

## Bovine enucleation: A retrospective study of 53 cases (1998–2006)

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**Abstract** – Medical records of 53 cattle undergoing enucleation (1998–2006) were reviewed. Assessments of the outcomes were done via client surveys. Descriptive statistics were generated on the affected population, the underlying disease, the complications, and the length of retention within the herd. Hereford cattle comprised the majority of the cases (30/53; 57%). Most cattle (84.9%) were diagnosed with ocular squamous cell carcinoma (OSCC). Follow-up information was available for 22 cattle. Para-orbital infection was documented in 10 of 53 cattle (19%). Five cattle died of various causes 2 months to several years after enucleation. One cow was culled due to recurrence of OSCC. Fifteen cattle were retained within their respective herds. This study documents that orbital infections are common, and recurrence of OSCC is infrequent in cattle having undergone enucleation.

**Résumé** – **Énucléation bovine : Une étude de cas rétrospective (de 1998 à 2006)**. Les dossiers médicaux de 53 bovins qui ont subi l'énucléation (de 1998 à 2006) ont été examinés. Les évaluations des résultats ont été réalisées par des sondages auprès des clients. Des statistiques descriptives ont été produites pour la population touchée, la maladie sous-jacente, les complications et la durée de rétention au sein du troupeau. Les bovins Hereford représentaient la majorité des cas (30/53; 57 %). La plupart des bovins (84,9 %) ont été diagnostiqués avec un carcinome squameux oculaire (CSO). Des renseignements de suivi étaient disponibles pour 22 bovins. L'infection para-orbitaire a été documentée chez 10 des 53 bovins (19 %). Cinq bovins sont morts de diverses causes entre 2 mois et plusieurs années après l'énucléation. Une vache a été réformée en raison de la récurrence d'un CSO. Quinze bovins ont été conservés dans leurs troupeaux respectifs. Cette étude documente que les infections orbitaires sont courantes et que la récurrence du CSO est rare chez les bovins qui ont subi l'énucléation.

(Traduit par Isabelle Vallières)

Can Vet J 2010;51:611–614

### Introduction

**E**nucléation is one of the most common orbital surgical procedures performed in cattle (1). Enucleation is technically simple, alleviates painful ophthalmic pathologies, and can halt the progression of neoplasias such as ocular squamous cell carcinoma (OSCC). While its value as a cost-effective procedure is evident to both practitioners and ranchers, there are few peer-reviewed publications evaluating complications and outcomes in enucleated cattle (1,2). In previous studies, the number of cattle included in each study was limited and minimal information was provided regarding complications of the

procedure and long-term outcome for cattle having undergone enucleation.

We hypothesized that enucleation would be associated with few post-operative complications and would remain an inexpensive and viable treatment option for ocular disease in cattle. The purpose of this retrospective study was to describe the population of cattle undergoing enucleation, clinical indications for enucleation, peri-operative complications, recurrence of disease, and longevity of the cattle within the herd.

### Materials and methods

#### Criteria for selection of cases

A computer-assisted search of medical records at the Kansas State University College of Veterinary Medicine identified cattle that had undergone enucleation of an eye between January 1, 1998 and December 31, 2006.

#### Medical records review and follow-up data

The medical records of the 53 cattle having undergone enucleation were examined to obtain the breed, gender, pregnancy status, eye affected, clinical diagnosis, medications administered, surgical procedure, suture material, and suture pattern used. Any peri-operative complications were recorded. Telephone interviews were conducted with owners to determine

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if complications were noted during convalescence, if recurrence of disease occurred, and to determine retention time of the animal within the herd.

## Statistics

Descriptive statistics were generated from the findings and reported as proportional and percent occurrence data.

## Results

Of the 53 enucleated cattle, there were 30 (57%) Herefords, 8 (15%) Angus, 6 (11%) crossbreds, 4 (8%) Simmentals, 2 (4%) Holsteins, 1 (2%) Gelbvieh, and 2 (4%) were unspecified with regard to breed. There were 42 (79%) cows, 3 (6%) bulls, and 8 (15%) cattle of unspecified gender.

The eye enucleations were performed in a haul-in outpatient clinic with the patient restrained in a chute, standing [unless dictated by age (for example, neonatal calf)], and in a cattle processing area (not in an operative suite). Of the 53 cattle enucleated, 47 were returned to the farm or ranch of origin the same day of surgery. The remaining 6 cattle that were hospitalized returned to the farm or ranch of origin after a mean stay of 1.7 d. One cow was hospitalized for 15 d because of a limb injury that occurred while the cow was being restrained in the chute during surgery.

