Cryosurgery

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Introduction

Cryosurgery is the medical application of cold to destroy tissue. Since the first veterinary reports on cryosurgery in 1970 (1), cryosurgery has become a widely accepted modality for the treatment of skin cancer in animals (2,3,4). In food animal practice cryosurgery is widely used to treat bovine ocular squamous-cell carcinoma. A preliminary report on the cryosurgical treatment of interdigital fibromas, papillomatosis and fibromas of glans penis is presented.

A treatment protocol that has resulted in a cure rate of more than 90% of bovine ocular squamous-cell carcinomas and the cryosurgical instrumentation required in veterinary practice are discussed in detail.

Cryosurgical Protocol for Bovine Ocular Squamous-Cell Carcinoma

Small premalignant lesions including focal ulcerations and papillomas on eyelids were treated without anesthesia. Eyelid lesions larger than 0.5 cm were treated following sedation with Rompun (Haver-Lockhart Laboratories). Multiple applications of topical anesthesia alone and in conjunction with retrobulbar anesthesia were used for treatment of lesions on the bulbar conjunctiva or cornea. If metastasis has occurred or the lesion was greater than 50 mm diameter with poorly defined margins or the adjacent bones had been invaded, treatment was not attempted. The skin around the lesions was clipped to remove debris and provide better exposure of lid lesions. The boundary of the lesion was marked with a felt marking pen. A thermocouple needle was placed at the base of the lesion and, when possible, a second thermocouple needle was placed 5-7 mm beyond the margin of the lesion. To prevent destruction of adjacent normal tissue, a polystyrene plastic shield was placed over the cornea and the skin below the lesion was covered with a 2-5 mm layer of petroleum jelly.

Liquid nitrogen spray was used on all eyelid and on most ocular lesions. A spray tip was selected that provided the most rapid rate of freezing without excessive runoff of liquid nitrogen droplets. A twenty-gauge or smaller spray tip was used for lesions less than 1 cm in diameter while an eighteen-gauge tip was used for lesions larger than 1 cm. The spray tip was held at a distance of 5-10 mm and directed toward the center of the lesion. Not only does this assure the greatest depth of freeze at the thickest portion of the lesion, but it also prevents under-freezing (less than -25°C) of areas if a rotating motion around the tumor is used. In experimental studies where porcine, bovine and equine skin was frozen with various units and various size spray tips held 5-10 mm from a central point, the iceball formed had a depth slightly more than one-third the diameter of the surface iceball (5). However, clinical judgment based on characteristics of the iceball should never replace tissue temperature monitoring.

The end point of the rapid freeze was when the thermocouple needle placed at the base of the lesion registered -25° to -50°C on the tissue temperature monitor and the iceball extended 3-5 mm beyond all margins of the lesions.

Tissue temperature monitoring was not used for corneoscleral lesions. Otherwise the method of treatment of corneoscleral lesions was the same as treatment of eyelid lesions. Freezing was terminated when the iceball extended 2-3 mm beyond the margins of ocular lesions.

Following a thaw to +5°C, all lesions were rapidly refrozen. Within one hour after the double freeze-thaw cycle, the frozen area appeared erythematous and edematous; within 24 hours, the area became dark, with the accumulation of blood cells from damaged micro vessels. This condition persisted until the third or fourth day after freezing, at which time necrosis occurred. Frequently, papillary lesions underwent necrosis and completely sloughed within one week after freezing. Often the frozen area remained covered with an eschar that separated 4-6 weeks after freezing, leaving a smooth, slightly erythematous scar. The rate of healing is directly related to the size of the original area frozen (6). Postoperative care was not required after freezing.

Instrumentation

Both liquid nitrogen and nitrous oxide units have been designed for veterinary use. Since nitrous oxide provides a working temperature of -70° to -90°C, the depth of freeze with nitrous oxide units is limited. Lesions greater than 1 cm in depth have to be excised or removed by electrosurgery prior to freezing with nitrous oxide units. Liquid nitrogen has a working temperature of -196°C and spray application of liquid nitrogen can rapidly lower tissue temperature to

-25°C at depths of 2-4 cm. Therefore, I routinely use liquid nitrogen units.

