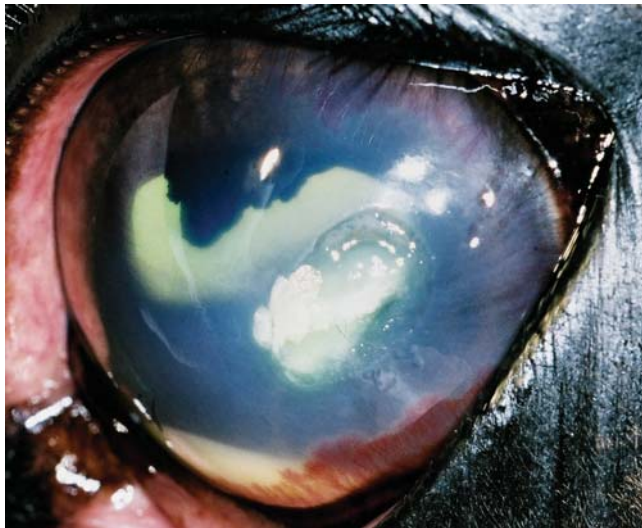


Fig 1a: This corneal ulcer began as a superficial ulcer that failed to respond to medical therapy. It worsened rapidly and when the patient was presented to the University of Florida College of Veterinary Medicine, a groove was present in the stroma surrounding the lesion and the centre of the corneal lesion was necrotic. Severe anterior uveitis was present evidenced by miosis and a significant amount of hypopyon. Severe blepharospasm was present. An *Actinomyces* sp. was isolated from this wound.

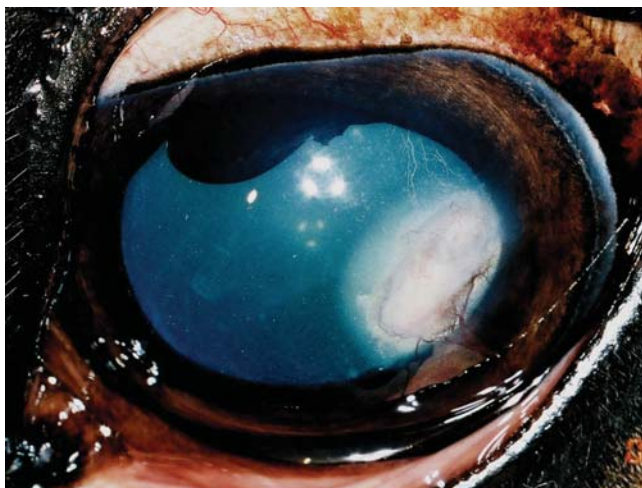
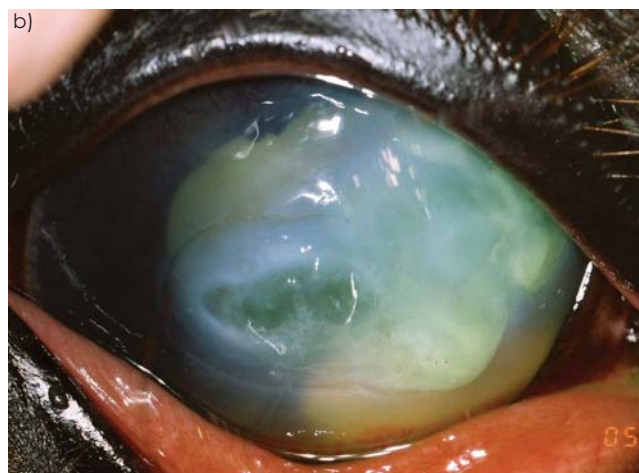
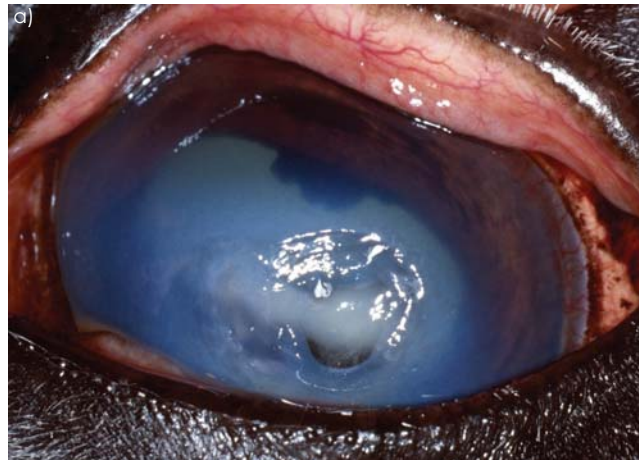


Fig 1b: Two months after the initiation of topical chloramphenicol as targeted therapy for the unidentified *Actinomyces* spp., the corneal ulcer and its associated uveitis had resolved and a scar remained.

and amnioglycosides, which are all being used with greater frequency in clinical practice (Brook 2001).

The cornea, under normal conditions, does not support the growth of anaerobes. However, in abnormal circumstances, particularly wherein certain risk factors develop including ocular trauma, pre-existing disease or recent surgery, low-oxygen conditions may arise which make a comfortable environment for anaerobic organisms. If any of these risk factors are present and an ulcer seems not to be responding appropriately, be on the look out for the anaerobe.



Figs 2a and 2b: Examples of serious corneal ulcers that were complicated by the presence of an anaerobe. Both wounds were infected with a mix of aerobic bacteria with *Clostridium* spp.

References

- Andrew, S.E., Nguyen, A., Jones, G.L. and Brooks, D.E. (2003) Seasonal effects on the aerobic bacterial and fungal conjunctival flora of normal Thoroughbred brood mares in Florida. *Vet. Ophthalmol.* **6**, 45-50.
- Brook, I. (2001) Ocular infections due to anaerobic bacteria. *Internat. Ophthalmol.* **24**, 269-277.
- Ferrer, C., Rodriguez-Prats, J.L., Abad, J.L. and Alió, J.L. (2004) Unusual anaerobic bacteria in keratitis after *in situ* keratomileusis: diagnosis using molecular biology methods. *J. Cataract refract. Surg.* **30**, 1790-1794.
- Hsu, H.Y., Lee, S.F., Harnstein, M.E. and Harcopos, G.J. (2008) *Clostridium perfringens* keratitis leading to blinding panophthalmitis. *Cornea* **27**, 1200-1203.
- Johns, I.P. (2009) *Bacteroides* sp. as a cause of anaerobic keratitis in a pony. *Equine vet. Educ.* **21**, 572-574.
- Ledbetter, E.C. and Scarlett, J.M. (2008) Isolation of obligate anaerobic bacteria from ulcerative keratitis in domestic animals. *Vet. Ophthalmol.* **11**, 114-122.
- Perry, L.D., Brinser, J.H. and Kolodner, H. (1982) Anaerobic corneal ulcers. *Ophthalmol.* **89**, 636-642.
- Rebhum, W.C., Cho, J.O., Gaarder, J.E., Peek, S.F. and Patten, V.H. (1999) Presumed clostridial and aerobic bacterial infections of the cornea in two horses. *J. Am. vet. med. Ass.* **214**, 1519-1522.