Clinical diagnoses recorded in the medical records were based on results of physical examination and clinician professional judgment. Ocular diseases justifying enucleation included OSCC in 45 cases (85%), retrobulbar lymphosarcoma in 2 (4%) cases, proptosis of the globe in 4 (8%) cases, rupture of the globe in 1 (2%) case, and an unspecified diagnosis in 1 case (2%).

The peri-operative protocols and surgical procedures used were at the discretion of the individual clinician. However, the cattle were conscious during all procedures (without use of general anesthesia) and restrained in a chute in the general working area of the clinic. Of the 53 cattle, 52 were restrained in a chute in a standing position, with the exception of a neonatal calf. The para-ocular surgical sites were clipped and aseptically prepared. Local anesthesia (lidocaine HCl 2%; Hospira, Lake Forest, Illinois, USA) was used for all cattle. The specific method of anesthesia to the intended surgical site was recorded in 15 cases. In 13 of the 15 cattle, the clinicians performed a retrobulbar block. A Peterson eye block was used in 1 case, and another case recorded the use of a ring block around the intended line of the skin incision.

Sedation was used in 19 (36%) cattle. Sedation protocols included the administration of xylazine in 11 (58%) cases, acepromazine in 4 (21%) cases, butorphanol in 1 (5%) case and combinations of these drugs in 2 (11%) cases.

The surgical procedure consisted of transpalpebral enucleation of the globe and para-orbital structures. The degree of para-orbital debridement depended on the individual case and degree of invasiveness of disease. In 1 case, the orbital artery was ligated using polyglactin 910 to provide hemostasis. Gauze packs or drains, or both, were temporarily placed in the orbit of 3 cows. Closure of the skin incision was accomplished through the use of horizontal mattress sutures in 17 (32%) cattle, a Ford interlocking continuous pattern in 7 (13%) cases, and a simple continuous pattern in 1 cow. The suture pattern used was not

specified in 28 (53%) medical records. No. 6 Nylon (Vetafil) suture was used for skin closure in 12 (23%) cases, No 6 caprolactam (Braunamid) suture was used for skin closure in 3 (6%) cases, chromic gut was used in 7 (13%) cases, polyglactin 910 was used in 1 (2%) case, and the suture material was unspecified in 30 (57%) cases.

Systemic antibiotics were used in 35 (66%) cattle and included oxytetracycline ( $n = 24$ ; 69%), penicillin ( $n = 10$ ; 29%), and florfenicol ( $n = 1$ ; 3%). Six of the cases had a cephalirin intramammary preparation placed in the orbit and 3 cases had a dissolved or intact sulphonamide oral bolus placed into the orbit. Flunixin meglumine was administered to 9 (17%) of the 53 cattle.

Intra-operative complications included hemorrhage in all cattle and transitory radial nerve paresis in 1 cow. No hemorrhage was severe enough to warrant supportive intervention outside of appropriate hemostasis measures such as ligation of the orbital artery (1), the use of hemostats, and suturing of the skin margins to form a seal. The transitory radial nerve paresis that occurred in a cow during the procedure was caused when the cow attempted to escape the squeeze chute and a forelimb became entrapped. The injury was medically managed with a hospitalization period of 15 d and resolved after several weeks with no further complications noted by the owner.

Of the 53 cattle, 10 (19%) developed orbital infection during the 21 d following surgery. Most cattle were re-evaluated at the clinic at the time of suture removal 14 to 21 d after surgical excision of the eye. The remainder of the short-term complications were documented on the farm or via telephone follow-up during the same time interval after surgery. Partial dehiscence of the suture line was noted in 3 of these cases. Affected cattle were treated by suture removal, wound lavage, and administration of systemic antibiotics in selected cases. No further complications were noted in these affected cattle. Two cattle had noted transitory serosanguineous or bloody unilateral nasal discharge in the week following enucleation. No treatment was initiated and no further signs were noted.