The ideal veterinary unit should have the following features: 1) Portable and sturdy for field use. 2) Precise control of the spray (on-off application). 3) Both closed probe and spray tips. 4) Contain a tissue temperature monitor. 5) Large reservoir to eliminate frequent filling with liquid nitrogen.

Three units used in our investigations are the C76 (Frigitronics, Inc.), Cryogun (Brymill Corporation), and the Cryo-Surg (Southwest Research and Development, Magnolia, Arkansas). The cost of a reliable cryosurgical unit complete with a tissue temperature monitor and storage Dewar will range from approximately $800 to $1,500.

Ocular Squamous-Cell Carcinoma

In 1975, Farris reported the treatment of 718 ocular squamous-cell carcinomas of cattle using various cryosurgical units and techniques (2). Tumors ranged in size from less than 5 mm to 7 cm in diameter and depth. A single freeze to -25°C at the base of the lesion, or until the iceball enveloped the tumor and a surrounding 2-4 mm of normal tissue, resulted in a 66% cure at a 6-month follow-up evaluation of 609 lesions. In 109 lesions treated with a double freeze-thaw cycle to -25°C, a cure rate of 97% was achieved.

Because a large number of cows were sold following a "cure," long-term follow-up has not been possible on a significant number of animals. However, a 4-year follow-up of 25 cattle with from 1-3 squamous cell carcinomas on the lids and corneoscleral junction has shown primary tumors develop at other sites on the lids or the corneoscleral junction in approximately 25% of the cattle. Recurrences were successfully treated using a double freeze-thaw cycle to -25°C. All recurrences were treated before tumor size had exceeded 1 cm in diameter.

Interdigital Fibroma, Fibroma of the Glans Penis, and Bovine Papillomatosis

Cattle were sedated with xylazine (Rompun®-Haver Lockhart) and treated in the standing position in a restraint chute. The claws were separated by placing a block of wood between the toes. A thermocouple needle was placed at the central base of the fibroma and strips of styrofoam were placed between the fibroma and the wall of the digits. Using a large spray aperture (18 ga.), the fibroma was rapidly frozen to -25°C. Following an unaided thaw to +5°C, the fibroma was refrozen.

The treated animal was returned to pasture without postoperative care. However, lameness from postoperative edema and the subsequent tissue slough has been observed in approximately 50% of the animals treated. Of the 30 interdigital fibromas treated, 88% were ablated after a double freeze-thaw and 13% were ablated following a second freezing 30-45 days after the primary freeze. Because of the sale of the animals, follow-ups were not obtained on 7% of the animals treated.

Cryosurgery shows particular promise in the treatment of fibroma of the glans penis and bovine cutaneous papillomatosis. Animals are restrained while standing and either tranquilized or treated without anesthesia. A double freeze-thaw cycle as described under treatment protocol is used. However, tissue temperature monitoring is not required. The rapid freezing is terminated when all of the neoplastic mass and 2-3 mm of surrounding normal tissue are included in the iceball. Only the base of large warts attached by a narrow stalk is frozen. To protect normal tissue, either 3-inch discs of 1/8" Teflon with various diameter punched-out centers can be placed over the mass to be frozen or petroleum jelly can be applied around the lesion. A significant advantage of cryosurgical treatment of fibroma of the glans penis is the minimal scarring that occurs after cryosurgery.

Summary

Cryosurgery has become the treatment of choice of bovine ocular squamous-cell carcinoma. In addition, cryosurgery is a modality that should be considered for treatment of other neoplastic and non-neoplastic lesions in cattle.

Cryosurgical units that deliver liquid nitrogen provide a more rapid freezing rate of large lesions and, thus, a higher cure rate than units designed for delivery of nitrous oxide.

Cryosurgery is a simple, rapid procedure; is economical; provides analgesia itself, due to sensory nerve injury; requires minimal preoperative and no postoperative medication; causes minimal side effects and may be repeated.

References

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