Telephone interview of the clients was performed a mean of 44 mo after enucleation (range, 2 to 108 mo). Long-term follow up information was obtained for 22 of the 53 cattle. The owners of an additional 7 cattle were contacted but did not recall the specific cases so the cattle were not included in the follow-up data. Of the 22 cattle that had long-term follow-up, 15 (68% of cattle having follow-up information) healed with no further complications and 5 cattle had died. Of the 5 cattle that died, 1 had lymphosarcoma, 1 had squamous cell carcinoma, 1 calf had died 1 to 2 mo after the enucleation due to an unrelated disease, one bull had died 6 to 8 wk after surgical excision of the eye with acute onset neurologic disease of unknown etiology, and a cow died of unknown cause several years after the surgery. One (5%) of the 22 cattle developed recurrent OSCC in the enucleated orbit 3 y after the initial surgery. This cow was culled from the herd without further treatment. One cow was culled several months after surgery because of reproductive failure. Eight cows were sold after having raised a calf (6 mo to 2 y following surgery). Two cows were retained in their herds for at least 6 y. Four cows remained within their respective herds

2 mo to 2 y after surgery. One cow was lost to followup after the initial healing period.

## Discussion

This study determined that enucleation was a successful treatment of severe ocular disease that was readily performed in conscious cattle on an outpatient basis without general anesthesia. The procedure successfully resolved a variety of ocular pathologies and allowed cattle to return to productive use at the herd of origin.

Enucleation is a common procedure in bovine practice but peer-reviewed literature regarding enucleation in cattle is scarce. Vermont's retrospective study of exenteration in 20 cattle is the only published report to the authors' knowledge that specifically details and evaluates enucleation in cattle. Other studies and case reports discuss the procedure in the context of treatment of OSCC, ocular trauma or lymphangiosarcoma (1–5).

Enucleation involves the removal of the globe with removal of para-orbital structures as dictated by the specific disease process and desired outcome. In cattle, the ocular diseases encountered can be quite extensive or infiltrative, necessitating aggressive debridement of the para-orbital structures. This type of enucleation procedure is typically referred to as extirpation or exenteration (6,7). Indications for enucleation include chronic endophthalmitis or panophthalmitis leading to blindness in the affected eye, chronic glaucoma leading to buphthalmia and associated retinal and optic nerve damage, intraocular neoplasms where intraocular surgery is not feasible, trauma or proptosis of the globe leading to irreversible damage of the eye and intraocular contents (8).

In cattle, the course of therapy for severe ocular pathology is dictated not only by the disease entity present but also by the intended purpose and value of the animal as well as the cost, frequency, and efficacy of the chosen treatment (1). If the underlying disease allows for salvage of an eye with retention of vision, efforts should be made to preserve the eye if practical. Cattle having had a ruptured globe due to horn trauma have been described as being at increased risk for contralateral eye trauma after removal of the injured eye (4). In cases where salvage of the eye is not feasible, enucleation offers the potential for complete removal of diseased tissue and a rapid return to function.

In the present study, Hereford cattle were overrepresented compared with the hospital population which is dominated by Angus breed cattle. This is likely due to the increased prevalence of OSCC in Herefords, especially those lacking significant amounts of corneoscleral pigmentation (9,10). The majority of the enucleation procedures were performed after a clinical diagnosis of ocular squamous cell carcinoma.

Most of the cattle were female. This predilection is likely due to a variety of factors, including the general population base of cow-calf ranches in the practice area and the perceived cost-benefit ratio of treating a breeding cow as compared with a steer or a bull within a particular herd.

Squamous cell carcinoma was the most common clinical diagnosis necessitating enucleation in this population of cattle. The size and location of the OSCC lesion dictate the course of therapy in most cases. Small lesions, < 2.5 cm, are

usually amenable to cryotherapy or hyperthermia with prior surgical debulking as needed (11). The success of cryotherapy has been reported to be as much as 71%, with a 97% success rate reported for lesions < 2.5 cm after 1 or 2 treatments of OSCC cancerous lesions in Hereford cattle (11,12). Success rates of up to 90.8% have been reported in cattle for which hyperthermia was used (13). Enucleation is recommended for treatment of large lesions where debulking is not feasible, as well as for intraocular lesions, or lesions that have recurred despite previous therapy. Radical en bloc resection of lymph nodes and the affected periocular structures has been described in cattle having extensive OSCC (14). The procedure is recommended in valuable animals with suspected but limited metastasis to the regional lymph nodes. This surgical procedure is invasive and has greater risk for damage to vital structures, and is best suited to tertiary care centers and not field conditions.

The only intraoperative complication causing concern in this study was a cow that suffered radial nerve injury. This injury was likely associated with the fractious nature of the cow. Chute injuries can be limited by optimizing facilities, training personnel, and using sedation in addition to local anesthesia. However, despite the best management, injuries occur occasionally when surgery is done in conscious cattle. In this cow, medical management of the radial neuropraxia resulted in return to normal function of the limb.

There are several complications associated with local anesthesia. Retrobulbar anesthesia has been associated with orbital hemorrhage, penetration of the globe, optic nerve injury, and acute death following injection into the optic nerve meninges. Accidental injection of anesthetic into the ethmoid turbinates has been observed during performance of the Peterson eye block (15). In the present study, most of the clinicians elected the use of a retrobulbar nerve block for sensory and motor blockade of the orbit and surrounding tissues and no local anesthetic complications were noted.

Complications associated with enucleation in animals include rupture of the globe during surgical manipulation with subsequent contamination of the surgical site, excessive orbital hemorrhage, excessive trauma to the remaining tissue leading to swelling or hemorrhage, discharge from the excision site due to an orbital infection, retained lacrimal duct or nictitans tissue, and peri-orbital cellulitis (8). There are few published reports of complications associated with bovine enucleation. Post-operative neurologic signs developed in a 12-year-old cow in 1 report (3). The cow developed degeneration of the right and left optic nerve tracts, the optic chiasm and the right vestibular nuclei 8 mo after enucleation necessitated as a result of an eye laceration.

The study reported herein documented that orbital infections were common in cattle having enucleation performed as outpatients under field conditions. In contrast, a retrospective study of 20 cattle undergoing exenteration found no post-operative infections (1). The discrepancy between these studies is likely due to several factors including: a larger population of animals in the present study, more detailed follow-up information, a different population of animals (primarily beef versus dairy cattle), a larger number of personnel involved in the procedure (a teaching setting), and a wider variation in surgical protocol.

Cattle with post-operative orbital infections represented a wide variation in case severity, with most cases having mild post-operative purulent discharge noted in the period between surgery and suture removal 14 to 21 d following the procedure. Although all cases responded to medical therapy, the high rate of post-operative infection emphasizes the need to perform aseptic preparation of the surgery site, utilize optimal surgical technique including proper tissue handling, and perform follow-up care. The nature of the disease and severity of tissues compromised by tissue pathology are expected to be associated with post-operative complications despite the circumstances under which the surgery is performed. One of the advantages to the enucleation procedure is that it can be done under varying circumstances and differing peri-operative protocols with relative success as evidenced by this study. Because of the retrospective nature of the study, it is difficult to determine what factors contributed to the post-operative infection rate. Antibiotic choice and route of administration varied between clinicians, with most cases receiving some type of systemically administered antibiotic at the time of surgery. Additional intraorbital infusion of antibiotics did not appear to affect the orbital infection rate but the small number of cases receiving intraorbital infusions limits the degree of inference from this study.

The cause of death was not determined in the 5 cattle that died. However, several of the cows exhibited signs of progressive metastatic neoplastic disease and may have died from complications of the original disease. The neurologic signs displayed by the bull that died 6 wk after enucleation could be related to the ocular disease, complications of the enucleation procedure, or an unrelated event.

Most cattle with long-term follow-up were retained within their respective herds for variable periods of time. Many of these cattle were retained for the sole purpose of delivering and/or raising a calf until weaning as stated by the owner at the time of enucleation. The decision to cull cows that had an enucleation procedure appears to be based on many factors, the most important being the perceived success of the enucleation procedure in treating the underlying disease. This is of particular concern in cattle with OSCC. In one study, a mean post-surgical survival time of 15 mo was reported in 21 cattle with OSCC (2). Of these 21 cattle, 17 had undergone enucleation, 2 had undergone cryosurgery and 2 had been culled without surgical treatment. Of the 17 cattle that had undergone enucleation, tumor recurrence was noted in 6 cases (2 to 14 mo after surgery). In this study, enucleation was recommended in cattle with OSCC to

extend the productive life of the cow. In the study reported herein, only 1 case of neoplastic recurrence was documented in the cattle with follow-up. This was similar to a previous study in which 1 of 20 cattle developed recurrent OSCC several months after surgery (1). While this suggests a relatively low rate of recurrence of OSCC in the present group of cattle, it is likely that this is an underestimation.

Enucleation remains a feasible, simple, inexpensive option of treatment for many types of severe ocular pathology. It has the potential to resolve chronic pain, infection, and neoplastic disease. Where neoplastic disease is advanced, it can be used to palliate and relieve discomfort so the cow can deliver or raise a calf. Enucleation can be performed with routine restraint and surgical equipment at minimal cost to the client. Post-operative infection of the operative site is common, but most cases require minimal medical therapy. Retention within the herd is based largely on owner preference.

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